



**From Theory to Practice of Change:
Lessons from SNV's Improved Cookstoves
and Fuel Projects in Cambodia, Kenya, Nepal and Rwanda**

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Cover photo: A woman in Cambodia uses an imported gasifier stove made available through an SNV Cambodia project. Photo by Oliver Johnson.

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ABSTRACT

This report compares the approach to cookstoves of SNV, the Netherlands Development Organisation, with evidence from the sector about how interventions can lead to market transformation. Case studies of improved cookstove and fuels projects in Cambodia, Kenya, Nepal and Rwanda are analysed to examine the potential for successful scale-up and local market transformation. The aim is to understand the quality of SNV's improved cookstove and fuel interventions in order to inform and improve future practice. There is growing awareness of the need to take a systems perspective to stimulate cookstove market transformation. A more holistic approach to cookstove interventions is emerging that combines efforts to understand users, link up actors, develop effective business models, and create an enabling environment. Many organizations are adopting this vision, but putting it into practice is not easy. It also takes time, as it requires partnerships and new modes of working. The case study analysis finds that a holistic approach to cookstove market transformation, including capacity-building activities, is common to all the programmes examined. It finds flexibility in the exact mode of engagement and technological focus in each country, determined by local contextual factors. Drawing on the case studies, three key features are found to characterise SNV's cookstove programmes: emphasis on knowledge co-creation, commitment to trust-building, and freedom to adapt. This enables SNV to be a dynamic learning organization, willing and able to reflect and improve.

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1. INTRODUCTION

Within the last three years, SNV, the Netherlands Development Organisation, has developed 17 projects in Asia and Africa to promote improved cookstoves (ICS), aiming to increase access to affordable clean cooking solutions at the household level. Led by country offices in Asia, Africa and Latin America, these projects have worked to bring together local and national stakeholders to develop sustainable ICS markets, strengthen their capacity, promote a choice of innovative technologies, and create an enabling environment to stimulate private-sector involvement. SNV's ICS projects are often combined with development and production of efficient, sustainable fuels such as briquettes, char powder and pellets. They focus on enhancing market-based approaches, whether the stoves are locally produced or sourced from international manufacturers.

In the context of its global ICS and sustainable fuels programme, SNV commissioned this study in order to validate the quality of its interventions and improve its practice. In particular, SNV wants to articulate its theory of change, based upon both best practices within the sector and the reality of its projects on the ground. Following these requirements, SEI undertook an exploratory study focused on four countries selected by SNV: Cambodia, Kenya, Nepal and Rwanda. This paper presents the findings of those studies and proposes an ideal theory of change.

The paper begins by exploring what is meant by the term “theory of change”, relating it to SNV discourse and wider literature on ICS market development. Section 3 sets out the methodological aspects adopted for carrying out the analysis, including our definition of ICS, the research methods used, and analysis and interview schedules. Section 4 presents the country studies: each starts with a short background on household energy, then details the SNV intervention and analyses its progress. Section 5 compares and contrasts the four case studies and presents the outcomes of a workshop held to initially discuss the results, leading to a revised theory of change. Section 6 presents conclusions and recommendations on the way forward.



A stove producer cooperative in Rwanda.

2. A THEORY OF COOKSTOVE MARKET TRANSFORMATION

A theory of change is an explanation of how and why a particular intervention will lead to a certain desired change or impact – establishing causal links (see Connell and Kubisch 1998; Fulbright-Anderson and Auspos 2006; Stein and Valters 2012; Weiss 1995). The change we are concerned with in this study is cookstove market transformation. In this section, we explore the wider literature and experiences on ICS market transformation and link it to SNV's approach to ICS interventions.

2.1 Lessons learned on cookstove market transformation

Over recent years, momentum has been growing at national and international levels around the need to increase adoption of improved cookstoves and clean fuels in order to address problems associated with continued use of traditional cooking methods. Such problems include diseases linked to cooking smoke, such as acute lower respiratory infections and chronic obstructive pulmonary diseases; burns from open fires; forest and land degradation due to continued demand for biomass fuels; and the large amount of productive time lost collecting and processing traditional fuels.

Cookstove market transformation involves change beyond the confines of individual projects. Beyond the scope and time frame of the project, consumers in the area, and potentially nationwide, must widely embrace new cooking practices, improved technologies and cleaner fuels (Atteridge et al. 2013). Market transformation also implies a transition from one-off financial inputs to a scaled-up and self-sustaining marketplace made up of producers, distributors, retailers, marketers, consumers, after-sales support, financial services, etc. This is not to discount the importance of initial support, but the idea is that it will ultimately be phased out. Such a transition must be demand-driven.

The transition from traditional cooking to one based upon new practices, technologies and fuels requires more than a transfer of hardware. Decades of experience have shown that the diffusion of new technologies is a complex and non-linear process (Johnson 2013; Ockwell and Mallett 2012). Hence, there is increasing recognition that efforts to achieve cookstove market transformation must address multiple factors (Cordes 2011; Rehfuss et al. 2013; Simon et al. 2012), such as technical specifications, design, quality, accessibility, finance, and the enabling environment. We group these into three categories, discussed below:

Understanding what users want and how to shift behaviour and mobilize demand: In the first place, the technical specifications of the stoves used in the intervention must actually meet the goals of improved efficiency and reduced emissions. A second fundamental requirement is that the product be desirable to the end user in terms of utility, cultural appropriateness, aesthetics, and perceived improvement over the old stove (Barnes et al. 1993; Cordes 2011; Rehfuss et al. 2013; Shrimali et al. 2011; Simon et al. 2012). This generally requires tailoring the stove design for different target audiences (Simon et al. 2012). Investing upfront in market research and applying a user-centred approach to the design of the stove can help ensure the development of a final product that users are motivated to purchase and adopt (Lambe and Atteridge 2012). If the stove provides tangible benefits, such as reduced fuel costs, the household has an incentive to adopt the stove (Brinkmann et al. 2014). The stove must also be durable; many users are in remote locations where the breakdown of a stove will simply result in it being discarded, which will also harm the ICS programme's reputation. Research has also demonstrated the importance of post-acquisition support, such as a repairs warranty and follow-up with users (Brinkmann et al. 2014).



A woman in Nepal prepares a meal in her kitchen.

Finding appropriate business models: This is vital to achieving a sustainable market where enterprises earn enough to keep going, users can afford the product, and financial backers get an adequate return on their investment. Lack of resources, both financial and human capital (e.g. technical expertise), is a frequently cited as a barrier to the success of cookstove projects. Access to seed capital for market research, product design and basic marketing is essential; otherwise, cookstove enterprises may struggle to get off the ground (Shrimali et al. 2011). On the demand side, even if the stove design meets users' needs and preferences, the poorest households often have difficulty managing the upfront cost of an improved cookstove (Shrimali et al. 2011). Innovative financing mechanisms, such as allowing households to pay in instalments, linking with village-level savings and loan schemes, and working with microfinance institutions to market and distribute stoves, can help overcome this barrier (Brinkmann et al. 2014).

Many cookstove projects subsidize stoves to keep them affordable, either directly (through price subsidies) or indirectly, by covering the costs of research and development, producer training, public awareness-raising, etc. The most successful cookstove programmes appear to have not applied direct subsidies to the price of the stove, but have instead used indirect subsidies to support R&D, manufacturing, and marketing (Akbar et al. 2011; Cordes 2011). A recent review of the enablers and barriers to the uptake of improved cookstoves found that large subsidies can diminish the perceived value of the stove, and thus reduce households' willingness to use, maintain and eventually repurchase the product (Rehfuess et al. 2013). Commercial ventures have a direct incentive to improve products on an ongoing basis to meet user needs and expand their customer base. But identifying the most appropriate commercial approach for any given context is not simple. Testing different distribution and supply chain models is costly, but can offer important lessons about what is most viable. The availability of stoves and fuel in local markets and the ease of installation and use in the home are very important to keep customers coming back – the ultimate benchmark for a sustainable market.

Creating an enabling policy and regulatory environment: To ensure a dynamic cookstove market, the enabling and regulatory environment must actively support innovation, enable scale-up, and facilitate competition. Learning needs to be harnessed to bring better and more affordable technologies to users. Standards are also important at the outset, to ensure that poor-quality products do not harm market development. Studies of the cookstove sector in India (Atteridge et al. 2013; Rehman et al. 2012) and Ghana (Agbemabiese et al. 2012) emphasize the importance of mechanisms that support technological experimentation to explore different technologies and business models, foster market linkages that facilitate increased technology diffusion, and set rules to establish a fair and competitive market that does not depend on subsidies.

These three pillars form the basis for a “systems” approach to cookstove market transformation, which emphasizes the importance of linking multiple stakeholders in order to contend with and successfully overcome multiple interrelated barriers.

2.2 SNV discourse on cookstove interventions

The latest trends in understanding how cookstove market transformation happens and the factors essential to its success are largely reflected in SNV discourse around its ICS and sustainable fuels interventions (see, for example, SNV 2014).

SNV has set out to achieve two **long-term impacts**: climate change mitigation, through reduced greenhouse gas emissions, and improved livelihoods, through improved health, greater income and reduced drudgery. The **medium-term outcomes** necessary for these impacts to be made are the wide-scale adoption of improved cookstoves and sustainable fuels; SNV’s aspirational target is to contribute to the dissemination and sustainable adoption of 2 million improved and clean cookstoves by 2020 (including biogas), benefiting about 12 million people.

In line with the evidence on how cookstove interventions can lead to market transformation, SNV has made **assumptions** about systemic barriers to clean cooking that it needs to address to achieve the desired medium-term outcome of wide-scale adoption of improved cookstoves and sustainable fuels. They include public policy and institutional capacity; the environment for private-sector development; cultural aspects, behavioural change and awareness, decision-making power and gender inequality; economic aspects such as availability of capital (to purchase, produce and distribute stoves); information about and accessibility of new technologies and services (installation, after sales); and bottlenecks in the value chains both for appliances and cleaner fuels. Hence, SNV’s interventions typically involve linking local and foreign stove producers with last-mile (i.e. customer-facing) distribution companies, to provide market intelligence to attract the private sector and reduce the risks of market engagement, and to help improve marketing and communication campaigns to test viable distribution models. SNV also seeks to influence the policy and regulatory environment to achieve better coordination and improved standards.

Given this starting point, the questions this analysis seeks to explore are: **How is this discourse being reflected in SNV practice on the ground? And what do these experiences tell us about the uniqueness of SNV’s market-based approach?** By looking at four country case studies, we analyse how SNV discourse is matched by reality in its interventions. This will allow us to propose an ideal theory of change that accurately captures SNV’s approach.

3. RESEARCH DESIGN AND METHODOLOGY

To address our research questions, we undertook studies in four of the 17 countries where SNV has ongoing improved cookstove projects: Cambodia, Kenya, Nepal and Rwanda. All but Kenya are Least Developed Countries – low-income nations facing substantial development challenges.¹ The cases were chosen by SNV to ensure diversity in geographical locations and settings, technological focus and project status. The small sample size limits our ability to generalize from these studies, but the cases still allow for a fairly broad spectrum of project characteristics to be explored, providing valuable lessons for all countries and ICS projects.

We collected data in two ways: first we conducted a thorough desk review of SNV project documents for each case (provided by SNV), as well as other literature and policy documents on the cookstove and broader energy sector context in each case study country. Second, we collected data in the field, via semi-structured interviews. Interviewees included stove users, SNV staff, supply chain actors working with SNV, policy-makers and others (e.g. NGOs, stove retailers, stove associations and sector experts). A list of interviewees is provided in Table 1. Since this research was geared to understanding SNV's approach, interviewees were selected based upon actors that SNV was directly working with or that had been identified as important stakeholders in the cookstove sector. The interviews differed slightly depending on the type of interviewee, but they had a set template and generally explored characteristics of the theory of change in order to uncover what aspects might be missing. A sample interview schedule can be found in Appendix A.

