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Global Alliance for Clean Cookstoves

Rwanda Market Assessment

Sector Mapping

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Accenture Development Partnerships

April 2012

Introduction

- This Market Assessment was conducted by Accenture Development Partnerships (ADP), the not-for-profit arm of the global management consultancy, Accenture, on behalf of the Global Alliance for Clean Cookstoves (the Alliance).
- It is intended to provide a high level snapshot of the sector that can then be used in conjunction with a number of research papers, consumer surveys and other sources (most published on the Alliance's website) to enhance sector market understanding and help the Alliance decide which countries and regions to prioritize.
- It is one of sixteen such assessments completed by the Alliance to:
  - Enhance sector market intelligence and knowledge.; and
  - Contribute to a process leading to the Alliance deciding which regions/countries it will prioritize.
- Full slate of market assessments include studies in: Bangladesh, Brazil, Colombia, East Timor, Ethiopia, Ghana, Indonesia, Kenya, Mexico, Nigeria, Peru, Rwanda, South Africa, Tanzania, Uganda and Vietnam.
- Each assessment has two parts:
  - Sector Mapping – an objective mapping of the sector.
  - Intervention Options – suggestions for removing the many barriers that currently prevent the creation of a thriving market for clean cooking solutions.
- In each Alliance study a combination of ADP and local consultants spent 4-6 weeks in country conducting a combination of primary (in-depth interviews) and secondary research. They used the same Market Assessment 'Toolkit' for each country so that comparisons can be made. The Toolkit is available free of charge to all organizations wishing to use it in other countries.
- **The Alliance wishes to acknowledge the generous support of the following donors for the market assessments: *Barr Foundation, Dow Corning Corporation, Shell Corporation, Shell Foundation,* and the governments of *Canada, Finland,* and *Spain*.**

This market assessment was produced by Accenture Development Partnerships (ADP) on behalf of the Alliance. The findings, interpretations, and conclusions expressed in this work do not necessarily reflect the views of the Global Alliance for Clean Cookstoves or its partners. The Alliance does not guarantee the accuracy of the data.

Content

- Executive Summary
- Project Approach
- Sector Mapping
  - Macro Environment Assessment
  - Social and Environmental Impact Assessment
  - Consumer Assessment
  - Cookstove Industry Assessment
  - Carbon Financing
- Sector Mapping Summary

Executive Summary (1/2)

Small and landlocked Rwanda is the most densely populated country in Africa and contains ~2.5 million households, of which more than 80% are in rural areas. In both urban and rural areas, the vast majority of households cooks on woodfuels (wood/charcoal), leading to major health issues and deforestation.

The Rwandan government initiated an Improved Cook Stove (ICS) program in the late eighties to combat deforestation. Various programs have been implemented since, leading to a penetration of 'improved' stoves of over 50% by 2009. However, the quality of these stoves varies greatly; often the improvement versus traditional methods is limited. In the last two years, the government has implemented new improved stoves programs for both rural and urban areas. In addition, many private cookstove programs are currently starting up, with the aim of utilizing carbon finance.

The driver for the government's involvement in cookstoves is the country's energy problem. Approximately 85% of Rwanda's energy comes from biomass, which has led to rapid deforestation over the last 20 years and is not sustainable. A large part of this biomass is used for cooking; in rural areas, most families collect wood while those in urban areas typically buy charcoal. The significant market for charcoal (~150,000 ton in 2008) has a total value of over $50 million, accounting for more than 2% of GDP; this is comparable to the market for electricity and is larger than the export value of coffee.

To combat the energy issue, the government drafted the Biomass Energy Strategy in 2009. All players in the cookstove sector are aware of the strategy and ensure to align with it. In general, President Paul Kagame's government has progressive policies and a focus on economic growth. Governance is well organized throughout, from the central government to the grassroots level: There are clear lines of communication down to representatives for every 10 households. Finally, it is significant to note that corruption is practically absent and that gender equality is a high priority at all levels of the government.

A key challenge for any cookstove program in Rwanda will be affordability of stoves and fuels: Although GDP has been growing rapidly in recent years, with $1,300 per capita GDP PPP Rwanda still ranks amongst the poorest countries in the world.

Executive Summary (2/2)

	Findings
Social and Environmental Impact	With more than 95% of the total population using biomass fuel for cooking, the health burden of IAP exposure is one of the largest in the world. Deforestation is also a major issue in Rwanda; improved cookstoves could significantly contribute to reducing the wood fuel deficit and thus reduce the problem. Finally, improved cookstoves could decrease fuel expenses for Rwanda's poor population
Consumers	The segment most in need of ICS are biomass collectors in rural areas. Representing 57% of consumers, this segment is most heavily impacted by IAP and deforestation (although the latter differs significantly per region). However, difficulty to distribute to the 'last mile' and very low disposable incomes make these consumers challenging to reach. Another complication is that the free supply of biomass means ICS have no direct economic benefits
Cookstove Industry	There are currently many private sector initiatives emerging in the cookstove sector. However, as the government is very influential in Rwanda, government support is key for any cookstove project. Projects should aim to align with the government vision to capitalize on the strong performance-based governance across all tiers. As the government focuses on economic growth, and Rwanda has no seaports and railroads, in-country manufacturing of stoves is preferable if feasible
Carbon Financing	The high fraction of non renewable biomass, strong governance and efforts to streamline the process create favourable carbon market attributes. Various private companies are currently looking to take advantage of this, although it's not without risk

