

The Use of Behaviour Change Techniques in Clean Cooking Interventions to Achieve Health, Economic and Environmental Impact

A review of the evidence and scorecard
of effectiveness



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Acronyms

3ie	International Initiative for Impact Evaluation	HBM	Health Belief Model
AusAID	Australian Agency for International Development (now DFAT)	IAP	Indoor Air Pollution
BCT	Behaviour Change Technique	IAQ	Indoor Air Quality
CDC	Centers for Disease Control	ICF	International Climate Fund
CSI	Clean Stove Initiative (Indonesia)	ICS	Improved Cookstove
DECC	Department of Energy and Climate Change (UK)	IDBP	Indonesia Domestic Biogas Program
DEFRA	Department for Environment, Food and Rural Affairs (UK)	ISO	International Standards Organization
DFAT	Department of Foreign Affairs and Trade (Australia)	IWA	International Workshop Agreement
DFID	Department for International Development (UK)	LPG	Liquid Petroleum Gas
DOI	Diffusion of Innovation (Theory)	NISP	National Improved Stove Program
ESMAP	Energy Sector Management Assistance Program (World Bank)	PATH	Program for Appropriate Technology in Health
EU	Expected Utility	QRG	Quality Review Group
EV	Expected Value	RtB	Room to Breathe (Program)
FCO	Foreign and Commonwealth Office (UK)	SCT	Social Cognitive Theory
FOAM	Focus, Opportunity, Ability and Motivation	TLUD	Top-Lit Updraft (Stove)
GACC	Global Alliance for Clean Cookstoves	TPB	Theory of Planned Behaviour
GCEP	Global Village Energy Partnership	TRA	Theory of Reasoned Action
HAP	Household Air Pollution	TTM	Transtheoretical Model (of Change)
		USAID	United States Agency for International Development
		WHO	World Health Organization
		WTP	Willingness to pay

EXECUTIVE SUMMARY

Despite decades of effort, around 2.8 billion people worldwide still rely on solid fuels such as wood, dung and coal to meet their basic domestic energy needs.^[1] This places strain on economies, human wellbeing and the environment. The use of solid fuels – exposing people to smoke from cooking – is the fourth most significant risk factor for disease in developing countries, causing four million premature deaths in 2010.^[2] What people do, i.e. their behaviours – for example, which cooking method and fuel they use; where they burn fires; how they use ventilation; and where children and adults are located – affects quality of life and can contribute to climate change.

The aim of this study was to review the use of behaviour change approaches in clean cooking interventions in resource-poor settings. Using publicly available data, the report synthesises the evidence of the use of behaviour change techniques (BCTs) for human and environmental outcomes and impact. The report includes a set of case studies on selected interventions that use BCTs and applies a scorecard to assess the effectiveness of each intervention's approach to behaviour change. The report then discusses the findings from the review and case studies and includes a set of recommendations for the clean cooking sector to consider. A planned task was to compare interventions through an economic return on investment (cost-benefit) lens, however the availability and consistency of data did not make this possible.

Clean cooking

06 Use of solid fuels on open fires or inefficient stoves causes high levels of household air pollution (HAP), resulting in harm to health. Much of the burden falls on women and children. Solid fuels can comprise a significant proportion of expenditure for poor households and contribute to environmental problems, including climate change and deforestation. Clean cooking solutions are the clean cookstove technologies, fuels, equipment, and practices that address the health, economic and environmental impacts associated with inefficient, dirty and dangerous technologies and practices. Early on the sector focused on technologies, but in time complementary approaches were applied, including participation, user-centred design and “bottom of the pyramid” marketing. Thanks to more rigorous and widespread testing, the impacts of technologies are better understood. Despite a drop in the proportion of households relying on solid fuel from 62% in 1980 to 42% in 2010,^[1] the actual number of households has changed little because of population growth. However, while this study examines case studies that have achieved some success, the required level of sustained, correct use of proven technologies to attain real benefits has not been widely achieved. The sector still needs to find ways to achieve success at greater scale.

Behaviour change

Behaviour change approaches have been applied to many public policy issues, with the ultimate aim of changing human behaviour. Approaches are wide ranging, including marketing, removal of financial barriers, community mobilisation and regulation. Historically, many interventions have been based on rational models of behaviour and scientists are now beginning to understand the primacy of non-rational, or affective influences on behaviour. There has also been a move toward multi-level models – addressing individual, interpersonal, community and national change – based on

evidence from issues such as HIV/AIDS, sanitation and reproductive health. One of these, social marketing, includes the concept of “exchange” (cost versus benefit) that underpins the relationship between the consumer and a brand. Some agencies have developed their own tools with common foundations, including the World Bank’s ‘SaniFOAM’ framework for sanitation behaviours^[3] and PSI’s ‘Bubbles’ framework^[4]. The evidence for the effectiveness of behaviour change approaches is growing from a strong base, including with more effective ways of measuring results and impact.

Behaviour change and clean cooking

Cooking practices in kitchens involve complex, long-practiced behaviours that present a significant barrier to the success of clean cooking interventions. Until recently, the application of behaviour change in the clean cooking sector has been largely limited to adoption of new technologies and addressing related practices such as location of cooking or changes to fuel preparation. The clean cooking literature seldom used the theories and language of behaviour change. More recently, a 2014 review found that behaviour change strategies reduced IAP exposure by 20-98% in laboratory settings and 31-94% in field settings, albeit with weak evidence.^[5] There is also a strong body of evidence developing around the determinants, or factors, that determine the barriers and benefits to behaviour change in the clean cooking sector. While several strong interventions have been identified through the review process, many would have been missed if too narrow a definition of “behaviour change approach” was applied. Therefore this study focused on behaviour change techniques (BCTs) as the building blocks for behaviour change.

Literature review

The literature review set out to answer the question of how BCTs have been used in clean cooking interventions aiming to achieve human and environmental impact. The team conducted a robust literature search of published, peer-reviewed literature supplemented with unpublished (grey) literature. The decision to include the grey literature, while compromising the strength and consistency of evidence used, was considered important to cover the breadth of work. The search process yielded 48 sources of data, which documented 55 interventions related to all aspects of the clean cooking value chain – 32 in Asia, 15 in Africa and 8 in the Americas – with a total of 20 countries covered.



Woman with baby while cooking on an open fire in Guatemala. Photo © N. Bruce

Table 5: Results of literature search grouped by 'Impact' and 'BCTs'

n = 55	Category	Interventions n (%)
Impact	Economic	37 (67)
	Health	32 (58)
	Environmental	20 (36)
Behaviour Change Techniques	Shaping knowledge	47 (86)
	Reward and threat	35 (64)
	Social support	35 (64)
	Comparisons	16 (29)
	Identity and self-belief	15 (28)
	Regulation	15 (28)
	Changing the physical environment	10 (18)
	Goals, planning and monitoring	3 (6)

Case studies

The table below provides the list of interventions selected for inclusion as case studies, chosen to reflect a range of important and interrelated factors: geography, scale, implementer, funder, scope, impact, and BCT. Each includes an overview of the intervention with a focus on the use of BCTs and a 'Scorecard of Behaviour Change Effectiveness'. The Scorecard consists of benchmark criteria for an effective behaviour change intervention, drawing on existing scorecards and frameworks.^[44-46] The criteria were: 1) behaviour focus; 2) target population; 3) barriers and benefits; 4) methods; 5) capacity building; 6) behaviour change results; 7) outcomes; and 8) impact. Each case study includes scores based on eight criteria, each containing 2-3 questions. Each question was worth one point for a maximum possible total of 22 points for each intervention, which was then converted to a percentage score.

Table 6: Case study interventions (summary)

Intervention	Lead Organisation	Score of Behaviour Change Effectiveness
Cambodian Fuelwood Saving Program	Geres	77%
China National Improved Stove Program	Ministry of Agriculture	64%
Energising Development Kenya Country Program (EnDev)	GIZ	86%
India Room to Breathe	Shell Foundation	73%
Indonesian kerosene to LPG conversion	Pertamina	86%
South Africa Northwest Province Behaviour Change Study	University of Witwatersrand	80%
Strategies for Improved Cookstove Adoption in Rural Uganda	Impact Carbon	82%

Discussion and conclusions

Analysis revealed a mixed picture of the use of BCTs in clean cooking interventions. The team could identify the BCTs and related activities, but the impact of the BCTs is difficult to establish due to a lack of credible and consistent data. There is limited variation in the BCTs used, which suggests that those more commonly used are considered more effective but this does not appear to be based on evidence. 'Shaping knowledge', 'reward/threat' and 'social support' appear more often and usually in combination. Shaping knowledge includes advertising or other promotion activities. The most common forms of rewards are economic ones, especially subsidies. Social support, especially in the form of change agents and cooking demonstrations, appear often. No interventions account for the influence of emotion and other subjective, affective experiences. Certain BCT groupings appeared less frequently that have been successful in other sectors, e.g. 'identity and self-belief'.

Behaviour change framework: the team developed a framework for clean cooking that places behaviour change techniques in relation to impact, outcome and intervention activities. Furthermore, the role of determinants as the enabling or limiting factors led the team to conceptualise them in a suggested clean cooking framework between the intervention and outcomes. Further work is needed on how to define and measure the effectiveness of a BCT as well as understand its relationship to other elements.

Journey to scale: the review and the case studies included programmes that achieved scale by reaching a "tipping point" where the new clean cooking technology became the norm. An example is Indonesia's transition to LPG, where the government learned from early problems by building a national regulatory framework and reaching out to change agents in beneficiary communities. Interventions should take into account relationships and context at the individual, interpersonal, community and national levels. The recruitment of change agents (especially as early adopters) and the use of cooking demonstrations, are key to success. Lessons from marketing demonstrate that the value of the product brand, both intrinsic and extrinsic, must be appealing and appropriate for the intended market, highlighting the importance of testing and piloting.

The lack of consistent and credible evidence limits the report's conclusions. However, the available material combined with evidence from other sectors enables a description of the elements that are more likely to ensure success in clean cooking interventions. Below are the team's recommendations for policy, interventions and research.

Recommendations

The following recommendations are based on the literature review and case studies produced for this report as well as evidence from behaviour change interventions in other sectors.

Policy and Interventions

1. Use of theories of change and behavioural approaches in strategies, plans and activities. This could be supported by a behaviour change implementation guide for clean cooking.
2. Ensure intervention activities operate on multiple levels – individual, interpersonal, community and national.

3. Use brands as an umbrella for different types of behaviours and consider joint investment in a category marketing campaign across different brands.
4. Make sure the product is appealing and appropriate: four quality signals are branding, pricing, physical features, and retailer reputation. These should be assessed in relation to the WHO guidelines on IAQ impact and the ISO IWA tiers of performance.
5. Engage change agents and use cooking and other product demonstrations to take impact to scale.
6. Improve knowledge management and research methodologies with a greater percentage of funding and consistent monitoring, evaluation and reporting of results, especially on behaviour change components.
7. Incorporate gender empowerment as an important and practical approach.

Further research

1. Refine the groupings of BCTs and test their validity.
2. Conduct rigorous evaluations using behavioural models and theories.
3. Further test the scorecard of behaviour change effectiveness.
4. Expand interdisciplinary research and learning between behaviour change specialists and clean cooking sector practitioners and policy-makers, including understanding the relationship between the context, determinants and behaviours.
5. Produce a general model of behaviour change for clean cooking.
6. Assess the role of behaviour change approaches in supporting big shifts in technology use.

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Woman cooking outside with BioLite stove Photo© N. Bruce

PART 1 INTRODUCTION

Despite decades of effort, around 2.8 billion people worldwide still rely on solid fuels such as wood, dung and coal to meet their basic domestic energy needs.^[1] Use of solid fuels for cooking was responsible for an estimated 4 million premature deaths in 2010 and 54% of total deaths from childhood pneumonia.^[2] What people do, i.e. their behaviours – for example, which stove and fuel they use; where they burn fires; how they use ventilation; and where children and adults are located – affects quality of life and contributes to climate change.^[6]

This study is intended to assess the evidence base and provide options for possible future interventions in the area of clean cooking, addressing health, climate, poverty and environmental concerns. The study is also intended to support improved practice in the clean cooking sector – including informing programmes already funded – and bringing behaviour change approaches more centrally into programme thinking. One of the original tasks was to compare interventions through an economic return on investment (cost-benefit) lens, however the availability and consistency of data did not make this possible.

Using publicly available data, the report synthesises the evidence of the use of behaviour change techniques (BCTs) for human and environmental outcomes and impacts in clean cooking interventions. The report includes a set of case studies on selected interventions that use BCTs and uses a scorecard to assess the effectiveness of each intervention's approach to behaviour change. The report then discusses the findings from the review and case studies and includes a set of recommendations for the clean cooking sector to consider.

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Clean cooking

In many developing countries, substantial proportions of the population cook using solid fuels are burnt on open fires or inefficient stoves, causing high levels of household air pollution (HAP). This pollution comprises a cocktail of toxic gases and particles known to cause a range of acute and chronic respiratory diseases as well as other health problems. It is one of the highest environmental risk factors globally and much of the burden falls on women and children in low-income countries. Solid fuels can comprise a significant proportion of financial and time expenditure for poor households. Although the proportion of households relying on solid fuel has dropped significantly – from 62% in 1980 to 42% in 2010 the actual number of households has changed little because of population growth. In addition to human impacts, the use of solid fuels can also contribute to local and global environmental degradation and pollution, including contributing to climate change.^[6]

Inefficient stoves also contribute to poor economic outcomes, due to higher material and opportunity costs. The inefficient stoves require more time to procure fuel, which takes the cooks, mostly women, away from potentially more productive activities, such as income generation and education. Also the repairs and fuel costs are sometimes much higher with traditional and inefficient stoves and their fuels. On the other hand, clean cooking technology markets can make a substantial contribution to income and other economic activity.

Gender plays a significant role in clean cooking interventions. Women are disproportionately impacted by dirty and inefficient cooking practices and reliance on biomass for fuel. Responsibility for fuel collection also often falls to women and children, which can place them in danger and may displace other activities including income generation and education. Women often play a vital role in the acquisition and use of clean cooking solutions because of their central responsibility for cooking and managing household energy needs.^[7] At the same time, men often also play central roles in the household, especially around finance and purchase decisions. However, men are often overlooked in the design of gender sensitive programmes and require different approaches to engage them in development solutions.^[8, 9]

Historical background

Interventions have sought to address the use of solid fuel in homes for many decades. The most significant and pervasive intervention has been the introduction of 'improved' or modified stoves, designed to improve efficiency of the cooking system, and reduce emissions or divert them outside of the home. These have been driven by a wide range of concerns including: protection of local forest resources; women's welfare; addressing household economic stresses; reducing health impacts; and protecting the global environment.

Although the technological principles have changed little over the decades, the materials used have changed, mainly resulting in improved performance and durability. Manufacturing approaches have also shifted towards centralised mass-production facilities, where products can be more easily standardised. The potential to obtain carbon finance through modified stove projects has helped to drive these changes. Other technologies such as solar cookers, as well as improvements in ventilation, have also played a part, but gained relatively little traction. The clean cooking sector was initially characterised by a focus on technological solutions, but in time complementary approaches were developed and applied to support technologies, including participatory approaches; user-centred design; and 'bottom of the pyramid' marketing techniques. The sector has also seen a focus on understanding and addressing the behaviours that underpin cooking, and consumption habits.

In the last decade more rigorous, standardised testing protocols have been developed and applied more widely, including the development of the ISO International Workshop Agreement, Guidelines for evaluating cookstove performance,^[10] in efforts to ensure more consistent quality of data. However, many interventions and technologies are still not systematically evaluated, and differences persist between laboratory and field results. WHO guidelines for indoor air quality have also been produced to guide targets for reducing health impacts from HAP.^[11] The Global Alliance for Clean Cookstoves (GACC) was created to mobilise national, donor, private sector and nonprofit resources toward the goal of universal adoption of clean cookstoves and fuels with a target of 100 million households by 2020. Despite many efforts and improvements in how stoves are designed, manufactured and promoted, the sector has yet to see a real breakthrough in terms of sustained adoption of clean cooking technologies at a rate faster than the pace of population growth.

Moving forward

Thanks to more rigorous and widespread testing, including HAP and stove performance, the impacts of specific technologies and behaviours are better understood, supported through benchmarks such as the IWA Tiers of Performance.^[10] There is also more widespread recognition that user needs are central to sound technology design. Some proponents assert that products may need to incorporate technical compromise in favour of usability and low cost, supporting users to progress step-wise up the stove tiers. Others emphasise that only through use of more advanced technologies will we achieve significant human and environmental impact. It is clear that no single solution will solve all problems.

Protecting the environment, providing economic opportunity as well as improving people's health are all now accepted as the clean cooking sector's central motivators. Recognizing the role of the private sector in ensuring sustainability and scale will be the key to future success in clean cooking. The scale of the 'bottom of the pyramid' market – the poorest strata of society – for modified stoves of around 1 billion people is widely seen as an opportunity for the sector to embrace the evidence and promise of commercial marketing approaches to help the most vulnerable. In addition the opportunities to reach those just above poverty lines, often with increasing purchasing power, are growing. Understanding household economics, local cultures and behaviours are accepted as keys to sustained adoption of new technologies and behaviour.

However, lessons learned only benefit the sector to the extent they are communicated and applied; effective interventions only work if they provide tangible advantages to adopters; and high-performance stoves will only be adopted if they meet user needs. There is still some way to go in each of these areas. A recent systematic review ^[12] indicates that adoption of clean cooking practices is influenced by multiple, inter-related factors including the degree to which technologies meet customer needs, provision of training and financing, and policy. However, none of these in isolation guarantees success, and their importance varies according to the context. Despite so much progress, sustained correct usage of clean cook stoves and fuels has not achieved the required scale, and some of the most significant barriers are the entrenched complex behaviours that characterise kitchens across the world. The field of behaviour change provides a variety of frameworks and offers new ways of addressing these factors.

Behaviour change

The literature on human behaviour has been described as "enormous" ^[13] and "bordering on the unmanageable" ^[14]. Yet this variety and depth of research into the drivers of, and barriers to, human behaviour change also provides a rich source of ideas, methods and tools drawn from diverse disciplines, including psychology, sociology, anthropology and economics. Appendix C describes behaviour change frameworks, theories and models relevant to clean cooking and draws on experience from other development issues.

Historically, many behaviour change interventions across a variety of sectors have been based on rational cognitive models of behaviour. Scientists are now beginning to understand the primacy of non-cognitive, affective influence on behaviour. There has also been a move toward multi-level (or ecological) models based on evidence from issues such as HIV/AIDS, sanitation, smoking, reproductive health and water. One of these, social marketing, includes the concept of “exchange” (cost versus benefit) that underpins the relationship between the consumer and a brand.

Some research has found that behaviour change is difficult and that there is little evidence to support the effectiveness of behavioural approaches.^[15] However the same work acknowledges that poor results often stem from a failure in conception, execution, or measurement. A 2010 meta-analysis of mediated health campaigns in the United States found small measurable effects on behaviour change ^[16]. A 2014 review of evidence for social marketing by Evans and colleagues found that evaluations show consistent improvements in behavioural mediators but mixed results in behaviour change.^[17] A systematic review conducted by Grilli and colleagues in 2002 found there is evidence that mass media interventions may have an important role in influencing the use of health care services.^[18]

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Men with LPG delivery bike Photo© N. Bruce

In 2014 PSI conducted a systematic review of literature published between 1995 and 2013 on social marketing for HIV, reproductive health, malaria, child survival, and tuberculosis in developing countries.^[19] The review included 18 studies on HIV/AIDS programmes with up to 100% increase in HIV condom use; 49% reduction in needle sharing; and increase in HIV testing. They found 13 studies on reproductive health with up to 55% increase in modern contraceptive use; and improvements in service utilization and quality of care. PSI also found 21 studies on malaria programmes, with 15-40% increases for infant use of bednets. The evidence base for the effectiveness of behaviour change approaches is growing and will be even stronger as intervention and evaluation designs are improved.

Prominent behaviour change frameworks

There are many development agencies utilising behaviour change approaches in their programmes, addressing issues such as sanitation, HIV/AIDS and nutrition. Prominent among them, with common foundations, are the World Bank's 'SaniFOAM' framework^[3] for sanitation behaviours and PSI's 'Bubbles' framework.^[4]

FOAM stands for Focus, Opportunity, Ability and Motivation. 'Focus' means the behaviours to be improved and identify whose behaviour needs to be changed. 'Opportunity' is whether an individual has the chance to engage in the desired behaviour. Five determinants under 'Ability' influence whether a person has the capacity to engage in a certain behaviour: knowledge, social support, self-efficacy, roles and decisions, and affordability. Under 'Motivation' are attitudes and beliefs, values, emotional/physical/social drivers, competing priorities, intention, and willingness to pay.

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The work currently underway by the USAID-funded TRAction project teams will likely produce useful results and evidence, including from the adaptation of the FOAM framework. One of these teams, led by PATH, is implementing an adapted FOAM framework in a project covering two-subcounties of Wakiso District, Uganda, using the Mwoto Cookstove.^[20]

Behaviour change and clean cooking

Behaviour change can be seen as a way to reduce the impacts of dirty or unsafe cooking. A 2014 review of published studies on IAP and child health impacts spanning 1983 – 2013 found that behaviour change strategies can reduce IAP exposure by 20-98% in laboratory settings and 31-94% in field settings, albeit with weak supporting evidence.^[5] There is also a strong body of evidence developing around the determinants, or factors, that determine the barriers and benefits to behaviour change in the clean cooking sector, including two recent systematic reviews.^[12, 21]

Based on team discussions it was assumed that many interventions aiming to change behaviours within the clean cooking sector are not based on behavioural models or theories of change. While several strong interventions have been identified through the review process, many would have been missed if too narrow a definition of "behaviour change approach" was applied. Therefore the study first reviewed how behaviour change has been applied in clean cooking interventions. Deeper analysis was then applied to a selection of case studies with discussion of the results. Finally the report will detail the team's recommendations on future research and how to incorporate behaviour change approaches in future interventions, as well as adapt those already in progress.

PART 2 LITERATURE REVIEW

The objectives for this literature review were to:

1. Define a set of impacts, outcomes, interventions, and behaviour change techniques (BCTs) used in the clean cooking sector.
2. Investigate and describe how the pre-defined BCTs have been implemented within the household clean cooking sector in resource poor settings.
3. Synthesise the evidence of the effectiveness of BCTs within clean cooking programmes on human welfare and the environment.
4. Identify case studies to present programmes that have shown impact from BCTs and use these as a basis to propose recommendations for optimising the potential for BCTs within the clean cooking sector.

Definitions and structure

An important starting point was to develop a “working consensus” among the team members on definitions for the elements to be reviewed and how these relate to each other. The consensus concluded that the highest-level element to be reported would be the ‘Impact’, followed by ‘Outcome’, ‘Intervention’, and ‘Behaviour Change Technique (BCT).’

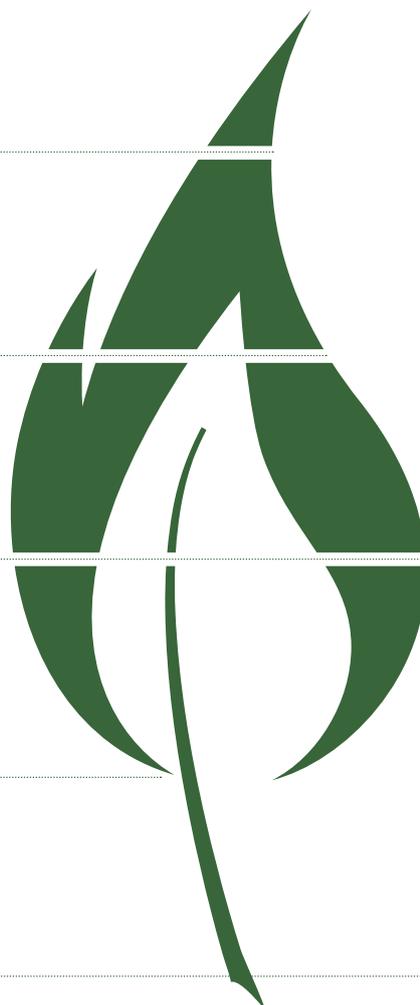
16

Impact

Outcome

Intervention

Behaviour Change Technique



Impact

“Impact” refers to the macro-level health, economic, and environmental changes brought about by a clean cooking intervention.^[22] Examples include a reduction in deforestation; a change in cases of respiratory disease, or a gain or loss to a country’s economy. Positive impacts are the ultimate goal of a behaviour change intervention.

Outcome

The next level is “Outcome”, which are the changes required to enable the positive impacts to occur. In total, nine possible outcomes were identified. All of these can be measured and tracked, often more quickly, easily and at less cost than impacts. Each of these outcomes has direct links to the impacts, however these can be in different combinations, e.g. time can have an economic benefit as well as a social one. Impacts may also be affected by other variables but it is increasingly possible to track outcomes with confidence of attribution to an intervention.

Table 1: Clean cooking outcomes

Clean Cooking Outcomes

1. Acquisition of technology (stove, fuel, hoods and chimneys)
2. Use of technology (measured, observed or reported)
3. Improved indoor air quality (ventilation, household air pollution and personal exposure)
4. Reduced emissions (environmental)
5. Reduced time demand (cooking, fuel collection, school attendance etc)
6. Health and safety (diseases, burns and other accidents)
7. Household fuel consumption and switching
8. Financial (monetary savings and income generation)
9. Increased local capacity (skills and tools).

Intervention

The third level is the “Intervention”, which refers to the strategy through which the outcomes and impacts are achieved. The intervention can be delivered as a programme, project or research study. The intervention can occur at several points along the clean cooking value chain, including manufacture, marketing, adoption and use. For example, a reduction in HAP (outcome), which should improve public health (impact), could be achieved by a strategy of expanding production and distribution of improved cookstoves. The following is a listing of the types of intervention (produced in advance of the search and then reviewed, validated and updated) used in the review.