Table 1: Summary of field interviews for case studies

Interviewees	Countries			
	Cambodia	Kenya	Nepal	Rwanda
SNV	3	2	4	3
Manufacturers/producers	1	3	1	2
Wholesalers	–	2	–	–
Distributors/Local capacity-builders	1	–	2	2
Retailers/Last-mile entrepreneurs	–	4	2	3
Financiers/MFIs	1	1	1	–
Households	6	8	8	5
Government	1	0	2	3
Other ICS actors	1	0	1	0
Total	14	20	21	18

During data analysis, interview data were triangulated across the groups interviewed to ensure validity of inquiry. This was followed by individual descriptions and assessments of each case study project, with reference to the theory of change and detection of external factors affecting projects. We then undertook a comparative analysis of the four case study projects, highlighting similarities and differences across projects with which to detect discrepancies in

¹ The UN describes LDCs as “low-income countries confronting severe structural impediments to sustainable development”. There are currently 48 countries with that designation. LDCs are identified based on three criteria: gross national income (GNI) per capita, the human asset index (HAI), and the economic vulnerability index (EVI). See: http://www.un.org/en/development/desa/policy/cdp/ldc_info.shtml.

the theory of change. This helped us to identify how SNV works and what value it adds in the cookstove sector.

In order to validate our findings, we held a workshop in Nairobi on 9–10 December 2014. The agenda and participants list can be found in Appendix B and C, respectively. The workshop acted as a data-gathering and project feedback tool and provided an important opportunity to build ownership among SNV staff of the theory of change and potential indicators. Such ownership is vital when implementing a global policy, especially in a fairly decentralized and flexible organization such as SNV. At the workshop, the global perspective on SNV's improved cookstove approach was presented, followed by an overview of the fieldwork insights gathered at that point. After a discussion, participants broke up into groups to identify key aspects of the theory of change. These were compiled into a revised theory of change and indicators associated with each component generated by the groups. Finally, individuals voted on what indicators they felt were easiest to measure and most important.

We noted that SNV's ICS programmes take different forms in different countries. For example, they might include multiple projects in one country (hence, a true programme) or just one (as part of an initial development of a programme). For ease of comparison, we focused on one main project in each country programme.



A retailer in Kenya sells biomass gasifier stoves.

4. THE PRACTICE OF COOKSTOVE MARKET TRANSFORMATION

In this section, we present case study storylines from the four case study countries: Cambodia, Kenya, Nepal and Rwanda. For each case, we give a short background to the household energy challenge in the country and then present the details of the SNV country office intervention. We close each case with our interpretation of the findings with reference to the theory of cookstove market transformation espoused in Section 2.

4.1 Advanced Clean Cooking Solutions Project, Cambodia

Background

Despite seeing a doubling of electricity access, from 15% in 1998 to 30% in 2010 (though mostly in urban areas), roughly 92% of Cambodia's 15.1 million people still rely on solid biomass fuels for cooking and heating. Charcoal is the most common fuel among the 63% of urban dwellers without access to modern energy services, while firewood is most common among the 98.5% of rural dwellers who have no access to modern cooking services. (Energylopedia 2015; Buysman and Mol 2013).

The country has highest per capita consumption of fuelwood in the Asia-Pacific region (Gumartini 2009). Biomass is expected to remain the dominant cooking fuel in rural Cambodia up to 2030 (UNDP 2008), and the pressure on biomass resources is leading to rising charcoal prices (about fivefold since 2005) and increasing deforestation.

Cambodia's cookstove sector has been dominated by the success of a 10-year improved cookstove programme set up by a French NGO, Groupe Energies Renouvelables, Environnement et Solidarités (GERES). The goal of the programme, which started in 2002, was to "create added value for the Cambodian household; to help organize the market with consideration to local customs; to invest in local players through transfer of our technical expertise; and to monitor the impact of the system that we had put in place" (GERES 2014). GERES' programme was built around the New Lao Stove, a more efficient version of the traditional bucket stove. This increase in efficiency allowed the programme to gain carbon credits. The programme is widely seen as a success, with over 3 million stoves distributed in Cambodia, essentially establishing the New Lao Stove as the baseline stove in Cambodia against which all other improved stoves are benchmarked.

Cookstove intervention

When SNV Cambodia began looking at expanding into the ICS sector, the success and widespread penetration of GERES' New Lao Stove suggested that the market for lower-tier stoves was already adequately supported and established. However, more advanced stoves that offer significant health benefits from reduced indoor air pollution were fairly uncommon and unknown in the Cambodian market. Hence, the SNV Cambodia ICS programme chose to focus on catalysing the market for these advanced stoves.

In January 2014, SNV Cambodia embarked on an internally funded two-year project, Advanced Clean Cooking Solutions (ACCS). The project aimed to encourage and build the market for higher-tier biomass stoves, in particular gasifier stoves,² as well as renewable biomass fuel products. It linked stove producers abroad with last-mile distribution companies

² Gasifier stoves work by burning the combustible gas produced through pyrolysis/carbonization of biomass. As a result, gasifier stoves do not generate the smoke produced by incomplete combustion of biomass in traditional stoves. There are two main kinds of gasifier stoves: forced draft and natural draft; the basic process is the same, but in forced-draft gasifiers, a fan is used to force air into the stove.

and generated market intelligence to attract the private sector and reduce the risks of market engagement, and to help improve marketing and communication campaigns to test viable distribution models.

In keeping with SNV Cambodia's desire to develop a functioning market in which consumers could choose between different products, the project incorporated the three imported gasifier stoves: the Philips HD4012 gasifier stove, the ACE-1 gasifier stove (made by African Clean Energy in Lesotho), and the HomeStove made by BioLite HomeStove made by BioLite, a US-based manufacturer. The last stove in the inventory was the Envirofit PCS-1 rocket stove, manufactured in India. Although it is not as efficient and clean as the gasifier stoves, its retail price of 40 USD made it a bridging option between the 4–5 USD New Lao stove promoted by GERES and the 130 USD ACE-1 stoves. In all cases, SNV acted as importer/wholesaler of stoves to show proof of concept, with the expectation that once a viable market was proven, the private sector would take over the role.

The project began with a variety of market intelligence activities, initially using the Philips stove, as it was one of the only commercially available forced-draft gasifier stoves at the time. There was an end-user market assessment, focusing on the market for stoves costing around 100 USD (which was the expected cost of a gasifier), and consumer acceptability/willingness-to-pay studies of the Philips, Biolite, Envirofit PCS-1 and ACE-1 stoves.

During discussions between SNV Cambodia and ACE about promoting the new ACE-1 stove, the latter mentioned a local distributor in Cambodia that was interested in distributing the stoves. This distributor is Lighting Engineering Solutions (LES), a local company that started out selling solar technologies and has recently expanded to include cookstoves.

This distribution arrangement prompted SNV Cambodia to connect with LES in mid-2014 in order to support and scale up the distribution of ACE-1 stoves. LES had also obtained finance from an impact fund in South Korea to support its plans to distribute the ACE-1 stove. Meanwhile, a separate project with a private philanthropic foundation – the Maddox Jolie-Pitt Foundation – served to generate consumer acceptability data for the Envirofit rocket stove and ACE-1. In addition, funds from the Asian Development Bank for a project entitled Harnessing Climate Change Initiatives to Benefit Women are being used to help local distributors identify female sales agents and to train and coach them.

Along with stove market assessments, SNV Cambodia undertook a rice husk pellet production feasibility study and a solid fuel survey of 2,100 households, and it developed a mobile monitoring system. All this was backed up by an innovative website dedicated to SNV's advanced clean cooking work in Cambodia and Laos.³

The next step, due in 2015, is the commercial piloting of stoves and pellet production, which will involve a number of new partners, such as WaterShed Ventures (stove distribution in Kampong Cham region), SGFE (pellet production and stove distribution in Phnom Penh) and Chamroeun Microfinance. Furthermore, SNV has just secured DFID-funding for a results-based finance project, which will also start in 2015.

Transforming the cookstove market

We present here the insights from the observations, conversations and interviews we undertook during a five-day field trip in Phnom Penh and Prey Veng province. In total, we

³ See <http://www.advancedcleancooking.org>.

interviewed 14 respondents, including with SNV staff. We also draw on information from documents provided by SNV staff.

Understanding and mobilizing users

We did not meet any stove manufacturers, as all were based outside of Cambodia. SNV, acting as importer, was the technology wholesaler. The plan for sustainability was to identify a private-sector actor to take over this function if the business seemed financially viable. SNV staff suggested would also consider supporting the establishment of a local entity to continue this role, but they believed such a proposal would be unlikely to gain support from SNV senior management. In terms of distribution, LES reported having benefited greatly from marketing training and support provided by SNV, as the cookstove market was a new area for the company.

On the demand side, we interviewed five households in four villages. All greatly valued their stove, particularly for the speed of cooking, lack of smoke and fuel efficiency. However, the cost of stove (170 USD) was far beyond the 70–100 USD that most households said they would typically be willing to pay, a figure which matches the findings of SNV Cambodia's willingness-to-pay survey. It appeared that households had been willing to pay the higher price because of strong existing connections with LES, an advantage that would not exist if the stoves were more widely disseminated. The commercial pilot of the stove in 2015 will elicit further information on this. In all five homes we visited, old wood or charcoal stoves were still used when large meals were being prepared. Households that kept pigs used their old stoves every day for preparing fodder.



An improved cookstove distributor with a stove user.

Finding appropriate business models

In Cambodia, SNV has purposely not engaged very much with government in the early stages of the project. SNV staff gave several reasons: perceived domination by GERES of engagement with the Ministry of Mines and Energy on cookstove issues; limited expectations of the Ministry's capacity; and a desire to focus on the private sector. However, we met with a senior Ministry official who appeared to have a keen interest in linking with SNV, particularly given recent concern over GERES' lack of plans for future work on cookstoves.

SNV appears to have had limited engagement with GERES, whose successful 10-year programme has mainly focused on building the distribution network it developed for its

lower-tier stove. GERES staff indicated interest in learning from SNV's programme on advanced cooking solutions. They expressed their own reservations about how the technology would fare, but also seemed eager to explore more advanced technology if SNV's work proved there was a market. GERES has developed a national association of cookstove supply chain actors, but only for its lower-tier stoves. Expanding this association to include actors in the supply chain for higher-tier stoves could offer a route to building up an inclusive national cookstove association to lobby government and build momentum and consensus on standards for the sector as a whole. However, there didn't seem to be much interest in doing this, although GERES staff did emphasize that they want to engage more with SNV and want both themselves and SNV to play advisory roles in the association, rather than the coordinating role that GERES has typically played. This suggests some opportunities in the future to have more coordinated efforts and knowledge-sharing.

Enabling environment, managing knowledge and advocacy

The programme in Cambodia has generated a significant amount of data over its first year. The website offers an innovative and accessible way to disseminate that information. It is too early to say whether or not capacity building has been effective, as the commercial pilot had not yet begun. However, the variety of connected projects that SNV has undertaken around cookstoves in Cambodia – from gender mainstreaming to results-based finance – shows a capacity for innovation and experimentation within SNV Cambodia. It offers unique opportunities to understand how different pathways and business models might lead to a sustainable cookstove market transformation. Potential partnerships with organizations such as 17 Triggers, an NGO focused on behaviour change, are likely to add further insights into how to achieve scale-up and market development.

4.2 Clean and Efficient Cook Stove Project, Kenya

Background

Kenya is at the forefront of cookstove development, marketing and distribution, with more than 30 years of activity in the sector (Winrock International 2011). It has one of the largest improved wood stove programmes in Africa, built around the Kenya Ceramic Jiko, which was designed in the mid-1980s through a collaboration between donors and local artisans, and the Maendeleo stove, developed in 1990s by ITDG (now Practical Action) and GTZ (now GIZ). Both are still widely used and are often regarded as the baseline stoves in Kenya.

However, until recently, the main actors involved in the development and dissemination of stoves were international development agencies and local NGOs, which supported local artisans to develop and distribute stoves. As SNV Kenya began to expand into the ICS sector in 2011, it was contracted by the Global Alliance for Clean Cookstoves (GACC) to work with GIZ to develop the ICS country action plan for Kenya. The result was the formation of the Clean Cookstoves Association of Kenya (CCAK), of which SNV Kenya is the chair.