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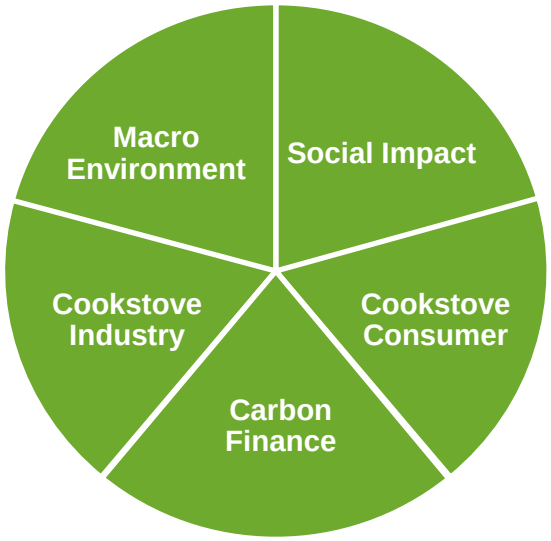
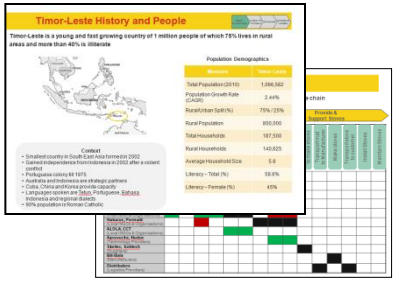
Project Approach

A structured approach first assessed the market for a cookstove industry and then used the Sector Mapping output to develop the Intervention Options and Relative Roadmap

Sector Mapping

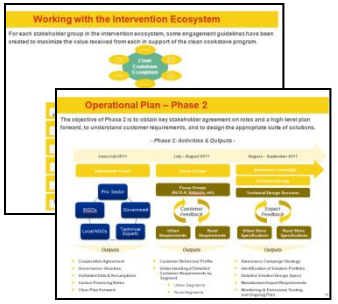




Sector Map

Strategy Development

Identify Intervention Themes → **Develop Recommendations** → **Develop Relative Roadmap**



Intervention Options And Relative Roadmap

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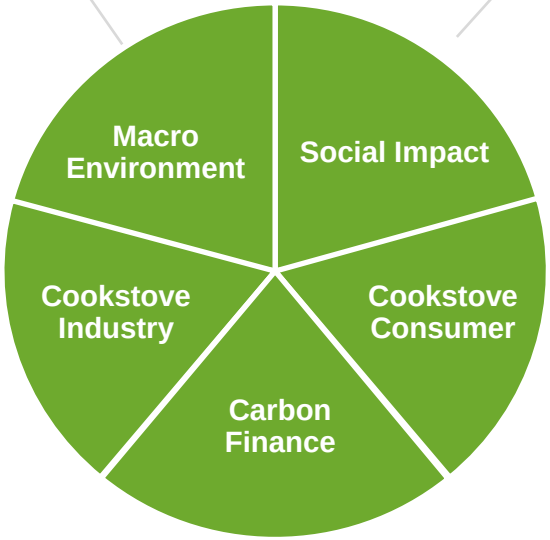
Sector Mapping Approach

Sector Mapping of the cookstove sector was conducted across five dimensions:

- *Social:* What is the country demographics & population distribution across regions?
- *Political:* How stable is government & what political risks will any program face?
- *Economic*: How much money do our potential customers have & what is the economic cycle?
- *Technological*: How sophisticated is the infrastructure & what is the plan for progress?
- *Environmental*: How do ecological conditions impact the success of cookstove programmes?
- *Gender:* How does gender play a role in clean cookstove use and purchase?



- How do people cook and what fuels are used in the region?
- What is the current IAP exposure profile of our target market? (Primary cause of IAP and size of problem)
- What are the other impacts caused by the use of poor cooking stoves?
- How does the impact of cookstoves stack up against other health & social priorities?

- What cooking devices are currently used within the region?
- Who are the main players active in the cookstove sector?
- What are the opportunities / threats for current & future cookstove programmes?
- How commercially attractive is the sector & what are likely to be some of the industry challenges?

- What carbon financing options exist for the country?
- What structures exist which can be leveraged for future carbon financing components?
- Which entities are likely to fill the required roles in the carbon finance operating model?

- What is the profile of the target population?
- How can the customer population be segmented / categorized?
- How big is each customer segment and what are its characteristics?
- What are the specific needs of each customer segment?