Table 2: Clean Cooking Interventions

Intervention Types	Description
Expand production and distribution of clean stoves and fuels	<ul style="list-style-type: none"> 🔥 Support for research and development. 🔥 Manufacturing support including business development and capacity building. 🔥 Innovative distribution models. 🔥 Deterrents to collection and use of old, dirty and damaging fuels.
Increase demand for clean stoves and fuels	<ul style="list-style-type: none"> 🔥 Consumer education on the risks and impacts of traditional cooking methods. 🔥 Social marketing campaigns that target barriers and benefits. 🔥 Communications campaigns on purchase of stoves and fuels.
Stimulate purchase of stoves and fuel	<ul style="list-style-type: none"> 🔥 Financing options such as rent-to-own, free trial periods and micro-loans. 🔥 Provision of other economic and financial incentives such as subsidies. 🔥 Engagement of change agents, including sales representatives, community health workers and peer educators. 🔥 Consumer participation in product design.
Maximise correct and sustained use of stoves and fuel	<ul style="list-style-type: none"> 🔥 Training on adapting to a new fuel, e.g. dry wood cut to correct size. 🔥 Instruction on cooking techniques such as lighting and maintenance. 🔥 Training on maintaining the stove according to manufacturers instructions.
Enhance household management practices	<ul style="list-style-type: none"> 🔥 Removing old, dirty stoves and fuels. 🔥 Increasing ventilation (natural and technology based) in kitchen. 🔥 Safe alternative place(s) for vulnerable family members. 🔥 Moving cooking away from the main house. 🔥 Promoting cooking habits that decrease exposure and fuel consumption.
Regulation and policy to enable scale-up	<ul style="list-style-type: none"> 🔥 Standards for stoves and fuels. 🔥 Restrictions and bans on stoves and fuels. 🔥 Government subsidies for clean fuels and improved technologies. 🔥 Environmental fees and taxes.

This definition does not include interventions to improve lighting alone, as this is not expected to make sufficient impact on HAP without changing cooking habits. It also will not include kerosene as a cleaner fuel intervention, as evidence suggests that kerosene may not provide reductions in HAP.^[23]

Behaviour Change Techniques (BCTs)

Initially the team had considered limiting the review to cover only those interventions that utilise and evaluate the impact of one of the more widely used behaviour change models or theories. The assumption, for the purposes of this study, was that we do not seek interventions that achieve behaviour change but those that do so informed by a behavioural theory of change. However, an initial scan of the clean cooking literature revealed few of these models or theories in use. This might be due to their relatively recent and limited adoption in the clean cooking community, as well as a lack of use of the behaviour change terminology. This would potentially exclude interventions that were useful for the study. Therefore the team decided to focus on the building blocks for these theories and models, namely behaviour change techniques, and to produce a list of these that would be useful for those working in the clean cooking sector. With work done recently on determinants (or factors) ^[12] and underway on segmentation, the team decided to focus on BCTs with the intent to synthesise it with other work to produce a better overall understanding of clean cooking interventions.

For the purposes of this review, we will define a BCT as the active component within a clean cooking intervention that helps produce behaviour change to improve human and/or environmental impact. BCTs in clean cooking can be identified in intervention activities undertaken at several points along the value chain. Using the Michie et al (2013) list of 93 BCTs as well as others drawn from the behaviour change and clean cooking literature, we produced a long list of BCTs to be used for this review.^[24] We then clustered these into eight groups to enable a more manageable way to report on their use (See Table 3 and Appendix A). These were produced in advance of the search and then reviewed, validated and updated.



Table 3: Clean cooking behaviour change techniques		
BCT	Description	Example for clean cooking sector
Reward and threat	Makes the adoption of behaviours seem attractive or makes the failure to adopt practices seem threatening. It is linked to the concept of “value exchange”, i.e. what desirable outcome will the audience receive for their compliance, or what undesirable outcome will they avoid.	Incentives for households to buy stoves
Shaping knowledge	This helps people to understand what clean cooking behaviours are, how to perform them, and where to acquire the technologies and materials needed to reduce HAP.	Radio announcements on stove availability
Changing the physical environment	Involves structural changes to the surrounding environment. It also refers to re-setting environmental defaults so that a new behaviour is easier to sustain due to sympathetic cues and triggers.	Construction of smoke hoods, chimneys and flues
Social support	Involves providing resources and facilitating influence. “Seeding” a new behaviour with a trusted person or group helps ensure the new behaviour appears desirable and starts to become the norm, leading people to want to emulate and model it.	Community health workers advising on fuel choice
Goals, planning and monitoring	Working with an audience’s goals involves unearthing their aspirations, ambitions and intentions, re-framing the new behaviour as a way of achieving these goals, and then facilitating the audience in realising their goals through the medium of the new behaviour.	Purchasing plans for new stoves
Comparisons	Provides a choice of options and the opportunity for people to compare what is available with those chosen by their peers, neighbours, friends and families.	Making a variety of stove models and fuels available
Identity and self-belief	Targets audiences according to their actual or aspirational roles. Gender and other roles determine how we perceive ourselves, how we are perceived, and how we are expected to think and act. Linked to this is the process of increasing people’s sense of self-efficacy and building momentum behind a desire to change their behaviour	Empowering women to decide on stove choice
Regulation	Regulatory mechanisms include bans and restrictions, or industry standards. They are a measure of enforcement as opposed to persuasion, and can amplify “softer” BCTs.	Restrictions on the use of certain fuel types

It is important to note that the four elements within this structure do not always represent distinct and separate levels. A clean cooking intervention may contain numerous BCTs and work toward achieving several impacts. An example is Pertamina Indonesia' national kerosene to LPG conversion program which had as a primary aim the reduction of government spending on subsidies, but also reported health and environmental benefits.^[25] Other projects – often the smaller, randomised controlled trials – may only use one behaviour change technique, in effect the intervention is the BCT and vice versa. An example of this is the South Africa Northwest Province Behaviour Change Study which tested selected behaviours to reduce exposure to HAP in young children, implemented by the University of Witwatersrand.^[26]

Methods

The review process aimed to identify literature that had documented evidence of the use of behaviour change techniques (BCTs) in clean cooking intervention activities. It excluded those that achieved behavioural outcomes without documented use of BCTs (see Figure 1). Without evidence or understanding of how the behaviour change was achieved, it is less likely that useful conclusions can be drawn and the findings would possibly weaken the results from interventions that utilised BCTs.

The search terms reflected the fuels, stoves and household management practices at the centre of clean cooking interventions and were based on previous systematic reviews carried out in the clean cooking sector.^[12] These terms included “chullah”, “LPG”, “biogas” and “cookstove” and their variations. The BCT terms were informed by terms used in behaviour change literature and ranged from the very broad, e.g. “intervention”, “behaviour change”, to the very specific e.g. “habit”, “trigger” and “norm” (See Appendix B for a full list of search terms used).^[24, 27, 28]

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A search of the published, peer-reviewed literature was conducted using major online research literature databases. The unpublished (grey) literature was also searched as systematically as possible using websites of key organizations within the clean cooking sector in addition to Google Scholar, as well as augmenting the search with personal communication and hand searching references within key reports. The decision to include the grey literature, while potentially compromising the strength and consistency of the evidence used, was considered important to cover the breadth of available data on behaviour change and clean cooking. The full list is available in Table 2 (following page).



Marketing mural on an Indian house Photo© N. Bruce

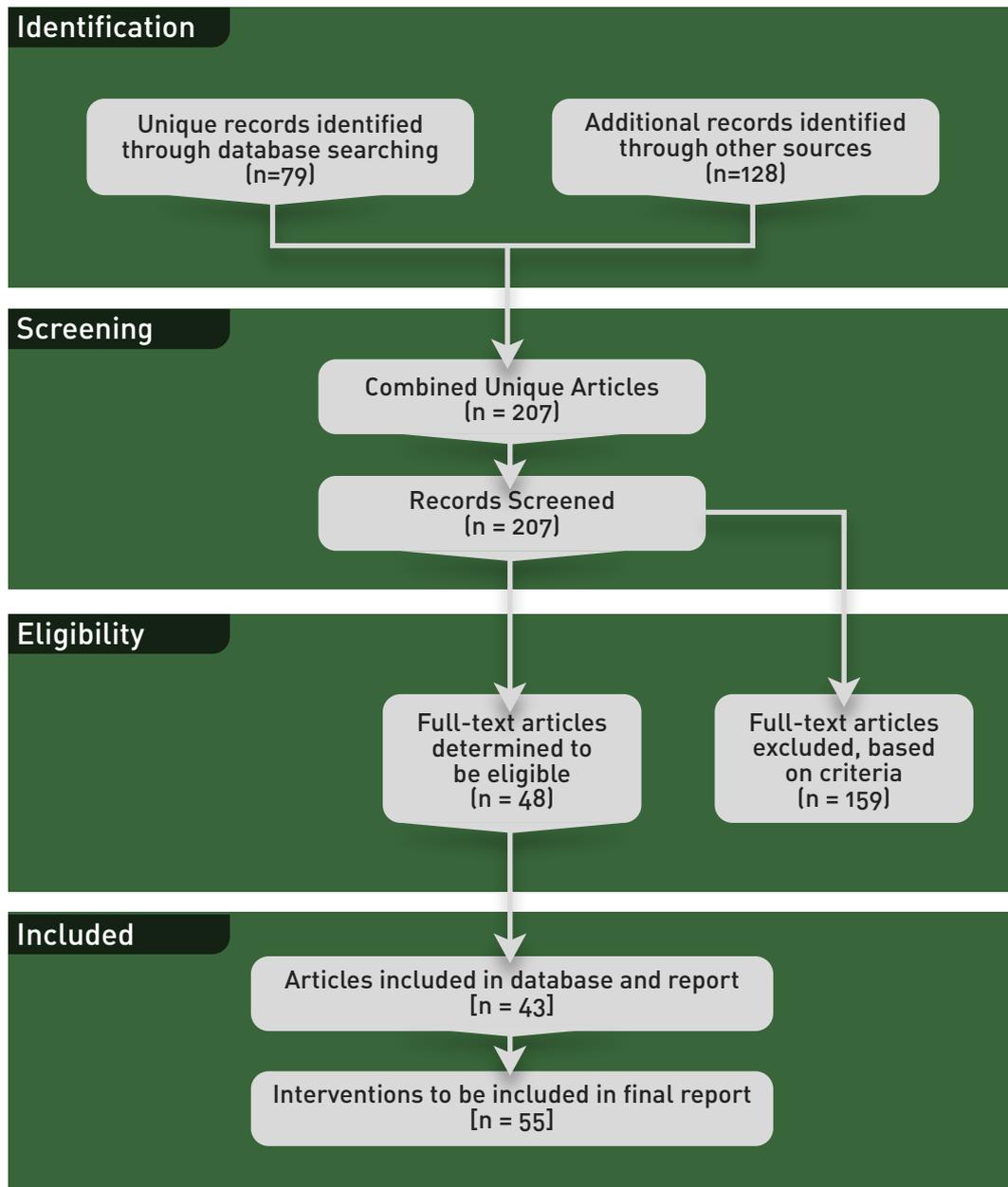
Table 4: Literature sources	
Academic Databases	Grey Literature
<ul style="list-style-type: none"> 🔗 EPPI-Centre database of health promotion research (Bibliomap) 🔗 Campbell Library 🔗 Cochrane Library 🔗 MEDLINE (Ovid) 🔗 Database of Promoting Health Effectiveness Reviews (DoPHER) 🔗 Public Library of Science (PLoS) 🔗 PubMed (NIH) 🔗 EconLit (EBSCO) 	<ul style="list-style-type: none"> 🔗 International Initiative for Impact Evaluation (3ie) 🔗 Research for Development (DFID) 🔗 International Encyclopedia of the Social and Behavioural Sciences 🔗 Web of Knowledge 🔗 Ashden Awards for Sustainable Energy 🔗 EnDev 🔗 Global Alliance on Clean Cookstoves (GACC) 🔗 Global Village Energy Partnership (GVEP) 🔗 HEDON 🔗 Partnership for Clean Indoor Air 🔗 WHO effectiveness review database 🔗 Renewable Energy and Energy Efficiency Partnership 🔗 USAID 🔗 WASHPlus IAP Updates 🔗 World Bank Energy Sector Management Assistance Program (ESMAP) 🔗 Google Scholar

The search process produced a long list of unique articles which was then screened to ensure all articles described clean cooking interventions utilising BCTs and also met the following criteria: 1) Implemented in low, low-middle and upper-middle income countries as defined by the World Bank income region classifications;^[29] 2) Documented in English; 3) Published and/or implemented since 2000. Articles describing formative research intended to inform future intervention design, or articles that were purely conceptual, were excluded.

The search process yielded a list of 207 unique references, which four members of the team reviewed to remove those that did not describe interventions or did not include the BCTs identified for the review (see Appendix A). After cleaning and screening, 48 items remained, which documented 55 interventions in the clean cooking sector. Figure 1 summarises the review process. The articles that remained after the screening phase were then reviewed in-depth, and the following information from each article was tagged and extracted in order to create a database of interventions, including title, date, implementer, partner, funder, setting, population size, impact, intervention type and the BCT(s) used.

Note that due to the diverse nature of the literature on clean cooking interventions, and the varying methods of reporting impacts and outcomes, we chose not to attempt a meta-analysis of the effectiveness of the reviewed interventions. The purpose of this report is to describe the nature of the interventions and literature with a focus on behaviour change effectiveness.

Figure 1. PRISMA diagram of search process



Quality assurance

A series of steps were taken to ensure the quality of the literature identification and data extraction process. The documents initially identified through the literature review were split among four team members for initial assessment to determine their relevance, and to assign them tags for coding. Further to this the first two authors randomly checked 10% of the 'accepted' list to ensure there was agreement on the process followed. The data was extracted and the results randomly reviewed by team members to ensure quality. Potential sources of differences in assumptions and approach in coding articles were identified and discussed. A consensus was reached about coding, and common procedures adopted where discrepancies had been identified. Due to heterogeneity of evidence types from the peer reviewed and grey literature, assessment of the evidence quality was only applied to the case studies covered in Part 3.

Results

Appendix G provides a summary of the basic information extracted for all 55 interventions gathered from the literature reviewed. The search process yielded 48 sources of data, which documented 55 interventions related to all aspects of the clean cooking value chain – 32 in Asia, 15 in Africa and 8 in the Americas – with a total of 20 countries covered.

Results – BCT level

Table 5 provides a summary of the BCTs coded in the search. The most frequently used BCT is that of “Shaping Knowledge”, found in 47 interventions. For example, the Improved Cookstove Program led by the Bangladesh Council of Scientific and Industrial Research included local demonstrations and seminars, attended by representatives of local government, which were designed to improve knowledge of the benefits of improved cookstove designs. This was supplemented by subsidised advertisements and short films on state-owned Bangladesh Television and Bangladesh Betar Radio, which created such a high level of demand that the program teams were inundated with requests for cookstoves.^[30]

In Ghana, an initiative to improve the supply chain for LPG access led by UNDP, established a community-based energy information and demonstration centre. Here, energy education was provided in the context of everyday domestic uses.^[31] As part of the program of ‘Health Education to Children and Heads of Households on Health Risks of Arsenic Exposure in Food Dried Over Coal Fires’, led by the Guizhou Center for Disease Control (CDC) in China, curriculum materials such as brochures, posters and videos were distributed in local schools to explain the link between the contamination of food and air by the use of unventilated indoor coal-fired stoves.^[32]

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The next most frequently found BCT group is “Rewards and Threats”, with 35 interventions applying this technique. For example, in Indonesia, the Domestic Biogas Program (known locally as Biogas Rumah or BIRU), led by the Dutch NGOs, SNV and HIVOS, offered end users of biogas digesters an investment incentive of approximately 25%.^[33] In Cambodia, the Fuelwood Saving Project, which was implemented by GERES, incentivised the production of the fuelwood-saving “New Lao Stove” by offering credit to producers at a rate of 12% per annum, in comparison with a commercial lending rate of at least 30%.^[34]

“Social Support” as a BCT is also frequently used, with 35 interventions appearing in our search. For example, the Indoor Air Pollution Reduction Program that was led by Concern, VERC and Winrock International in northern Bangladesh, established a cadre of promoters and community leaders trained in the health risks of indoor air pollution and improved stove design. This ensured local capacity to carry on all aspects of the intervention beyond the life of the project. Building formal community structures was found to facilitate initial community buy-in and ultimate ownership of, and long-term responsibility for, the project.^[35] The Cambodia Fuelwood Saving Project adopted a similar approach by working with an existing network of cookstove producers and retailers and by recruiting ‘pioneer producers’ to test improved stove designs and train others in their production.^[34]

“Comparisons”-based approaches were used in 16 interventions to encourage new behaviours. For example, the Tezulutlán Improved Stove Project in the Baja Verapaz region of Guatemala contacted local leaders interested in promoting the improved stoves. The team visited the homes of these local leaders, built the Tezulutlán improved stove in situ and monitored its performance over the course of four months. Subsequently, local leaders were

asked to invite friends and family members to view the stove and evaluate its performance. Local leaders also recruited motivated people in the community to promote the improved stove design to wider audiences.^[36]

15 interventions used “Identity/Self-Belief” BCTs, for example the Deepam Scheme to promote LPG connections in the Indian state of Andhra Pradesh was implemented through established grassroots women’s self-help groups. This served to link the promotion of LPG to support for women’s development and financial independence.^[37] In Kenya, local women’s groups played a key role in the Smoke Project. During the project, women’s groups organised meetings of their members, through which group leaders served as links between the project facilitators and community members.^[38]

15 interventions also contained “Regulation” as a BCT. For example, in Lao PDR, the government identified the development of regulations and guidelines for clean cookstove implementation as a key priority for the successful implementation of the Clean Stove Initiative that is led by the World Bank and AusAID in the capital city, Vientiane, as well as the provinces of Bolikhamsai and Khammouane.^[39] In Guatemala, a number of government policies indirectly support the implementation of various improved cookstove initiatives. These include a Forestry Policy (1996), a National Policy for Food and Nutrition Security (2008), and a National Policy on Climate Change (2009). However, it has been recognised that these policies are isolated and need to be coordinated to further develop the improved cookstove sector.^[36] In China, the government was active in the certification and standardisation of improved cookstove design as part of the National Improved Stove Program (NISP).^[40]

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Ten interventions in this literature search involved “changes in the physical environment” as a BCT. For example, in India the Hindustan Petroleum Corporation (HPCL) “Rasoi Ghar” programme facilitates clean and safe cooking by adapting the traditional concept of the community kitchen, or Sanjha Chulha. Villagers provide spaces or rooms, in which HPCL construct a kitchen platform, install pipes and LPG-powered stoves, and provide utensils as well as safety instruction manuals and display boards. To date, 14,000 of these structures have been constructed.^[41]

Activating people’s “Goals” as a BCT is the least widely used in the clean cooking sector, and it only documented in three interventions. One example of goals being activated in a behaviour change intervention is PATH’s conducting of formative research in Uganda to identify its audience’s motivations (e.g. intentions, priorities and values) for adopting the TLUD. They then used this insight to inform intervention design. For example, PATH found that fathers were motivated to be seen as more sophisticated and better-off than their neighbours, so ICS promotions aimed at men were designed with the flowing message: “Get the latest and greatest before your neighbour”.^[42]

Results – impact and outcome levels

Table 5 provides a summary of the impacts and outcomes coded in the search – the human (health and economic) and environmental benefits. Economic benefits were widely reported, with (n = 15 articles and n = 37 interventions) documenting an economic related impact (negative or positive). For example, of those targeted by the Bangladesh Council of Scientific and Industrial Research (BCSIR) Improved Cookstove Program, 84.5% of user households reported experiencing financial benefits due to decreased expenditure incurred in fuel

procurement, and 67% of households reported using biomass slurry resulting in savings of between 10-800kg of chemical fertiliser per household per year (an average saving of BDT851.66 or USD10.95 per year).^[30]

The next most frequent impact documented in the literature was that of health (and safety related) benefits (n = 24 articles and n = 32 interventions). For example, the Ugandan Energy Saving Stove Project reported a 21% reduction in acute respiratory diseases among stove users; while post-intervention surveys of participants in the Kenya Ceramic Jiko (KCJ) Project found that 82% of respondents cited increased safety when handling the stove, and 70% reported a reduction in indoor air pollution and smoke.^[30]

Environmental benefits were documented the least (n = 12 articles and n = 20 interventions), although some interventions did reveal interesting environmental impacts. For example, in-home surveys in Mexico showed that Patsari stoves allowed the average family to reduce fuel consumption by 67% (roughly 3 1/2 tons of wood annually) ^[43], while the Ugandan Energy Saving Stove Project saw a 60% reduction in wood consumption at a household level and 90% reduction at an institutional level.^[30]

The most frequently reported outcome was that of technology (stove and/or fuel) uptake (n = 25 articles and n = 47 interventions), such as the Mongolia Improved Space Heating Stoves Program exceeded its goal of disseminating 7,000 improved cookstoves and distributed over 15,000 units.^[30] Long-term, sustained stove usage, however, was generally not reported.

26 Indoor air quality (IAQ) improvement was the next most documented outcome (n = 18 articles and n = 26 interventions). For example, the Nepal Healthy Hoods saw indoor smoke levels reduced by 65%, indoor particulate levels by 88%, and indoor carbon monoxide levels by 96%. The 2014 review conducted by Barnes found that behaviour change strategies have reduced IAP exposure by 20-98% in laboratory settings and 31-94% in field settings, depending on whether the intervention included new technology or focused on behaviour alone.

Table 5: Results of literature search grouped by 'Impact' and 'BCTs'		
n = 55	Category	Interventions n (%)
Impact	Economic	37 (67)
	Health	32 (58)
	Environmental	20 (36)
Behaviour Change Techniques	Shaping knowledge	47 (86)
	Reward and threat	35 (64)
	Social support	35 (64)
	Comparisons	16 (29)
	Identity and self-belief	15 (28)
	Regulation	15 (28)
	Changing the physical environment	10 (18)
	Goals, planning and monitoring	3 (6)

PART 3 CASE STUDIES

Table 6 provides the list of interventions selected for inclusion as case studies (see Appendix D for the full case studies). These were chosen from the final 55 interventions to reflect a number of important and interrelated factors: geography, scale, implementer, funder, scope, impact, and BCT. Some are national level programmes, eg. China and Indonesia; others are smaller donor programmes, eg. Kenya and India; others are field experiments, eg. South Africa and Uganda. The choices do not reflect any endorsement of the projects, technologies or organisations involved. Information was taken from publicly available literature identified during the search plus, where possible, personal communication with project staff. Not all project organisations could be contacted and therefore there some gaps remain in the data reported.

Scorecard of behaviour change effectiveness

The team produced a scorecard of behaviour change effectiveness (see Appendix E) consisting of benchmark criteria for an effective behaviour change intervention, drawing on existing scorecards and frameworks.^[44-46] The criteria were: 1) behaviour focus; 2) target population; 3) barriers and benefits; 4) methods; 5) capacity building; 6) behaviour change results; 7) outcomes; and 8) impact. Each case study includes scores based on eight criteria, each containing 2-3 questions. Each question was worth one point for a maximum possible total of 22 points for each intervention, which was then converted to a percentage score.

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The scores were based on the data collected through the literature review and supplemented through the authors' correspondence with intervention managers. The information used is based on the reported impacts and outcomes of each intervention, as well as the activities using BCTs and no further field research or independent verification was conducted. The score does not imply a rating for the intervention's overall effectiveness as there are many variables and data not captured or verified by this study, including for the non-behaviour change components. It also does not assess the technical aspects of the technology used nor compare the scale of impact. The scores are summarised in Table 6 below.

For each of the case studies, the team also assessed the strength of evidence available for the intervention. For this we produced a Strength of Evidence Assessment sheet (see Appendix F) adapted from DFID's Assessing the Strength of Evidence guidelines.^[47] This includes the following principles of quality: 1) Conceptual framing; 2) Openness and Transparency; 3) Appropriateness and rigor; 4) Validity; 5) Reliability; and 6) Cogency. The team assessed a maximum of two primary sources for each intervention for each of the principles and gave a rating of high, moderate or low quality.

Table 6. Case Study Interventions							
Intervention	Lead Organisation	Behaviour Change Techniques used	Budget	Outcomes/Impacts	Score of Behaviour Change Effectiveness	Scorecard of behaviour change effectiveness	
Cambodia Fuelwood Saving Program	Geres	Reward and threat Shaping knowledge Social support Comparisons Regulation	USD2.5 million plus sale of Verified Emission Reductions	<ul style="list-style-type: none"> ■ 1.9 million stoves sold 2007 – 2013 ■ Savings of USD19.28 per family per year; ■ USD16 million saved in fuel expenditure nationally per year; ■ 249,000 tonnes of wood saved; ■ 1.3m tonnes of biomass charcoal saved; ■ 65,000 hectares of forest saved; ■ 2.3 million tCO₂eq of greenhouse gas emissions saved; ■ 200,000 tonnes of CO₂ saved. 	77%	<ol style="list-style-type: none"> 1. Behaviour focus 2. Target population 3. Barriers and benefits 4. Methods 5. Capacity Building 6. Behaviour change 7. Outcomes 8. Impact 	
China National Improved Stove Programme	Ministry of Agriculture	Reward and threat Shaping knowledge Social support Goals, planning and monitoring Regulation	USD154 million	By 1998, 185 million of China's 236 million rural households had improved biomass or coal stoves.	64%	<ol style="list-style-type: none"> 1. Behaviour focus 2. Target population 3. Barriers and benefits 4. Methods 5. Capacity Building 6. Behaviour change 7. Outcomes 8. Impact 	

Table continued on the next page...