Cookstove intervention

Surveys undertaken by the GACC, and knowledge gained from chairing the CCAK, showed that most ICS actors in the Kenyan market worked with lower-tier stoves, and that a gap remained in the area of advanced technologies and alternative fuels. Hence, after an initial Finnish-funded project demonstrating charcoal briquettes in Eldoret, in 2014 SNV Kenya embarked upon the Clean and Efficient Cook Stove Project, a two-year, SNV-funded pilot to build a market supply chain for gasifier stoves.

The project set out to build capacity and link together gasifier stove producers, distributors, retailers (acting as last-mile entrepreneurs) and financial organizations. The project promoted four types of stoves: two imported forced-draft gasifier stoves from The Energy Resources Institute (TERI) in India and Philips in South Africa (with which SNV had a global partnership), a locally manufactured forced-draft gasifier stove from SCODE (which also acted as a distributor), and a locally manufactured natural-draft gasifier from Wisdom Stoves.

The different technology design, locations of manufacture and features offered resulted in a wide range of consumer prices: the Wisdom natural-draft stove cost 3,500 KES (about 40 USD); the SCODE stove about 8,000 KES (90 USD), though this cost was subject to change; the Philips stove about 11,000 KES (120 USD) and the solar panel-powered TERI stove with phone charging capabilities, roughly 16,000 KES (175 USD).

To distribute these stoves, SNV Kenya works with two organizations: Sustainable Community Development Services (SCODE) and Visionary Empowerment Programme (VEP). SCODE, a local NGO, was established in the mid-1990s and focuses on environmental issues, including renewable energy and sustainable land management. It established a working relationship with SNV Kenya in the biogas sector, but has also worked with other organizations on cookstoves. Not only did it work directly with local community-based organizations, but it offered practical solutions through its own technology production facilities. It already had a line of lower-tier cookstoves and was very interested in developing a more advanced cookstove. At the same time, TERI, which had developed a gasifier stove of its own, gave approval to SCODE to act as a distributor of its stoves and to use its design to develop a locally produced gasifier.

VEP works with about 18,000 women throughout Kenya. Like SCODE, VEP started working with SNV Kenya as an implementing partner in the biogas sector. It had gained experience in cookstoves by working with Paradigm and Ecozoom in 2011, and through this project it became the sole distributor of Philips stoves in Kenya and also became a distributor for Wisdom stoves.



A stove distributor in Kenya, where SNV has focused on gasifier stoves.

The project situated SCODE and VEP as key nodes in the supply chain network, and hence focused on linking them with stove producers, financial organizations and retailers. To foster and solidify these linkages, SNV Kenya worked with SCODE and VEP to undertake stove consumer trials (for the SCODE and Philips gasifiers, respectively), generate market intelligence (e.g. through willingness-to-pay surveys), develop market strategies and distribution models (e.g. through interviews and focus group discussions), and identify potential partner microfinance institutions. Even though VEP was a microfinance institution itself, it still sought to link with others to widen the distribution. SNV Kenya also funded SCODE, VEP and Wisdom Stoves to attend various events, such as agricultural shows and farmer field days, to promote their products.

An additional, but still unrealized, component of the SNV project is to have Ecozoom develop a pellet manufacturing facility in Kenya. Experience with gasifier stoves and sawdust pellet production in Zambia highlighted the need to establish a market for stoves first, and only then begin to produce the fuel locally. Hence, the project has focused on building up demand and testing the use of pellets, but it had not yet reached a scale at which pellet production makes economic sense. The flexibility to adjust implementation has itself been important to sustainable and steady market development, especially during the first half of the project.

Two further projects set to start in 2015 could further strengthen SNV Kenya's broader ICS programme. The first is a DGIS-funded pilot project for pay-as-you-go ICS in Kenya and Ghana, within which SNV Kenya will continue to work with VEP. The second is a DFID-funded results-based finance project, which will give 20,000 customers vouchers for 1,000 KES (about 11 USD) each to buy pellets, as an incentive to buy gasifier stoves; it will also provide risk cover and incentives to microfinance institutions to give out 100,000 KES (1,100 USD) of loans to retailers (last-mile entrepreneurs). At the time of the interview, in late 2014 SCODE had sold about 50 stoves, while Wisdom Stoves had sold 1,000 units in total (not only through VEP), and VEP had sold about 600 Philips stoves.

Transforming the cookstove market

This section presents findings based on observations, discussions and interviews conducted during four days of field visits to Nakuru, Thika and Nairobi. In total, we undertook 20 interviews, including with SNV staff. We also draw on information from documents provided by SNV staff.

Understanding and mobilizing users

On the supply side, both local stove producers have capacity to scale up, by investing in new equipment and/or increasing staff. SNV has helped SCODE and Wisdom undertake stove testing to help improve and validate product quality. For distributors (VEP and SCODE), SNV has hired dedicated staff to help build their marketing and distribution capabilities.

On the demand side, the seven stove users interviewed (one school, six households) reported that were generally satisfied with the stove, although we observed a number of challenges: use of wet wood; poor electricity supply that meant the fan wouldn't work; inappropriate use of fuel (using too many pellets per meal); and lack of knowledge about alternative fuels. On the other hand, we found some interesting user innovations, such as metal stands to help improve the usability of the stove.

Some retailers did not show much interest in the stoves, perhaps because they had no way to demonstrate their use. SCODE seemed to be limiting distribution, because it had not finalized the design and price of its stove. Meanwhile, VEP had ordered more Philips stoves due to

high demand, and Wisdom Stoves had increased production due to increasing demand. The stoves seemed to have strong aspirational appeal, with distributors stating that people were attracted to the stove and tempted to buy, but that price was still a key issue. The willingness-to-pay survey that SNV commissioned showed that users were willing to pay 8,000 KES (90 USD) for the Philips stove, making it a challenge to distribute it at 10,000 KES (110 USD) or more. Potentially a more effective approach would be to target middle-income users.

With regard to gender balance and social inclusion, VEP typically provides loans to women's groups, so this means stove diffusion is often among women. For SCODE, there does not appear to be any specific focus on women as users, retailers or producers, although women are acknowledged to be the main users, and SCODE does have female staff and works with women retailers.

Finding appropriate business models

As chair of the CCAK, SNV has been able to engage fully with other stakeholders in the market, and it is also trying to engage with government and build momentum for policy change and standards development. The CCAK is still in its infancy, and it may compete with other industry associations, such as the Improved Stoves Association of Kenya (ISAK), but it seems to be widely regarded as a force for positive change.

In interviews, project partners said they greatly valued the advisory services provided by SNV, namely advice on technologies, market linkages, market analysis support and financial support to attend marketing events (e.g. road shows). It would appear that without SNV support, technology development and/or uptake would have been much weaker. Distribution business models are an area in which the partners were keen for more support.

Enabling environment, managing knowledge and advocacy

SNV's approach to building a supply chain and linking entrepreneurs appears to be important in supporting market development. However, it increases the number of middlemen between SNV and users, making stove uptake more difficult to monitor. At present, it appears that SNV calculates uptake in terms of stoves sold.

While SNV appeared to be supportive of all the gasifier stoves it promoted, and also any other gasifier technology on the market, the distributors did not appear to be so neutral. This led to a number of challenges. First, SCODE seemed to focus on its own stove, which was cheaper than the TERI stove on which it was based. However, perfecting this stove (in terms of technology and pricing) has taken time, and SCODE has delayed distribution to retailers, preferring to sell a small number of stoves directly. Second, Philips is promoting its stove through a separate campaign in which Equity Bank provides loans, which VEP sees as competition to its microfinance scheme. This has been resolved, with SNV's help, which emphasizes the flexibility of SNV, a positive trait that is not easily captured in a results chain.

Finally, in most cases, SNV has chosen project partners with whom it had prior relationships (via biogas projects), ensuring a high level of mutual trust from the start of the project.

4.3 Improved Cookstoves Programme with Carbon Finance in Far West Nepal

Background

Nepal is a Least Developed Country, with gross national income of only 730 USD per capita in 2013,⁴ and a quarter of its people living below the national poverty line. More than 80% of the population is rural, and about 86% of national energy consumption involves traditional biomass, such as fuelwood, crop residues and animal dung, mainly for domestic use (Surendra et al. 2011; Water and Energy Commission Secretariat 2010). Only 40% of the population has access to electricity, and only 29% in rural areas 29% (ibid.). There is large potential for renewable energy resources, including hydropower, solar, wind and bioenergy, but it has yet to be realized, and biomass is expected to remain the primary fuel for households in the foreseeable future (Malla 2013).

The stoves used by most rural households in Nepal are homemade, built on the ground with locally available materials such as mud, risk husks and clay. The stoves vary in size, depending on the size of the household. They average a 10% efficiency, and smoky kitchens with high toxic waste exposure are common across Nepal (SNV Nepal 2012). As in many other countries, traditional stoves appeared deeply embedded in the culture; interviewees noted that cooking on such stoves is a vital part of their ancestral customs and heritage.

Nepal has had a national improved cookstove programme in place since 1999, operated by the Alternative Energy Promotion Centre (AEPC), a government agency under the Ministry of Science, Technology and Environment. The programme has taken a national, systematic approach to improved cookstove dissemination, and as of June 2012, around 620,000 stoves had been distributed (SNV Nepal 2012). The programme covers 64 of Nepal's 75 districts. There are also a handful of smaller improved cookstove initiatives run by national or local NGOs across the country.

Cookstove intervention

SNV Nepal's ICS programme, Improved Cookstoves Programme with Carbon Finance in Far West Nepal: Sustainable Cooking Energy through Market Led Approach, has been implemented in close partnership with the AEPC and two local capacity-builders, CRT/N and RDSC. The programme contributes to achieving the goals of the national Clean Cooking targets under the framework of the National Rural and Renewable Energy programme (NRREP). It builds on SNV's extensive experience in the renewable energy sector in Nepal, gained through the implementation of the National Biogas Programme. SNV's core role has been to coordinate and facilitate activities carried out by the main implementing partners, CRT/N and RDSC, while enhancing the enabling environment by providing technical support and advisory services to the AEPC.

SNV launched its ICS programme, initially in three hilly districts (Doti, Dadeldhura and Baitadi) of the Far-Western Development Region of Nepal, in July 2012. In 2013, on request of the government, this was extended to include another four districts in the same region. The area was selected due to its particularly low energy access, with almost 100% of households relying on fuelwood for cooking and heating. Thus, by providing an improved cooking option, the programme could make a large impact. The region is also relatively homogenous, socially and culturally, which limits the number of variables to consider in the stove design.

⁴ Data from the World Bank's World DataBank, <http://databank.worldbank.org/data/home.aspx>.

The programme aims to supply ICS to 150,000 families in the initial five-year phase, using a market-led approach supported by carbon revenues. The stated objective is to support socio-economic development among the rural poor through accelerated dissemination of a clean cooking energy solution that is “affordable, effective and socially acceptable”. The project is being developed through a Clean Development Mechanism (CDM) Programme of Activities (PoA) to finance the intervention in the medium term.

The stove being distributed is a wood-burning rocket chamber encased in a mud body, developed by CRTN through a process of careful user interaction and laboratory testing to ensure high efficiency, low emissions and user acceptance. The stove scores high on safety and has 23% thermal efficiency (Regional Cookstoves Testing and Knowledge Centre). The metal combustion chamber and accessories are manufactured in four metal workshops in Dadeldhura and Dhangadi, and are then transported to the villages, where they are installed in homes by promoters trained by CRTN and RDSC, who also provide instructions on stove use and maintenance. The casing is made from local materials, (bricks, mud, rice husk, ash).



The rocket stoves being distributed in Nepal.

The promoters also follow up with households to ensure that the stoves are being used correctly and to deal with any problems. A more expensive metal portable stove model is also being piloted in conjunction with a micro-lending scheme. Quality assurance is a crucial part of the programme, put in place to ensure carbon finance requirements are met. CRTN has developed a stringent quality assurance and maintenance protocol, which promoters and local partner organizations are expected to comply with.