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Intervention Options Approach

Intervention development was conducted by using sector mapping as input to identify intervention areas, develop recommendations and develop a high level operational plan

Sector Mapping

- Favorable and unfavorable factors contributing to development of a cookstove industry on following dimensions:
  - Macro Environment
  - Indoor Air Pollution
  - Consumer
  - Current Cookstove Industry
  - Carbon Finance

Intervention Themes Identification

- Identify possible interventions to promote a clean cookstove industry by:
  - Addressing the unfavorable factors
  - Aligning with the favorable factors

Intervention Development

- Customer Segment Strategy:
  - Identify appropriate technology to serve each customer segment
  - Develop holistic customer strategy including marketing, financing
- Overall Strategy
  - Develop strategy for stakeholder engagement across segments
  - Develop strategy for awareness raising across segments
  - Identify possible NGOs & programs to partner with

Relative Roadmap

- Develop a high-level, long term directional plan that includes:
  - Indicative relative timing of initiatives
  - Dependencies between initiatives addressed
  - Rough assessment of time to complete initiatives
  - Short activities and milestones

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Acknowledgements

Many organizations made valuable contributions to this study with their knowledge of Rwanda and experience in cookstove initiatives

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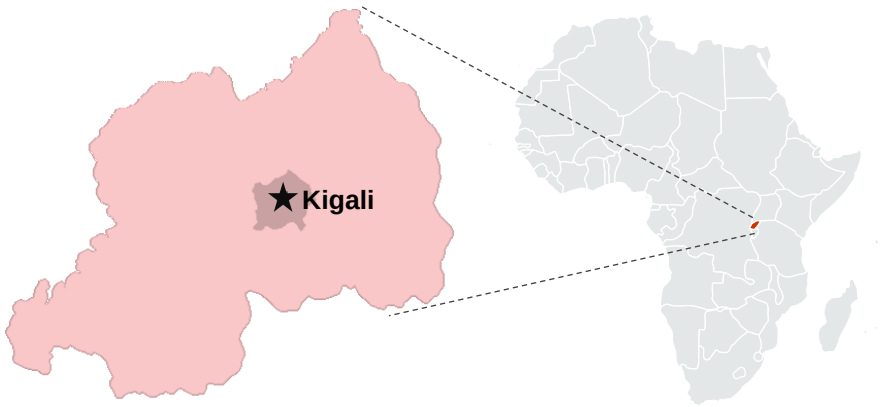
Social Environment

Rwanda is the most densely populated country in Africa and contains ~2.5 million households. Small and landlocked, it currently has a very large rural population, but a high urbanization rate



"Rwandans are honest people – I regularly receive repayments on loans I wrote off a long time ago"
- American solar light distributor

Context

- Rwanda gained independence from Belgium in 1962. Ethnic tensions and external factors culminated in the 1994 genocide (predominantly) targeting the Tutsi minority; it has been largely stable since 1995
- Official languages: Kinyarwanda (universally spoken), French, English
- Roman Catholic 56.5%, Protestant 26%, Adventist 11.1%, Muslim 4.6%, indigenous beliefs 0.1%, none 1.7%

Population Demographic	Rwanda
Total Population (2011)	10,718,379
Population Growth Rate (2011)	2.8%
Rural/Urban Split (%)	81% / 19%
Rural Population	8,681,887
Total Households	2,421,587
Average Household Size	4.3
Literacy – Total (%)	70.4%
Literacy – Female (%)	64.7%
Life Expectancy (years)	58.02
Population below poverty line	44.9%

-Implications –

Cookstove interventions will have to address the large shares of the population living in rural areas and living in poverty

Sources: Government Statistics, World Bank, CIA World Factbook

Administration and Governance

Rwanda has a very clear governance structure. Every 10 households has a representative in the local community to act a representative and ensure clear lines of communication

"I can honestly say that during my 8 years here, no one at any level of government, local or national has asked for a bribe"
- International investor

Administrative Map

- The Country is divided into 5 provinces, 30 districts, 418 administrative sectors and 9,165 cells (utugari) that are run very effectively. Messages make it to grassroots level quickly
- The capital city, Kigali, is the only major city, with over 700,000 inhabitants; there are 14 additional minor cities
- There are large regional differences in geography and income

"In Rwanda, there is a mandatory community service day from 8:00am to 11:00am, on the last Saturday of each month called Umuganda meaning community service…all able bodied persons above the age of 18 and below 65 are expected to participate in volunteer community work… the benefits of Umuganda are not merely economic. The day is intended to build community involvement and strengthen cohesion between persons of different background and levels…people can access authorities to articulate their needs and voice opinions on various issues."
- Rwanda Governance Board website

- Implications -

The strong governance and community initiatives have been used extensively by previous cookstove schemes and should continue to be utilized

Sources: Interviews, Government sites, The Guardian, Financial Times

Political Environment

Rwanda has a strong, directive government with progressive policies and a focus on economic growth. Governance is well organized throughout, from the central government to the grassroots level

Political Structure

- Presidential unitary republic, multi-party system
- The President has broad, unilateral powers to create and administer policy
- The President is elected by popular vote every 7 years and appoints all Cabinet members

Vision 2020 (initiated in 1999)

- Aims to transform Rwanda into a middle income country (requiring an annual growth rate of at least 7%), by moving from a subsistence agriculture economy to a knowledge-based society, with high levels of savings and private investment, reducing dependence on external aid.
- Cross-cutting issues given high priority: gender equality, sustainable environmental and natural resource management and ICT
- "Vision 2020 is to be achieved in a spirit of social cohesion and equity, underpinned by a capable state" – MINECOFIN
- Targets were again refined in March 2012 e.g. increase life expectancy to 66 years from the previous target of 55

Current Government

- The Rwandan Patriotic Front (RPF) has been the dominant political party in the country since 1994
- Paul Kagame has been President since 2000

Working with the Government

- The government is focused on economic growth and has progressive environmental policies
- The government is highly directive and uses performance targets at all levels, internally and externally (e.g. for NGOs)
- Unique for the region, corruption is practically absent (lower than in e.g. Brazil, Italy and Turkey)