Table 6. Case Study Interventions							
Intervention	Lead Organisation	Behaviour Change Techniques used	Budget	Outcomes/Impacts	Score of Behaviour Change Effectiveness	Scorecard of behaviour change effectiveness	
Energising Development Kenya Country Programme	GIZ	Shaping knowledge Change the physical environment Social support Comparisons Goals, planning and monitoring Regulation	USD10.5 million	<ul style="list-style-type: none"> ■ 1.4 million stoves installed serving 7 million people. ■ 1.5 million tonnes of firewood – 84,000 ha of primary forest. ■ 4,200 people working as self-employed stove dealers. ■ Saving of USD17.10 per month on wood per household ■ Devices reduced emissions by up to 30% 	86%	<ol style="list-style-type: none"> 1. Behaviour focus ★★★★★ 2. Target population ★★★★★ 3. Barriers and benefits ★★★★★ 4. Methods ★★ 5. Capacity Building ★★★★★ 6. Behaviour change ☆☆☆ 7. Outcomes ★★★★★ 8. Impact ★★ 	
India Room to Breathe	Shell Foundation	Shaping knowledge Social support Comparisons Goals planning and monitoring	USD350,000	<ul style="list-style-type: none"> ■ 30% increase in awareness of the negative effects of traditional cooking methods and availability of ICS. ■ 11,500 stoves sold, 7,053 via the MFIs ■ Stove reduced fuel consumption by 23%, HAP by 25% for CO and 5% for PM2.5. 	73%	<ol style="list-style-type: none"> 1. Behaviour focus ★★★★★ 2. Target population ★★★★★ 3. Barriers and benefits ★★★★★ 4. Methods ★★ 5. Capacity Building ★★★★★ 6. Behaviour change ☆☆☆ 7. Outcomes ★★☆☆ 8. Impact ☆☆☆ 	
Indonesian kerosene to LPG conversion program	Pertamina	Reward and threat Shaping knowledge Change the physical environment Social support Comparisons Regulation	USD 1.15 billion	<ul style="list-style-type: none"> ■ 44 million packages provided in 15 provinces. ■ USD 2.9 billion saved in subsidies ■ 8 LPG terminals, 53 LPG cylinder factories, 31 stove factories, 14 regulator producers, and 22 filling stations. ■ USD 1.7 billion of investment ■ 28,176 new jobs created. ■ Reduction of 6 million kl of kerosene/year reduced CO2 emissions by 8.4 million tonnes. ■ Reduced fuel expenditure by 30%. 	86%	<ol style="list-style-type: none"> 1. Behaviour focus ★★★★★ 2. Target population ★★★★★ 3. Barriers and benefits ★★★★★ 4. Methods ★★ 5. Capacity Building ★★★★★ 6. Behaviour change ★★★★★ 7. Outcomes ★★★★★ 8. Impact ★★ 	

Table 6. Case Study Interventions							
Intervention	Lead Organisation	Behaviour Change Techniques used	Budget	Outcomes/Impacts	Score of Behaviour Change Effectiveness	Scorecard of behaviour change effectiveness	
South Africa Northwest Province Behaviour Change Study	University of Witwatersrand	Comparisons Shaping knowledge Social support Goals, planning and monitoring	USD 25,000	<ul style="list-style-type: none"> ■ Investigative not programmatic ■ Median PM reduced by 85% ■ Median CO reduced by 69% ■ Child CO exposure reduced by 34% 	80%	1. Behaviour focus ★★★★★ 2. Target population ★★★★★ 3. Barriers and benefits ★★★☆☆ 4. Methods ★☆☆☆☆ 5. Capacity Building ★★★★★ 6. Behaviour change ★★★★★ 7. Outcomes ★★★★★ 8. Impact ☆☆☆	
Strategies for Improved Cookstove Adoption in Rural Uganda	Impact Carbon	Goals planning and monitoring Shaping knowledge Social support Comparisons	USD 600,000	<ul style="list-style-type: none"> ■ Investigative not programmatic ■ No consistent evidence that information on product attributes improves peoples WTP ■ Time payments increased WTP by 41% ■ Uptake of ICS rose to 57% with optimal contract; ■ Only 1% of households returned the stoves at the end of the free trial 	82%	1. Behaviour focus ★★★★★ 2. Target population ★★★★★ 3. Barriers and benefits ★★★★★ 4. Methods ★★☆☆☆ 5. Capacity Building ★★★☆☆ 6. Behaviour change ★★★★★ 7. Outcomes ★★★☆☆ 8. Impact ☆☆☆	

PART 4 DISCUSSION AND CONCLUSIONS

Analysis of the literature review and case studies

Analysis of the findings from the literature review and the case studies reveal a mixed picture of the use of BCTs in clean cooking interventions. The report has been able to identify the BCTs and the activities in which these have been used, but less clear is the effectiveness. While some good quality data is available, often absent are data on the outcomes and impacts of activities using BCTs, particularly those that are directly attributable. The lack of evidence for BCT impact means that we can only make best guesses on the most “active ingredient” in the intervention, in anticipation of further research on those interventions. It was not possible to compare the impact or cost effectiveness of these interventions. However we were able describe how the BCTs were used and compare that with the benchmark criteria developed for the Scorecard of Behaviour Change Effectiveness.

There appears to be limited variation in the types of BCTs used in the interventions reviewed. ‘Shaping knowledge’, ‘reward/threat’, ‘social support’ and “comparison” appear more often and usually in combination. This suggests that these BCTs are considered more effective by the designers but do not appear to be based on evidence. Shaping knowledge, such as advertising or other promotion campaigns, appears consistently. The most common forms of rewards are economic ones, including the subsidies provided by governments, NGOs and other providers of clean cooking technologies. Social support, especially in the form of change agents and cooking demonstrations appear to be one of the most common BCTs. Unfortunately no evidence was found of interventions that account for the influence of emotion and other subjective affective experiences on “rational” decision-making and behavioural intent. An example of which would be recent work by Biran et al carried out in India which showed substantial increases in handwashing with soap through a scalable intervention based on emotional drivers such as disgust, nurture and status.^[48]

This suggests that a “typical” clean intervention is one that promotes an economic incentive for the new technology combined with some form of social support. For example, the Shell Foundation developed partnerships with micro finance institutions in India which it credited with the program’s success. Impact Carbon used rent-to-own models in Uganda to entice potential users. And both EnDev and Geres used micro-credit schemes in Kenya and Cambodia respectively. We will now examine some of the key dynamics from these case studies more closely.

The Shell Foundation Room to Breathe project was unique from the interventions selected for case studies as it used a social marketing approach in its design and implementation. This was one of only a few interventions that used one of the leading behaviour change models. The SF program appeared to make use of a mix of promotion materials, group activities and personal communications. Its approach to monitoring enabled them to adapt the intervention to include microfinance options when stove

sales were initially slow. The intervention also used early adopters to demonstrate the technology, which is regarded as an effective tactic for changing behaviour. The impact did not meet the intervention's targets of 50,000 in sales, with only 11,000 units being sold. However the inclusion of financial incentives and the engagement of change agents significantly boosted the sales rate. The lessons learned have enabled SF to improve the design of interventions in other countries.

The Impact Carbon project in Uganda featured a six-month feasibility study before commencement of the implementation activities for the two randomised controlled trials. The team considered this useful to enable the Impact Carbon team to undertake both baseline data collection and formative research, as well as test the key elements of the intervention. During this period they engaged the target communities to choose from a range of stoves available for their use. They also tested the marketing messages with focus groups. Looking at the implementation activities, the selection of health, financial and time messages could be seen as problematic. Health, financial and other rational messages are considered the minimum required but not sufficient on their own to change behaviours. The section that follows highlights some examples of non-rational BCTs that may have been useful. The weak results reported for the use of marketing messages also do not account for whether it was the channels or the messages. The success of the financial mechanisms was encouraging but it may have been the promotion during group sessions that made them work effectively. It appears likely that effective interventions require flexible financing mechanisms communicated with the right messages through the right channels.

32 The Wits behaviour change trial in South Africa was different in that it did not include the use, promotion or sale of any technology. It tested only messages to change people's habits, delivered by health workers. The work was a 'proof of concept' to try to understand whether behaviour change has the potential to work in contexts of extreme poverty, where solid fuels are burned in close proximity and where access to cleaner technologies is difficult. The use of Trial of Improved Practices (TIPS) methodology is similar to Bandura's techniques of mastery modelling which suggests breaking significant changes in behaviour into smaller tasks. The combination of measuring behaviour change (observed and reported) plus the IAP outcome is considered effective. The significant reduction in IAP achieved is encouraging but the small sample size means scaling up is required.

The Geres Cambodia intervention was scored as highly effective, in part because it exceeded its sales targets. This is considered a supply side approach to behaviour change as it focused on building the stove production and distribution network. Given the project promoted a charcoal stove the health impact would likely be similar and therefore not represent an improved impact. This project had other market-based solutions, which included incentives such as low interest loans and business advice. The focus on strengthening the capacity of the supply chain makes the change more likely to be sustainable.

While there may have been consistent reporting of a limited number of BCTs, the variation and inconsistency comes in "how" to deliver these BCTs. While not covered by the scope of the literature review, the case studies revealed a wide range of ways in

which the BCTs were delivered. The “how” can be seen as the channel through which the BCT is communicated, also known as the marketing mix. Often materials such as leaflets or posters were produced, it appears without testing or understanding of how these would be received. This meant it was difficult for the team to determine whether it was the BCT or its delivery that was effective. It appears many of the interventions reporting significant impacts have focused on the barriers and benefits all the way along the clean cooking value chain. An example is the Pertamina Indonesia LPG conversion program, which drew on the findings from pilot programmes to focus on convincing kerosene suppliers to move to LPG and ensure community readiness for the conversion.

Lessons from other sectors

The literature review and development of the case studies demonstrate that certain BCT groupings (e.g. identity and self-belief) have appeared less frequently in clean cooking and some more frequently (eg. comparison). Given the wide range of behaviour change interventions, the following is a summary of some of the experiences with these BCTs in other sectors in order to understand how they might be applied in clean cooking interventions.

BCT: Comparison

Social comparison and persuasive arguments have been widely used in triggering behaviour change, by providing information about what other subjects are doing, allowing to compare their behaviour with those of others. Interventions based on such behaviour change techniques can be found in numerous fields of applications in high-income countries. The use of comparison techniques to promote behaviour change can be found in the environmental management sector. An evaluation of studies conducted by electric and gas utilities companies in the USA reported that providing customers with feedback on home electricity and natural gas usage based on peer comparisons, has reduced energy and electricity consumption, with sustained decrease over time.^[49]

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Other applications of social comparison techniques can be found in the water, sanitation and hygiene (WASH) sector in low-income countries. Sanitation marketing programmes, enabling sanitation adopters to compare latrines models, have been increasingly been used to generate behaviour change and demand for sanitation. Examples of engaging potential latrine buyers through a decision making process by means of comparison are seen in Cambodia (WaterShed), Madagascar (WSUP and WaterAid). Although to date there are no specific evaluation of the impacts of such techniques on sustained behaviour change of customers, monitoring studies report an increase of latrines sales.^[50]

BCT: Identity and self-belief

The use of identity and self-belief techniques to change behaviour have been widely used in interventions in HIV prevention^[51] and in the WASH sector, both in a developing and developed country context. Identity and self-belief techniques have been widely used in the WASH sector to empower individuals to use appropriate sanitation facilities and/or cease unhealthy habits and improving their hygiene behaviour. A successful approach based on these techniques is Community Led Total Sanitation (CLTS).^[52] CLTS uses participatory tools to empower communities to analyse their sanitation and hygiene conditions and initiate a collective action for behaviour change. Empowering tools are used to build a collective identity, which eventually leads communities to strive for and

achieve an open-defecation free status. The CLTS approach has been adopted in several developing countries and in many cases it has been integrated in national sanitation approach by governments.^[53]

Another successful example of building identity and empowering communities is that of Community Health Clubs (CHC), where participatory techniques are used to teach members about disease prevention in the community and empower people to make decisions to change their hygiene and sanitation practices. An evaluation of CHCs in Zimbabwe showed that within two years latrine coverage rose to 43% in the intervention area compared with a 2% increase in the control area.^[54] Club members' hygiene practices (including hand washing) were also significantly changed in comparison to the control group.

Condom use and other sexual risk reduction practices may require not only the ability of an individual to carry out a behaviour but also the ability of an individual to negotiate the behaviour with a sexual partner. Numerous interventions to promote safer sex have therefore included a focus on self-efficacy with respect to condom use and empowerment with respect to negotiation for less risky practices in the context of a sexual interaction. Much of the literature relates to small-scale intervention studies or pilot studies, often set in the USA with outcome measures relying on self-reports of social-cognitive and behavioural variables. Examples of studies from low- or middle-income countries include Ethiopia^[55], Malawi^[56], Armenia^[57] and Nigeria^[58]. These quasi-experimental studies found increases in measures of self-efficacy, empowerment and self-reported condom use or intention to use.

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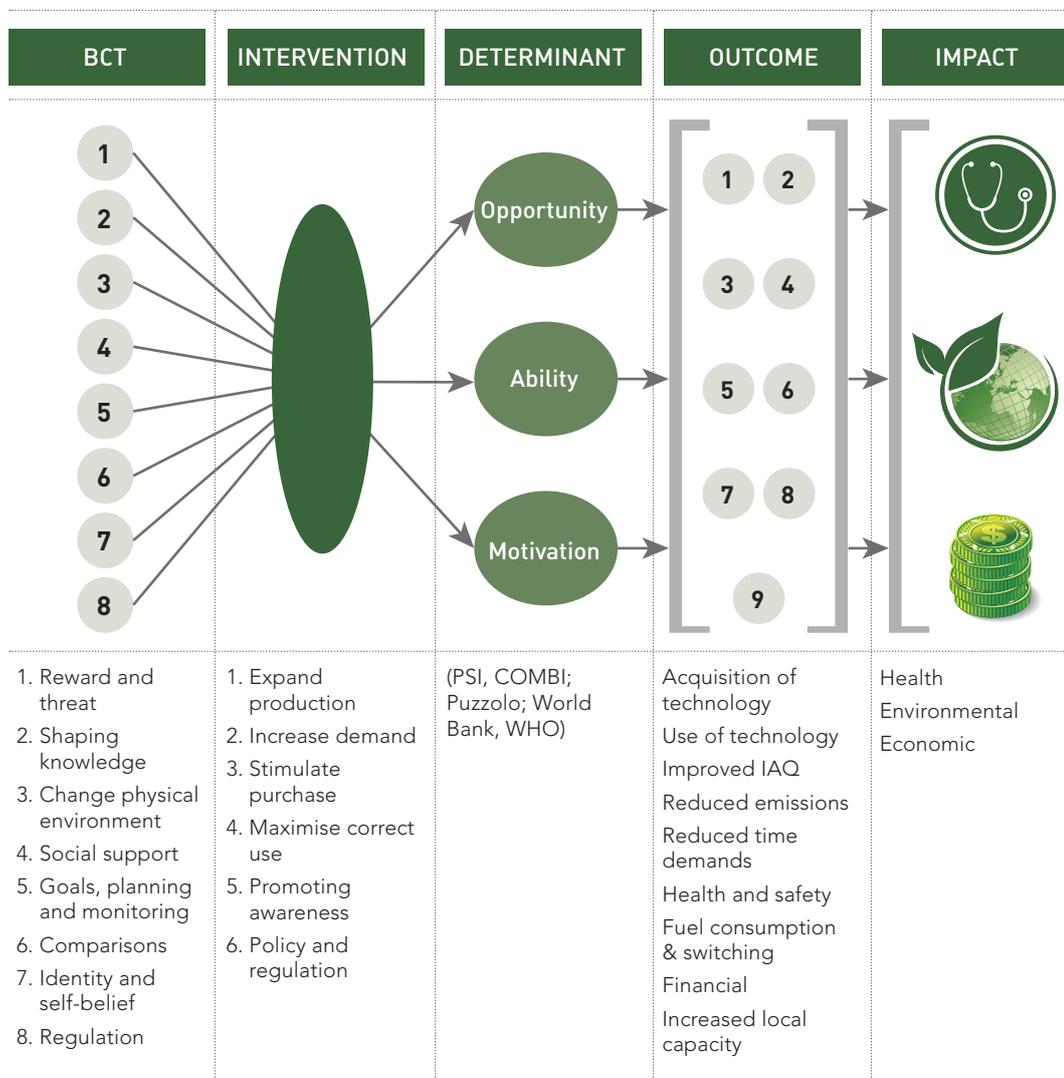
These techniques could be adapted for use in the clean cooking sector which has often focused on the technology and individual sales. One possible way would be the creation of a sense of community around the practices of clean cooking. This would include focusing on the individual's ability to make the change as well as the support of the community to enable its members to do so.

A behaviour change framework for clean cooking

The team required time to come to a "working consensus" on the nature of a BCT. Up to the time of publication, debate continued around how to interpret a BCT and its relationship to other elements in the clean cooking intervention framework. Specifically this related to the concept of the BCT as the "what" (content) versus the "how" (channel) of an intervention's activity. This debate reveals the complex nature of the relationship between BCTs. An example is when a regulation is passed to support a clean cooking intervention, e.g. a law providing for a subsidy or a restriction on a particular fuel, such as on LPG in the Pertamina Indonesia conversion program. To be effective, the law must be communicated (shaping knowledge), enforced (reward and threat) and supported (social support). This type of interaction between BCTs shows that further work is needed to understand its nature. Was it the regulation that was effective or was it the way people used it to shape knowledge? Or perhaps it was the social support that made it effective? These considerations led the team to the conclusion that more effective interventions have a mix of BCTs which complement each other.

As mentioned in Part 1, the report does not include segmentation of consumer markets, which is the subject of ongoing work by the Global Alliance on Clean Cooking and others. Collecting and understanding data to enable segmentation will be vital to efforts to scale up clean cooking solutions. This segmentation must not be limited to demographic or geographic data but also include behaviour related information, such as purchase intent and psychological typologies. The team also made a decision not to focus on the determinants (or factors) that influence behaviours. This was due to the existing body of work, including the 2013 systematic review carried out by Puzzolo et al.^[12] The determinants are the enabling or limiting factors, which can help ensure more successful delivery of clean cooking policies and programmes. This and other research suggests there are multiple determinants specific to each context. The logical place for the determinants in the clean cooking framework is between the intervention and outcomes as illustrated in Figure 2.

Figure 2: Clean cooking intervention framework



Use of theories of change and behavioural approaches

The absence of researched and tested theories of change to underpin the design and implementation of interventions is considered a shortcoming for many of the programmes reviewed. A theory of change enables the intervention manager to set out and articulate the concepts and assumptions which underpin the anticipated change process. Most interventions are framed around a belief about how the program will work, but the process through which the outputs will turn into outcomes needs to be considered and articulated, and its theoretical foundations made explicit.^[59] For example, “shaping knowledge” was the most frequently used BCT found in this study, however there was often little demonstrated understanding of how people produce, use and share information.

Compared to similar sectors, there is a significant absence of specific strategies, plans and activities based on behaviour theory, models and research. Interestingly, it appeared that many managers and funders had anticipated that their programmes would effect behaviour change and therefore could be described as behaviour change interventions. Some of the case studies did utilise behaviour change models; others that did not were also considered effective in changing behaviours. However because these did not explicitly use or refer to behavioural models or theories, it is difficult to determine how and why these were effective. This not only makes expansion more problematic, it also means that other countries or communities with similar challenges and opportunities may not be able to learn from these programmes.

Journey to scale

36 The team also identified a “journey to scale” in which programmes reached a “tipping point” after which the new clean cooking technology became the norm. An example is Indonesia’s transition to LPG, which experienced significant problems and resistance in the early stages. It was able to learn from these problems and adapt the rollout of the programme, including reaching out to change agents in beneficiary communities as part of its socialisation activities. This, combined with a **strong national regulatory framework**, appeared to ensure the conversion programme reached the tipping point and national adoption. A similar approach was taken in the China National Improved Stove Project, with strong government oversight and local support, including development of the technology by a specialist agency, a **focus on national standards** and rollout using demonstration teams.

Another example of this journey to scale can be found with M-Pesa, a mobile-phone based electronic payments system operated by Safaricom, which was adopted by 8.5 million Kenyans in its first 2½ years. After small pilots involving less than 500 customers, M-PESA launched nationwide, increasing the likelihood that the service could reach a critical mass in a short time frame. At launch Safaricom had 750 stores, and had made sure to cover all of Kenya’s 69 district headquarters. This was a high-risk strategy with the brand’s reputation at stake. It was also a huge logistical challenge that led to customer and store confusion and delays in the first few months. However, it achieved the purpose of establishing national visibility and top-of-mind awareness among large segments of the population. Logistical problems decreased after a few months, leaving **strong brand recognition and a trusted national network**.^[60]

The use of brands has significant promise for this sector because brands enable the grouping of behaviours under one strategic relationship umbrella.^[61] A stove has to be at least as good functionally (its intrinsic attributes) as the old one, otherwise all other efforts are more likely to fail – and simultaneous use of multiple stoves (stove stacking) will continue. Also the aspirational and emotional appeal (the extrinsic attributes) of the brand must be strong. While this review did not cover the use of brands specifically, few of the programmes reported investment in understanding and improving the relationship between the consumer and their brand(s).

Turning to another sector, CARE and PSI used branding and media campaigns in conjunction with community mobilization in Madagascar to promote the use of a water treatment system. The program increased sales from 76,000 in March 2000 to 250,000 in December of the same year.^[17] Another example is the Cancer Council of Australia's SunSmart program which helped reduce the incidence of skin cancer.^[62] SunSmart educates Australians to 'Slip (on a shirt), Slop (on sunscreen), Slap (on a hat), Seek (shade from sun) and Slide (on sunglasses)'. One useful clean cooking brand example comes from Unilever, which is selling their Royco branded clean(er) cook stoves to employees and consumers in Africa (Royco is one of Unilever's food flavouring brands). These energy saving stoves use 50% less charcoal than ordinary stoves and cook food faster, while producing less smoke. While the team did not review the results of this programme, the use of the Royco brand would likely draw on the trust Unilever has built in its brands. The significant potential for a well-known brand to take a clean cooking product and build on that brand recognition was one of the main discussion points at the Clean Cooking Conference held in London on 1 May 2014.¹

The review also noted several interventions took into account the various **relationships and dynamics, including at the individual, interpersonal, community and national levels**. It appears it is not enough to address personal perceptions and behaviours, interventions must include activities that reflect the relationships in the household as well as social norms and national regulations. For example, Shell Foundation's Room to Breathe project in India shows that social marketing messages must be convincing for the women who are doing the cooking, as well as to both husband and wife who share the decision making on the purchase of a new stove. The more top-down interventions, such as India's National Biomass Cookstoves Initiative (NBCI), did not appear to be based on research or activities designed to deal with behavioural challenges, nor engage local communities in the decision-making or solutions for their own problems.

While the technology (especially stoves and fuels) was not an explicit focus for this study, it is worth emphasising that the experience of many interventions shows that **the product must be appropriate for the intended users**. While there are many criteria that could be used to assess products, one useful set is the four product quality signals that have received the greatest attention in the marketing and economics literature: branding, pricing, physical features, and retailer reputation.^[63]

¹ Session 7 'The state of the art – practitioner panel on ground realities, market and consumer dynamics, financing and carbon markets.' The panel featured: Chris Loxley (Unilever), Simon Collings (GVEP), Monika Rammelt (GIZ), Ron Bills (Envirovit) and was chaired by Radha Muthiah (Alliance). Ref: http://r4d.dfid.gov.uk/pdf/outputs/GACC/Clean_Cooking_Conference_Summary_of_Participant_Feedback.pdf

Connected to this concept of getting the technology right is the need to ensure the **availability of accessible and appealing financing options**. New stoves are expensive for the targeted households and creative and realistic ways should be developed to enable the purchase to happen. This can be directly linked to the 'reward/threat' BCT grouping, which featured as the most common one found in the review. These financing options include subsidies, micro loans, trials and rent-to-own programmes. An example comes from the Shell Foundation Room to Breathe project, which initially fell short of the sales momentum needed to achieve scale and impact. The project subsequently negotiated partnerships with micro finance institutions in India and sales increased significantly. Shell Foundation has used this experience to inform other interventions and enable them to achieve scale.

Another aspect of achieving scale is the **recruitment of change agents and use of cooking demonstrations**, which consistently appeared in the case studies. The way the products are introduced to the community must be right, including consultations with leaders, demonstrations and engagement of sales agents, health workers and other change agents. Several projects recruited members of the target populations who were early adopters of clean cooking technologies and then deployed them as change agents in their communities. In the Shell Foundation India project, Navya Disha, an NGO partner, recruited and trained 35 stove promoters (SP). The SP promoted the stove at the same time as the loan officer collects weekly repayments. This served to confirm what was said by the promoters as well as to show there are already many in the community who are using the new stove. Stove demonstrations were held in the evenings to enable men to attend. Cooking demonstrations were also used in the Impact Carbon project in Uganda as well as the China National Improved Stove Program.

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Drawing on the team's finding that the 'Identity and Self-Belief' BCT was underrepresented in the interventions reviewed, the role of gender in clean cooking interventions is an important practical and moral consideration. This review found evidence that **programmes with gender sensitive designs were effective**. One example is the Deepam Scheme to promote LPG connections in the Indian state of Andhra Pradesh being implemented through women's self-help groups. Women's input is critical at every stage along the clean cooking value chain. Women can be economically empowered in the production process; consumer finance options enable women to purchase clean cooking solutions; women-led businesses often play a unique role; women are a key to scaling distribution; and women are well-positioned to ensure proper maintenance and care of improved cookstoves.^[7]

Gender empowerment approaches mostly focus on women and have positioned men as either absent actors or perpetrators of harmful practices. Although local cultural practices should be taken into account, intervention designs should consider how to work better with men on their terms. Development programmes are beginning to engage men and position them as participants with unique needs, aiming to improve collaboration with men to achieve a better relationship with women and improve the impact of programmes on families.

Limitations

The team had planned to conduct a cost effectiveness analysis (CEA) to provide a comparison between the case studies, however the available data and resources did not make this possible. In some cases impact and outcome measures were not collected, in others the cost information was not available. Also the measures of effectiveness differ across interventions, e.g. for health and economic impacts, which means direct comparison is not yet possible.