A key innovation of SNV’s programme is the market-led approach. Local metal workshops manufacture the cookstove chambers as a core part of their business. Participating households contribute labour and materials to the construction of the stove and, depending on their labour input, may also pay a nominal fee, which ensures that the initiative is demand-driven. The business model uses performance-based systems to build capacity and develop the market. Local NGOs and CBOs train entrepreneurs in cookstove marketing and installation, and the entrepreneurs then work on commission, which incentivizes them to reach cookstove installation targets. The long-term goal is for the entrepreneurs to become independent cookstove retailers, without the need for external support.

Carbon revenues, though not enough to sustain the programme, especially given the low prices in current markets (Lambe et al. 2014), are important for the initial financial sustainability and scale-up of the initiative. Four component project activities (CPAs) have been registered under the PoA, and verification was expected to start in March–April 2015. SNV has a buyer in place for the carbon credits, which covered upfront payments for cookstove installation and baseline studies. The carbon revenues generated will be used to cover subsidies to the stove manufacturers (metal shops) and to the households. In light of the collapse of the carbon market since 2012, which has had severe negative impact on many carbon-financed cookstove projects (Lambe et al. 2014), carbon revenues are now only considered a supplementary source of funding.

Despite some delays in 2013–14, overall the programme is on track to deliver on interim targets. Implementation began in mid-2012, with 33,000 stoves installed by July 2013.

Transforming the cookstove market

The findings presented in this section are based on observations, conversations and interviews conducted during a three-day field trip to the Far Western Region. In total, we spoke to 21 interviewees, including SNV staff. It also draws on information provided by SNV staff in Kathmandu and Dadeldhura and by AEPC representatives in Kathmandu.

Understanding and mobilizing users

We visited one of the four workshops producing stove parts for the programme. The workshop demonstrated clear capacity to achieve production at scale: since they joined the programme, the business has expanded, with significant investments in modern machinery and an increased number of staff dedicated to ICS. Cookstoves now constitute a larger share of their business than previously. SNV's system of quality assurance has also helped to improve the consistency and quality of the stoves.

The national government prescribes a 30% quota of women employees, and SNV Nepal encourages local partners to work in line with this quota. Based on our observations, the partners seem to be making efforts to prioritize women when recruiting promoters and to ensure the inclusion of marginalized groups. For instance, the director of the partner in Dadeldhura spoke at length of how his organization is making every effort to employ people across the caste system.

Several interviewees both from the AEPC and the local partners highlighted that the entire Far-Western Development Region is made up of marginalized populations, so by design, the programme is focusing on these sections of society.

On the demand side, we interviewed eight households in three different villages. All confirmed strong demand for the stoves in their particular villages: most interviewees suggested that “everyone in the village” either already had the improved stove, or wanted it. High demand was also confirmed in an interview with a small MFI/lending cooperative in Dadeldhura that reported having a long list of customers eager to buy a stove as soon as the supplier managed to catch up with demand. The Rural Development Service Centre (RDSC), one of the local partners, also said it had already exceeded its demand mobilization targets. This suggests that the demand-driven model put in place by SNV Nepal is working.

Finding appropriate business models

Based on one day of interviews in Kathmandu and the three-day field trip, which included an expert from the national cookstove programme, SNV Nepal appears to be adding value in



A stove workshop in Nepal.

terms of providing advisory services to the national government, notably the AEPC, on how best to implement ICS interventions. This observation is supported by the fact that SNV Nepal has been invited to take over the government's national cookstove programme in the Far-Western Development Region. Furthermore, the head of AEPC identified SNV's market-led approach as being innovative and a key success factor for the programme.

SNV is also providing technical assistance to AEPC in drafting the national programme document on clean cooking for all by 2017. The national government has avoided a market-driven approach in the past, but this suggests a change in direction for how ICS is implemented in Nepal. In addition, SNV Nepal staff said they are providing general strategic input on how key Nepali actors in the household energy sector can work coherently towards the same goal – for instance, AEPC and CRT/N on test centres, based on their respective capacities. The gradual bridging between (the former competitors) AEPC and CRT/N was confirmed in interviews with CRT/N.

SNV Nepal has also helped strengthen CRT/N. The organization no longer focuses only on technical aspects, but takes a more holistic approach to ICS design and interventions. This was confirmed by the fact that CRT/N is now building capacity on all levels, including monitoring, operations and maintenance. CRT/N representatives also demonstrated an awareness of the need to engage with users to understand how ICS are used and how to drive behaviour change, something which previous experience tells us is often lacking in a technology oriented organization. Furthermore, CRT/N now understands the value of a market-based approach and, crucially, how to achieve it by designing desirable products and ensuring high quality. The need for quality assurance was evidenced by the newly developed test centre (funded by the GACC, an application SNV Nepal encouraged CRT/N to submit) and by the use of a technological innovation “roadmap” (designed by SNV).

Enabling environment, managing knowledge and advocacy

While capacity-building for local NGOs is missing from SNV's current results chain (the long-term objective for SNV is for the private sector to fill this role), it is clear from our field trip that SNV Nepal is strengthening the capacity of the local NGOs involved in the ICF programme. The “business model” SNV Nepal has put in place, where local partners are paid on performance (300 rupees, about \$3, per stove) appears to be creating a clear incentive for partners to run their operations in a more professional, business-like manner. For instance, while the subsidy provided by SNV Nepal is crucial to get the stove to the market, partners are free to create demand as they wish – e.g. by working with community-based organizations (whom they pay) or by staying in a particular location until demand is saturated.

SNV Nepal's choice to limit its role to providing guidance and targets thus seems to have empowered local partners to tailor their approaches to the local circumstances. The partners interviewed also demonstrated clear ability to manage and implement a robust monitoring system, including quality control. This included spot-checking the work of community-based organizations to check for fraudulent activities and ensure targets are being met. A quality assurance system is also in place at the local partner level, where the first 15–20 installations done by a new promoter are checked by a more experienced installer. In addition, we found the partners were able to reflect on their own systems and compare them with others' – for instance, different CDM monitoring techniques.

In the private sector, SNV Nepal's market-led approach has stimulated demand and thus allowed the ICS manufacturer we met to grow his business. The long-term plan is to enhance the market-driven approach by having promoters act as distributors/retailers. The workshop

owner and SNV Nepal have introduced this idea to promoters, but no one has yet taken to the task. This idea could be pursued further, e.g. continue to present opportunity to promoters, but combined also with business training to be more attractive to individuals. Another way to strengthen private-sector actors would be to expand cooperation with microfinance institutions or smaller loan cooperatives. This could create a more direct link between access to finance and a new technology, a key pillar in any market-led approach. If such an approach were to be developed, it matters how the loans are packaged. Providing a direct loan for an ICS, as is currently being done by the small loan cooperative interviews in Dadeldhura, makes users likelier to use the stove than if money for a stove is part of a larger loan package.

As we did not interview any households that had used the stove for more than a couple of months, we cannot provide any reliable observations on long-term switch or sustained demand over time. However, our literature review and previous research experience tells us that the (long-term) enabling environment could have been strengthened by obtaining a more nuanced understanding of users' needs already in the baseline study. A standard socioeconomic study should thus be complemented by a more rigorous qualitative analysis that goes beyond a simplified analysis of cooking behaviour, and considers also the wider socio-cultural context of long-term technology adoption (other technologies in use, needs, preferences, etc.). Such a study could then be used to develop a realistic assumption on switching/use of other stoves that could be tested and re-tested in the same households over several years. Without such a comprehensive baseline study, it is also impossible to assess the severity of complaints that we heard from households – e.g. on difficulties making roti, the need to use two potholders, and the need for several heating sources. Given their constant interactions with users during monitoring, the local partners have a clear understanding of households' needs and constraints when using the stove. It would be worthwhile to capitalize on this strength and knowledge to further develop the user-focused element.

4.4 Market-based Solutions to Eliminate Energy Poverty, Rwanda

Background

Modern energy access in Rwanda is quite limited (REMA 2009; Safari 2010). As of 2012, national statistics show, only 18% of households had access to electricity, and 98% relied on traditional biomass as their main energy source for cooking (about 82% on firewood, 13% on charcoal, and 3% on grass or leaves). In rural areas, 93% of households used firewood. The rate of biomass use for cooking has barely changed since 1991. Asked by census-takers why they did not use modern energy sources, households cited the high cost of the equipment and fuels (NISR 2014a). Despite substantial improvements since 2000, 45% of the population lived in poverty as of 2011, and 24% in extreme poverty (NISR 2014b).

Vision 2020, a 10-year development plan approved in 2000, stressed the need to increase electricity access to 35% and reduce wood consumption by 50% (Republic of Rwanda 2000). The expectation was that Rwanda would slowly decrease firewood use for cooking by introducing alternative fuels such as LPG and solar and thermal technologies. Given the uncertainty of technology diffusion, however, the country also set out to accelerate production of ICS using biomass, with the idea that the market would evolve over time (REMA 2009).

In 2013, the Second Economic Development and Poverty Reduction Strategy (EDPRS2) set explicit targets for the use of clean cookstoves. It noted that less than half of households used ICS, and aimed to deliver 400,000 low-tier ICS at an affordable cost to households (Republic of Rwanda 2013), with each district given a target. The government's national ICS

programme, meanwhile, aims to achieve 100% diffusion of ICS. SNV is secretary of the National ICS Platform, which also includes Care, Practical Action and some consultants.

Cookstove intervention

SNV Rwanda entered the ICS sector in 2013, with a project called Market-based Solutions to Eliminate Energy Poverty. The project was initially designed to last a year, and focus on market development for improved wood and charcoal stoves, including the existing *canamake* and *canarumwe* stoves, which had been developed through a previous project by Practical Action and the Energy, Water and Sanitation Authority (EWSA), the government agency in charge of the national ICS programme at the time.

SNV submitted a proposal for the project to EWSA in early 2013, with the hope that it could be funded under its World Bank-financed Sustainable Energy Development programme (SEDP). EWSA already had a good working relationship with SNV Rwanda through engagement in the biogas sector. However, approval took some time, and by then, only four months were left in the SEDP grant term. Hence, EWSA asked SNV Rwanda to undertake a four-month project. Officials at EWSA viewed the project as a trial or consultancy to see if scale-up would happen. However, SNV Rwanda staff believed that all parties knew that the project would take longer than the four months allocated and expected that extensions would be awarded without any difficulty.

The project aimed to develop the supply chain and marketing, to expand the network of 15 producers in 30 districts that had been established through the EWSA/Practical Action project. SNV Rwanda originally sought to promote and develop the market for different types of stoves, but given the reduced time frame, it was only feasible to focus on one. Thus, with the unsustainability of fuelwood use being a critical issue in Rwanda, and charcoal supply chains requiring a very different approach, the project focused on the *canarumwe* stove.

The *canarumwe* stove was designed by Practical Action, drawing on the design of the Kenya *maendeleo* stove (also known as the *upes*i stove or *jiko kisasa*), which was also designed by Practical Action (then known as ITDG) and promoted by GIZ (then GTZ) in the 1990s. Like



A craftsman works on a stove at a manufacturing cooperative in Rwanda.

the *maendeleo* stove, the *canarumwe* goes through a number of stages before being installed in the kitchen. Locally found clay is mixed with sand and fashioned into a stove shape using a mould; this includes the cutting of the door and adding of pot rests. The stove is then dried for two to three weeks before being fired. The fired stove is installed in the user's kitchen by surrounding it with a mixture of mud and stones, which are usually provided by the household. Installation can take anything from 15 minutes to two hours, depending on the skill of the installer. After installation, the stove is left for some days to dry before use, and the household is given instructions on how to use and maintain the stove. Excluding the contribution of mud and stones, the stove and its installation typically cost 2,500 RWF (around 3.50 USD), and should last up to five years.