"This is not a country looking for hand-outs; each year, our annual plan has to be approved and we need to demonstrate that we're building local skills for the future. The government is very supportive of NGO and private sector initiatives, but they must align with the national strategy e.g. Vision 2020"
- Foreign NGO employee

- Implications -

A cookstove program should aim to align with the government vision to capitalize on the strong performance-based governance that goes down to grassroots level

Sources: Interviews, Government sites, The Guardian, Financial Times, Corruption Perceptions Index 2011

Economic Environment

Rwanda ranks amongst the poorest countries in the world with $1,300 per capita GDP PPP; a large majority of the population works in agriculture, although half of the GDP is generated in services

Key Economic Indicator	
GDP (2010)	$5.63 billion
GDP Per Capita (PPP) (2011)	$1,300
Economic Growth Rate (2011)	7.0%
Inflation Rate (2011)	3.9%
Unemployment *(hard to measure as many people are subsistence farmers or do opportunistic jobs)*	0.6% (2003); 80% of 15+ population is employed (2008)
Youth Unemployment (1996) *(hard to measure as many people are subsistence farmers)*	0.7%

Key Economic Indicator	
Exports (2011 est.)	$293 million: coffee, tea, hides, tin ore *Major markets*: Kenya, DRC, China, Swaziland, US, Pakistan
Imports (2011 est.)	$1.307 billion: foodstuffs, machinery and equipment, steel, petroleum products, cement and construction material *Major suppliers*: Kenya, Uganda, UAE, Tanzania, China
GDP composition (2011 est.)	Agriculture: 34% (80% 2006 labour force) Industry: 14% (3% 2006 labour force) Services: 52% (17% of 2006 labour force)

Financing can be an issue in Rwanda, even with a proven financial record and strong business plan, I was recently told that 130% collateral was required for a reasonably small loan (often impossible for a small business)

– Founder of an established clean-tech company

- Implications -

Promoting low-cost cookstove options is likely to play a major role in demand growth for cookstoves across Rwanda; the infrastructure to produce stoves on industrial scale is limited

Sources: World Bank, CIA World Factbook, IMF, UNCTAD

Gender

Gender equality is a high priority at all levels of the government, as well as within the private and NGO sectors. However, ownership rights and civil liberties remain unequal

Policy, government, and institutional frameworks for gender issues

- 2003 Constitution prohibits gender-based discrimination, although women continue to face social inequality
- 2003 elections (1st since 1994) saw the greatest proportion of women elected to any parliament in history, 56%. Law states a minimum of 30% (at all levels)
- Ministry of Gender and Family Promotion (MIGEPROF) established to "ensure effective gender mainstreaming and full participation of women in all activities related to the socio-economic development of the nation"[1]
- Women outnumber men (since 1994) and play an important role in the formal sector and society overall – 1/3 Rwandan women are the head of household
- Policy and practice differ e.g. polygamy though illegal impacts 1/10 women
- 82/146 countries in the 2011 Gender Inequality Index (UNDP)

Key Gender Issues in the Country

- The genocide saw a significant increase in sexual violence and GBV remains an issue, although often unreported
- Women suffer limited access to finance through traditional bank loans and the Civil Code still limits freedom of movement – married women must respect their husband's decision with regard to place of residence

Gender Equality Statistics
***** denotes 2005-2010

	Male	Female
Primary school net attendance ratio*	84%	87%
Secondary school net attendance ratio*	5%	5%
Tertiary school attendance (relative)	56%	44%
Youth (15-24 yrs) literacy rate* *Adult lit. rate* = 71%*	77%	77%
Ministers/ Parliamentarians	71%/ 44%	29%/ 56%

- Implications -

Although gender discrimination is addressed by government policies, focus remains necessary to realize this equality in practice

Source: [1] MIGEPROF website, RSY 2011, GenderIndex.org, World Bank, UNICEF, and UNDP, interviews

Infrastructure

Rwanda has progressive policies regarding health care, telecommunication and education and is working to improve its unfavorable transportation infrastructure

	Health Care	Telecommunication	Education	Transportation
Current Situation	• Over 90% of people are covered by national health insurance and pay regular contributions (defined by income level) • Infant mortality rate was halved in the last 5 years and is currently 59 deaths / 1000 live births • 54% of the population has access to improved sanitation	• Mobile telephone coverage has grown to 92% of the population • <5% of population used internet in 2009; government is setting up rural "tele-centers" • Adoption of television is limited to urban areas, but radio has national reach	• 70.4% literacy rate • Net enrollment in primary education is relatively high at 96%; attendance ratio is >80% for both boys and girls • Secondary education attendance ratio is only 5%	• Landlocked Rwanda has no seaports and railroads • Paved road network between Kigali and most major cities/towns; over 75% of roads is unpaved, often in bad condition • Road transport from seaports in neighboring countries suffers from corruption
Government Priorities	• Decentralization of the health system • Maternal & infant mortality • Community participation in the management and financing of health services	• Transform the country into an ICT hub by 2020; laying fiber optic across the country • Increase competition between mobile phone providers	• Universal equitable access to education • Improve education, particularly skills development • Combat illiteracy	• New international airport with greater capacity, operational in 2016 • Provision of adequate roadway capacity to accommodate larger numbers of vehicles