The lack of consistent and credible evidence for clean cooking interventions using behaviour change techniques restricts the team's ability to draw conclusions across the sector. However the evidence that is available enables a description of the elements that are more likely to be successful and provide recommendations for design and implementation of clean cooking interventions as well as further research. It is clear that cooking demonstrations, the right product, and understanding of the barriers and benefits along the value chain have all played a role in effective interventions. The following section will provide these recommendations in order to assist policy, programme and research practitioners and academics to improve their work in clean cooking. As the evidence base is built further and different approaches tested, it is the expectation of the team that behaviour change approaches will secure its role as the "special sauce" in clean cooking interventions in resource poor settings.

PART 5 RECOMMENDATIONS

Policy and interventions

The recommendations developed by the team should be understood as suggestions for policymakers and practitioners aiming to improve the effectiveness of their work in the clean cooking sector through better use of behaviour change approaches. Due to the limited scope of the study, and lack of data on effectiveness of specific BCTs, the team was unable to produce recommendations that direct governments, donors or their partners to specific types of interventions. Likewise it is not possible to assert that those aiming towards one type of impact were more likely to succeed, or that a certain set of BCTs was more effective than others. These challenges remain and should be explored further as part of the additional research recommendations outlined below.

1. Use theories of change and behavioural approaches

Intervention designers should develop a programme-specific theory of change that draws on existing research and other evidence to show how the expected outcomes will be achieved in a population given the local conditions. This may include replicating a similar intervention (or combination of activities) in similar circumstances, which has

previously produced the expected effects. Planners would also use their professional judgment and extrapolate from similar interventions in different circumstances. Making the intervention's hypothesis explicit and discussing the strength of evidence which supports it will provide a more solid foundation for the planned path from outputs to outcomes.^[59] Managers and researchers in the clean cooking sector are strongly encouraged to consider incorporating strategies, plans and activities based on behavioural theory, models, experience and research. To assist in this process, a useful tool would be a guide on implementing behaviour change in clean cooking interventions.

2. Ensure intervention activities operate on multiple levels

Clean cooking interventions should combine activities operating at multiple levels as part of their design. This includes the various relationships and dynamics at the individual, interpersonal, community and national levels. The national and community levels refer to regulation, policy and partnerships that produce an enabling public policy environment for the intervention to operate.^[64] In turn, interventions should incorporate activities based on local and individual insight and experience as well as interpersonal relationships.

3. Use brands as an umbrella for different types of behaviour change

The power of the brand comes from both its role as a signal of quality and the emotional appeal of its values. To make significant improvements in clean cooking, very often multiple behaviours need to be changed and maintained in order to have lasting health, environmental and economic outcome benefits. Brands can group the products, services and behaviours required to do this. Researchers and managers should consider more strategic use of brands to build the connections and ownership between consumer and the new behaviours and associated products and services. Consideration should also be given to a category marketing campaign, which would entail a joint investment in promoting improved stoves and/or fuel across different product brands.

4. Make sure the product is appealing and appropriate

Given the prominent role that products play in this sector – from stoves to fuels to chimneys and other technologies – getting these right is crucial to an intervention's success. While behaviour change approaches may help make adoption successful, producers and policymakers need to make sure the health, economic and environmental impacts of particular products deserve the investment.

Careful consideration needs to be made of the health and environmental impact of the selected technology, which could be guided by the recently revised WHO guidelines on indoor air quality and the ISO IWA tiers of performance.^[10] Pricing of stoves and fuels appears to be a crucial element of success in clean cooking, with discounts, subsidies, rent-to-buy offers and other approaches all playing a role. The physical features mean the stove must be easy to use, safe and, perhaps most importantly, deliver the required benefits. Finally, retailer reputation, including for customer service and their role in the community, is vital to success in clean cooking.

5. Engage change agents to take impact to scale

To achieve scale, clean cooking interventions should recruit change agents and use cooking and other product demonstrations. Change agents carry the trust of the target communities and can be identified using a wide range of tools and techniques. Activities could include consultations with leaders, demonstrations and engagement of sales agents, health workers and other change agents. The success of product demonstrations and deployment of change agents will build help support a retailer's reputation and strengthen the brand.^[65]

6. Improve knowledge management and research methods

Effective knowledge management is vital to development interventions. It enables the designers, funders and implementers of interventions to track and improve their impact. The limited capacity of organisations to manage their knowledge is a critical issue. The lack of funding and other resources for monitoring and evaluation is a common theme in reviews and discussions of development interventions, and ultimately resulted in a limited ability to evaluate the causes of their success. Similarly with the clean cooking interventions reviewed for this study, the team found an inconsistent mix of research, monitoring and evaluation methods, funding and reporting. In particular, the absence of capabilities, systems and other resources for tracking the impact of behaviour change activities represents an obstacle to greater understanding and improvement of these interventions.

A narrow set of research methods, whether these are quantitative or qualitative, also has the potential to restrict the evidence base. Making decisions on what to research and measure and then providing resources to enable this is critical as there are a host of influences that could affect the link between behaviour and outcome.^[66] The team recommends that donors, governments and other policymakers and managers should consider allocating sufficient resources to enable effective knowledge management, especially by local organisations implementing these interventions. These should be based on a mix of research methodologies to ensure that results can be verified and the complexities of the intervention's context can be taken into account.

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7. Incorporate gender empowerment approaches

Women are significantly impacted by dirty and inefficient cooking practices and they often hold the key to the success of interventions designed to address these issues. Men too suffer from the negative impacts and their absence from intervention designs restricts the likelihood of sustained success. The review showed a lack of use of the BCT grouping related to identify and self-belief, which includes gender as well as the notion of self-efficacy. Improving understanding of the unique needs and roles of women and men will provide more opportunities to optimise their roles in clean cooking interventions.

Further research

The team has also produced a list of further areas of research to complement the recommendations aimed at improving policy and interventions. **These are as follows:**

- 1. Refine the groupings of BCTs and test the validity:** this will help with more consistent reporting and planning of behaviour change interventions and activities in the clean cooking sector and should complement efforts in other areas.
- 2. Conduct evaluations using behavioural models and theories:** many designs do not explicitly state a behavioural theory or model. However, many of the interventions reviewed in this report may contain activities that lend themselves to one or more of the popular frameworks. Evaluations of clean cooking interventions using these theories and frameworks may help to improve understanding of their impact and increase their effectiveness.
- 3. Further test the Scorecard of Behaviour Change Effectiveness:** the results obtained from the case studies have provided a useful foundation for the analysis of clean cooking intervention effectiveness. However, these were based on the available data and analysis and could be improved, including through in-country evaluations. Further testing will also help refine and improve the scorecard, including in other sectors.
- 4. Expand interdisciplinary research and learning:** the experience of this team in producing this report can be used as a representation of the principle of interdisciplinary collaboration. For many aspects of clean cooking, researchers are confronted with questions that defy easy categorisation in or solution by traditional disciplinary frameworks.^[67] Teams and resources should be drawn not only from areas such as health, environment, energy and technology; but also from psychology, marketing, sociology, neurology and anthropology, among many others that constitute the field of behaviour change. As an example, the work done on the factors affecting adoption of clean cooking technologies confirms the role of determinants in the clean cooking framework. These determinants, as well as the contexts in which they operate, provide a useful consideration for clean cooking interventions. Further work is needed to understand the relationship between determinants and behaviour change frameworks and techniques in clean cooking. Attention should be paid to ensure better designs to ensure higher quality results.
- 5. Produce a general model:** building on work in clean cooking and other sectors, it would be valuable to further develop and test a generalizable model for behaviour change in clean cooking. This model would provide a useful template for intervention design as well as a frame for evaluating current and past clean cooking interventions.
- 6. Assess the role of behaviour change approaches in supporting big shifts in technology:** a common theme in the literature is the apparent compromise between achieving widespread adoption of a new technology and providing products made with the highest technical standards. However given the need to improve impact, the drive towards significantly more effective technologies is key. Therefore further work is needed to test whether behavioural frameworks can assist populations to make the big changes needed in clean cooking.

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Woman cooking on improved chulha stove in India Photo© K. Jagoe

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The Use of Behaviour Change Techniques in Clean Cooking Interventions to Achieve Health, Economic and Environmental Impact

A review of the evidence and scorecard of effectiveness



APPENDICES:

The Use of Behaviour Change Techniques in Clean Cooking Interventions to Achieve Health, Economic and Environmental Impact

A review of the evidence and scorecard
of effectiveness



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The Use of Behaviour Change Techniques in Clean Cooking Interventions to Achieve Health, Economic and Environmental Impact

A review of the evidence and scorecard of effectiveness

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Acronyms

3ie	International Initiative for Impact Evaluation	IAQ	Indoor Air Quality
AusAID	Australian Agency for International Development (now DFAT)	ICF	International Climate Fund
BCT	Behaviour Change Technique	ICS	Improved Cookstove
CDC	Centers for Disease Control	IDBP	Indonesia Domestic Biogas Program
CSI	Clean Stove Initiative (Indonesia)	ISO	International Standards Organization
DECC	Department of Energy and Climate Change (UK)	IWA	International Workshop Agreement
DEFRA	Department for Environment, Food and Rural Affairs (UK)	LPG	Liquid Petroleum Gas
DFAT	Department of Foreign Affairs and Trade (Australia)	NISP	National Improved Stove Program
DFID	Department for International Development (UK)	PATH	Program for Appropriate Technology in Health
DOI	Diffusion of Innovation (Theory)	QRG	Quality Review Group
ESMAP	Energy Sector Management Assistance Program (World Bank)	RtB	Room to Breathe (Program)
EU	Expected Utility	SCT	Social Cognitive Theory
EV	Expected Value	TLUD	Top-Lit Updraft (Stove)
FCO	Foreign and Commonwealth Office (UK)	TPB	Theory of Planned Behaviour
FOAM	Focus, Opportunity, Ability and Motivation	TRA	Theory of Reasoned Action
GACC	Global Alliance for Clean Cookstoves	TTM	Transtheoretical Model (of Change)
GCEP	Global Village Energy Partnership	USD	US Dollar
HAP	Household Air Pollution	USAID	United States Agency for International Development
HBM	Health Belief Model	WHO	World Health Organization
IAP	Indoor Air Pollution	WTP	Willingness to pay

APPENDIX A

BEHAVIOUR CHANGE TECHNIQUE GROUPS

The team produced the following list of BCTs and their groupings for this review based on the work of Michie and others.^[1]

1. Reward and threat
2. Shaping knowledge
3. Change the physical environment
4. Social support
5. Goals, planning and monitoring
6. Comparisons
7. Identity and self-belief
8. Regulation

2. Shaping knowledge

Instruction
Education
Communications
Marketing
Substitution
Replacement
Habit
Rehearsal
Practice
Training
Reinforcement
Sensitisation
Conditioning
Public relations

3. Change the physical environment

Environmental restructuring
Defaults
Logistics
Delivery
Access

4. Social support

Social support
Change agents
Community leadership
Community intervention
Communities of practice
Co-creation
Messengers
Community health workers
Outreach workers
Norm
Social influence
Social pressure
Conformity
Identity

1. Reward and threat

Reward
Value exchange
Threat
Incentive: coupon, voucher, discount, price-promotion, subsidy, hand-out, sponsor, donation/donate
Cost
Shaping
Contingency
Negative reinforcement
Punishment
Sanction
Disincentive
Prompts
Cues
Triggers
Choice design
Decision architecture
Priming
Health consequences
Environmental consequences
Economic consequences
Social consequences
Emotional consequences
Fear-appeal

A06

5. Goals, planning and monitoring

Intentions
Ambitions
Aspirations
Action planning
Problem solving
Commitment
Contract
Feedback
Monitoring
Self-monitoring
Maintenance
Transtheoretical model
Stages of change model

6. Comparisons

Modelling
Social comparison
Reference groups
Persuasive argument
Pros and cons
Comparing future outcomes

7. Identity and self-belief

Mental rehearsal
Self-talk
Self-efficacy
Health belief model
Self-affirmation
Reframing
Cognitive dissonance

8. Regulation

Regulation
Standards
Ban
Restriction

A07

APPENDIX B

LITERATURE SEARCH PROCESS

The two lists of searchable terms in Table 7 used for the review provide a contribution to the development of a BCT taxonomy for the clean cooking sector. The creation of a definitive list of intervention terms and BCT terms specifically for this sector, however, has not yet been attempted (to the best of our knowledge) and would require a wider and more intensive collaboration between behaviour change and clean cooking experts from policy, programme and academic arenas.

Table 7: Search terms	
Column 1: Intervention	Column 2: Behaviour Change Technique
stove*	Behav* AND chang*
cookstove*	educat*
cook* AND technol*	communicat*
cook* AND fuel*	market*
chulha*/chulla*/chula*	promot*
plancha*	inform*
'clean(er) fuel(s)'	awareness
pellet*	"increase production"
briquette*	"expand distribution"
fuel*	"Increase demand"
LPG	"improve practice"
"LP gas"	"decrease exposure"
"petroleum gas"	"chang* perceptions"
biogas	purchas*
bio-gas	financ*
biodigester	norm*
bio-digester	incentiv*
ethanol	"value exchange"
smoke hood*	reward
chimn*	behav* economics
flue*	nudg*
ventilat*	default*
	trigger*
	"choice architecture"
	habit
	replac*
	train*
	reinforc*
	conditioning
	messenger*
	regulat*
	cook* AND educat*
	interven*

A08

In order to create the final search string, the “Intervention” search terms from Column 1 were then combined with the “BCT” search terms from Column 2 (using the Boolean “AND”) in order to create the following Boolean search syntax:

(stove OR cookstove OR (cook* AND fuel) OR (cook AND technol*) OR (chulha* OR chulla* OR chula*) OR plancha* OR (clean* fuel*) OR pellet* OR briquette* OR fuel* OR LPG OR LP gas OR (“petroleum gas”) OR biogas OR bio-gas OR bio-digester OR ethanol OR (smoke hood*) OR chimn* OR flue* OR ventilat*) AND ((behav* AND chang*) OR educat* OR communicat* OR market* OR promot* OR inform* OR awareness OR (increase production) OR (expand distribution) OR (increase demand) OR purchas* OR (improve practice) OR (decreas* exposure) OR (chang* perceptions) OR financ* OR norm* OR incentiv* OR behav* economic* OR nudg* OR (“value exchange”) OR reward OR habit OR replac* OR train* OR default* OR trigger* OR (“choice architecture”) OR reinforc* OR conditioning OR messenger* OR regulat* OR interven*)

This Boolean search was entered into the academic databases listed in the left-hand column of Table 2 in the main report.

Where possible, the database searches were conducted at the level of “title, keyword and abstracts” and restricted to those implemented after 2000. When these options were not available, a wider search field was adopted, especially in the case of smaller databases. While the length and syntax of the Boolean search string was accepted by the academic databases, it was necessary to amend the search string for the grey literature. There were two reasons for this: first, some of the grey literature sites do not have a searchable database (e.g. who.int), and so searches of these sites had to be conducted via Google, using the addition search parameter www.websitename.xxx (e.g. www.who.int). There was also a limit on the number of characters that it is possible to enter into a Google search, so when searching the grey literature through Google, searches had to be conducted in stages. Second, the majority of the grey literature sites do not accept some Boolean syntax, so some search terms had to be written out fully, e.g. many sites do not recognise forward or backward truncation, so instead of searching “behav*”, for example, it was necessary to search “behaviour OR behaviour OR behav OR behavioural OR behavioral”.

A09

The team aimed to search the original Boolean string as faithfully as possible across all databases, however, it was necessary for each team member to maintain a certain amount of flexibility in their search tactics in order to obtain the most useful results from each source. In instances where the number of search results exceeded 400 articles (e.g. www.campbellcollaboration.org searched through google.com resulted in 15,000+ results), Google Scholar was used instead of the general google.com search. This generally revealed more restricted, and therefore fewer, search results. The grey literature search was also augmented by hand searches of key references. Four members of the team undertook the search and data extraction process, with two members conducting a quality check of 10% of the results.

APPENDIX C

BEHAVIOUR CHANGE BACKGROUND

The literature on human behaviour has been described as “enormous”^[2] and “bordering on the unmanageable”^[3]. Yet this variety and depth of research into the drivers of, and barriers to, human behaviour change also provides a rich source of ideas, methods and tools drawn from diverse disciplines, including psychology, sociology, anthropology and economics. This section will describe behaviour change frameworks, theories and models relevant to clean cooking and draw on experience from other development issues.

Foundations of behaviour change

Individuals are an essential unit of behavioural research and practice but are not the only one. However all other units, whether they are groups, organizations, communities, or nations, are composed of individuals. Lewin’s field theory, as one of the earliest theories, forms the basis for most contemporary work on individual behaviour, including those that focus on barriers, facilitators and stages of change.^[4] During the 1940s and 1950s, Rosenstock, Hochbaum, and others at the U.S. Public Health Service, began pioneering work to understand participation in tuberculosis screening programs.^[5] This and related work led to the Health Belief Model (HBM), which posits that behaviour is determined by beliefs about threats to wellbeing, the effectiveness and outcomes of particular actions and perceived capacity to adopt the behaviour (self-efficacy).

A10

Value expectancy theories, which include both the HBM and the Theory of Reasoned Action (TRA) and its companion, the Theory of Planned Behaviour (TPB), interpret behaviour as cognitive, arising from a decision-making process that involves planning based on outcome expectations. Due in part to its intuitive appeal and simple structure based on progressive stages of change, the Transtheoretical (TTM) or Stages of Change model quickly became one of the most widely used frameworks. However, several reviews have not found support for stage-based interventions as an effective way to change some behaviours, including physical activity and smoking.^[6]

Economics: rational choice and utility

Classic economic theory represents a starting point for modelling many aspects of human behaviour, using the concept of “rational choice” and “utility”. Rational choice theory assumes decisions are based on a calculation of the expected costs and benefits. Utility can be referred to as levels of personal satisfaction, happiness or benefit. It can also include the welfare of others as part of one’s own utility. Another assumption is that information acquisition is a cost and that individuals will acquire information optimally, as they do with any decision. Although the rational choice model is useful in certain circumstances, other theories have emerged in order to account for decisions and behaviours that rational choice fails to predict.^[7]

In an attempt to systematically explain deviations from rational choice, bridges have been built between economic theory and psychology, creating an interdisciplinary

subgroup called “behavioural economics”. Behavioural economics provides numerous examples of instances where the principle of rationality appears “violated” as result of innate but subconscious cognitive biases and heuristics in judgement and decision-making. Heuristics are mental shortcuts that humans use to reach decisions, but which also lead to systematic errors, or biases, in judgement and decision-making.^[8] Heuristics can thus be used to explain the idiosyncrasies in our apparently rational decision making for which “rational theory” cannot account. These approaches have been made popular by the books, *Thinking Fast and Slow*, *Predictably Irrational* and *Nudge*, and mainstreamed into public policy by behavioural insights teams in governments and other agencies in the UK and globally.^[8-10]

Values, attitudes and beliefs

Social-psychological models build on rational theory and utility by mapping the relationships between a range of determinants that influence behaviour. In Expectancy Value (EV) Theory – rational choice approached from the discipline of psychology – a person balances their beliefs about an object (or behaviour) with the value they attach to the attributes of the object/behaviour. The focus on attitude-formation and deliberation is a common factor in many social-psychological models.

Historically, many interventions across a wide variety of sectors have been based on rational cognitive models of behaviour. Psychologists are now beginning to understand the primacy of non-cognitive, affective influence on human behaviour. With this the limitations of traditional rational models are being revealed. Accordingly, the theories of behaviour that have dominated psychological and economic research to date are now being updated to account for these influences.^[8, 11]

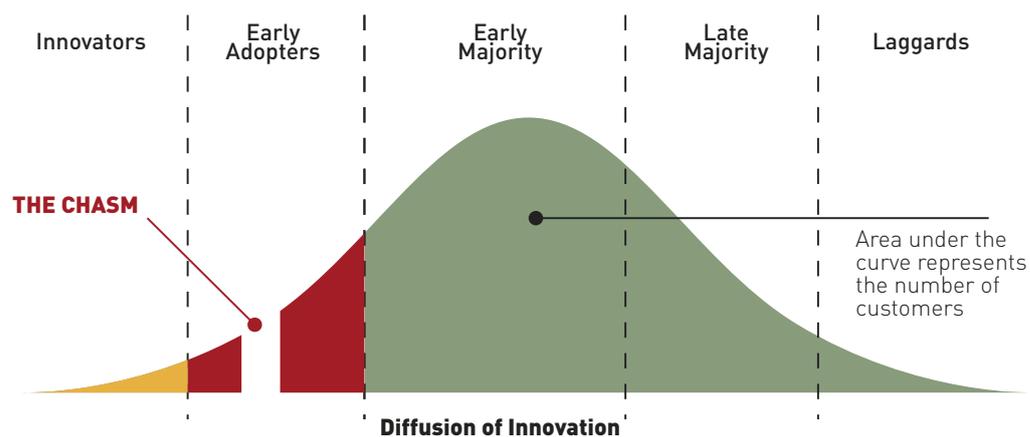
A11

The individual, community and multi-level frameworks

The evolution of behaviour change has seen a move toward multi-level models. This is based on work on issues such as HIV/AIDS, sanitation, smoking, reproductive health and water. This experience has confirmed that human behaviours are a product of multiple types and sources of influence. One source of influence is the interactions people have with others within their social networks. This shift fuelled the rise of multi-level (or ecological) models that have guided the development of powerful interventions in public policy.

Understanding the nature of a community – its structure, dynamics and history – is essential to the success of programs designed to change behaviour.^[12] The community as a web of influence on members can help explain how interpersonal interactions may influence individuals.^[6] Most multi-level theories focus on individual, social, and environmental factors, e.g. barriers, social norms, rewards and punishments. Social Cognitive Theory (SCT) posits that behaviour is the product of the dynamic interplay of personal, behavioural, and environmental influences. This theory focuses on people’s potential abilities to change their environments to suit their purposes. SCT also emphasizes the human capacity for collective action, working together in organisations and social systems to benefit the entire group. According to Bandura, promotion of public health can be viewed as an illustration of this, as societies seek to control the environmental and social factors that influence health behaviours and outcomes.^[13] SCT seeks to provide explanations for virtually all human phenomena which helps explain why it has not been tested comprehensively.^[6]

One of the most influential theories about how new behaviours and technologies spread is Rogers' "Diffusion of Innovation" (DOI). DOI explains how innovations (both social and technological) can spread at an exponential rate due to interactions between and within social networks. The core dynamic of DOI can be expressed as an S-curve, which shows that while it is slow for a new innovation to be adopted, at around 10-20% adoption, the rate accelerates very fast (due to the influence of social networks and peer influence) until it levels off again when adoption rates reach around 80-90%. The adoption rate at which a new innovation "tips over" and starts to spread exponentially demonstrates the concept of "critical mass". A modern interpretation of the DOI can be found in Gladwell's *Tipping Point* (2000).



A12 Changing habitual behaviours

Habit refers to a consistent reaction to external stimuli combined with the consistency of a behaviour in the face of changing circumstances (Lewin, 1951). Individual behaviour is the product of social dynamics, and is reinforced through adherence to group standards. Bandura's Mastery Modelling (1977) technique requires the acknowledgement of automatic responses to behavioural cues, so that when certain situations are encountered, new 'reflex' responses can be trained to become habits. The techniques of mastery modelling also include reducing big behaviour change goals into more manageable steps, for each of which cues can be constructed.

Marketing and social marketing

Marketing is a "social and managerial process by which individuals and groups obtain what they need and want through creating and exchanging products and value with others"^[14]. Prominent in marketing is the theory of exchange (cost-benefit) that provides the foundation for the relationship between the consumer and a brand, which traditionally includes a product or service. Practitioners often refer to the marketing mix, which is the set of variables that can be manipulated to achieve the marketer's aims. These are also referred to as the "Four Ps" – product, place, price and promotion.^[15]

Since 1952, when Wiebe asked the question, "Why can't you sell brotherhood...like you sell soap?"^[16], social marketers have attempted to answer it by developing and testing commercial marketing models and applying them to social issues. Leading models include the one developed by Andreasen^[17] with his six points for effective social

marketing; and the UK's National Social Marketing Centre's eight benchmark criteria, led by French and Blair-Stevens.^[18] Several key elements for effective social marketing can be distilled from these models:

1. The importance of customer orientation, rather than top down approaches, putting the individual at the centre of the intervention;
2. Insight based on formative and behavioural research, using proven theoretical approaches;
3. Clear and measurable behavioural goals for an intervention, not broad policy priorities or political statements;
4. An understanding of the consumer's barriers and benefits to the change, leading to creation of intrinsic and extrinsic value, often through the creation of brands, for which the intended recipient is willing to exchange their resources (money, time etc);
5. A mix of methods for communications activities, e.g. media and traditional forms of communication, as well as adjustments to price and promotion of products, services and behaviours; and
6. Take into account competition from opposed interests and behaviours as well as from other public issues.

Segmentation is an important component of marketing as it clearly defines an intervention's target group(s) demographically, geographically or attitudinally (using psychographics). In DOI theory the public is segmented by their propensity to adopt an innovation ('innovators', 'early adopters', 'early majority', 'late majority' and 'laggards', while in the Stages of Change, the public is segmented by their desire to convert to the new behaviour. In alcohol harm prevention programmes, drinkers are segmented according to when and how much they drink. Thus behavioural segmentation is considered a key component of social marketing programmes.^[19]

A13

Role of brands in behaviour change

Brands build relationships between consumers and products, services, or lifestyles by providing beneficial exchanges and adding value to their objects. Brands can be measured through associations that consumers hold for products and services. Commercial brands and branding have been defined based on three constructs^[20]:

1. Relationship between consumer and product or service (marketing focused on the consumer and building the brand-consumer relationship).
2. Value (for the consumer) added to a product or service.
3. Exchange (cost and benefit) between product or service and consumer.