The project relied on partnering with two local capacity-builders, Billem Innovations and Africa Evangelical Enterprise (AEE), to help attract, train and build stronger links between new and existing producers, mobilizers and installers in 10 districts in Rwanda. Billem Innovations is a private company set up by Hestian Innovation as part of a multi-country carbon-financed cookstove programme. Although it has only seven staff in Rwanda, it had been a partner in the earlier ESWA/Practical Action project, and thus knew the technology and had experience building capacity in the field. The opportunity to work in five new districts was attractive, as it offered a chance to generate more carbon revenues. The other five districts were looked after by AEE, a local NGO with 200 staff working across 21 districts. Although AEE had little experience with cookstoves, it had strong links with local communities and a good track record from working with SNV Rwanda on education and agriculture. These different but valuable traits made Billem and AEE the kinds of strong partners that SNV Rwanda needed to help meet its targets in the initial four months.

Working with district officials, SNV supported Billem and AEE to do supply chain strengthening and capacity-building activities. These activities, financed and supervised by SNV Rwanda, consisted of linking producers to cooperatives willing to buy stoves in bulk and distribute them, and training people within these cooperatives to act as mobilizers and installers. Guided by district officials, five cooperatives in each district were selected to act as distributors, each consisting of at least two mobilizers and one installer. Since the project did not involve any technology development or training of new producer cooperatives, Billem and AEE simply worked with existing producers to improve their processes and link them to distributor cooperatives. Along with financing and supervising these activities, SNV Rwanda designed the communications strategy and took care of all reporting to EWSA.

The contract was signed in October 2013, and stove production began straight away. However, after various delays, a two-month extension was granted, and then, after seasonal rains hindered the drying and distribution of stoves, a further six-month extension. Thus, the project ultimately lasted nearly 12 months, as initially planned. Upon completion, it was declared a huge success, achieving 138% of the target of producing and selling 18,000 stoves in four months was exceeded. Still, these positive results amount to only 1–3% of current district targets, so considerably more work is needed.

Transforming the cookstove market

In the analysis below, we present findings based on observations, conversations and interviews during a five-day field trip to Kigali and Nyagatare and Kerehe districts. In total, we undertook 18 interviews, including with SNV staff. We also draw on information from documents provided by SNV staff.

Understanding and mobilizing users

In the two producer cooperatives we met, production capacity was about 200–300 stoves per week. The key challenge for both producers was securing adequate storage facilities. The three distributor cooperatives we met were fairly different: one was made up of motorbikers, another of maize farmers, and the third of beekeepers. Their membership numbers ranged from around 25 to 75, and each sold a total of 200–800 stoves. Although jobs had been created, the cooperatives tended not to see stove distribution (mobilization and installation) as a full-time activity. Links between producers and distributors appeared fragile and in need of further support. Transportation was commonly noted as a challenge, particularly since distances were often long and roads were poor, and often stoves would break during the journey. Also, there was a general feeling that the producer-distributor link still relied on Billem, AEE and SNV to help encourage communication.

For those involved in distribution, profit margins were fairly low (roughly 200 RWF per stove, or less than 30 US cents) and many mobilizers and installers spoke about the long distances they often had to travel to reach households, which made the profit margins seem even lower. Of the 2,500 RWF paid by consumers, 1,100 typically went to the producers, 300 RWF for transport, 300 RWF to the distributor cooperative, 300 RWF to the mobilizer and 500 RWF to the installer. Yet even with narrow profit margins, many households still found this consumer price too high. This often made the job of mobilizers challenging. They reported finding interested customers who just couldn't afford to buy the stove.

Those who had bought it overwhelmingly praised it for its efficiency, though a few complained about the stove not retaining heat. Smoke was not reduced significantly, but extremely high fuel savings were reported, a factor which often led the stove to essentially sell itself among neighbours of stove owners. Most stove owners also said they no longer used any other stove because of the improved efficiency and the fact that they could cook all types of food on it. There appeared to be a really good monitoring system in place, which was important for Billem's carbon credit programme. AEE has not done a proper survey with SNV on stove usage yet, but some households we met had bought two or three, showing how much they valued the stove. Billem staff noted that in a survey in 2013, before the project started, they had found that general use was 90% after two years, and 70% of households used only the *canarumwe* stove. Where there was no usage, it was typically because of poor training and awareness.

In terms of gender issues, there was no explicit focus mentioned, but it was observed that most producers and mobilizers were women and most installers were men. There is ample room for a more gender-inclusive approach in further cookstove projects.

Finding appropriate business models

In our interview with government officials, it appeared that there was little knowledge about differences between ICS types. The district environment officers who are largely responsible for ensuring that district and national targets for cookstoves are met covered all energy issues, so they were generally not experts on cookstoves. This meant that any opportunity to meet cookstove targets was taken up, regardless of the technology and distribution model used. Hence, in some cases, there were programmes giving out free stoves, which has been shown to harm the development of a sustainable market (see GIZ n.d.). SNV staff also reported a problem with the lack of standards for stoves, with the fairly standardised *canarumwe* competing with many locally produced stoves of varying quality and efficiency.

Engagement with district officials and grassroots leaders has been important for achieving successful project implementation and continuing activities after the project's end. As noted above, SNV Rwanda is also a key actor in the initiation of the national ICS platform. Although this is still in its infancy – only two meetings had been held by the end of 2014 – there is potential for this platform to offer a place to share knowledge and coordinate dialogue with the government, and to discuss issues such as the impact of free stoves on market-based initiatives.

Enabling environment, managing knowledge and advocacy

Both AEE and Billem emphasized that SNV Rwanda had helped them build their capacity, albeit in different ways. AEE learned about market-based/value-chain approaches, which the staff hope to use in other programmes. Billem found it novel and valuable to work with cooperatives and district officials. Both are developing further activities in cookstoves and are active in the new ICS platform that is developing in Rwanda.

Many actors still appeared to view their supply chain activities as a part-time business, and so there is concern over sustainability. That said, the targets were exceeded, so SNV Rwanda has clearly shown there is a market to develop. Hopefully further project funding will allow them to continue their work in the area.



A kiln for firing stoves at a manufacturing cooperative in Rwanda.

5. DISCUSSION

In this section, we start by comparing the case studies to draw out the similarities and differences between SNV cookstove projects in the four countries. By combining these insights with currently perceived international best practice, we propose a theory of change to reflect SNV's approach to cookstove interventions.

5.1 Comparing case study stories

We compare the four country cases based on several criteria: from the time frame, to the technology and fuel involved, to market development strategies used, to SNV's role in the ICS sector overall. Table 2 at the end of this section summarizes the comparisons, which are discussed in more detail below.

Time frame/establishment/funding

Activities in Kenya and Nepal have been running for three years, while activities in Rwanda and Cambodia started just over a year ago. In all cases except Rwanda, the projects we looked at were designed to last two years or more. The project in Rwanda had been planned for one year, was cut short to four months by the funder, but ended up lasting almost 12 months after extensions. The projects in Cambodia and Kenya are about half-way through their funding period, while Nepal is further along, and Rwanda has finished. Funding for all but the Rwanda project came from SNV internal funds, with Nepal also receiving carbon credits and soon to be receiving funds from the OPEC Fund for International Development (OFID). The project in Rwanda was funded by the World Bank, through the Government of Rwanda.

Time frame is an important factor to consider when assessing the impact of ICS projects given the behavioural barriers that must be overcome at the household level when using a new technology. It was difficult to assess cookstove uptake in the case countries, since the households we met with had been using the stoves for a relatively short time (1–6 months). Some research shows that without significant post-acquisition support to households, cookstove use can drop off after the first year (Hanna et al. 2012). It would be useful to revisit these cases at a later stage (after at least three years) to assess household level adoption.

Although there may be variation depending on the context, it is generally accepted that bringing cookstove interventions to scale takes time; the World Bank and others estimate the average time frame to be 5–10 years (World Bank, 2015). This means the cases studied here are just getting started, and should be carefully tracked over the coming years. This longitudinal perspective should underpin the framework for monitoring and evaluation.

Technology and fuel

The projects used different technologies, reflecting the market niche that SNV identified and aimed to fill. In both Kenya and Cambodia, where GIZ and GERES, respectively, had successfully established programmes in lower-tier stoves, SNV focused on relatively unexplored advanced biomass gasifiers. Arguably, the long experience with developing markets for improved cookstoves in Cambodia and Kenya has paved the way (e.g. in terms of awareness-raising and local technical and business capacity development) for a more diversified market allowing for multiple tiers of ICS tailored to various market segments. In Kenya, both locally produced and imported stoves were used, making use of the global partnership with Philips (and heightened by the presence of Philips in Nairobi as its East Africa hub). In Cambodia, the focus was purely on imported gasifiers, initially Philips, but as Philips did not seem too responsive (unlike in Kenya), the ACE-1 became the stove of choice, although SNV is actively seeking variety in the market.

In Cambodia and Kenya, new fuels – pellets – were also part of the project/programme, tied in with the distribution of gasifier stoves. Pellet use has been tested in both countries, but in neither project set out to produce pellets. This is not necessarily a problem, but reflects the SNV country offices' desire to ensure that a solid stove distribution network and demand are in place before significant investment is made in pellet production facilities.

Meanwhile, in Nepal and Rwanda, SNV focused on building the supply chain for lower-tier stoves. In Rwanda, SNV took on technology developed by Practical Action and the government to expand and strengthen the production and distribution network. In Nepal, SNV worked to build up a market-led approach to stove distribution, supporting the activities of local stove producers and capacity builders.

Thus, SNV clearly targets its interventions in terms of technology and fuel choice depending on local context, in particular the level of maturity of market development in the cookstove sector in each case, and specific needs and capacities at the sub-national level.



A household with three improved stoves in Rwanda.

Selection of cookstove technology is a crucial factor, given that a key long-term impact for SNV is improvements in household health. Recent research suggests that substantial health benefits can only be achieved if indoor air pollution is sharply curtailed, which requires using very low-emission technologies (WHO 2014). In practice this means that only the top-performing biomass cookstoves (i.e. high-performing gasifier stoves) or clean fuels should be promoted to achieve SNV's household health goals.⁵ It is thus positive that SNV is actively supporting the development of value chains and markets for more advanced technologies, where feasible. A long-term ambition for SNV could be to gradually develop similar markets in countries that do not yet have experience with more advanced technologies, where market development for lower-tier cookstoves can be seen as an interim step on this trajectory.

Market development

In all projects, market development was a central feature of SNV's engagement. In most cases, having this as the main project goal was a relatively different approach than many other cookstove initiatives had taken. In all projects, SNV worked to build up linkages between different actors in the supply chain, from producers, to wholesalers/distributors, to retailers, to end users. The main method involved partnering closely with local capacity-builders and/or local private-sector entities – LES, NRG, SGFE and MJP in Cambodia; SCODE and VEP in Kenya; CRT/N and RDSC in Nepal; and AEE and Billem in Rwanda – who would act as distributors and trainers of retailers and sales agents. SNV linked these local entities with either local or foreign technology manufacturers. This approach appears to be working well in each case. As noted in Nepal case description, we found clear evidence of enhanced local

⁵ Interim international guidelines for stove performance developed through an International Workshop Agreement have set five tiers of performance (0–4) across four categories: efficiency/fuel use, total emissions, indoor emissions and safety. A stove may qualify as Tier 4 in one category, but rate lower in others. In the context of our discussion, this would mean biomass stoves that perform at Tier 3 across categories. For details, see the GACC website: <http://cleancookstoves.org/technology-and-fuels/standards/iwa-tiers-of-performance.html>.

capacity to generate demand at the local level, install improved cookstoves and provide after sales support to customers. Furthermore, SNV Nepal has plans in place to increase the role of the private sector in the future scale up of the programme.

Supply chains were still in need of some support in most cases, but significant steps were taken to build up a functioning market and in some cases, markets are clearly emerging. For example, in Nepal, where all materials for constructing cookstoves are locally sourced, the key components (combustion chambers) are manufactured by local firms. The local manufacturer we interviewed had already made significant investments to scale up cookstove production, which clearly indicates that the market is beginning to grow. Given that most projects were only around half-way, there is considerable time to solidify the supply chains and pursue exit strategies. In Cambodia and Kenya, a number of other sources of funding have been secured to undertake parallel activities to support cookstove market development. Yet in Rwanda, the market still requires further support for it to be firmly established.