- Implications -

The lack of seaports and railroads makes import and distribution of cookstoves expensive; the high penetration of health insurance and mobile phones implies people are able to save some money

Source: Ministry of Health, Unicef, NY Times, IMF, CIA World Factbook, Economist

Energy Sector

Most of Rwanda's energy is derived from biomass, half of which is unsustainable; access to electricity is low and prices are high while thermal energy generation is depleting foreign reserves

Key Energy Indicators	
Composition of primary energy use (2011)	Biomass: 85% (half is unsustainable) Petroleum products: 11% Electricity: 4%
Electricity by generation method (2011)	Hydropower: 59% Thermal (mostly diesel, heavy oil): 40% Methane: 1%
Population with access to electricity (%) (2017 target = 50%)	10% Current electrification rate is 9%

"A reliable supply of energy is a basic prerequisite for economic development and improvement of living standards for all"

Rwandan Development Board, Rwanda Energy Investor Forum, 29 February 2012

The Rwandan government has created two energy strategies:

Biomass Energy Strategy

- Increase the sustainable supply of wood fuels
- Increase the efficiency of energy use (cooking)
- Promote the production of alternative fuels

Electricity Strategy

- Substantially increase generation capacity and energy access across the country
- Develop least cost electricity generation options from indigenous energy resources

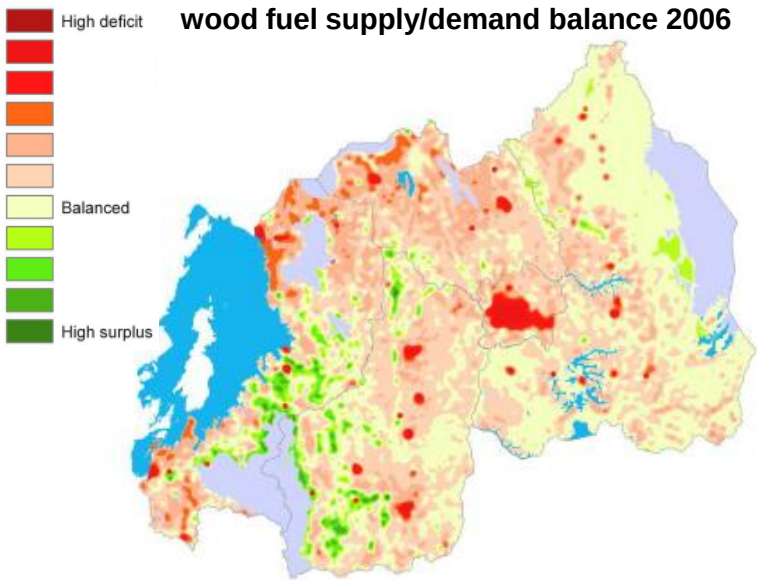
- Implications -

The large biomass market is likely to exist for many years due to poor access to electricity and a lack of alternatives. The government is planning a leap in electricity access in the next 5 years

Sources: Ministry of Infrastructure, Rwanda Development Board, Biomass Energy Strategy 2009

Ecological Environment

Rwanda has quickly been losing forest cover, and wood fuel deficits exist in a large majority of districts



wood fuel supply/demand balance 2006

Source: WISDOM Rwanda - FAO Jan 2011

…like the prohibition of use of plastic bags, being fined for littering, having people cutting grass and sweeping the streets several times a week, it is part of making Rwanda one of the cleanest countries in Africa
– International Youth Delegate

Climate

- Although close to the equator, Rwanda's climate is temperate due to the altitude; the temperature is around 24°C year round
- Rwanda has two rainy seasons (February to April, November to January); Kigali receives on average 1007 mm (39.6 in) of precipitation annually

Deforestation

- Rwanda lost 37% of its forest cover (around 117,000 ha) between 1990 and 2010. Currently almost all wood comes from plantations
- Annual demand for woody biomass in Rwanda currently is 2.9 Mt, more than double the available productivity of 1.1 Mt; the supply/demand balance differs highly by region as depicted
- The government aims to restore a 30% forest cover by 2020; its Biomass Energy Strategy is the basis for all interventions

Other Environmental Issues

1. Overpopulation (most densely populated country in Africa)
2. Erosion (great amount of hills in combination with deforestation)

- Implications -

The high wood fuel deficit in Rwanda means that any cookstove program should address this issue (in line with the Biomass Energy Strategy) in order to gain government supported

Sources: CIA World Factbook, interviews

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Cooking Habits

Although regional & income differences exist, cooking habits across Rwanda are similar with beans and cassava at the heart of many meals and women responsible for cooking that takes place indoors

Type of Food

- Ingredients of a typical Rwandan meal are rice, beans, cassava, chapatti, cabbage, boiled beef, sweet potatoes, bananas and pineapple
- Beans are part of most meals as the only widely available source of protein and take multiple hours to cook
- *South* – Typically more simple meals due to relatively high poverty
- *East* – More focus on dairy as a source of nutrition, less meals cooked
- *West* – Areas around lake Kivu tend to include fish in their diet, predominantly tilapia and sambaza

Cooking Habits

- Most cooks are women, often assisted by girls
- Cooking usually takes place indoors both in urban and rural areas
- Pots of different sizes are used, and the cooks often want to be able to adjust the stove to provide maximum support for the pot
- Biomass use is diverse with families using whatever they can collect
- Some households with access to ICS/modern fuels still use charcoal for cooking beans for economic reasons, due to the long cooking time
- Previous projects have looked to improve behaviour, but have experienced serious, sometimes detrimental, changes to IAP due to QA gaps e.g. encouraging people to move the stove indoors and use a chimney is only beneficial if the chimney functions as designed