Brands in public policy are the associations that individuals hold for behaviours, or lifestyles that embody multiple behaviours. Branded messages typically are theory based, and there is a body of evidence on their effectiveness in behaviour change interventions, especially in nutrition, tobacco control, and HIV/AIDS. Since many clean cooking interventions involve products, services and behaviours, e.g. purchase of an improved stove and its fuel and their consistent use, change can require more than just affecting consumer choice. This makes the use of effective branding strategies a key consideration for this sector.^[21]

APPENDIX D CASE STUDIES

1. Cambodian Fuelwood Saving Program: Geres
2. China National Improved Stove Program: Ministry of Agriculture
3. Energising Development Kenya Country Program: GIZ
4. India Room to Breathe: Shell Foundation and Envirofit
5. Indonesian kerosene to LPG conversion: Pertamina
6. South Africa Northwest Province Behaviour Change Study:
University of Witwatersrand
7. Strategies for Improved Cookstove Adoption in Rural Uganda: Impact Carbon

CASE STUDY ONE

CAMBODIAN FUELWOOD SAVING PROGRAM: GERES

Lead organisation	Groupe Energies Renouvelable, Environnement et Solidarités (GERES) Cambodia
Partner organisation(s)	Department of the Environment of Kampong Chhnang Province, Cambodia (Provincial); Cambodian Ministry of Industry, Mines and Energy (National); Institute of Standards, Cambodia (National); Development and Appropriate Technology, (DATE), a Cambodian national NGO.
Country and province/ state	Not designed as either a national nor provincial programme, but intended to work with the cookstove supply chain (a sectoral approach). The programme was active in the provinces of: Kandal, Kampong Cham, Kampong Speu, Prey Veng, Kampong Chhnang, Phnom Penh Municipality, Siem Reap and Battambang.
Budget and funding sources	Phase 1 (1997 – 2002): Start-up funding from the European Union, comprised 80% of financing. The remainder was funded by GERES and other donors. Phase 2 (2002-2006): Eur1.9 million total with European Commission Eur1.5 million and Eur0.4 million from other donors. Post 2006: funding from the sale of Verified Emission Reductions (VERs).
Dates of program (phases)	R&D: 1997 – 1998 Prototype & Testing: 1999 National Production & Dissemination: 2002 – ongoing
Target population/ market segments:	Supply: Cookstove producers and distributors; Demand: Families, commercial food producers and retailers who use charcoal for cooking.
Technology used	Stove: New Lao Stove (NLS); Fuel: charcoal
Behaviour Change Technique(s)	Activities included new business opportunities and financing mechanisms for producers; advertising on the product benefits; comparisons in fuel-savings and regulation of production standards and processes. The BCTs include: Reward and threat Shaping knowledge Social support Comparisons Regulation
Results	<ul style="list-style-type: none"> 🌿 1.9 million stoves sold 2007-13; 🌿 Savings of USD19.28 per family per year; 🌿 USD16 million saved in fuel expenditure nationally per year; 🌿 249,000 tonnes of wood saved; 🌿 1.3 million tonnes of biomass charcoal saved; 🌿 65,000 hectares of forest saved; 🌿 2.3 million tCO₂eq of greenhouse gas emissions saved; 🌿 200,000 tonnes of CO₂ saved.

SCORECARD	
Criterion	Score
1. Behaviour focus	★☆☆
2. Target population	★★★★
3. Barriers and benefits	★★★★
4. Methods	★★
5. Capacity Building	★★★☆☆
6. Behaviour change results	★☆☆
7. Outcomes	★★★★
8. Impact	★★
Total score (% of max 22)	77.3%

Background and context

The CFSP is a GERES project that emerged from the need to limit the devastating effects of logging on Cambodia’s forest ecosystems. In Cambodia, wood provides for more than 80% of people’s cooking energy needs, almost all of which comes from unsustainable and illegal logging of local forests. In order to reduce the environmental impacts of household cooking, GERES were tasked with creating a programme to develop, disseminate and stimulate purchase of an Improved [charcoal-burning] Cookstove (ICS), which would save on wood and charcoal. As a result, the New Lao stove (NLS) was created, which saves 22% of fuel compared to traditional charcoal stoves and has a cleaner combustion.

Overview of intervention

GERES aimed to create a reliable private-industry, supply-side infrastructure for the NLS, while simultaneously stimulating demand for the stoves through marketing activities.

Intervention Type	Target Outcome(s)	Target Impact(s)
Expand production & distribution of NLS	Acquisition of stove	Environment: reduce deforestation
Increase demand for NLS	Reduce household fuel consumption / reduced emissions	
Regulation of production standards	Reduce household expenditure on fuel	

Key actors

A technical team developed the “New Lao Stove”, identified producers of traditional stoves, and re-trained them in the production of the NLS. Local production of the NLS ensured a decentralised, local supply and created local employment. A promotion and marketing

team was created to raise awareness of, and stimulate demand for, the NLS. GERES also facilitated the establishment of the “Improved Cookstove Producers and Distributors Association of Cambodia” (ICOPRODAC), with the remit to train local manufacturers in NLS production; introduce new producers in a controlled manner; support producers to expand their capacity; to establish an affordable price per unit that could still generate profit for manufacturers and retailers; and to ensure quality control via inspection procedures and quality assurance seals (seals monitored by the Institute of Standards of Cambodia [ISC]). The ICOPRODAC was regulated by the Cambodian Ministry of Industry, Mines and Industry.

Budget overview

Total budget for the National Production and Dissemination phase (2002 – 2006) was 1.9 million EUR. The European Commission provided Eur1.5 million, while Eur0.4 million was obtained from various donors. Following the cessation of EU funding, the project was funded by the sale of Verified Emission Reductions (VERs).

Activities, including technologies used

The charcoal-burning New Lao Stove was adapted from the Traditional Lao stove and achieves an average fuel saving of 22% over earlier models. It has the same feel and functionality and could be used with the same utensils as the traditional stove. The CFSP trained locals in the production of the NLS and developed ongoing training and monitoring programmes to ensure that producers had the ability and the resources to manufacture high volumes of stoves at a consistently high standard. A micro-credit fund and a savings service was set up to provide producers and distributors easier access to 12% credit that would help them scale up their enterprises and invest in technologies to enable them become more efficient. A holistic marketing and promotional campaign (TV & radio spots, sponsorship, and demonstrations) was also rolled out in order to raise awareness of the benefits of the NLS and stimulate demand.

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Behaviour Change Techniques (BCTs)

Shaping knowledge, in the form of marketing communications; reward and threat, in the form of financing options for producers; and regulation, in the form of quality control monitoring and labelling, were the primary BCTs used.

Activity	BCT(s)	Target Population	Target outcome(s)	Time frame	Content	Channel
Advertising	Shaping Knowledge	Potential domestic and commercial end-users	Acquisition of stove	2000 – 2008	Durability; fuel-saving; cost-saving; nicer cooking environment; how to choose a certified stove; where to buy NLS	TV & radio
Advertising	Shaping knowledge	Retailers	[Consumer] Acquisition of stove	2000 – 2008	Pictures and descriptions of the NLS were provided to retailers so they could identify the NLS when consumers requested it by name	Print posters in retail outlets
Visual brand identity of stove	Regulation	Everyone in value chain: producers, distributors, retailers, end-users	Acquisition of stove	Since 2002	Because production was local and decentralised, a visual brand identity was created for the NLS so that the product could be easily recognised by everyone along the value chain.	Product design and promotional channels
Advertising	Shaping knowledge	Retailers	Acquisition of stove	Since 2000	Pictures and descriptions of the stove to enable retailers readily identify the product	Posters in retail outlets
Cooking Demonstrations	Shaping knowledge Comparisons Social Support	Potential domestic and commercial end-users	Acquisition of stove	2002 – 2008	Demonstrations of ease of stove use & fuel savings compared to traditional charcoal stove	Cooking demonstrations by trainers in marketplaces and villages

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Activity	BCT(s)	Target Population	Target outcome(s)	Time frame	Content	Channel
Sponsorship	Shaping knowledge	Domestic and commercial end users	Acquisition of stove			Sponsorship of sport and cultural events: Dragon Boat Racing (audience of 300,000); Kampong Chhnang Provincial Football (audience of 20,000)
Free stoves	Rewards and Threat	Domestic end users	Reduced household fuel consumption; Reduced household expenditure on fuel; Improved IAQ	1999 – 2000	Free NLS units were given to families in the Kampong Chhnang region during the pilot phase to stimulate demand.	Disseminated by GERES staff
Micro-credit	Reward and Threat	Producers and distributors	Increased local capacity	2003 – 2010	Micro-credit fund set up to support growth of the production and distribution network, e.g. 12% loans from GERES to manufacturers for new machinery to increase supply.	Personal relationship management between GERES and manufacturing & distribution network

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Table continued on the next page...

Activity	BCT(s)	Target Population	Target outcome(s)	Time frame	Content	Channel
Price framing	Reward and Threat	End users	Acquisition of stove Financial (monetary savings)	2002 – 2008	Communicate that “expensive” stove price could be recouped in 6 months through fuel savings	All promotional material mentioned that the new cookstove saved 30% on fuel
Regulation of supply side	Regulation	Producers and distributors	Financial (monetary savings and income generation) Technology and fuels regulated; policies implemented Increased local capacity	Since 2003	The Improved Cookstove Producers and Distributors Association of Cambodia (ICOPRODAC) was set up to control prices, increase production capacity and monitor quality	Mobile technical teams ensure standards are adhered to, and those who pass quality check are eligible to receive quality label. The label is communicated to the public as a quality assurance label

Impacts

Key reported impacts

By the end of the national production and dissemination phase in 2006, 220,588 NLS units had been sold. This was an increase of 630% on the original sales target of 35,000 NLS units. Sales targets post 2006 were set at an average of 2,500 units per month, but are currently at levels ten times that, with the average monthly sales between Jan 2007 and Dec 2013 being 22,706 for a total of 158,942 units sold during the period. The estimated impacts of these efforts (from May 2003 – Dec 2013) are as follows: monetary savings of USD19.28 per family per year, equivalent to USD16 million saved in fuel expenditure nationally per year; 249,000 tonnes of wood saved; 1,296,836 tonnes of biomass charcoal saved; 64,841.82 hectares of forest saved; 2,289,771 tCO₂eq of greenhouse gas emissions have been saved; 208,161.00 tonne CO₂ equivalent saved.

Evaluations

Although this programme is reported on in a very favourable light, and has indeed surpassed its target objectives, the literature fails to report on the macro forces that may have contributed to the success of the CFSP. It is anecdotally reported that the rise in the price of gas and oil in 2007/8 led many to “convert back” to charcoal-burning stoves, while a growing economy and improvements to national infrastructure are believed to have made the NLS more affordable and more easily disseminated. In addition, there is no peer-reviewed literature evaluating the design of the CFSP or the causal relationship between elements of the programme and the reported sales data.

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RATING ON THE STRENGTH OF EVIDENCE:

Geres (2010) Fuel-wood Saving With Improved Cook-Stoves in Cambodia Monitoring Report (2010)

RATING: LOW

Scorecard of behaviour change effectiveness

There was no behavioural goal of the CFSP, the only proxy measure for behaviour change was stove sales. GERES invested in a significant R&D phase in order to understand the needs of the end user, however, and to ensure their product design was useable and appealing, and that the barriers to NLS uptake were reduced (e.g. by making the stoves affordable, readily available, raising awareness of them, and ensuring quality control in order to establish consumer confidence). The NLS was promoted using a mix of BCTs (financing, knowledge shaping, regulation), and many impacts were reported on, including charcoal saved, trees and forest saved, and money saved by families. Behaviour change, however, was not reported on, since there were no specific behavioural targets for this programme.

Conclusions

The CFSP has been successful in building the supply side and generating demand for the NLS. The fact that this is a commercial solution to the clean cooking problem means that supply-side stakeholders have a vested interest in growing the market for the NLS, and so are committed to creating efficiencies in production, and in actively developing their business. The creation of the 'Improved Cookstove Producers and Distributors Association of Cambodia' has ensured that quality standards have remained consistently high, building and protecting consumer confidence in the product. Finally, the product design, with its similarities to the traditional stove, has meant that users feel comfortable converting to the new technology. Ultimately, this programme has been successful in creating, disseminating and generating demand for ICSs, and thus in reducing charcoal usage and in protecting forest-land. However, monitoring of stove stacking is not undertaken, and as such, we cannot know if the NLS is being used exclusively. If it is not, this undermines the validity of the reported results and impacts arising from reported reductions in charcoal consumption.

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CASE STUDY TWO

CHINA NATIONAL IMPROVED STOVE PROGRAM: MINISTRY OF AGRICULTURE

Lead organisation	Ministry of Agriculture
Partner organisation(s)	Local county agencies
Country and province/state	China – 806 counties
Budget and funding sources	USD154 million: Government of China
Dates of intervention	National Improved Stove Program (NISP): Phase One: 1983 – 1992. Phase Two: Approximately 1990-1995. Phase Three: 1995 – onwards.
Target population/ market segments:	Poor rural households that burn coal, wood and crop waste in “traditional” stoves indoors for cooking and heating.
Technology used	Various improved stoves adapted to suit local needs (i.e. available fuel source). NISP first focused R&D on efficient biomass stoves, but later focussed on efficient coal stoves.
Activities and Behaviour Change Technique(s)	Comparisons Shaping knowledge Social support Goals, planning and monitoring Regulation
Results	By 1998, 185 million of China’s 236 million rural households had improved biomass or coal stoves.

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SCORECARD	
Criterion	Score
1. Behaviour focus	★★★☆☆
2. Target population	★★★☆☆
3. Barriers and benefits	★★★☆☆
4. Methods	★★☆☆☆
5. Capacity Building	★★★☆☆
6. Behaviour change results	☆☆☆☆☆
7. Outcomes	★★★★★
8. Impact	★★☆☆☆
Total score (% of max 22)	64.0%

Background and context

In the face of perceived energy constraints, China's Ministry of Agriculture (MOA) launched the NISP in 1983 to facilitate the rapid dissemination of improved stoves to rural households. MOA worked with local county agencies on R&D and improving the stove industry, developing improved stoves and disseminating them to rural households. Because the programme was co-funded by local counties, the NISP tended to go to those regions that were better off. The NISP was not a poverty alleviation programme.

Overview of intervention

The NISP's primary objective was to address the perceived energy shortage in rural China through the rapid dissemination of more efficient stoves.

Intervention Type	Target Outcome(s)	Target Impact(s)
Expand production and distribution of clean stoves and fuel	2-4 generations of improved stoves were rolled out during the NISP	Economic Environmental
Increase demand for clean stoves and fuels,	Raise awareness and demand for improved stoves and ensure correct	
Stimulate purchase of stoves and fuel, Maximise correct and sustained use of stoves and fuel:	sustained use of the technology	
Regulation and policy to enable scale-up		

Key actors

MOA was the implementing agency, planning was done by the State Development Planning Commission (SDPC) and the Ministry of Finance under the direction of the State Council.

- Ministry of Agriculture (MOA): Key oversight of the NISP
- Local County Agencies: Provided funding and human capital support to MOA under the NISP, acting as local partners implementing the programme to local households.
- Research Organisations: specially created research organisations funded by MOA developed improved stove designs.
- County Rural Energy Offices (CREOs): Key implementing agencies for the NISP. CREO's exist in most counties, typically within the Bureau of Agriculture.

Budget Overview

From 1983 to 1990, central government spending on the NISP and similar provincial programmes was USD154 million, which covered 786 counties. This excludes

contributions from local governments and households. Most funds from the central government were spent on R&D rather than on direct stove subsidies. Households paid about 94% of costs associated with purchase and installation from 1993 to 1999. According to the Sinton et al. (2004) study, the average subsidy for improved biomass stoves was 26%, and usually ranged from 10% to 40% of the cost. Subsidies were rare for coal stoves, and were usually lower than for biomass.

Key technologies and activities

Technology: NISP supported a variety of improved stoves to be adapted to suit local county conditions (cooking practices, climate, available fuel sources, etc.). Stoves were designed to raise energy efficiency to 20-30% compared to traditional stoves (10-15%).

Activities

Phase 1: MOA worked with local counties as implementation partners to disseminate improved stoves. MOA funded competitions and R&D to stimulate advanced stove designs while local county agencies mostly provided outreach to households. Several generations of improved stoves emerged and were localised to meet fuel source and cooking practice requirements. Households bore the vast majority of the cost of materials and installation.

Phase 2: MOA wound down the R&D and dissemination efforts once the pressure on biomass fuel sources had been reduced. It then started to focus its attention on supporting the commercialisation of the stove industry (stove manufacturers and energy service companies) via tax and loan benefits to rural energy companies.

Phase 3: From the mid 1990s, MOA focused on the standardisation of the stoves via extension services and certification systems. Today, it is largely market actors who develop and disseminate improved stoves.

Behaviour Change Techniques (BCTs)

The NISP was a long-term programme that aimed to alleviate the perceived energy shortage by introducing widespread use of improved stoves across China.

Activity	BCT(s)	Target Population	Target outcome(s)	Time frame	Content	Channel
Design Competitions	Comparisons	Local County Agencies and R&D organisations	Acquisition of technology (stove, fuel, hoods and chimneys): Development of new, improved stoves	First phase of NISP. 1983 –1992	Design competition required stoves fit local conditions	
National training efforts – stove builders and installers	Shaping Knowledge	Stove builders and installers	Technology and fuels regulated; policies implemented, Increased local capacity (skills and tools): To ensure correct installation and performance of improved stoves	First phase of NISP. 1983 – 1992		Training was done at the county/ provincial level. Details of training programmes not available.
National training efforts - government agencies	Shaping Knowledge	Government agencies like the CREOs	Technology and fuels regulated; policies implemented, Increased local capacity (skills and tools)	First phase of NISP. 1983 – 1992		China Center of Rural Energy Research and Training established with Italian aid to train personnel, including radio and TV programmes. All provinces have 2-year agricultural colleges that offer rural energy courses. Professional Technical Certification Centers in Beijing and most provinces provide courses and training.

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Activity	BCT(s)	Target Population	Target outcome(s)	Time frame	Content	Channel
National training efforts – end users	Shaping Knowledge / Social Support	End users in the households	Use of technology (measured, observed or reported): Ensure acceptance of new technologies and maximise use	First phase of NISP. 1983 – appx 1992		Demonstration teams visit households to show how to use and maintain stoves.
Creation of Standards and Certifications to ensure Quality Assurance across the NISP	Goals, planning and monitoring/ Regulation	Local county agencies who held contracts under the NISP.	Technology and fuels regulated	Unspecified, though there was a greater focus on standard creation and certification systems in the Third Phase (after 1995).	Standards for stove efficiency ranged from 20-32 %. Most counties had emissions criteria as well.	Included an 'Energy Star' style label for energy savings devices.

Results and Impacts

The NISP is considered the world's largest publicly funded stove improvement effort. China's MOA reports that by 1998, 185 million of China's 236 million rural households had improved biomass or coal stoves. Between 2-4 generations of improved stoves were disseminated in most counties.

Evaluations

Researchers have stated that, although the programme was responsible for the wide dissemination of improved stoves, it is likely that some of figures on the number of households were overstated. Researchers have also pointed out that the NISP did not measure the long-term impacts on indoor air quality. One major study that aimed to determine NISP's impact on indoor air quality was conducted in 2002 of 3,476 households across three provinces (Zhejiang, Hubei, and Shaanxi). It found that most homes use multiple stoves with a mix of different fuels (up to 34 different fuel combinations). This means that although improved stoves were found to result in reduced PM concentrations indoors for biomass fuel, the efficiency gains were often negated when households used coal (especially in winter when additional stoves and fuels are burned for space-heating).

RATING ON THE STRENGTH OF EVIDENCE:

Sinton, J.E. et al. (2004):
Edwards, R. et al. (2007):

RATING: HIGH
RATING: HIGH

Scorecard of behaviour change effectiveness

The clear behavioural goal of the program is to switch people to improved stoves and fuels. The behaviour change techniques utilized in NISP activities included subsidies, demonstrations, training and outreach. It is not clear whether behavioural research was used nor whether the NISP used a variety of data sources. The NISP demonstrated an understanding of the financial barriers and the need for social mobilisation to support the rollout of new stoves. It is not clear whether it took competition into account, although there is clear evidence of stove stacking. The NISP used elements from different intervention types include expanding production and increasing demand.

The NISP incorporated a variety of capacity building activities, including training for household users and standards and training for stove and fuel suppliers. The results indicate high success in numbers of households reached. The 2001-2 evaluation confirmed the uptake of stoves but reported it was not clear that health impacts were improved. An M&E framework and standardised tests were used in the evaluation but it was not clear what was used in the original project, including whether behaviour change indicators were measured.

Conclusions

The NISP, which by the late 1990s had installed some 185 million improved stoves in rural households, is often described as the world's most successful national improved stoves programme. Later researchers have suggested that self-monitoring and reporting of the NISP likely overstates the rate of improved stove penetration into rural households. Researchers for a 2002 evaluation of the NISP have also noted that simply providing improved biomass cook stoves may not be enough to reduce indoor air pollution when households are using highly polluting coal-fuelled space and water heating stoves. The successes can be attributed to the combination of national government oversight; investment in R&D; capacity building for suppliers; and demonstrations and outreach for household users.

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CASE STUDY THREE

ENERGISING DEVELOPMENT KENYA COUNTRY PROGRAM (ENDEV): GIZ

Lead organisation	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
Partner organisation(s)	Energising Development (EnDev) is an ongoing multi-donor Energy Partnership programme, funded by Germany, the Netherlands, Norway, Australia, Switzerland and the UK. Partners in Kenya include the Ministry of Energy, Ministry of Agriculture, NGOs, private sector and church organisations.
Country and province/state	The programme covers 20 counties in Western, Central, Lake Victoria and parts of lower Eastern Kenya.
Budget and funding sources	Budget: USD10.5 million (2005-2014)
Dates of intervention	The project completed its first phase in July 2009 and is currently on its 2 nd phase running up to Dec 2014
Target population/ market segments:	Biomass dependant households and institutions, such as schools, colleges, and small-scale businesses in rural areas.
Technology used	Two types of wood-burning stoves - the Jiko Kisasa stove and the rocket stove.
Activities and Behaviour Change Techniques (BCT)	The activities included raising awareness of the advantages of clean cooking, capacity building of stove makers to market, produce and then sell and install the stoves, establishing financing mechanisms. EnDev-K also supported the Kenya Bureau of Standards in establishing new standards for the approval of biomass-burning stoves. The BCTs identified are: <ol style="list-style-type: none"> 1. Shaping knowledge 2. Change the physical environment 3. Social support 4. Comparisons 5. Goals, planning and monitoring 6. Regulation
Results	<ul style="list-style-type: none"> ■ 1.4 million stoves installed serving 7 million people. ■ 1.5 million tonnes of firewood saved – 84,000 ha of primary forest. ■ 4,200 people working as self-employed stove dealers. ■ Saving of USD17.10 per month on wood per household ■ Devices reduced emissions by up to 30%

Key actors

EnDev-K works in partnership with the Ministry of Energy and Petroleum and the Ministry of Agriculture. Through the latter, it reaches out to the rural target groups using the ministry's countrywide network of extension services in its Home Economics Department.

SCORECARD	
Criterion	Score
1. Behaviour focus	★★★★
2. Target population	★★★★
3. Barriers and benefits	★★★★
4. Methods	★★
5. Capacity Building	★★★★
6. Behaviour change results	☆☆☆☆
7. Outcomes	★★★★
8. Impact	★★☆
Total score (% of max 22)	86.4%

Background and context

Traditional biomass accounts for 97% of Kenya’s domestic energy requirement in the rural areas and is mainly used for cooking. The country’s firewood demand is about 3.5 million tonnes per year, while its annual supply is only around 1.5 million tonnes. This deficit has led to high rates of deforestation resulting in desertification, land degradation, droughts and famine. The majority of the population, particularly in rural areas, lives in poverty and cannot afford modern energy services, with most households using energy inefficient three-stone-fires for cooking.

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Overview of intervention

In 2005 EnDev Kenya (EnDev-K) was launched to reach 7.5 million Kenyans with modern cooking energy by the end of 2014. As of Dec 2013, the programme reported it had reached 6,979,943 people.

Intervention Type	Target Outcome(s)	Target Impact(s)
1. Expand production and distribution of clean stoves	Acquisition of technology (clean cookstove)	Economic: generate income and job opportunities by creating a sustainable stove market. Environment: reduce unsustainable deforestation. Health: protecting health, especially of women and children
2. Increase demand for clean cook stoves	Use of technology (reported)	
3. Stimulate purchase of clean stoves	Decreased household wood fuel consumption	
4. Maximise correct and sustained use of stoves	Financial (promoting local economy by proving jobs)	
5. Promoting awareness of clean cooking options and negative impacts of traditional cooking methods.	Increased local capacity (stove building and entrepreneurial skills)	
6. Policy and regulation of standards for biomass stoves	Time demand (increased availability of free time through reducing fuel procurement)	
	Reduced emissions	
	Health and safety	

Budget overview

With a budget of USD10.5 million (2005-2014) EnDev has helped to disseminate about 1.4 million improved stoves by December 2013. For each stove, EnDev invested less than 500 Kenyan Shillings (USD6.24). Based on one stove per average family of five, the invested sum is less than USD1.30 per head¹.

Activities, including technologies used

EnDev-K aimed to build a sustainable market for improved stoves. To create this market, two interventions were carried out simultaneously: awareness raising to create demand and then training stove builders/installers to address the demand. The programme focuses on building the technical, entrepreneurial and organisational capacities of those involved in the production, marketing, installation and wider take up of improved stoves, and it encourages these stakeholders to take a commercial approach. Many of these activities are carried out with the support of the network of Ministry of Agriculture home economic officers.

The programme supports the use of two types of stoves – Jiko Kisasa and the rocket stove. To meet the required standards for the Jiko Kiassa, EnDev educated and trained special producer groups on the use of the right materials and equipped them with the proper tools. Manufacturers mass-produced the required combustion chambers in kilns and stove companies and individual stove builders purchased the chambers to install in the stoves. In rural areas the trained installers build Jiko Kisasa stoves directly in people's homes using mud and clay.

Rocket stoves are also made by individual stove builders but are thought to be 20% more efficient than the Jiko Kisasa. Rocket stoves are available without chimney and they are constructed in different sizes, and possibly for one and two pots. They can be built for either domestic or institutional purposes. To sustain this development, EnDev also helped to establish the Improved Stoves Association of Kenya (ISAK) in 2007. The aim of the association was to provide a lobby forum for the various actors (stove builders and producers) in the clean cooking sector.