Capacity-building

Training of local capacity-builders and local private distributors, who in turn would build the capacity of retailers and sales agents, was crucial to all projects. Most partners expressed gratitude for the advisory support and training they had received from SNV. The “training of trainers” approach seemed to work well and increases the chance of sustainability, although it remains to be seen if the local capacity-builders and local private distributors will continue training people after the projects are completed. In any case, the local knowledge that they brought to projects was in many cases vital in helping select retailers and sales agents to act as mobilizers and installers. The training on marketing and distribution models was considered novel and motivating, filling a knowledge gap for most actors. For instance, LES in Cambodia greatly appreciated SNV’s support in training the women entrepreneurs. Meanwhile, in Rwanda, Billem found SNV’s encouragement to liaise with district offices a novel and useful way to get better engagement with local cooperatives.

Role in the sector and other key actors

In all countries, SNV was considered a major, if new, player in the cookstove sector. Perhaps more importantly, and particularly in Nepal and Kenya, SNV was described as a trusted partner and player. However, engagement with other cookstove actors and government policy-makers varied from project to project. In Cambodia, there was limited engagement with GERES, the big cookstove player in the country, and with the government. This was largely due to a focus on private-sector development, and there were indications that during the second half of the project, engagement with GERES and government officials would increase. Meanwhile, in Kenya, SNV chairs the Clean Cookstove Association of Kenya (CCAK) and has very close links with the government and other actors in the sector, such as GIZ. In Nepal, there were also strong links with government, given that the cookstove programme contributed to achieving the goals of national clean cooking targets under the framework of the government’s National Rural and Renewable Energy programme (NRREP). In Rwanda, a national ICS platform is only just developing, but SNV is closely involved and has good links with government. Interestingly, the biogas programme in each country generally appears to have contributed to a positive perception of SNV from the government’s perspective, although in not every country was it linked with the same ministry.

Table 2: Comparison of case study details

	Cambodia	Kenya	Nepal	Rwanda
ICS activities established	January 2014	2012	July 2012	November 2013
Current major project/ programme	Advanced Clean Cooking Solutions	Clean and Efficient Cook Stove Project	Improved Cookstoves Programme with Carbon Finance	Market-based Solutions to Eliminate Energy Poverty
Time frame	Jan 2014 – Dec 2015	Jan 2014 – Dec 2015	Jan 2012 – July 2017	Nov 2013 – Aug 2014
Status (as of April 2015)	Half-way; commercial pilot still to start	Over half-way, commercial testing being done (561 of 2,500 target sold)	Over half-way; targets met (33,000 ICS sold), hoping for carbon credit issuance end 2015	Ended, targets exceeded
Funding	SNV	SNV	SNV, carbon finance (advance), OFID	World Bank
Technology	Imported gasifier stoves	Local and imported gasifier stoves	Local rocket stoves	Local permanent rocket stove
Fuel	Biomass + pellets	Biomass + pellets	Wood	Wood
Other projects/ programmes	National Biogas programme, Gender and CC project, RBF	National Biogas programme, RBF, PAYG	National Biogas programme	National Biogas programme, RBF
Role in the sector	New player, leading in advanced ICS	Leading player in advanced ICS, chair of CCAK	Leading player, technical advisor to government	Leading player in infant ICS Platform
Other key actors	GERES	GIZ, Ecozoom, Envirofit	Government, GIZ	Practical Action
Testing facilities?	Yes, at GERES (funding constraints)	Yes, KIRDI and UoN (but limited capacity)	Yes, CRTN in Kathmandu	No, use CREEC in Uganda
GACC relationship	Consultations and interventions	1 of the GACC's 6 priority countries	Consultations and interventions, GACC financed testing facility	Consultations and interventions
Producers	ACE, Philips, Biolite, Envirofit, Prime, SGFE (rice husk pellets)	SCODE, TERI, Philips, Wisdom, Ecozoom (pellets)	Asian Metal Power Uddog (AMU), Durga Engineering Works (DEW)	Local potters (cooperatives)
Wholesalers/ importers	SNV in interim	SCODE, VEP	N/A	N/A
Distributors	LES, NRG, SGFE, MJP	As above	Local partner organizations (LPOs)	Billem/AEE (LCB), various cooperatives
Retailers	N/A	Local shops, others still being recruited	N/A	
Mobilizers/ sales agents	Chamroeun Microfinance staff	Local shops, SCODE and VEP, roadshows	LPOs, promoters	Usually from cooperatives
Installers	As above	SCODE or off the shelf	LPOs, promoters	Usually from cooperatives

5.2 Proposing an ideal theory of change

Combining insights from case studies, international best practice and workshop discussions, we devised a theory of change to reflect SNV's approach in cookstove interventions, shown in Figure 1 at the end of this section. As noted earlier, we view a theory of change as comprising impacts, medium-term outcomes, short-term outcomes, outputs and activities, with clearly defined assumptions and indicators linking each.

Long-term impacts and medium-term outcomes

The **long-term impacts** remain those that SNV had set out in early documents, and which were clearly endorsed during the workshop: climate change mitigation, through reduced greenhouse gas emissions, and improved livelihoods, through improved health, higher incomes and reduced drudgery. These were felt to be clear and consistent with SNV's goals and well-reflected in most of the projects. For example, the SNV Cambodia project aimed at "5,000 rural and peri-urban people with improved health outcomes and more expendable income ... [and] reduction in greenhouse gas emissions by 2.0 tons of CO_{2e} per HH per year". However, we need to acknowledge that not all cookstoves in the different projects can deliver the desired health benefits, even if adoption is 100%. We suggest that SNV projects support a trajectory towards increasingly cleaner stoves/fuels – i.e. projects disseminating lower-tier technologies should be viewed as stepping stones to projects that promote cleaner and more advanced technologies. This will have implications for how projects are monitored and what indicators are used.

There are two **medium-term outcomes** (or initial pre-conditions) necessary for these impacts to be realized. Firstly, the ability to consistently generate income to improve people's livelihoods requires the establishment of a sustainable ICS and biomass fuel market. The assumption is that if users pay the full cost of the stove, that payment will not only cover all costs incurred by actors along the supply chain, but also allow them to derive an income. An indicator to show when such a sustainable market is established is difficult to define. But an indicator for job creation, such as number of local entrepreneurs (men and women) involved in commercially viable businesses, is important. An indicator for income generation, such as percentage increase in profits along the value chain, is also important.

Second, reducing greenhouse gas emissions, improving health and reducing drudgery require the increased adoption (ideally, exclusive use) of ICS and improved sustainable use of biomass, which, as the literature shows, are more likely to be achieved through a market-driven approach. The assumption is that when stoves meet certain standards, emissions will be lower, efficiency higher, and lives easier. A typical indicator associated with increased adoption is the number of cookstoves distributed to households – indeed, SNV set an aspirational global target, to distribute 2 million improved and clean cookstoves by 2020 (including biogas), benefiting about 12 million people. However, this presumes that possession of a stove equals use of that stove. By adoption, we specifically mean use. Simple targets associated with number of stoves sold may not tell the whole story.

We suggest complementing stove sales figures with additional indicators related to usage, the data for which can be collected from random sampling of users, ideally through a mix of methods. For example, remote sensors could be used in a sample of households to objectively establish the extent to which ICS is being used and is displacing the traditional stove. These data should be complemented with qualitative methods (e.g. interviews and focus groups with cookstove users) to uncover the reasons why households continue to use traditional stoves. These user-focused data could be used to identify ways to strengthen the programme (e.g. enhancing after sales support, awareness-raising), as well as cookstove design features that

need to be improved. This data collection could be integrated into the current monitoring activities already in place in the various programmes. For instance, during interviews with LPOs in Nepal, those responsible for monitoring household use specifically mentioned that they often received elaborate feedback on the user-friendliness of the stove. If collected systematically, such information could prove useful in improving stove design, for instance.

A good target for the deployment/adoption of high-quality improved cookstoves might be to have sold stoves to 50% of households in a target area and have 90% of the stoves still being used as the main stove after one year. Meanwhile, impact on users' well-being could be demonstrated by achieving an 80% satisfaction level. Indicators based on such targets would help SNV Cambodia to much more robustly assess whether it has achieved its aim of "1,000 rural and peri-urban households cooking with clean and efficient cooking appliances", and whether this aim had helped to meet medium-term outcomes. Table 3 summarizes the long-term and medium-term impacts desired and potential indicators.

Table 3: Desired impacts and potential indicators to gauge success

Time frame	Impact/outcome	Indicator	Target
Long-term impact	Climate change mitigation	% fuel savings	30%
		% thermal efficiency	25%
	Improved livelihoods, health and well-being	% of satisfied end users	80%
		% reduction in household expenditure on fuels	tbd
Medium-term outcome	Establishment of sustainable ICS and biomass fuel market	% reduction in time spent collecting fuel	tbd
		% of households exclusively using ICS	tbd
		Reduction in PM and CO to within WHO recommended levels	100%
Medium-term outcome	Establishment of sustainable ICS and biomass fuel market	No. of local entrepreneurs (men and women) involved in commercial viable businesses (i.e. number of employment contracts signed)	tbd
		Demand for repairs and maintenance service (no. of service jobs executed per month)	tbd
		Number of new products aimed at different market segments (after 5 years)	tbd
	Increased adoption (use) of ICS and improved sustainable use of biomass	% of households in target area who have bought stoves	50%
		% of stoves used as main stove after 1 year	90%
Medium-term outcome	Increased adoption (use) of ICS and improved sustainable use of biomass	% of users willing to re-buy stove if/when it breaks	tbd
		Number of new requests/orders for ICS per month	tbd
		% of households seeking repairs if ICS breaks	tbd

Short-term outcomes, outputs and activities

So how do you catalyse adoption (i.e. use as well as possession) of ICS and more efficient and sustainable use of biomass? How do you establish a sustainable ICS and biomass fuel market? From the review of best practices among other cookstove actors – for example, GIZ, Practical Action, GERES – in Section 2 and insights from the case studies in Section 4, we

conclude that SNV's approach to achieving these medium-term outcomes involves undertaking activities, generating outputs and achieving shorter-term outcomes in four⁶ distinct but interlinked pillars for SNV's theory of change:

- Understanding user needs;
- Market linkages and capacity development;
- Testing innovative business, distribution and finance models; and
- Supporting the enabling environment.

Understanding user needs

Crucially, as demonstrated in the literature, cookstove programmes are likelier to meet their objectives when the end user is considered at every point along the value chain, from design to marketing and delivery, including the type of end-user finance mechanism applied. Incorporating users' needs and preferences into the design of the cookstove is critical to ensuring that the stove is used consistently and correctly by the household (see Table 4). Thus, the success of the entire project/programme hinges on getting this right from the start. The type of information required to design a cookstove technology (and delivery programme) from the perspective of the user goes beyond compiling market data such as household's willingness and capacity to pay for a new stove. We suggest that SNV's understanding of "user needs" be widened significantly to include a broad spectrum of behavioural drivers such as culture, aesthetics, aspiration and peer/community effects.

Even when a user-focused approach to technology design is taken from the outset, the only way to know whether the stove will be used is to test it in the field. Finding out exactly what happens inside the household when a new stove is introduced is notoriously difficult, since the data collection methods typically used (household surveys) are often not adequate for capturing complex socio-cultural factors, and households tend to exaggerate the extent to which the new cookstove is used. As mentioned previously, we recommend a mixed-methods approach to understanding how and to what extent cookstoves are being used, as well as user acceptance and satisfaction.

Appropriate indicators that user needs have been met could include: the percentage of households using stove exclusively or for the majority of daily cooking needs, and the number of households buying a new stove of the same type when the original wears out or breaks.



A household with a high-end improved stove in Nepal.

⁶ We have expanded here from three identified in earlier sections to four, because we believe understanding users' needs requires its own pillar.