- Implications -

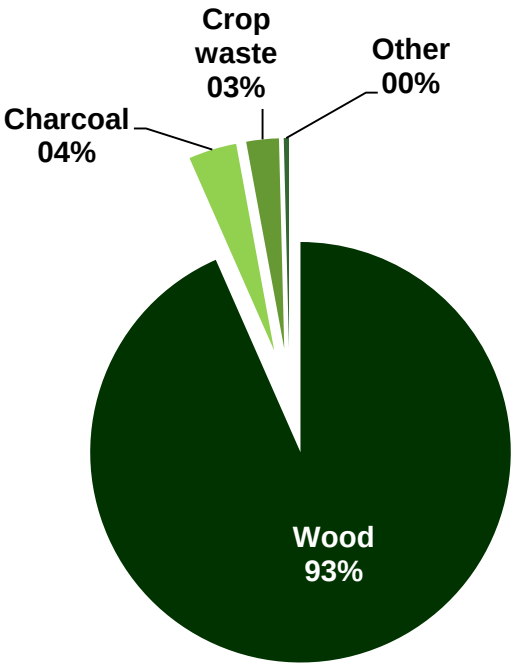
Stove designs should fit with cooking habits such as the long cooking of beans and the use of pots of different sizes. Stoves for rural areas should burn different types of biomass

Sources:Interviews

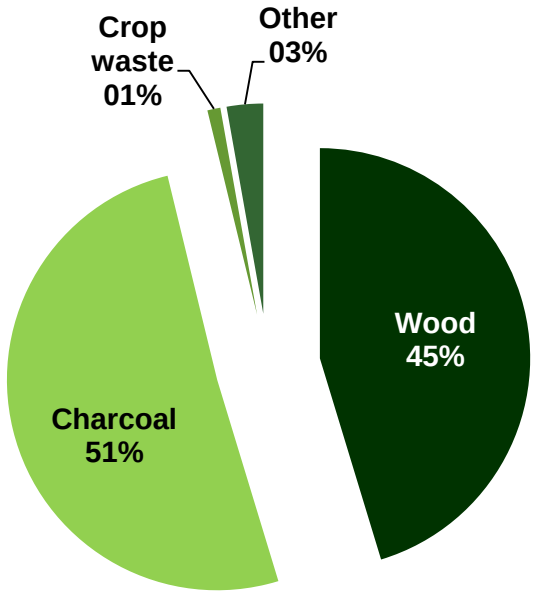
Fuel Usage & Availability

Wood (biomass) is the dominant household fuel in Rwanda, accounting for 93% in rural and 45% in urban areas. Charcoal accounts for 51% in all urban areas combined, and for 65% in the capital Kigali

Total Rural Fuel Use



Total Urban Fuel Use



Fuel use & availability

- Wood (biomass) is the dominant fuel in both urban and rural areas, accounting for 86% of total cooking fuel
- Kigali is slightly different from other urban areas; charcoal represents 65% of fuel use there
- On a national level, the household fuel use distribution remained approximately constant between 2000 and 2011 (the use of charcoal rose slightly)

- Implications -

Given the heavy reliance on wood fuels, any successful intervention must either use stoves that are able to cook on wood (biomass) or charcoal or provide the fuel as a part of the intervention

Source:
Rwanda EICV2 Survey 2006

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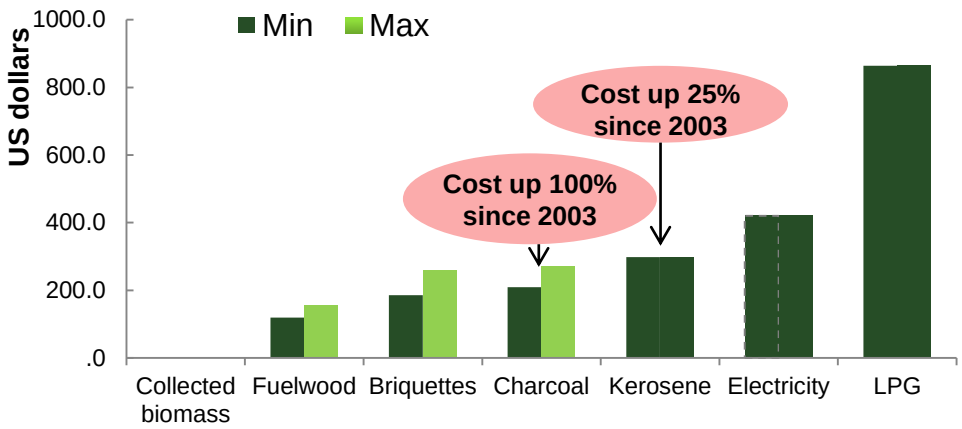
Available Fuel Cost

Burning wood fuels is significantly cheaper than cooking using modern fuels, especially for those who collect the fuel themselves and/or cook on an improved stove with increased efficiency

Household Fuel Cost per Year (USD, 2008)