The activities of EnDev-K also include support for the Kenya Bureau of Standards in establishing new standards for the approval of biomass-burning stoves. It is also working with the Energy Regulatory Commission on the development of controls to regulate the actors, design and use of improved cooking stoves.

Behaviour Change Techniques (BCTs)

The activities within which BCTs were used include the provision of technical, business and organisational capacity building for men and women, creation of technical manuals for stove constructors, and a national consumer education campaign. EnDev established financing mechanisms to provide loans that link financial institutions, SMEs and customers. EnDev-K also supported the Kenya Bureau of Standards in establishing new standards for biomass stoves.

¹ All costs originally quoted in Euros converted to USD using 1 euro= USD1.36

Activity	BCT(s)	Target Population	Target outcome(s)	Time frame	Content	Channel
Consumer education	1. Shaping knowledge	Biomass dependent population in Kenya	Correct and consistent use of technology (reported)	2005 – ongoing	Correct use of stove	Technicians who sell or construct stoves in the households
Awareness raising and stove promotion	1. Shaping knowledge 3. Social support 4. Comparisons	Biomass dependent communities in western, central and parts of Eastern Kenya ² .	Acquisition of technology (clean cookstove) Correct and consistent use of technology (reported)	2005 – ongoing	Awareness creation on the benefits of clean cookstove at various levels	Ministry of Agriculture Home Economic Officers Local public meetings called <i>barazas</i> which bring the whole community together. Clean cooking radio campaign, fliers, posters, leaflet
Capacity training for stove builders	1. Shaping knowledge 2. Change the physical environment	Stove builders, installers and producers including men and women	Financial (promoting local economy by proving jobs) Increased local capacity (stove building and entrepreneurial skills)	Ongoing in new areas and follow ups through out in old areas	How to ensure quality production, marketing and entrepreneurial skills,	Organised targeted training. Collaborating with the Ministry of Energy and Petroleum (MoE&P) to build the capacity of 16 Energy Centres across Kenya.
Establishing financing mechanisms	5. Goals, planning and monitoring	SME's and stove end-users	Acquisition of technology (clean cookstove)	2008 – 2012	Access financing for stove businesses	Commercial and parastatal financial institutions
Establishing new standards for biomass stoves.	6. Regulation	All stakeholders within the cookstove sector	Technology regulated	2012 – ongoing	Standards for all clean cookstoves in the Kenyan market	Stakeholder in working group with KEBS leading the process

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² Special target groups have been also reached by the project, including farmers who have learned about the stoves through the promotional activities of agri-business firms; and people living with HIV/AIDS, nearly 900 of whom now have new stoves due to the project.

Impacts

Key reported impacts

By end of 2013, some 1.4 million stoves had been installed around Kenya, serving 7 million people.

Environment: EnDev-K reports that each stove saves around 1.09 tonnes of firewood every year, which adds up to over 1.5 million tonnes saved by the 1.4 million stoves now in use.³ This is equivalent to 84,000 ha of primary forest. At the same time, the associated annual reduction in carbon emissions is estimated to be about one million tonnes.

Economic: 4,200 people are now working as self-employed dealers in stoves. On average, a stove builder makes between USD100 and USD200 a month. Most of them install or produce only ten stoves a month, which leaves them plenty of time to pursue a second business.

With an improved cook stove, most households spend less than USD5.70⁴ per month for wood energy, while households using a three-stone fire pay up to USD22.80 per month. A daily wage on the countryside is around USD2.90 to USD4.60. Institutions like schools/restaurants save USD4.60 to USD9.10 each day.

Health: EnDev-K reports the programme has improved the health situation of women and children. In comparison to an open fire, modern cooking devices reduce emissions up to 30% for the types of stoves being promoted under EnDev,

EnDev-K continues to work with the Energy Regulatory Commission on the development of controls to regulate the actors, design and use of improved cooking stoves.

Evaluations⁵

Scorecard of behaviour change effectiveness

The EnDev Kenya programme demonstrates a commitment to implementing behaviour change techniques along the full spectrum of the value chain. The project included activities that used BCTs such as shaping knowledge through consumer education campaigns and the provision of technical, business and organisational capacity building for men and women, and rewards plus goals and planning, which involved innovative financing schemes to promote the purchase of ICS and regulation through the support of the Kenya Bureau of Standards in establishing new standards for biomass stoves.

³ Based on reported stove use reported in the Sustainability Study March 2013

⁴ Costs originally in Kenyan shillings (KES) converted using 87.7 KES= 1 USD

⁵ Reports received from EnDev did not sufficiently outline the evaluations carried out to gain the impact data to allow an assessment of the strength of evidence to be conducted.

The content and channels for the marketing and awareness raising messages are well researched and recently evaluated and based strongly on the 4P's social marketing framework. Capacity building is a strong enabling component of the EnDev programme and the programme has an emphasis on training workshops for stove building skills as well as business techniques in addition to providing financing solutions for the producers.

While there is no evidence of behaviour change directly attributable to the BCT, the programme report does have detailed evidence of numbers of stoves sold, reported usage and resulting fuel savings and reduction in emissions.

Conclusions

EnDev has considered many ways to use BCTs to address barriers and promote benefits to increase the production and uptake of stoves in Kenya. They have also implemented ways to ensure consistent quality of products and generation of small local self-sustaining businesses to produce the stoves on a large scale. Innovative financing provided for the builders and promoters facilitates entry into the market. Recent evaluation of the communication strategy showed media such as radio and TV to be effective channels for marketing but most information regarding the new stove transmitted by word of mouth. Barriers remain in the form of cost and inadequate accessibility, suggesting consideration needs to be given to further expand the financing solutions for consumers.

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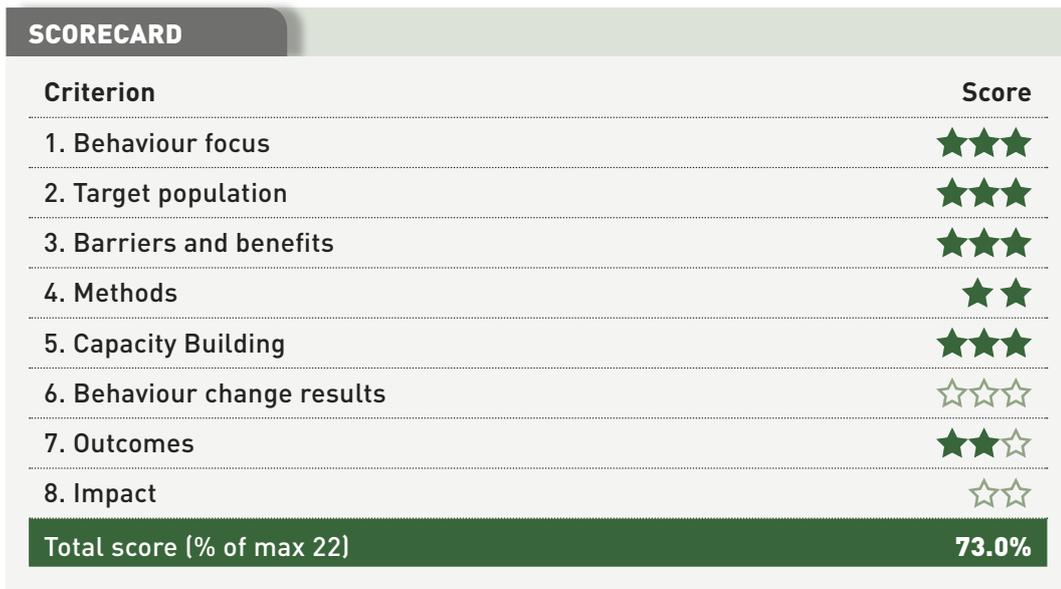
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CASE STUDY FOUR

INDIA ROOM TO BREATHE: SHELL FOUNDATION

Lead organisation	Shell Foundation
Partner organisation(s)	Envirofit International, SELCO, First Energy and Grameen Koota
Country and province/state	State of Karnataka in Southern India.
Budget and funding sources	USD350,000 (Shell Foundation)
Dates of intervention	2009 – 2012
Target population/ market segments:	The biomass-dependant population in Shimoga, one of 26 districts in the State of Karnataka. In this state 90% of the lower socio-economic groups burn biomass fuels on low efficiency stoves, either mud chulas or three stone fires.
Technology used	Primarily the Envirofit's G-3300: a wood-burning rocket stove with a metal combustion chamber.
Activities and Behaviour Change Techniques (BCT)	Activities included removing barriers to liquidity constraints through micro finance institutions and social marketing using village demonstrations and street theatre. Local men and women were trained to promote stoves through NGOs, microfinance institutions and government health programmes. The BCTs identified are: <ul style="list-style-type: none">■ Shaping knowledge■ Social support■ Comparisons■ Goals planning and monitoring
Results	<ul style="list-style-type: none">■ 30% increase in awareness of the negative effects of traditional cooking methods and availability of ICS.■ 11,500 stoves sold, 7,053 via the MFIs■ Stove reduced fuel consumption by 23%, HAP by 25% for CO₂ and 5% for PM2.5.



Background and context

Shell Foundation (SF) has worked to develop a market for clean and efficient cookstoves in biomass dependant populations since 2002. During this time SF has developed several alternative routes to market through innovative finance solutions (carbon and consumer financing). The creation of a long-term partnership with Envirofit International in 2007 has led to over 750,000 stoves sold across Asia, Africa and Latin America. In 2008 the SF launched the Room to Breathe (RtB) programme in the state of Karnataka in Southern India. The SF estimate that 70% of the people in this state are negatively impacted by household air pollution (HAP) from burning solid fuels on inefficient traditional cookstoves.

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Overview of intervention

The RtB programme aimed to raise awareness of HAP and the benefits of improved cook stoves (ICS) by 30% in households currently cooking with biomass on traditional cookstoves in the district of Shimoga within the state of Karnataka. The target was to sell 58,000 clean stoves whilst achieving a campaign spend per additional stove sold of USD5.75. This initial campaign spend was identified through a combination of trialling social marketing activities and anecdotal evidence from business with existing experience marketing ICS.

Intervention Type	Target Outcome(s)	Target Impact(s)
Expand production	Acquisition of technology	Environmental
Increase demand	Increased local capacity	Economic
Stimulate purchase		Health
Promoting awareness		

Key actors

SF conducted all social marketing activities in close collaboration with partner ICS businesses (Envirofit, First Energy and SELCO) which made sure stoves were available in nearby retail outlets.

Budget overview

The total cost of the campaign was USD350,000 – costs per stove sold varied significantly by activity from USD4 marketing through MFIs to, in one case, USD135 through SAH⁶. SF believes that successful initiatives could be replicated more cheaply by local organisations. Rather than rely on unsustainable donor driven subsidies the project worked over time to reduce the marketing costs per stove if any of the initiatives proved to be successful. The project now utilises carbon finance to reduce the cost of the stove and all local awareness-raising activities were embedded in the sales, marketing and distribution costs of the stove.

Activities, including technologies used

The campaign initially aimed to increase awareness of the negative effects of traditional cooking and the benefits of new stoves in Shimoga district of India through a wide range of social marketing activities. The social marketing strategy focuses on all of the 4Ps – product, price, place and promotion. Recognizing several barriers to stove uptake, the campaign evolved to include partnerships with MFIs to address liquidity constraints by allowing households to pay for the stoves in weekly USD1-2 installments.

Three brands and five models of modified stoves were originally included in this social marketing campaign: the Envirofit's G-3300 (1399 rupees or USD28); Prakti's Single (750 rupees or USD15) and Double Pot promoted by SELCO (1100 rupees or USD22); and First Energy's Oorja Plus (1250 rupees or USD25) and Oorja Super (1575 rupees or USD33). However due to supply issues with the Prakti and Oorja stove, the majority of the stoves sold as part of this marketing campaign were the Envirofit G3300 model.

Behaviour Change Techniques (BCTs)

A combination of social marketing activities was carried out. Two approaches were used:

1. A 'blitz' of different marketing activities;
2. Partnerships with MFIs that raised awareness of HAP and the benefits of ICS and offered affordable financing solutions.

⁶This activity was quickly stopped after a short duration.

Activity	BCT(s)	Target Population	Target outcome(s)	Time frame	Content	Channel
Low intensity social marketing campaign	Comparisons Shaping knowledge Social support	70 villages in the Shimoga district, Karnataka state.	Acquisition of technology (stove, fuel, hoods and chimneys) Increased local capacity (skills and tools)	October 2009 – January 2010	Main marketing messages related to savings (cost, time) and health benefits as well as promoting the stove as a modern aspirational appliance.	Static wall paintings Van campaigns using flip chart story, educational games and a cooking demonstration carried out by a 'SF Didi' ⁷ Deployment of Sustained Activists Householders (SAH ⁸), one per 5,000 people. Promotional leaflets in households. Stove demonstrations held at weekly markets. 'Tea parties' using the stove held at the weekly market. Testimonials were given by early adopters of the stove. Flipcharts used by the SAH's included a story related to cookstoves. RtB branded houses.
Medium intensity social marketing campaign	Comparisons Shaping knowledge Social support	40 villages in the Shimoga district	Acquisition of technology (stove, fuel, hoods and chimneys) Increased local capacity (skills and tools)	April 2010 – July 2011	Identical to content for low intensity activities.	Identical to low level with the addition of: New SAH model, which was trialed for 3 months in 40 out of the 110 villages. Instead of going door-to-door the SAHs worked with local self help groups (SHGs).

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Table continued on the next page...

⁷Influential local woman nominated by village leaders.

⁸SAHs were local women aged 22-45 years each articulate, educated and socially active in the village community. SAHs were paid a monthly salary with a possibility of bonuses for high performance. SF funded this activity however the aim was to create a sustainable model where the cost for the SAHs would be built into the price of the stove. To achieve this each SAH would need to sell 50 stoves per month.

Activity	BCT(s)	Target Population	Target outcome(s)	Time frame	Content	Channel
High intensity social marketing campaign	Comparisons Shaping knowledge Social support	10 villages in the Shimoga district	Acquisition of technology (stove, fuel, hoods and chimneys) Increased local capacity (skills and tools)	April 2010 – June 2010	Identical to content for low and medium intensity activities. Education given in households regarding the harmful affects of smoke in the kitchen	In addition to the medium level activities 100 government 'Anganwadi 'health workers' were deployed, each covering approximately 1,000 people each. Small incentives were given for promoting and arranging sale of stoves. Community stove demonstrations
Partnerships with MFIs	Goals planning and monitoring Comparisons Shaping knowledge	400,000+ members of Grameen Koola (GK). An MFI based in the state of Karnataka.	Acquisition of technology (stove, fuel, hoods and chimneys) Increased local capacity (skills and tools)	April 2010 – January 2012	Identical to content for social marketing activities plus loans offered to people who wanted to buy the stove.	The trained stove promoters used leaflets, posters and flipcharts to promote the stove while GK loan officer collected loan repayments. Cookstove demonstrations held in evenings (to allow men to attend). Timed payments

Impacts

Key reported impacts

The main reported impacts of the programme were; a 30% increase in awareness of the negative effects of traditional cooking methods and the potential and availability of ICS in the communities. From an initial target of 58,000, the campaign sold 11,500 stoves, 7,053 of these were via the MFIs⁹.

In a study carried out a community similar to those targeted by the RtB campaign, the stove reduced fuel consumption by 23%, HAP by 25% for CO and 5% for PM2.5. However levels remain significantly higher than the WHO recommended levels. Therefore these reductions in HAP will unlikely be sufficient to have a significant health impact on those exposed.

Evaluations

Social marketing campaign evaluation

Surveys were conducted in two sets – before and after trial activities and before and after expansion activities. The results showed that the primary drivers of biomass use were cost and availability. Negative health messaging is not enough to convince people to adopt ICS. It is important to create messages that are closely aligned to the triggers (typically cost and time savings) and barriers to stove purchase. 94% of households said buying a stove was a joint decision between husband and wife, which means social marketing must reach both audiences. Women were most moved by the claims of the stove offering reduced smoke while remaining close to traditional methods (i.e. it uses the same fuel and produces food that tastes good). Male consumers focused more on the economic benefits. Barriers tended to be less gender specific. When households who had not bought a stove were asked why, 55% said they thought the stove was too expensive. 21% said they were not sure how to operate it or were uncomfortable with new technology. 18% felt it would not deliver on the benefits promised.

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RATING ON THE STRENGTH OF EVIDENCE:

Strength of evidence:

RATING: MODERATE

HAP and stove use outcome evaluations

Although not carried out as a direct component of the RtB programme, SF carried out extensive monitoring of the G3300 stove in Karnataka State at the same time the social marketing campaigns were being carried out in the nearby Shimoga district. This was in partnership with Berkeley Air Monitoring Group.

⁹Note: The stove sales were based on numbers reported by the ICS manufacturers

Key Results

After purchase of the G3300, the average 48-hr kitchen CO and PM2.5 concentrations decreased by 25% and 5% respectively. Neither of these changes was statistically significant though CO was borderline ($p=0.07$). The average 48-hr PM2.5 concentrations seen after G3300 stove installation ($264\mu\text{g}/\text{m}^3$ ($\text{SD}\pm 214$)) are still significantly higher than WHO annual interim guideline for PM2.5 of $35\mu\text{g}/\text{m}^3$ – the level recommended by the WHO to achieve significant health impacts. A statistically significant reduction of 23% was seen in wood fuel use after the introduction of the G3300 compared to measurements taken prior. This matched user perceptions, as all households reported that the G3300 saved fuel. The G3300 was used for on average one-third to one-half of biomass cooking tasks, though this varied considerably from week to week within each home.

Scorecard of behaviour change effectiveness

The RtB programme implemented a range of activities using BCTs to raise awareness of the detrimental impacts of traditional cooking methods and the benefits of ICS with an overall aim of increasing demand and stimulating purchase of ICS. Using a social marketing framework, including the 4Ps, SF implemented a comprehensive awareness raising campaign through a “hybrid of marketing and social marketing i.e. promoting a social product and positive behaviour change.” This involved a mix of pre-piloted activities using BCTs such as shaping knowledge, social support and comparisons. An extensive survey was carried out prior to implementing the BCTs to gain a broad understanding of the triggers and barriers to uptake in the target market. Continual monitoring and assessment of impact measured by reported stove sales revealed that liquidity constraints were a significant barrier to purchase. These were addressed effectively through the implementation of ‘goals and planning’ techniques namely through close collaboration with local MFIs.

The behaviour change measured by the programme were numbers of stoves sold however without relative data collected during a similar timeframe with no BC intervention is not possible to calculate percentage of change attributable to the project.

Conclusions

The report presents a candid overview of the challenges related to social marketing in the clean cooking sector. The RtB programme demonstrated a measured success in raising awareness about the negative impacts of traditional cooking methods and benefits of ICS through a varied social marketing package. The programme is relative unique within the clean cooking sector in that it set out to implement social marketing activities and then directly measure their effect. The programme demonstrated how important it is to know your market in order to identify the optimal motivator for purchase for both men and women. Rather than the traditional, frequently used health and environmental messages, those that succeeded related to ease of use, dependability, and money saved. Piloting these messages and the channels for their delivery was key to achieving increased awareness but SF demonstrated that messaging alone is not

sufficient to trigger stove sales. In Expansion Phase 2 of the program SF implemented BCTs to address the barriers to stove purchase including liquidity constraints and suspicion of new product.

SF staff reported that their greatest success was the partnership with MFI Grameen Koota (GK), where they combined stove promotion activities with stove loans to address both lack of awareness and price barriers simultaneously. They managed to do this at a cost of USD4.00 per stove. 3-4 times more stoves were sold when offered with access to micro finance solutions. Although the stove sales remained well below the initial target of 58,000, the lesson learnt and the business model implemented have been used by MFIs to sell stoves and other products. The lessons learnt have also been used to create an efficient business model, which has been embedded into the Envirofit sales, marketing and distribution activities.

Overall SF advocate increasing support for distribution partnerships, awareness raising linked to policy and government support and innovative culturally sensitive ways to finance the value chain – including consumer finance but also working capital to address that barrier to scale. However the first step is to create demand.

SF stated that there is a need for wholesale finance through MFIs to provide products and services to rural communities and subsequently more organisations to support MFIs to execute this. In response to this SF has partnered with the New Delhi based organisation, Dhama Life, which aims to address the barriers to uptake of innovative products in poor rural communities by creating a rural distribution network providing customised products (including the Envirofit G3300 stove) and services sold at a socially affordable price. They use innovative micro-finance and credit solutions for both rural entrepreneurs and consumers. Based in 4 Indian states the project is planning to expand into Africa in the next few months. <http://www.dharmalife.in/index.html>

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References

Shell Foundation (2013), *Social marketing in India: Lessons learned from efforts to foster demand for cleaner cookstoves*. Downloaded from <http://www.shellfoundation.org/download/pdfs/FINAL+Social+Marketing+in+India.pdf>

Monitoring and Evaluation of the G3300 Cookstove in South India by Berkeley Air Monitoring Group August 2011

Personal Communications, Pradeep Pursnani, Deputy Director - COO, Shell Foundation. March 2014

CASE STUDY FIVE

INDONESIA KEROSENE TO LPG CONVERSION: PERTAMINA

Lead organisation	Pertamina (State Oil and Natural Gas Mining Company)
Partner organisation(s)	Ministry of Energy and Mineral Resources, Ministry of Industry, Ministry of Women's Empowerment, Ministry of Small and Medium Enterprises
Country and province/state	Indonesia (national, except for the areas of Papua, West Papua, Maluku, North Maluku, East Nusa Tenggara, and remote islands)
Budget and funding sources	USD1.15 billion: Government of Indonesia
Dates of intervention	2007 – 2011
Target population/market segments:	Households with monthly incomes <USD150 in areas with LPG infrastructure readiness and high consumption of kerosene.
Technology used	"Package" consisted of a 3kg LPG cylinder, first fill of gas, one-burner stove, hose and regulator.
Activities and Behaviour Change Techniques (BCT)	<p>The activities included a national legislative framework; engagement of local government; preparation of agents and retailers in the supply chain; distribution and socialisation to households.</p> <p>The BCTs identified are:</p> <ul style="list-style-type: none"> ■ Shaping knowledge ■ Social support ■ Comparisons ■ Goals planning and monitoring
Results	<ul style="list-style-type: none"> ■ 44 million packages provided in 15 provinces. ■ USD2.9 billion saved in subsidies ■ 8 LPG terminals, 53 LPG cylinder factories, 31 stove factories, 14 regulator producers, and 22 filling stations. ■ USD1.7 billion of investment. ■ 28,176 new jobs created. ■ Reduction of 6 million kl of kerosene/year reduced CO₂ emissions by 8.4 million tonnes. ■ Reduced household fuel expenditure by 30%.

SCORECARD	
Criterion	Score
1. Behaviour focus	★★★☆☆
2. Target population	★★★★★
3. Barriers and benefits	★★★★★
4. Methods	★★★☆☆
5. Capacity Building	★★★★★
6. Behaviour change results	★★★☆☆
7. Outcomes	★★★☆☆
8. Impact	★★★☆☆
Total score (% of max 22)	86.0%

Background and context

Kerosene, the main fuel for households and transportation, has been subsidised for decades by the Government of Indonesia (GOI). The state-owned Pertamina was tasked to reduce energy use and lift the enormous burden on state finances posed by subsidies on petroleum products. LPG has several advantages compared to many other traditional fuels. It improves health for those affected by indoor air pollution; it reduces emissions of greenhouse-related pollutants; and it reduces pressure on natural forests. Use of LPG also eliminates time and labour devoted to gathering biomass fuels and reduces efforts need for cooking and cleaning, which traditionally place a larger burden on women and children.

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Overview of intervention

In 2007 Indonesia undertook a massive energy programme to reduce the use of kerosene as the primary cooking fuel and increase the use of LPG in more than 50 million households.

Intervention Type	Target Outcome(s)	Target Impact(s)
1. Expand production and distribution of clean stoves and LPG fuel	Acquisition of technology (stove and LPG fuel)	Economic: reduce the national subsidy on kerosene and improve household savings
2. Increase demand for clean stoves and LPG	Household fuel consumption and switching	
3. Stimulate purchase of LPG	Financial (monetary savings)	Environment: reduce carbon emissions
4. Maximise correct and sustained use of stoves and LPG	Technology and fuels regulated; policies implemented	
5. Promoting awareness of and facilitating enhanced household management practices to decrease LPG consumption.	Increased local capacity (supply chain)	
6. Regulation and policy to enable scale-up		

Key actors

The Ministry of Energy and Mineral Resources (MEMR) was coordinator of implementation. Pertamina handled procurement of the 3kg LPG cylinders and the supply of LPG. The Ministry of Industry managed procurement of gas stoves, hoses, and regulators. The Ministry of Women’s Empowerment conducted socialisation of the conversion program. The Ministry of Small and Medium Enterprises was the distributor of the LPG packages.

Budget overview

The GOI’s total investment of USD1.15 billion included, through Pertamina, procurement and distribution of the package of stove and fuel. The GOI also invested in new LPG terminals, retail filling stations and distribution networks.

Activities, including technologies used

The free “Package” consisted of a 3kg LPG cylinder, the first fill of gas, plus a one-burner stove with hose and regulator. The activities conducted included a national legislative framework based on the Presidential Decree of 2007 which appointed Pertamina as the executor of the programme, supported by relevant ministries and local governments, including national budget allocations. Pertamina also had the key role of converting kerosene agents and retailers to become LPG agents and retailers. Kerosene withdrawal was accomplished by gradually cutting the agents’ allocation and supply.