Table 4: Results chain related to market analysis and value chain development

Time frame	Outcome/output/activity	Indicator	Target
Short-term outcome	Incorporating users' needs and preferences into the design of the cookstove	% of households using stove exclusively or for the majority of daily cooking needs	tbd
		Number of households repurchasing cookstove when it wears out/breaks	tbd
Output	Understanding of user needs	Number of behavioural drivers assessed as contributing to user decision-making regarding new stove use	tbd
	Understanding of market segments	WTP analysis conducted for different segments	tbd
Activity	Market analysis (supply and demand, willingness-to-pay surveys) Analysis of behavioural drivers such as culture, aesthetics, aspiration and peer/community effects.		

Market linkages and capacity development

SNV's work on market linkages and capacity development aims to achieve three main outcomes (see Table 5). The first is to develop an effective and robust (i.e. connected) value chain for ICS and alternative fuels, with new job opportunities. This requires increased and stronger business linkages (product to consumer), which SNV can help achieve by facilitating business-to-business links. There are several indicators that could be used to measure achievement of this outcome, such as the number of new supply chain actors per year, the percentage growth in incomes against a baseline scenario, or the number of jobs created.

A second desired outcome is strengthened enterprises, with good capacity to deliver a good product (including production) and understand their target market. This is achieved by training enterprises so they have enhanced technical and business capacities, with the training needs assessment and training for entrepreneurs and producers done or supported by SNV. An indicator for this outcome could be the number of local SMEs capacitated to profitably distribute ICS and renewable biomass products, as set by SNV Cambodia. But this requires a clear measure of an enterprise's capacity. A proxy indicator could be the number of trained entrepreneurs, disaggregated by gender, age, etc. Alternative indicators could be the percentage increase in enterprises compared with a baseline year, or percentage increase in annual sales or profits.

The third desired outcome is diversification of products in the marketplace. To achieve this, SNV works to ensure that a range of tested product combinations are available by enabling R&D on alternative fuels/stove-fuel combinations. The proposed indicator for assessing this outcome is the number of different stove varieties on the market, with a target of at least five.

Table 5: Results chain related to market analysis and value chain development

Time frame	Outcome/output/activity	Indicator	Target
Short-term outcome	Effective and robust (i.e. connected) value chain for ICS and alternative fuels, with new opportunities for jobs	Number of new supply chain actors per year	235 3
		% of increased incomes against baseline scenario	tbd
		Number of new jobs created	tbd
		Number of different stove varieties on the market	tbd
	Strengthened enterprises, with good capacity to deliver product (incl. production) and understand their target market	% increase in entrepreneurs compared to baseline year	33%
		% increase in sales per year	50%
	Diversification of products	Number of different stove varieties on the market	min. of 5
Output	Increased & stronger business linkages (product to consumer)	Number of value-chain actors in regular contact with each other	tbd
	Trained enterprises with enhanced technical & business capacities	Number of trained entrepreneurs, disaggregated by gender, age, etc.	tbd
	Tested product combinations	Number of products meeting test criteria	min. of 3
Number of tested products (stoves/fuels) introduced to actors in the VC		min. of 3	
Activity	Facilitate business-to-business links User focused impact measurement using mixed methods Training needs assessment & training for entrepreneurs, producers R&D on alternative fuels/stove-fuel combinations		

Testing innovative business, distribution and finance models

By testing innovative business, distribution and finance models, SNV focuses on achieving two main outcomes (see Table 6). The first is to make stoves more affordable and/or increase access to finance. This involves having in place viable business/distribution models and appropriate financial models/products/incentives. Activities to achieve this include developing and testing distribution and financial models. Assessment of this outcome can be done through indicators such as number of types of credit facility available to end users and enterprises, percentage of enterprises that have access to a credit facility, number of credit beneficiaries, stove cost as a percentage of willingness-to-pay (such as +/- 15%) or percentage increase in users buying stoves without financial assistance (gender-disaggregated). Also important might be the number of business models and financial models adopted by actors.

The second outcome is to have more informed users, raise awareness and increase acceptance of ICS. One precondition to achieving this is the availability of a gender-differentiated marketing strategy and tools, which requires concrete activities to explore how best to differentiate. It is important to note that various enabling environment activities and outputs – such as awareness-raising campaigns and policy advocacy – will also have a bearing on this outcome. Indicators for this outcome could be number of new customers per year, with a target of at least 1,000, and annual increase in sales, with a target of doubling sales.

Table 6: Results chain related to testing innovative financial, distribution and business models

Time frame	Outcome/output/activity	Indicator	Target
Short-term outcome	Greater access to finance/stove affordability	Number of types of credit facility available to end users and enterprises	at least 2
		% of entrepreneurs SNV is working with have access to credit facility	50%
		Number of credit beneficiaries	tbd
		Cost of stove is certain % of willingness-to-pay	+/-15%
		% increase in users buying stove without financial assistance (gender disaggregated)	tbd
	Informed users, raised awareness and acceptability (BC)	Number of new households per year	1,000
		Annual increase in sales	doubling
Output	Viable business/distribution models	% profits per stove	8-10%
		Number of business models used by entrepreneurs	tbd
	Appropriate financial models/products/incentives	Number of financial models adopted by actors	tbd
	Gender-differentiated marketing strategy and tools	Number of tools in place and being used	at least 1
Activity	Developing and testing distribution models		
	Developing and testing financial models		
	Developing ICS and fuels marketing strategies and tools		

Supporting the enabling environment

An effective and supportive enabling environment involves three key outcomes: high-quality cookstoves being deployed in the market, effective learning among actors within the sector, and gender mainstreaming in cookstove activities (see Table 7). None of these outcomes can depend on SNV's interventions alone. Indeed, they require coordinated action among a wide range of actors in the sector. However, there are certain activities and outputs that SNV engages in that contribute to these outcomes. Regarding all these outcomes, SNV's awareness-raising activities lead to informed end users and other stakeholders.

Meanwhile, through its policy dialogue activities and support for stakeholder platforms (such as the Clean Cookstoves Association of Kenya), SNV engages actively to influence policy and establish national quality standards, which are important to achieve a level playing field, build consumer confidence and guide financial investment. In Nepal, SNV has facilitated the establishment of a national cookstoves testing facility, which is a crucial element of the enabling environment for the development of national cookstove quality standards.

A key indicator for achieving the first outcome is the percentage of stoves promoted by SNV that meet international or national standards, with a target of 100%. However, it is important to clarify the specific tier, since international standards include lower-tier stoves that have

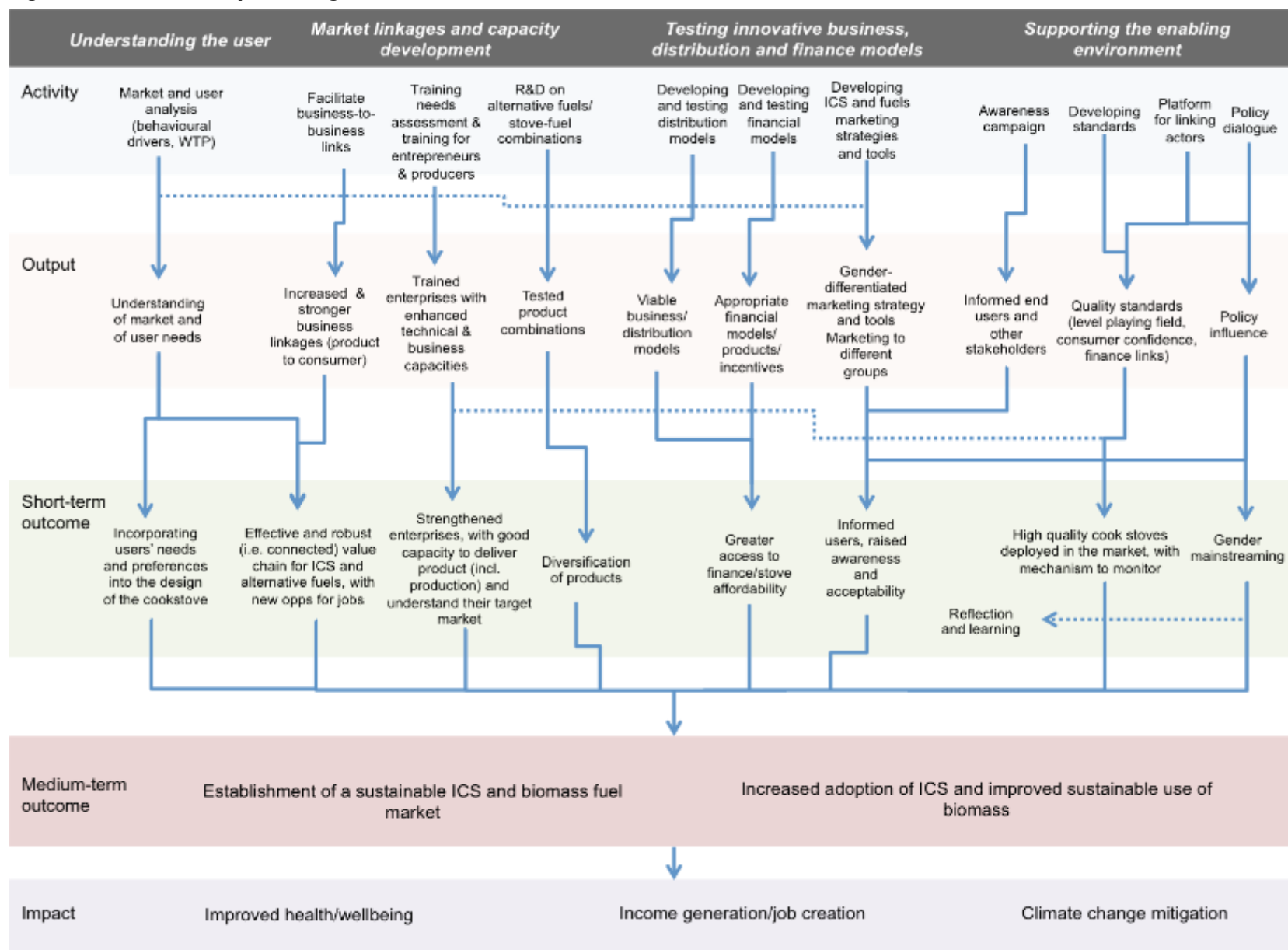
little health impact. As noted above, it is important that this indicator is seen as dynamic, with all SNV programmes moving towards promotion of higher-tier stoves in the long run.

An indicator of effective learning is more difficult to define, but through surveys it would be possible to ascertain the number of people using SNV knowledge products. It would also be possible to measure quantitatively and qualitatively the number of multi-stakeholder dialogue engagements. An initial measure of policy influence – the measurement of which is rather obscure – might be the number of government officials with knowledge of SNV project results or the number of requests made by government or other sector partners for SNV support or services.

Table 7: Results chain related to enabling environment

Time frame	Outcome/output/activity	Indicator	Target
Short-term outcome	High quality cookstoves deployed in the market, with mechanism to monitor	% of stoves promoted that meet ISO or national standards	100%
	Learning	Number of people using knowledge/lessons learned product	–
	Gender mainstreaming		–
Output	Informed end users and other stakeholders		–
	Quality standards (level playing field, consumer confidence, finance links)	SNV-supported ICS are tested in line with IWA standards	–
	Policy influence	Number of multi-stakeholder dialogue engagements Number of government officials with knowledge of project results	-- –
Activity	Awareness campaign Developing standards Platform for linking actors Policy dialogue		

Figure 1: Revised theory of change



6. CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to analyse four ICS and fuels projects against SNV's draft theory of change and best practices of other organizations, in order to recommend improvements to SNV's approach and propose an ideal theory of change. This was done by undertaking field research on SNV projects in Cambodia, Kenya, Nepal and Rwanda, as well as reviewing literature on cookstove market transformation. We interviewed 72 actors in the cookstove market, including households, cookstove producers and distributors, SNV staff, SNV project partners and government officials. We reviewed project documents and locally relevant cookstove-focused literature for each of the country case studies. We also validated our research during an internal SNV workshop in Nairobi in December 2014, where we presented preliminary findings and further refined the updated results chain for SNV's improved cookstove and fuel interventions.