Source: Biomass Energy Strategy Rwanda 2009

Notes

- The maximum and minimum costs for fuel wood and charcoal represent the use of a typical normal stove (max) or typical improved stove (min)
- The maximum and minimum costs for briquettes represent the use of papyrus charcoaled briquettes (max) or municipal solid waste briquettes (min)

Pricing and Supply Observations

- The data represents only a snapshot taken in 2008
- The general trend that with rising incomes households prefer more convenient cooking solutions is not observed in Rwanda, and high prices are likely to blame for this
- Many people pay nothing for fuel, although this means they need to spend time collecting it
- It is generally assumed that deforestation is the reason for the rapid increase in the price of charcoal
- Improved charcoal generally sells for the same price even though efficiency is higher
- Briquettes are in an experimental phase; the production and use is limited

- Implications -

The free supply of biomass suggests that not all cookstove initiatives can focus on the direct economic benefits. Clean options based on electricity or LPG will have low adoption

Source: Biomass Energy Strategy 2009, Interviews

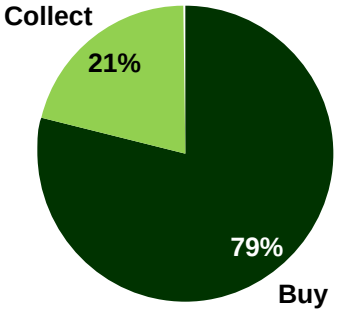
Livelihoods

Most rural households spend hardly any money on fuels for cooking, but charcoal production does contribute a large amount to the rural economy

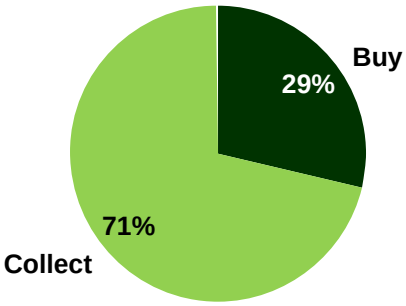
Share of consumers spending money on fuel

- About 70% of rural households use gathered firewood as primary fuel, with 30% gathering firewood daily
- In 80% of cases, collecting firewood is combined with working in the fields or collected by children coming from school
- Some 85% of rural households state that firewood gathering is problematic, the main concerns being inconvenience (57%), access problems (35%) and long distance to collect (13%)

Kigali City



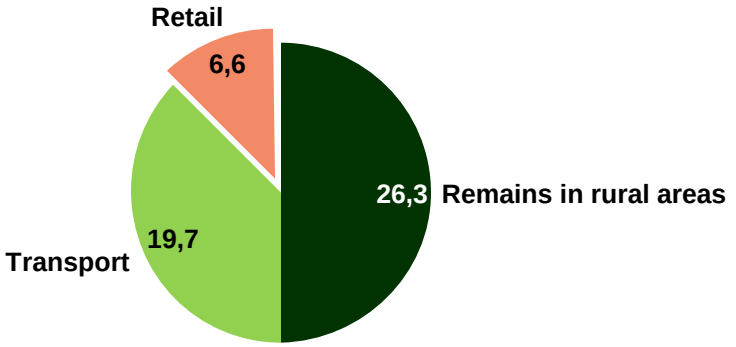
Other provinces



Role of charcoal in the rural economy

- The total market for charcoal in 2008 was approximately 150,000 ton per year; the total value is more than US$ 50 million, accounting for more than 2% of GDP
- This implies that the charcoal market has the same order of magnitude as the market for electricity (~$55 million) and is larger than the export value of coffee ($38 million)
- The charcoal market is currently unregulated an untaxed

Segmentation of annual charcoal market value ($ mln)



- Implications -

Any intervention in the charcoal value chain should take into account the impact on the rural economy

Source: Biomass Energy Strategy 2009, RBESS 2009

Indoor Air Pollution (IAP) in Rwanda

With more than 95% of the total population using biomass fuel for cooking, the health burden of IAP exposure is one of the largest in the world

	Population (Households)	% Using Biomass	Total exposed to IAP
Rural (81% of total pop.)	2,019,043 →	97% →	1,950,396
Urban (19% of total pop.)	473,603 →	95% →	447,555
		Total →	**2,397,951** (96% of total population)

Health Impact

- 12,500 deaths and a total number of 493,000 DALYs attributable to solid fuel use
- 5.8% of the total burden of disease is caused by solid fuel use
- Both numbers are amongst the top 20 most affected countries in the world

"There are some concerns that the fumes produced by burning Eucalyptus leaves (a common fuel source) are cancerous, although there is no scientific proof to date"
– Local entrepreneur

- Implications -

The relatively very high number of DALYs and deaths attributable to IAP presents a strong case for cookstove interventions in Rwanda