Activity	BCT(s)	Target Population	Target outcome(s)	Time frame	Content	Channel
Presidential Decree	8. Regulation	Public servants	Technology and fuels regulated; policies implemented	2007 – 2011	Pertamina as the executor of the programme. Local agencies to allocate budget.	Government bureaucracy networks.
Preparation of agents and retailers	4. Social support 5. Goals, planning and monitoring	Kerosene agents and retailers	Convert them to become LPG agents and retailers	2007 – 2011	The ratio of LPG-to-kerosene energy effectiveness for cooking: 1:0.57, later revised to 1:0.4. Indonesian National Standard (SNI) certification	Kerosene agents Local NGOs
Distribution	3. Change the physical environment	National	Acquisition of technology (stove, fuel, hoods and chimneys)	2007 – 2011	“Package” consisting of a 3kg LPG cylinder, first fill of gas, one-burner stove, hose and regulator	Network of the Ministry of Small and Medium Enterprises.
Socialisation	1. Reward and threat 2. Shaping knowledge 4. Social support	National		2007 – 2011	Use and handling of the stove and LPG cylinder, Designation of LPG refill locations	Kerosene agents Local NGOs

Impacts

Key reported impacts

By the end of 2009, the programme had been implemented in 15 provinces with more than 44 million conversion packages provided to citizens.

Economic: By May 2010 the state's gross subsidy saving was more than USD2.9 billion. Impacts on economic development include establishment of new industrial facilities and creation of jobs associated with them, including 8 LPG terminals, 53 LPG cylinder factories, 31 stove factories, 14 regulator producers, and 22 filling stations. USD1.7 billion of investment and 28,176 new jobs were created. The conversion also erased dependence on imported kerosene, which had reached approximately 3 million kl in 2006. In addition, in 2009 Pertamina was able to export its surplus kerosene production of 426,000 barrels.

Environment: Achieving Pertamina's 2010 target of a reduction of approximately 6 million kl of kerosene/year would reduce CO₂ emissions by 8.4 million tonnes per year. For comparison, in 2005 Indonesia's total direct energy-related emissions were 312 million tones CO₂ equivalent per year. In other terms, the reduction would exceed the CO₂ emissions from the total number of cars sold annually in Indonesia.

Other: Package recipients said that they cook faster, have a cleaner kitchen, and reduced their expenditure on cooking fuel by approximately 30%. Following the Presidential Decree, various supporting legal instruments were issued and national parliament agreed to included the programme in the state budget.

Evaluations

The data for this case study were mostly taken from Budya and Arofat (2011). The evaluations reported were conducted by Pertamina in cooperation with other GOI agencies but not using an independent agency. These focused mainly on the economic and environmental impacts plus stove distribution. There was no data available for health impacts or outcomes. Additional reports include:

Consumer satisfaction survey: conducted by Frontier, a private research company. On average, respondents used a 3kg LPG cylinder in 10.58 days, with daily cooking time of 1.92h. On average the respondents using only LPG bought each month three refills of the 3kg LPG cylinder at a cost of Rp13,800 per refill (USD1.38). Of the 62.1% of respondents who use only kerosene for cooking, the average uses 4.41 litres of kerosene a week at a cost of USD12.52.

Ministry of Finance survey: this evaluated the programme's effectiveness among 288 respondents who were housewives and receivers of the 3kg LPG packages. It found that the average monthly savings was Rp 16,420 (USD1.64).

RATING ON THE STRENGTH OF EVIDENCE:

Budya, H., & Yasir Arofah, M. (2011)
Wibowo, E. (2013)

RATING: LOW

RATING: LOW

Scorecard of behaviour change effectiveness

The project used regulation and reward of free new technology but makes no mention of behaviour change theory or models. The reports demonstrate an understanding of target populations, however research appears to be economic and social, not behavioural. The project combines an increase in barriers for kerosene (costs) with lowering of barriers for LPG (access to technology plus social mobilisation). Pertamina has used a mix of intervention designs to increase demand, expand distribution, stimulate purchase etc. Within this it has used a mix of activities from promotion of the regulations to demonstrations of new technology to households. To build capacity, they worked with the full supply chain to convert kerosene sellers to LPG. It is unclear from the sources available what tools and other resources were produced, nor the design of the M&E framework. The impacts described above were very positive and constitute national scale conversion, however greater adoption of behaviour change approaches could have improved outcomes.

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Conclusions

The success of the Pertamina programme was due to their understanding of the target population and anticipation of the barriers to change, e.g., by providing a free initial package to households. Pertamina learned from initial problems and used national regulation combined with an integrated community mobilization programme. This included cooking demonstrations and programme socialisation. They recruited existing fuel distributors (kerosene retailers) and helped reduce risks in the new businesses, including by provide financing and other support.

According to Pertamina, demonstrations and social unrest occurred because of incomplete information and sometimes conflicting interests. Explosions were not caused by LPG cylinders but by the following: (1) Accessories; (2) Lack of understanding on how to use them; (3) Illegal manufacturing and distribution practices; and (4) Unsafe

environmental conditions. There were reports in the media about scarcity of kerosene in areas that were not conversion targets. Pertamina attributed this scarcity to groups that bought kerosene outside converted areas and sold it in converted areas. NGOs eventually supported the programme after concluding they could contribute to its benefits by supporting community socialisation.

To minimise these and other negative impacts and risks, the current fuel (in Indonesia's case kerosene) should initially be withdrawn gradually but then rapidly to limit the period of consumer pain. A monitoring centre should be created to mitigate risks and provide the consumer with contact points to solve issues that may appear.

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CASE STUDY SIX

SOUTH AFRICA NORTHWEST PROVINCE BEHAVIOUR CHANGE STUDY: UNIVERSITY OF WITWATERSRAND

Lead organisation	University of the Witwatersrand
Partner organisation(s)	Manoff Group; South African Medical Research Council
Country and province/state	South Africa
Budget and funding sources	ZAR 250,000 (USD25,000): USAID and SAMRC
Dates of intervention	2003 – 2004
Target population/ market segments:	Two groups (intervention and control) of 30 households from two poor rural villages, Madibe Makgabane and Tsunyane, in North West Province of South Africa.
Technology used	Used existing stoves and fuels. No technology was introduced in this programme.
Activities and Behaviour Change Technique(s)	Community Health Communicators held two face-to-face meetings with households to provide education on health impacts of stove smoke and to discuss recommended behaviour change techniques to adopt. BCTs used: Shaping knowledge Comparisons Social support Goals, planning and monitoring
Results	Investigative not programmatic <ul style="list-style-type: none"> ■ Median PM reduced by 85% ■ Median CO reduced by 69% ■ Child CO exposure reduced by 34%

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SCORECARD	
Criterion	Score
1. Behaviour focus	★★★★
2. Target population	★★★★
3. Barriers and benefits	★★★☆☆
4. Methods	★★☆☆
5. Capacity Building	★★★★
6. Behaviour change results (2.67/3)	★★★★
7. Outcomes	★★★★
8. Impact	☆☆☆☆
Total score (% of max 22)	80.3%

Background and context

The programme aimed to determine the effectiveness of low-cost behaviour change techniques on reducing indoor air pollution caused by cook stoves in rural South African communities. Technology solutions, such as improved efficiency stoves, have often been cost-prohibitive in these poor communities. The researchers targeted two groups in rural South Africa over a 12-month period to see which behaviour change techniques could be linked to improved indoor air quality levels. The villages were chosen because they were far enough away from urban areas to not be affected by urban air pollution and because they were considered to be socio-demographically similar. The villages were chosen far enough apart to minimise 'message contamination' between the villages.

Overview of intervention

The intervention sought to evaluate the effectiveness of low-cost community counselling interventions on reducing indoor air pollution from stoves in rural South Africa.

Intervention Type	Target Outcome(s)	Target Impact(s)
Promoting awareness of and facilitating enhanced household management practices.	Leave at least 2 points of ventilation open if burning indoors, especially upon ignition and when adding more fuel	Health: Reduced smoke in the house Health: Significant improvement on indoor air pollution levels
	Eliminate indoor air pollution from burning fuel by only using outdoor stoves or burning areas	Health: minimise young children's exposure to indoor air pollution.
	Children kept in another room or out of the house entirely, especially during periods of increased smoke, such as during ignition or when adding more fuel	

Key actors

Researchers conducted a formative research phase before collecting baseline and 12-month follow-up data on behaviour change and indoor air pollution levels in households. Health Communicators conducted information sessions with primary caregivers and family members at start of the programme. The Chief and leaders of the village hosted the first presentation session to the community. They agreed to put the burning of fuels and indoor air pollution issue as an agenda item in community meetings. Primary caregivers were the key point of contact with researchers and person holding the greatest influence on implementation of behaviour change techniques in the households. Family members were important stakeholders during the consultation and information sharing process.

Budget overview

Phases 1 and 2 were co-funded by USAID (through the Manoff Group). Phases 3 and 4 were funded by the South African Medical Research Council.

Activities, including technologies used

Phase 1 featured formative research to identify potential behaviours. Phase 2 involved research to test the recommended behaviours. Phase 3 was the intervention study of 30 households with a control group. Phase 4 was the qualitative research to understand what happened in both comparison and intervention group. The intervention focused on facilitating behaviour change and did not introduce new technologies. It used the following activities:

- **Baseline Air Quality Measures:** Baseline indoor air pollution data was collected before introducing the intervention to the community.
- **Community Presentation:** The intervention began with a presentation at a special community meeting attended by approximately fifty households and hosted at the chief's homestead.
- **Face-to-Face Outreach:** The promoted behaviour change techniques were disseminated through face-to-face interaction between trained communicators and the intervention group's households. The communication strategy was based on a Trials of Improved Practices (TIPs) methodology (Dicken and Griffiths, 1997). In a first meeting, a trained health communicator spoke to the primary caregiver and the family about the health impacts of exposure to indoor air pollution. This was followed by a discussion and information sharing session about the particular household's current indoor air pollution levels (as determined by the baseline data collection), current household behaviours and potential changes to these behaviours. During the 60-90 minute session, households were encouraged to implement the three previously mentioned BCTs.
- **Follow-Up Outreach:** One week later, the trained communicators paid a 'reminder visit' (lasting 30 to 60 minutes) to the households to see how they were coping and to encourage them to continue with their agreed behaviours.
- **12-Month Air Quality Measures:** Twelve months later, researchers returned to the households to conduct follow up data collection of the indoor air pollution levels.

Activity	BCT(s)	Target Population	Target outcome(s)	Time frame	Content	Channel
Presentation Meeting to kick off Intervention	Social Support	Community	Increased local capacity (skills and tools): Gain community support of the programme.	Held at the start of intervention, as a “kick off” meeting	Presentation about the intervention	Community Meeting/ Presentation in the chief’s home attended by about 50 households
Education session on health	Shaping Knowledge	Primary caretaker and family of households within intervention group	Increased local capacity (skills and tools): Inform households on the dangers of stove smoke to their children’s health	After baseline indoor air pollution measures had been taken		Face-to-face meeting with a health communicator
Information Sharing session at the home	Comparisons	Primary caretaker and family of households	Increased local capacity (skills and tools): information about indoor air pollution; discuss and choose from recommended ICSs	After baseline indoor air pollution measures had been taken		Face-to-face meeting with a health communicator
Follow-Up Outreach visits	Goals, planning and monitoring	Primary caretaker and family of households	Monitor progress and remind population of their goals	One week after education sessions	Encourage them to continue with their agreed behaviours.	Trained communicators paid a ‘reminder visit’ (lasting 30 to 60 minutes) to the households.

Impacts

Both the control and the intervention group improved air quality between the first baseline measurements and the air measurements taken twelve months later. When disaggregated by indoor burning, the intervention group achieved much better results than the control group. Among the indoor burners, the median PM reduction was 85% in the intervention compared to 28% in the control group. The median CO reduction in the intervention group was 69% compared to 38% in the control group. Of particular importance was the fact that child CO exposure was reduced by 34% in the intervention group and remained the same among the control group. In spite of families being encouraged to burn only outdoors, researchers found that even homes that had an outdoor burning area still burned an indoor fire during the colder parts of the winter for heating – over two thirds of homes with outdoor burning areas burned an indoor fire during the winter.

Evaluations

The reports used for this case study was based on the team's measuring of behaviour change and evaluation of the outcomes after 12 months of implementation. This was supplemented with personal correspondence. As reported, the strengths of that study included that it used a before-after component to analyse the effectiveness of the intervention; used a similar control group; took into account seasonality (winter) when exposures were highest; built in a period of evaluation of twelve months or more; and measured child exposure in addition to atmospheric levels of air pollution.

Weaknesses included that the control group showed evidence of a possible Hawthorne Effect caused by the presence of the monitoring equipment. Also the sample size is relatively small which may affect the replicability of the results. While the methodology for measuring the effects of this community counselling approach to behaviour change is sound, it did not test or compare other types of activities using behaviour change techniques, eg. advertising, incentives or entertainment.

A55

RATING ON THE STRENGTH OF EVIDENCE:

Barnes et al (2011)

Barnes et al (2004)

RATING: HIGH

RATING: HIGH

Scorecard of behaviour change effectiveness

The project goals are based on behaviours relating to cooking outdoors, ventilation and child proximity to cooking. It uses a community counselling model and associated behaviour change techniques. The communication strategy was based on a Trials of Improved Practices (TIPs) methodology which appears similar to Bandura's concept of mastery modelling. The project focused on caregivers for children under 5 years as well as the family and community stakeholder influencing them. It implies an understanding of the problems that prevent change but does not address specific barriers or

competition other than current (old) behaviours. It features a mix of activities and BCTs as part of model but only one intervention type. Not changing the stove or fuel will mean reduced potential for impact and ability to scale. Training activities developed knowledge of target population but it is not clear whether the project built the capacity of local organisations or provided tools and other resources. The project monitored indoor air pollution indicators using standard tests and measured behaviour change. It was successful in outcome as it reduced indoor air pollution, including median PM by 85% and 34% for children under 5 years.

Conclusions

The study demonstrated that activities using behaviour change techniques can be effective in reducing exposure to indoor air pollution. However, as Barnes et al point out, while behaviour change techniques can have a positive impact in reducing indoor air pollution, studies of technical solutions (such as improved cook stoves and fuels) show greater improvements in indoor air quality. This intervention shows that the community counselling approach was successful in this context, however it is not yet known whether this could be as effectively applied to the full clean cooking value chain, including the production and dissemination of new stoves and fuels. It is also not yet clear whether it could be scaled up to provincial or national levels in South Africa or beyond. The combination of monitoring behaviour change as well as the HAP outcomes makes it very strong. Overall this project makes a useful contribution to the evidence base for the effectiveness of behaviour change approaches in clean cooking.

References

Barnes, B., Mathee, A., & Thomas, E. (2011). The impact of health behaviour change intervention on indoor air pollution indicators in the rural North West Province, South Africa. *Journal of Energy in Southern Africa*, 22(3).

Barnes, B. R., Mathee, A., Krieger, L., Shafritz, L., Favin, M., & Sherburne, L. (2004). Testing selected behaviors to reduce indoor air pollution exposure in young children. *Health Education Research*, 19(5), 543-550.

CASE STUDY SEVEN

STRATEGIES FOR IMPROVED COOKSTOVE ADOPTION IN RURAL UGANDA: IMPACT CARBON

Lead organisation	Impact Carbon
Partner organisation(s)	Sub-awardees: Haas School of Business at the University of California, Berkeley, the Centre for Integrated Research and Community Development (CIRCODU), Consultant partner: Berkeley Air Monitoring Group
Country and province/state	Rural areas of the Mbarara region of Uganda
Budget and funding sources	Approximately USD600,000 in order of contribution; USAID TRAction, Impact Carbon, Cornell University
Dates of intervention	2011 – 2013
Target population/ market segments:	98% of households in rural Uganda use solid fuel for cooking; 85% cook with wood (Uganda Bureau of Statistics and ICF International Inc. 2012) Almost all families cook on a traditional three-stone fire, usually located within an enclosed kitchen or cooking hut.
Technology used	Envirofit G3300: Wood burning rocket stove
Activities and Behaviour Change Technique(s)	A series of randomised control trials (RCTs) exploring the impact of BCTs on willingness to pay and stove uptake. Activities using BCTs included innovative financing solutions and marketing messages delivered via several channels. The BCTs used include: Shaping knowledge Comparisons Social support Goals, planning and monitoring
Results	Investigative not programmatic <ul style="list-style-type: none"> ■ No consistent evidence that information on product attributes improves people's WTP ■ Time payments increased WTP by 41% ■ Uptake of ICS rose to 57% with optimal contract; ■ Only 1% of households returned the stoves at the end of the free trial

A57

SCORECARD	
Criterion	Score
1. Behaviour focus	★★★★
2. Target population	★★★★
3. Barriers and benefits	★★★☆☆
4. Methods	★★★☆☆
5. Capacity Building	★★★☆☆
6. Behaviour change results	★★★★
7. Outcomes	★★★☆☆
8. Impact	☆☆☆☆
Total score (% of max 22)	81.8%

Background and context

Impact Carbon was awarded USAID TRAction Project funds in 2011 to conduct research on expanding the 'Uganda Efficient Stove Project', which has commercially sold thousands of improved charcoal stoves in Uganda. The study tested behaviour change communication (BCC) strategies to increase the purchase and use of improved, wood burning stoves in regions of Uganda where wood is the primary cooking fuel. The Mbarara region was selected after an extensive feasibility study - it had not had any district-wide stove projects in the previous three years, households reported a significant amount of time collecting fuel each week (10-20 hours/week per household), and a high (~90%) rate of households in rural areas (outside Mbarara's town centre) use wood for cooking fuel. Furthermore a large portion of cooking is carried out in an enclosed kitchen and thus the households were expected to benefit more from the emissions reductions of an improved cookstove than one which regularly cooked outdoors.

Overview of intervention

The main focus of the research was how to improve adoption of fuel-efficient cookstoves through behaviour change communications. Particular focus was placed on transitioning households from primarily utilizing their three-stone fire to usage of the fuel-efficient cookstove(s) for cooking.

Intervention Type	Target Outcome(s)	Target Impact(s)
Increase demand	Acquisition of technology	Health
Stimulate purchase	Use of technology	Environment
Promoting awareness	Air pollution	
	Household fuel consumption	

Key actors

The project team worked with a local stove distribution partner, UpEnergy, based in Kampala. The study team developed the marketing messages during a 6-month feasibility study. They then worked in conjunction with local governments, schools and health centres to support the messaging and educational initiatives. Local community members (focal point person) who had the trust and respect of the end users were hired to organise and gather participants for cooking demonstrations or product “road shows” as well as to be responsible for the collection of time payments. A small commission for each stove payment was paid to the focal point person to help motivate collection.

Budget overview

The project cost approximately USD600,000. This was collated through grants and donations from (in order of contribution) USAID TRAction, Impact Carbon and Cornell University. The stoves were sold at varying prices according to which study.

Activities, including technologies used

The stove disseminated as part of this research project was the Envirofit G3300 wood burning rocket stove, chosen from a group of four modified cook stoves by local women during a feasibility study. Approximately 1,000 stoves were purchased from UpEnergy in Kampala. The stoves were stored locally and then depending on the study either sold at a central meeting point in the village during a cooking demonstration or at a focal point person’s house.

Four RCTs were carried out to test: (1) Do marketing messages, liquidity constraints, and household bargaining effect willingness to pay for a more efficient stove in rural Uganda; (2) Can different sales offers (e.g., free trial, time payments and the right to return) increases willingness to pay and uptake; (3) What effects does ownership of an efficient stove have on the use of old and new stoves, fuel use, and indoor air pollution from kitchen level concentrations of particulate matter¹⁰ and (4) What role do peer effects play in adoption of non-traditional cookstoves?.

A59

Activity	BCT(s)	Target Population	Target outcome(s)	Time frame	Content	Channel
Effect of marketing messages and time payments on willingness to pay research study	Shaping knowledge Social support Goals planning and monitoring	36 parishes in rural Uganda (n=2297 participants)	Acquisition of technology (stove, fuel, hoods and chimneys)	January – March 2012	Marketing messages allocated to 4 different groups: 1. Health; 2. Money and timesaving's; 3. All messages; 4. Control group with no message ¹¹ . 'Vickery second-price auction' ¹² Two payment schemes 1. Pay within a week of the auction (47 carried out) 2. Pay the second highest bid for the stove in four equal weekly installments (45 of these carried out). Both require a 25% deposit at time of auction.	Focal point person in each parish. Live cooking demonstrations
Innovative financing programs	Reward and threat Goals, planning and monitoring Social support Shaping knowledge	10 parishes in Mbarara received traditional sales offer (n=412) and 14 received novel sales offer (n=720).	Acquisition of technology (stove, fuel, hoods and chimneys)	March – June, 2012	Marketing messages [same as described above]. Free trial of stove followed by rent-to-own and right to return.	Recruitment of potential customers by Local Community Development Officer, a quasi-governmental official and Focal point person in each parish. Sales meeting where the ICS and the appropriate sales offer were presented.

¹¹ Both the health and time/money saving messages used a combination of photos and information in the words of a local woman who had trialled the Envirofit G3300 in her home. Some photos were purposely hard hitting such as a baby smoking a cigarette. The marketing message related to health includes: "Smoke from the cookfire is poison. It makes you feel light-headed or dizzy, makes you cough, and can cause sore eyes or a sore throat from the smoke. Smoke from cookstoves causes serious diseases including pneumonia and bronchitis. These diseases from cookstove smoke caused as many child deaths in Uganda as malaria. Prior market assessment had shown that health and money saving messages were more motivating than aspirational messages. The marketing message related to time and money savings cited reported fuel savings from a local family who bought fuel and trialled the G3300 cookstove.

¹² In a Vickery second-price auction, participants submit sealed bids for a product, and the highest bidder wins the auction and pays the second-highest bid.

Impacts

These research projects had investigative rather than programmatic aims. The results from the studies are described below.

Evaluations

Four RCTs were carried out. At the time of reporting data was available for two:

1. What marketing messages are effective at increasing willingness to pay for a more efficient stove in rural Uganda.

Carried out in 36 parishes in rural Uganda, the study tests three potential factors affecting willingness to pay (WTP). First, the team conducted a RCT using a crossed (or orthogonal) method to test whether two marketing messages increase WTP for a new cookstove. Second, using a within-subjects comparison, the effect of time payments on WTP was tested. Third, motivated by a model of intra-household decision-making, a correlation study was conducted to test the effect on WTP of being female, indicators of intra-household decision making, and earning a stable income.

Results

A61

There is no consistent evidence that information on product attributes, including those related to health and time/money savings, improves WTP.

Adding time payments significantly increases WTP (by 41% compared to 'pay within a week scheme'). Each additional asset owned (e.g., TV, mobile phone) predicted 10% higher WTP. Having a stable income predicted 8-10% higher WTP for both men and women participants, although this effect does not occur in married women. There are large gender differences, on average men are willing to pay 21-23% more than women. Given evidence of lower purchasing power of women, future stove projects should consider promoting stoves with features valued highly by men.

2. What sales offers (e.g., free trial, time payments and the right to return) increases willingness to pay and uptake.

Possible explanations of poor ICS uptake are present bias, liquidity constraints, and poor information on fuel savings and stove durability. The RCT aimed to establish if these barriers to stove purchase could be overcome with the following benefits offered:

1. **Free Trial:** to address the barrier of imperfect information about energy savings;
2. **Time Payments:** at the end of the free trial, they could return the stove with no obligation or, if they liked the stove, they could purchase it with four even weekly payments. This aimed to address liquidity constraints and present bias;
3. **Right to stop time payments and return product at any point during time payments,** which addresses the barrier of imperfect information on product durability.

The RCT was carried out in 24 rural parishes of the Mbarara region (est. population coverage 120,000–151,000). 10 parishes were randomly selected to receive the traditional sales offer (pay within the week) and 14 to receive the optimal contract. With the assistance of the local Community Development Officer, a quasi-governmental official, a local focal point person was recruited in each parish. This focal point person then motivated people to attend a sales meeting where the ICS and the appropriate sales offer were presented.

Results

Uptake of an efficient wood-burning stove was 5% with the traditional offer (after participants were given one week to raise funds), and rose to 57% with the optimal contract. The success of the optimal contract depends on the stoves being appealing to consumers. If return rates of novel offer stoves are a good proxy for the stoves' appeal, then the small percentage of households returning the stoves at the end of the free trial (1%) suggests that the stoves were well suited to their customers' needs. As the free trials were presented at a community demonstration it possible that social influence led to a higher uptake.

RATING ON THE STRENGTH OF EVIDENCE:

Levine et al (2014)

RATING: HIGH

Scorecard of behaviour change effectiveness

The project included activities that used BCTs such as shaping knowledge through cooking demonstrations; social support by employing local respected focal point persons; and rewards plus goals and planning, which involved innovative financing schemes to promote the purchase of ICS.

A detailed feasibility study used mixed methods to gain a comprehensive understanding of the target populations prior to undertaking any BC intervention. The innovative timed payment and free trial recognises and works to address liquidity constraints and suspicion of a new product as barriers to ICS uptake. Marketing demonstrations augmented with innovative financing options were used to increase demand and then facilitate uptake. These demonstrations and sales meetings built capacity by involving local organisations, including the local Community Development Officer, a quasi-governmental official, and the focal point person in each parish.

Outcomes included a significant increase in WTP (41% compared to 'pay within a week scheme') and a sales offer that includes time payments, free trial and right to return led to a 57% of those exposed to the intervention purchasing the stove compared to a 5% rate in those receiving a traditional sales offer.

Conclusions

This was a well-planned and executed series of RCTs aiming to establish the impact of BCTs on stove uptake and use. Unfortunately the data on usage and subsequent impact on HAP and fuel consumption were not available at time of reporting but the data related to interventions aiming to address barriers to uptake is robust and serves to provide guidance for practice in the field.

A63

While the design of each RCT ensured that the team was able to control for many variables there are still some questions that require consideration. For example, as they were not given priority by the early focus groups it is not known whether marketing activities using more emotional messages e.g. those based on social desirability or shame may have resonated more with the target population rather than the messages tested (health benefits/time and money savings). Similarly, the innovative financing may have been also been successful because of the presentation in a group setting, bringing into play 'social norming' effects. Overall the results presented provide a solid contribution to understand the effects of behaviour change approaches in clean cooking interventions.

References

Levine D., Beltramo, T., Blalock, G., (2014), *The Effect of Marketing Messages, Liquidity Constraints, and Household Bargaining on Willingness to Pay for a Nontraditional Cookstove*. CEAGA Working Paper Series No. WPS-035. Centre for Effective Global Action. University of California, Berkeley.