Here we present SNV's common approach, highlight the strengths it achieves through diversity and context-specificity, and present recommendations of where it might still be improved or further clarified.

6.1 SNV's common approach to ICS and alternative fuels interventions

The country reviews identified three commonalities in SNV's cookstove projects that echo best practices related to cookstove market transformation: a systemic approach to market development; commitment to innovation in technology, fuels, financial mechanisms and distribution models; and gender mainstreaming.

Systemic approach to market development

The importance of fostering a market-based approach to the diffusion of cookstoves is well appreciated within the sector and in all SNV projects, market development was a central feature of SNV's engagement. Common to SNV cookstove projects in all four countries studied here was the systemic approach to market development. This systemic approach consists of three main features.

First, it involves understanding the potential market. Many cookstove interventions are supply-driven, taking the market demand for cleaner and more efficient cookstoves as given. However, this neglects the complexity of factors affecting household cooking patterns and how new technologies are diffused within the established household cooking system. Better understanding of user needs, and ensuring producers and suppliers are cognizant of those needs when designing products and distribution models, is vital to building a responsive and transformative cookstove market. SNV typically works to achieve this through market assessments, pilot studies and user testing. By doing so, SNV engages with households at an early stage to understand the viability of new technologies and explore how users adapt their behaviour to these new technologies. Since market conditions vary between (and often within) countries, the characteristics of SNV programmes differ across countries, bearing testament to SNV's ability to tailor interventions to the local context.

Second, the systemic approach involves strengthening linkages between various actors active in the market in order to effectively connect supply and demand. SNV worked in all projects to establish or strengthen linkages between different actors across the supply chain, from producers to wholesalers/distributors to retailers to end users. This was typically done by forming close partnerships with local capacity-builders and/or local private-sector entities that could act as nodes in the network between suppliers on the one hand and end users on the

other. With regard to supply, SNV fostered backward linkages to either local or foreign technology manufacturers that local capacity-builders and/or local private-sector entities could take advantage of. At the same time, SNV's reputation as a trusted, and embedded, partner in the cookstove sector in its various implementing countries allowed gave credibility to its partners through which they could build trust with various partners.

The third feature of SNV's systemic approach to market development – and closely connected to the strengthening of linkages – was the training of local capacity-builders and local private distributors, who in turn would build capacity of retailers and sales agents. This was crucial to all projects. The “training of trainers” approach empowered local capacity-builders and local private distributors to undertake the selection of retailers and sales agents to act as mobilizers and installers. The training on marketing and distribution models was considered novel and motivating, filling a knowledge gap for most actors.

Commitment to innovation

SNV's commitment to innovation manifested itself in its efforts to promote greater market penetration and scale-up of new technologies. In cases where the market for lower-tier cookstoves was already saturated, SNV cookstove programmes promoted higher-tier stoves, such as the relatively unexplored advanced biomass gasifiers. However, rather than viewing commitment to innovation as a commitment to new technologies, SNV also sought to help bridge the gap between technology development and technology commercialization. Hence, where the market for lower-tier stoves existed and appropriate technology had been developed, SNV programmes focused on scaling up its market penetration.

Second, where possible SNV pursued the development of alternative fuels, something that has typically been neglected by most cookstove interventions. Where advanced biomass gasifiers were promoted, the production and distribution of biomass pellets were also made part of the project/programme. The distribution of cooking equipment and cooking fuel was typically tied together. By linking fuels and technologies, SNV aimed to transform the cookstove market such that it went beyond simply end-use technology to creation of a more sustainable biomass value chain. While this goal is more ambitious and challenging, it will also lead to a much larger impact on climate change mitigation, livelihoods, health and well-being.

Third, SNV's commitment to innovation is evident in its attempts to foster innovative financial mechanisms and distribution models for cookstoves. In all cases, projects were developing and testing financial mechanisms and distribution models tailored to the local context, such as pay-as-you-go schemes, incorporating the high initial cost of gasifier stoves into monthly pellet costs, linking with local cooperatives that can provide financing to a ready distribution network of members, and utilizing the influence of local opinion leaders and women's groups.

Gender mainstreaming

Although not all projects had specifically sought to mainstream gender issues, all SNV programmes were giving increasing emphasis to gender. This was specifically highlighted during the internal workshop in Nairobi. In one programme, SNV had engaged in a large project on harnessing climate change mitigation initiatives to benefit women, the focus of which is to strengthen the role of women in the supply chain for advanced biomass stoves, primarily as sales agents and promoters. In a number of other projects, SNV engaged with women's groups as producers, distributors or sales agents, especially where they were already in well-organized groups that could access finance and regularly engage with and influence others in the community. And, in parallel with this study, SNV has partnered with ENERGIA

to help build strategies and tools for mainstreaming gender in all its programmes. This last activity will help to give concrete guidance as to how to mainstream gender into the results chain presented in Section 5.

6.2 Ensuring context-specificity within SNV's common approach

Based on our four case studies, it is clear that the respective SNV offices possess the capacity to plan, initiate and implement well-functioning improved cookstove projects that are tailored to fit local circumstance, including choice of technology and local partners. The advisory services approach – where SNV provides sector-specific advice to actors involved on different levels in the value chain, also seems to increase the appeal of SNV as a partner in the sector. In all cases, SNV demonstrates an ability to master an adaptive approach that is key to any organization seeking to make a lasting impact across many different locations.

A unique and important aspect of SNV's approach is the way in which its programmes differ, yet maintain an SNV identity. The programmes in all four country case studies followed a similar approach and philosophy around the factors necessary to achieve cookstove market transformation. However, they involved different technologies, different modes of engagement and different levels of government interaction, all according to what was appropriate in the local context. This highlights three unique elements of SNV's approach:

- SNV programmes pursue co-creation of knowledge with key partners in order to design the most appropriate set of market transformation activities for the local conditions.
- Through such knowledge co-creation activities, SNV engages in trust-building processes central to ensuring strong relationships with direct partners and supply chain actors. In many cases, this trust-building takes advantage of trust developed in other sectors (such as biogas).
- SNV's approach embraces adaptability. While it can be hard to define an approach that is adaptable, it is precisely this meta-level adaptability that defines the approach. Leaving country offices to co-develop programmes based on strong mutual trust allows SNV to be a dynamic learning organization, constantly striving to try new ideas, seek innovative partnerships and reflect internally on what works and how to improve. This is what will keep SNV at the forefront of cookstove market transformation processes.

It is important to note the limitations to these conclusions. While we saw clear patterns, the SNV projects in each of the four countries are at very different stages, with very different levels of stove distribution. They are fairly young (two to three years at most), and almost all (except Rwanda) are yet to be completed.

6.3 Recommendations for improving and clarifying SNV's common approach

There are still a number of areas which SNV could improve and clarify its approach to ICS market transformation:

- A more nuanced understanding of “user needs” (beyond market research, to include socio-cultural drivers of behaviour) should be integrated into the theory of change and incorporated at every step along the value chain.
- A mixed-methods approach should be taken to understand household adoption of improved cookstoves. Usage should be objectively monitored using cookstove sensors. The reasons for low usage rates should then be explored using qualitative methods. This information could also be fed back to stove designers and producers,

allowing for an iterative design process that allows for continuously adapting the stove to match user preferences.

- There is a need for clarity regarding the criteria used for selecting the type of technology and fuel at each project location, and also for streamlining these criteria with the stated main goal of the intervention. As noted earlier, the evidence shows that either advanced biomass cookstoves or clean fuels are required to achieve the desired health benefits. Though lower-tier ICS can have multiple livelihood and environment benefits, they should be understood as an interim measure on a trajectory towards clean cookstoves, and their limited impact on household health should be reflected in SNV's approach.
- Monitoring of adoption should be conducted continuously and longitudinally (ideally over a five-year period). It is only after a longer time period that one can begin assessing the "real" impact of the intervention. The four case studies examined for this study should be revised in three to five years to assess progress.
- SNV's theory of change should be seen as a dynamic learning tool. As such, it should be tested regularly (once a year) and revised by SNV staff across the organization.
- In some cases, SNV is clearly well established at the national level as a convener of sector-wide stakeholders and trusted partner in the eyes of the government and other key stakeholders. This experience in partnership-building should be transferred to other countries where SNV is less well established in the cookstove sector.
- In some cases (e.g. Nepal and Kenya) SNV plays a key role in knowledge management – for example, in building capacity for cookstove testing to support development of national quality standards. This core capacity will become increasingly important as the WHO guidelines on ICS are operationalized. SNV should endeavour to build similar capacity in other countries where it currently does not exist.

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APPENDIX A: SAMPLE INTERVIEW QUESTIONS

The following provides a sample of interview questions asked to different actors in the cookstove sector.

To SNV staff on the role of SNV:

- Can you describe the set-up of the programme, and where you see yourselves making the biggest difference?
- How do you understand market transformation within the ICS and other sectors in Kenya?
- What is the general progress on implementation? How far, how many households (accepted and rejected)?
- How does the project/programme fit into Kenya's wider ICS sector development?

To distributors on the enabling environment:

- What is most needed to strengthen the sector?
- What incentives are needed to stimulate a market-led approach in Kenya? (RANK in order of importance)
- How is implementation going? What's working well, not so well?
- Can you describe the set-up of training on stove production and building business linkages in concrete terms – what does it look like?
- What measures are you taking to strengthen the role of women in promoting and installing ICS?

To installers on stove installation:

- How was the overall progress in the project? How many stoves have you installed?
- What have been the most significant delays, challenges?
- Do you know the usage rate of the stoves? (Households switching? How measured?)
- Do you ever hear complaints from households about the stoves? Who do you hear them from? What are the main issues?
- How do you deal with feedback/complaints?
- Do you do maintenance? Would you like to?

To households on their stove:

- What stove are you currently using?
- Describe the process of getting/hearing about the new stove (promoter knocked on door? came to a village meeting? heard on radio?)
- Had you ever seen it before / heard about it before promoter came to you?
- What was it the promoter said that made you decide to get the stove?
- How much would you pay for the stove? Pay upfront?
- Cash ready or need to borrow? If borrowing, where from?
- Do your neighbours/friends have or going to get such stove?
- What are your impressions of best/worst thing about the stove?
- What are the improvements on your previous stove?
- If you could change anything about the stove, what would it be?
- What would do you do if stove breaks? Fix yourself? Get assistance? If so, where from?

APPENDIX B: WORKSHOP AGENDA**Tuesday 9 December**

08:30-09:00	<i>Arrival and registration</i>	
09:00-09:30	Welcome and introductions	DVH + SNV Kenya
09:45-10:30	SESSION 1: Overview SNV's cookstove programme and theory of change (results chain) – i.e. background to the validation mission	DVH
10:30-11:00	<i>Coffee break</i>	
11:00-12:30	SESSION 2: Report from SEI validation mission Followed by inputs from SNV country staff on what is working and what is not working in their particular ICS project(s)	OJ + SNV country staff
12:30-14:00	<i>Lunch</i>	
14:00-15:15	SESSION 3: The results chain Unpacking the results chain	OJ + DVH
15:15-15:45	<i>Coffee break</i>	
15:45-16:45	SESSION 4: The results chain (continued) Updating the results chain	OJ + DVH
16:45-17:00	Wrap-up and thoughts on the day	OJ + DVH

Wednesday 10 December

09:00-09:30	Introduction to Day 2	OJ
09:30-10:30	SESSION 5: Metrics Questioning the role of metrics	OJ + DVH
10:30-11:00	<i>Coffee break</i>	
11:00-12:30	SESSION 6: Metrics (continued) Building consensus around metrics	OJ + DVH
12:30-14:00	<i>Lunch</i>	
14:00-15:15	SESSION 7: Critical topics not yet discussed Participants were encouraged to put ideas in a suggestion box earlier in the workshop. This was to ensure we do not miss any key topics.	OJ + DVH
15:15-15:45	<i>Coffee break</i>	
15:45-17:00	SESSION 8: Looking forward How to improve knowledge sharing and learning across SNV projects and country offices	OJ and DVH

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