APPENDIX E

SCORECARD OF BEHAVIOUR CHANGE EFFECTIVENESS

Note: The criteria were drawn from existing scorecards and frameworks.^[18, 22, 23] Each case study will include a score based on eight (8) criteria with multiple questions. Each question is worth one (1) point for a maximum possible total of 22 points. The reviewer answered each of the questions for each of the 8 criteria with a simple yes or no response and provided notes. The subtotals were then tallied using those responses. For example, if one criterion has three related questions and an intervention scores two answers of 'yes' and one of 'no', the sub-total for that criterion would be 2/3. The total score from a possible maximum of 22 was then converted to a percentage.

Scorecard of Behaviour Change Effectiveness								
Criterion	Question 1	Y/N	Question 2	Y/N	Question 3	Y/N	Score	Notes
1. Behaviour focus	Does the intervention have specific behaviour change goals?		Does it use behaviour change theory and/or models?		Does it use behaviour change techniques?		/3	
2. Target population	Does it demonstrate a robust understanding of the target population?		Is it based on market, behavioural and consumer research, including segmentation?		Does it combine data from different sources?		/3	
3. Barriers and benefits	Does it incorporate an understanding of what the person has to give/do to get the benefits proposed?		Does it take account of, and resolve, problems that prevent people changing their behaviour?		Does it incorporate an understanding of what competes for the time and attention of the target population?		/3	
4. Methods	Does it use a mix of intervention types (e.g. increasing demand, expanding distribution)?		Does it use a mix of activities to deliver the BCT(s)?				/2	
5. Capacity Building	Does it build the skills, resources and capabilities of the target population?		Does it build the skills, resources and capabilities of local organisations, agencies and implementers?		Does it include development of tools and other resources?		/3	
6. Behaviour change results	Did the project measure % of behaviour change attributable to this intervention?		No change/negative: (0 points) <10% change (1/3 point) 10-20% change (2/3 point) >20% change (1 point)		Does it include a mix of methods to measure behaviour change?		/3	
7. Outcomes	Did the project measure % of change in outcomes attributable to this intervention?		No change/negative: (0 points) <10% change (1/3 point) 10-20% change (2/3 point) >20% change (1 point)		Does this intervention include standardised tests (e.g. HAP monitoring and/or temperature sensor monitoring)?		/3	
8. Impact	Did the intervention report on the impacts (e.g. health, economic, environmental)?		Were the impacts positive?				/2	
Total score							/22 %	

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APPENDIX F

CASE STUDY STRENGTH OF EVIDENCE ASSESSMENT

Title of study/paper	Lead Organisation	Reviewer's initials

Principles of quality	Associated principles	YES/ NO/ CAN'T TELL	Comments
Conceptual framing	Does the study acknowledge existing research?		
	Does the study construct a conceptual framework?		
	Does the study pose a research question?		
	Does the study outline a hypothesis?		
Openness and Transparency	Does the study present or link to the raw data it analyses?		
	Does the author recognise limitations/weaknesses in their work?		
Appropriateness and rigour	Does the study identify a research design?		
	Does the study identify a research method?		
	Does the study demonstrate why the chosen design and method are appropriate ways to explore the research question?		
Validity	Has the study demonstrated measurement validity?		
	Is the study internally valid?		
	Is the study externally valid?		
Reliability	Has the study demonstrated measurement reliability?		
	Has the study demonstrated that its selected analytical techniques are valid?		
Cogency	Does the author 'signpost' the reader throughout?		
	Are the conclusions clearly based on the study's results?		
Reviewer's notes			

A66

Study quality	Definition	Requirements	Score [tick one]
High	Demonstrates adherence to principles of appropriateness/rigour, validity and reliability; likely to demonstrate principles of conceptual framing, openness/ transparency and cogency	Has 9 or more 'yes' responses to the key 'shaded' questions	✓ (?)
Moderate	Some deficiencies in appropriateness/ rigour, validity and/or reliability, or difficulty in determining these; may or may not demonstrate principles of conceptual framing, openness/ transparency and cogency	Has 8-5 'yes' responses to the key 'shaded' questions	✓ (?)
Low	Major and/or numerous deficiencies in appropriateness/rigor, validity and reliability; may/may not demonstrate principles of conceptual framing, openness/ transparency and cogency	Has 4 or less 'yes' responses to the key 'shaded' questions	✓ (?)

Notes to consider when completing strength of evidence assessment ^[47]

The following principles are features required for a study to be considered of a high quality. They may be covered explicitly or implicitly by the author of a single study.

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1. Conceptual framing

High quality studies acknowledge existing research or theory, and make clear how the current/new analysis sits within the context of existing work. They typically construct a conceptual or theoretical framework, which shows how a researcher thinks about an issue, and lays bare their major assumptions. High quality studies pose specific research questions or hypotheses to which the research seeks to respond.

2. Openness and transparency:

High quality studies should be transparent about the design and methods that have been employed, and the data that has been gathered and analysed. This allows for the study results to be reproduced by other researchers, or modified with alternative formulations.

As such, failure to disclose the data and code on which analysis is based raises major questions over the credibility of the research. An important sign of quality is whether the author is being self-critical and open about limitations and alternative interpretations. Pointing out inconsistencies with other results helps put the study in its proper context. There is also the question of independence: a study paid for and/or conducted by an aid agency might be perceived as less independent than a study conducted by a third party: ideally, a high quality study will be explicit about how it was funded.

3. Appropriateness and rigour

What it means: This refers to the appropriateness of the design and methods to the research question and its rigorous application. There are two main types of (see above), and many types of methods. None is necessarily 'better' or 'worse', but some designs and methods are certainly more appropriate for use in specific settings or for responding to particular types of research question than others. Typically, experimental research designs tend to be more appropriate for identifying, with confidence, the presence of causal linkages between observable phenomena. However, if the methods are improperly applied, it is possible for experimental studies to be of a low quality. The diverse array of observational (or 'non-experimental' designs) may be more appropriate for contexts and phenomena which cannot easily be explored through experimental designs, such as exploring the mechanisms behind a causal linkage, or for deepening understanding of people and behaviours that lie at the heart of most development processes. Crucially, using an inappropriate method to tackle a question in a particular context is unlikely to yield credible or useful results.

How to assess appropriateness and rigour: The reader of the single study should try to identify the specific question that the paper's author is trying to address. Is it about identifying causation? Is it about quantification of a trend, or about the meaning and implications of a trend? Is the research based on developing a conceptual model and then confronting that model with the data? Answering such queries is a good starting point in determining whether or not the research design and methods employed were appropriate for the study question and the context.

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4. Validity

If a study is valid it measured accurately what it planned to measure. The validity of a measurement tool (for example, a test in education) is considered to be the degree to which the tool measures what it claims to measure.

What it means: There are several types of scientific validity. Three of the most important are covered here.

Measurement Validity: During the data collection phase of a study, a researcher may set out to measure or interrogate a particular concept. S/he typically selects a particular indicator to do so (e.g. metres as an indicator to measure distance). 'Measurement validity' describes whether or not the indicator is well suited to measure the concept in question. For example, if a study wants to measure individual welfare, it has to choose a valid indicator of 'welfare'. Family income, individual health, or individual happiness might be valid indicators, but, in contrast, the value of national exports would be much less satisfactory.

Internal Validity: Some studies (typically experimental and quasi-experimental designs) seek to demonstrate that the emergence of one factor is attributable to (i.e. causing) another. For example, a study may show that rich people tend to live in expensive neighbourhoods. But are they rich because they live in a wealthy neighbourhood, or is the causal relationship working the other way round? Assessing the 'internal validity' of a

study means evaluating whether or not the technique that the study uses to explore such causal chains is satisfactory. If the design doesn't take account of 'unseen' (sometimes called 'confounding') factors that might be causing a particular phenomenon, then the study may over- or under-estimate the importance of a particular issue as a cause of an observed outcome or behaviour.

External Validity: This describes the extent to which the findings of a study are likely to be replicable across multiple contexts: can they be generalised?

How to assess validity: In the case of measurement validity, it is important to repeatedly consider whether or not the indicator chosen fully captures the concept being measured. Are there other dimensions of the central concept that are being ignored? In the more complex case of internal validity, a starting point is to try to think of other possible causal mechanisms that the researcher has not acknowledged. In the case of external validity, the reviewer needs to consider whether the case or context being studied is highly particular, or is 'generalisable' to multiple settings.

5. Reliability

What it means: Reliability usually means one of two things. First, the reliability of a measurement means that not only is the right 'thing' being measured but also that it is being measured consistently and accurately. Second, the reliability of an analytical technique means that during the processing or use of data, the analysis is likely to produce consistent results when repeated multiple times.

A69

An unreliable measurement instrument could potentially undermine an entire study. 'Birth weight' might be the right thing to measure in a piece of research, but if not measured accurately, the study is flawed. The reliability of an analytical technique boosts the robustness of a study. If a different result were produced every time the same data was processed with the same technique, the study would not be reliable.

How to assess reliability: Consider the instrument or indicator being used for measuring the concept. Some indicators (like corruption 'scores' based on 'expert judgement') may be particularly prone to unreliability or bias. When assessing the reliability of analytical techniques, consider how any weaknesses in the technique might bias the findings of a study, or mean that different results could be produced.

6. Cogency

What it means: A high quality study will provide a clear, logical argumentative thread that runs through the entire paper. This will link the conceptual (theoretical) framework to the data and analysis, and, in turn, to the conclusions. High quality studies will avoid making claims in their conclusions that are not clearly backed up by the data and findings.

How to assess cogency: If the principles of good reporting have been followed, the author of a high quality study should 'signpost' the reader through the various sections of the study. Try to consider whether or not you would have written the same conclusion or executive summary for the study based on the analysis and results it presents.

APPENDIX G

FULL LIST OF INTERVENTIONS*

A70

Title of Intervention	Lead Implementer(s)	Partners/Advisors	Funder(s)	Dates	Country
BCSIR: Improved Cookstove Program	BCSIR - Bangladesh Council of Scientific and Industrial Research	Bangladesh Ansar and Village Defense Party (Ansar-VDP); Bangladesh Rural Development Board	Bangladesh Government	1988 – 2001	Bangladesh
BCSIR/LGED Biogas Plant Program	Bangladesh Council of Scientific and Industrial Research (BCSIR); Local Government Engineering Department (LGED)	Union Parishads; Bangladesh Department of Agricultural Extension; Bangladesh Department of Livestock Services	Bangladesh Government; Global Environment Facility	1988 – 2005	Bangladesh
National Domestic Biogas/Manure Program	Bangladesh Government through the Infrastructure Development Company (IDCOL); Kreditanstalt fur Wiederaufbau (KfW); Netherlands Development Organisation (SNV)	23 partner organisations, including construction, lending and manufacturing partners	Kreditanstalt fur Wiederaufbau (KfW); Netherlands Development Organisation (SNV)	2006 –	Bangladesh
Sustainable Energy for Development Program (SED)	Bangladesh Ministry of Power, Energy and Mineral Resources; German GIZ	Over 200 partner NGO organisations and micro-enterprises	Deutsche Gesellschaft fur Internationale Zusammenarbeit GmbH (GIZ)	2004 – 2010	Bangladesh
Demand Experiments on Improved Cookstoves in Bangladesh	Center for Economic Policy Research (CEPR); the Department for International Development/ London School of Economics/University of Oxford International Growth Centre (IGC); National Bureau of Economic Research (NBER); Stanford Medical School; Yale School of Management	BRAC	National Institute of Child Health and Human Development; National Science Foundation; DFID/LSE/ Oxford International Growth Centre; Woods Institute for Environment; Stanford University; Yale University	2008 – 2009	Bangladesh
Indoor Air Pollution Reduction Program	Winrock International; Village Education Resource Center (VERC); Concern Worldwide Bangladesh (Concern)	Appropriate Rural Technology Institute (ARTI), India	USAID	2005 – 2007	Bangladesh
New Lao Stove: an improved cookstove for improved lives	GERES, Cambodia	Cambodian Ministry of Energy, Mines and Industry; RWEDP programme, FAO	European Commission	2002 – 2009	Cambodia

Table continued on the next page...

Title of Intervention	Lead Implementer(s)	Partners/Advisors	Funder(s)	Dates	Country
World Bank/ Government of China Indoor Air Pollution program	Government of China	World Bank	World Bank/Government of China	2002 – 2006	China
Health education to children and heads of households on health risks of arsenic exposure in food dried over coal fires	Guizhou Centers for Disease Control	UNICEF	Government of China	2005 –	China
National Improved Stove Program (NISP)	Chinese Ministry of Agriculture's Department of Environmental Protection through County Regional Energy Offices (CREOs)		Government of China	1983 – late 1990s	China
UNDP-PPPUE Improving Supply Chain for Liquefied Petroleum Gas Access in the Tamale Metropolis	New Energy	Tamale Metropolitan Assembly; Tamale/Savelugu LPG User Association; UNDP Ghana Office, Accra; Ghana Ministries of Energy and Finance	UNDP	2005 – 07	Ghana
LPG Rural Energy Challenge	World Liquid Petroleum Gas Association (WLPGA) and UNDP		UNDP	2003 – 2006	China, Ghana, Honduras, Morocco, South Africa and Vietnam
Social Investment Fund/Fondo de Inversion Social (FIS) Program	Department of Baja Verapaz, Intervida (NGO); FIS (decentralised government agency); private manufacturers supply stove parts (plancha chimneys)			1996 – 2001	Guatemala
Intervida Program	Department of Baja Verapaz, Intervida (NGO); FIS (decentralised government agency); private manufacturers supply stove parts (plancha chimneys)			1999 – 2001	Guatemala
Tezulutlan Project	Department of Baja Verapaz, Intervida (NGO); FIS (decentralised government agency); private manufacturers supply stove parts (plancha chimneys)			1999 – 2005	Guatemala

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Table continued on the next page...

Title of Intervention	Lead Implementer(s)	Partners/Advisors	Funder(s)	Dates	Country
Randomized Exposure Study of Pollution Indoors and Respiratory Effects (RESPIRE)	University of California, Berkeley; University of Liverpool; Universidad del Valle, Guatemala; University of Bergen, Norway		National Institute of Environmental Health Sciences (NIEHS); WHO; AC Griffin Family Trust.	2002 – 2004	Guatemala
Mirak Improved Stove	Centre de Recherché en Development International (CRDI); World Bank; CARE Haiti; Bureau des Mines et de l'Energie (BME)			1983 – 2009	Haiti
Deepam Scheme to promote liquefied petroleum gas (LPG) connections	Development of Women and Children in Urban Areas; Van Samrakshan Saniti (Forest Protection Committee).	Andhra Pradesh State Civil Supplies Corporation (APCSC); District Rural Development Agencies (DRDAs)	Government of Andhra Pradesh	1999 – 2002	India
National Programme on Improved Chulhas (Andhra Pradesh)	Non-conventional energy Development Corporation of Andhra Pradesh (NEDCAP); Khadi & Village Industries Commission (KVIC)	Regional Engineering College, Warangal; Indira Awaz Yojana	Government of India	1983 –	India
National Programme on Improved Chulhas (Gujarat)	The programme was first implemented in Gujarat by the Forest Department (1983-1988), and subsequently by the Rural Development Agency	Gujarat Energy Development Agency (GEDA); Khadi and Village Industries Commission (KVIC); National Dairy Development Board; All India Women's Conference; MS University Baroda	Government of India	1983 –	India
National Programme on Improved Chulhas (Haryana)	Haryana Department of Women and Children through a network of over 7,000 mahila mandal women's groups	Energy Research Centre, Punjab University	Government of India	1983 –	India
National Programme on Improved Chulhas (Karnataka)	Department of Rural Development and Panchayat Raj; Indira Awaz Yojana and Swacha Grama schemes.	Karnataka State Council and Technology	Government of India	1983 –	India
National Programme on Improved Chulhas (Maharashtra)	Rural Development and Water Conservation Department; Maharashtra Energy Development Agency; Khadi & Village Industries Commission (KVIC)	Appropriate Rural Technology Institute, Pune	Government of India	1983 –	India
National Programme on Improved Chulhas (West Bengal)	Social Welfare Department and the West Bengal Renewable Energy Development Agency; Khadi & Village Industries Commission (KVIC). A network of over 150 NGOs.	Kalyani University	Government of India	1983 –	India

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Title of Intervention	Lead Implementer(s)	Partners/Advisors	Funder(s)	Dates	Country
Gosaba Rural Electrification Project	West Bengal Renewable Energy Development Agency (WBREDA); Indian Ministry of Non-conventional Energy Sources (MNES); Sunderban Development Department, Forest Department and South 24 Parganas Zilla Parishad		MNES (75%); State of West Bengal (25%)	1997 –	India
HPGAS Rasoi (community kitchens)	Hindustan Petroleum Corporation		Private company: Government of India Enetrprise	1998 – current	India
Room to Breathe (RtB)	Shell Foundation; Envirofit, First Energy and SELCO	Grameen Koota (GK) microfinance institution; Department of Rural Development and Panchayati Raj; Minister of Social Welfare, Karnataka; Deputy Commissioner, Shimoga District; CEO Zilla Parishad, Shimoga District	Shell Foundation	2008 – 2012	India
National Biomass Cookstoves Initiative (NBCI)	Ministry of New and Renewable Energy (MNRE)	Indian Institute of Technology, New Delhi Institute of Minerals & Materials Technology(IMMT) Maharana Pratap University of Agriculture & Technology	MNRE	2009 –	India
National Project on Biogas Development (NPBD)	Ministry of Non-conventional Energy Sources (MNES) through State Nodal Departments and Agencies (such as the Department of Rural Development, Agriculture, Science & Technology); Khadi & Village Industries Commission (KVIC); the National Dairy Development Board (NDDB).	9 technical institutes based in agricultural universities; Reserve Bank of India (RBI); National Bank for Agriculture and Rural Development (NABARD)	Government of India and individual states	Launched in 1981 - programme evaluation in 2002	India
Commercial Kitchen Improved Cookstove Initiative	Sustaintech India Private Limited (SIPL); Technology Informatic Design Endeavour (TIDE)			2007 –	India

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Title of Intervention	Lead Implementer(s)	Partners/Advisors	Funder(s)	Dates	Country
Strategies for Improved Cookstove Adoption in India	Duke University	The Energy and Resources Institute (TERI), India Central Himalayan Rural Action Group (Chirag), India Nexleaf Analytics, Los Angeles, CA Scripps Institution of Oceanography, San Diego, CA	TRAction/USAID	2011 – ongoing	India
Indonesia Domestic Biogas Program (IDBP), known locally as the BIRU (Biogas Rumah) program	Government of Indonesia; the Humanist Institute for Development Cooperation (HIVOS) (Program Manager)	Netherlands International Development Organisation (SNV)	Dutch Government	2009 – 2013	Indonesia
Indonesia Clean Stove Initiative (CSI), part of the East Asia Pacific Clean Stove Initiative	World Bank	Global Alliance for Clean Cookstoves (GACC)	AusAID; World Bank Asia Sustainable and Alternative Energy Program (ASTAE)	2012 – 2030	Indonesia
Indonesian kerosene to LPG conversion	Pertamina			2007 – 2012	Indonesia
Energising Development Kenya	EnDev	Ministry of Energy / Ministry of Agriculture / Ministry of Education / NGOs / Private Sector Players / Church Organisations	German-Dutch-Norwegian Energy Partnership programme, Energising Development (EnDev).	2005 - 2012	Kenya
Kenya Lou pilot cookstove improvement project	Centers for Disease Control and Prevention, Kenya Medical Research Institute	Safe Water and AIDS Program (SWAP)		July 2008–March 2009	Kenya
Smoke Project	Intermediate Technology Development Group (ITDG)	Liverpool University (UK) University of Nairobi (Kenya)	DFID; WHO; GlaxoSmithKline; Veta Bailey Charitable Trust; Ajahma Charitable Trust; Emerging Markets	1998-2001	Kenya

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Title of Intervention	Lead Implementer(s)	Partners/Advisors	Funder(s)	Dates	Country
Clean Stove Initiative (CSI) for Laos PDR	World Bank	Ministry of Energy and Mines (MEM); Ministries of Agriculture and Forestry, Science and Technology, Health, Finance, Industry and Commerce, Natural Resources and Environment, and Information, Culture, and Tourism; National University of Laos; and Lao Women's Union.	AusAID	2013-	Laos
Patsari Stove Project	Interdisciplinary Group for Appropriate Rural Technology (GIRA) and Center for Ecosystems Research (CIEco), Autonomous University of Mexico (UNAM); University of California, Berkeley		Shell Foundation in collaboration with the Institute of Engineering at UNAM and the Mexican Government	2003-2006	Mexico
Improved Space Heating Stoves Program	Mongolian Ministry of Nature and Environment; World Bank, Energy Sector Management Assistance Program (ESMAP)	Mongolian Women's Federation Mon San Co.	Golden Development Fund (XAC)	2003-2007	Mongolia
The Nepal Biogas Support Programme	Initiated by the Netherlands Development Organisation (SNV)	Government of Nepal, DGIS, KfW, the Agricultural Development Bank of Nepal (ADB/N); SNV; Gobar Gas Company		1992 - 2003	Nepal
Energy Sector Assistance Program	Nepalese Government through the Alternative Energy Promotion Center (AEPC); Energy Sector Assistance Program (ESAP)	Coordinated by local government	The Nepalese, Danish and Dutch Governments provided funding of roughly \$60 million.	1999-2012	Nepal
Healthy Hoods Project	Practical Action	Bosch and Siemens Home Appliances Group (BSH); Bundeswehr University, Munich; central and local government in Nepal.	Practical Action	2011-2013	Nepal
Pilot Commercialization of Improved Cookstoves in Nicaragua	The Energy Sector Management Assistance Program (ESMAP) (a global technical assistance partnership administered by the World Bank and sponsored by bi-lateral official donors)	Comision Nacional de Energia (CNE); PROLEÑA; Center for Entrepreneurship in International Health and Development School of Public Health University of California, Berkeley	World Bank and donors from Belgium, Canada, Denmark, Finland, France, Germany, the Netherlands, Norway, Sweden, Switzerland, and the United Kingdom.	2002	Nicaragua

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Title of Intervention	Lead Implementer(s)	Partners/Advisors	Funder(s)	Dates	Country
Peru Healthy Kitchen/ Healthy Stove	Winrock International; Centro de Ecología y Género (Centro ECO)		USAID	2003-2007	Peru
Study Testing Selected Behaviours to Reduce Indoor Air Pollution Exposure in Young Children	Medical Research Council of South Africa; Academy for Educational Development; Manoff Group		USAID CHANGE Project; AED with the Manoff Group.	Winter 2002	South Africa
Community Counselling in Rural South Africa	University of the Witwatersrand	Medical Research Council of South Africa		2005-7	South Africa
LPG Exchange and Subsidy Programme	Eskom, state utility company	Department of Minerals and Energy (DME); Liquid Petroleum Gas Safety Association of Southern Africa (LPGASA)	Eskom	2006	South Africa
Anagi Improved Cook Stove Program	Ceylon Electricity Board (CEB); Ceylon Institute of Scientific and Industrial Research (CISIR); Industrial Development Board (IDB); Integrated Development Organisation (IDEA); Intermediate Technology Development Group (ITDG); National Engineering Research and Development Centre (NERD); Overseas Development Administration, now DFID (ODA)		Phase I: ODA, Novid (Netherlands), Helvetas (Switzerland), Vita and ATI (USA), Dian Desa (Indonesia) and Gandhiniketan (India). Phase II: Ministry of Power and Energy and the Netherlands Directorate-General of Development Cooperation (DGIS). Phase III: CEB, ODA, the Ministry of Power and Energy. Phase IV: IDEA, Asia Regional Cookstove Project (ARECOP) and UNDP.	1972 - 2005. The four phases were: Design and testing (1972-1983); Promotion and Dissemination (1985-1990) through the National Fuel-wood Conservation Project; Commercialisation (1987-1996) through the Urban Stoves Project and the Rural Stoves Marketing Project; Diversification and reaching the poor (1996-2005)	Sri Lanka
Carbon Clear's Clean Cookstoves Project	Carbon Clear and World LP Gas Association	Practical Action, WDAN (Women Development Association Network) Nile Petroleum	Registered carbon credit program	Ongoing	Sudan

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Title of Intervention	Lead Implementer(s)	Partners/Advisors	Funder(s)	Dates	Country
LPG Stove Scale-up	Practical Action	Women Development Associations developed by Practical Action to train women in various aspects of entrepreneurship	Department for International Development (DFID), the WHO and several smaller trusts and donors.		Sudan
Ugandan Energy Saving Stove Project	Gesellschaft für Technische Zusammenarbeit/ German Federal Ministry for Economic Development and Cooperation (GTZ)	Ugandan Ministry of Energy and Mineral Development; NGOs involved in implementation, community mobilisation, awareness raising, trainings, and monitoring. Makerere University in Kampala (technical backup).	Co-financed by the Dutch government and part of the wider Ugandan-German "Promotion of Renewable Energy and Energy Efficiency Programme" (PREEEP)	1999-2008: Phase I (1999-2004), Phase II (2005-2008)	Uganda
Strategies for Improved Cookstove Adoption in Rural Uganda	Impact Carbon	Haas School of Business at the University of California, Berkeley; Centre for Integrated Research and Community Development (CIRCODU), Uganda; Global Village Energy Partnership (GVEP), Uganda	TRAction/USAID	2011-ongoing	Uganda
Strategies for Improved Cookstove Adoption in Urban Uganda	PATH	Berkeley Air Monitoring Group (BA); Centre for Integrated Research and Community Development (CIRCODU), Uganda; Joint Energy and Environment Programme (JEEP), Uganda	TRAction/USAID	2011-ongoing	Uganda
Ugastove	Uganda Stove Manufacturers Ltd (Ugastove); Haas School of Business, University of California, Berkeley	Market research NGO CIRCODU	2004-06	2004-	Uganda

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* These 55 interventions were included as a result of the literature review process described in the main report.

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The Use of Behaviour Change Techniques in Clean Cooking Interventions to Achieve Health, Economic and Environmental Impact

A review of the evidence and scorecard
of effectiveness