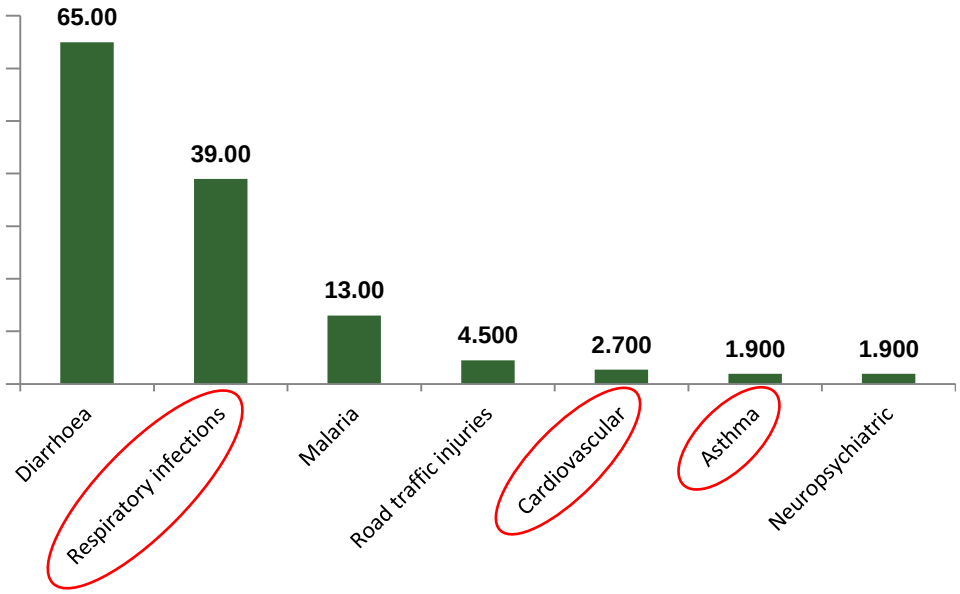
Sources: WHO, CIA World Factbook, Government statistics, Biomass Energy Strategy Rwanda

GLOBAL ALLIANCE FOR CLEAN COOKSTOVES

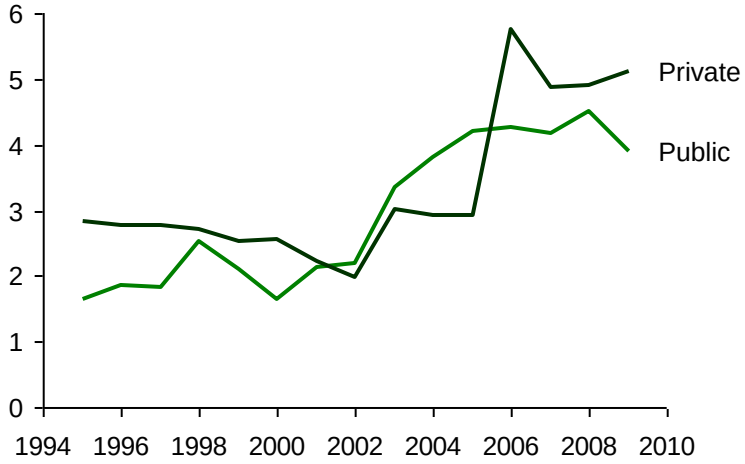
Indoor Air Pollution vs Other Priorities

Although the government focuses on economic growth, its relative spend on health is increasing and Indoor Air Pollution is one of the main causes of disease in Rwanda

Rwanda disease burden
(DALYs/1000 capita/year)



Health Spending
(% of GDP)



- Implications -

IAP is one of the main causes of disease while both public and private focus on health is increasing

Sources: WHO, Index Mundi

GLOBAL ALLIANCE FOR CLEAN COOKSTOVES

The Role of Gender

Women play an integral role in the cookstove market, with all sectors utilizing their experience and networks across the board, from raising awareness, product development to marketing and sales

Roles

- Women are far more likely to be exposed to IAP in their role as primary cook; girls are also more likely to assist in cooking than boys
- Women have a large role within major household purchasing decisions, but the man usually controls the budget
- 32.1% households are headed by women – this is due in part to the genocide

Challenges

- 62% women headed households are below the poverty line and the women are often widows – it may prove difficult to involve these households due to family commitments
- Women often lack ready access to capital (even household budgets), so entrepreneur models may struggle

Opportunities

- CARE has strong compulsory targets for female involvement in projects (including cookstoves)
- Training women is viewed as more beneficial in the long term, since women tend to be inherently more invested in the stove improvements
- Women are often integral to any consumer awareness and education campaigns as they are viewed as having more credibility

- Implications -

The continued presence of women in the sector improves the ability to connect with end consumers and increases the growth potential, although men often make the purchase decision

Sources:
UNDP, Interviews and field visits

Environment Impacts

A key driver for the government is the opportunity to reduce deforestation and the associated environmental, social and economic impacts

Deforestation

- The markets for clean fuels and cookstoves can have key impact on the deforestation issue:
  - The BEST strategy suggests training charcoaling professionals to use more efficient methods/equipment, aiming to reach 15% efficiency in weight (currently 12%) among at least 50% of the producers by 2015 (over 60% by 2020)
  - The residential sector consumes ~2.7Mt. Increased use of ICS, along with these realistic improvements in charcoal making techniques could reduce this to 2.2Mt
- According to the U.N. FAO, 17.6% of Rwanda is forested, 1.6% of this is primary forest, the most bio diverse and carbon-dense
- There is currently an annual deficit of 1.8 Mt of wood. It is expected that this could be reduced to 0.75 Mt with improved management/conversion efficiencies
- Over 20% people in rural areas live in areas of serious wood fuel deficit and high poverty

Associated Issues

- The drastic loss in forest cover has resulted in considerable biodiversity loss, soil erosion, degradation and landslides, due to the vast number of steep hills and subsistent farmers situated upon them
- Rwanda is prone to flooding, often in relation to the cycles of El Nino / La Nina. The impact is exacerbated by the increasing population, urbanisation rate and value of flood prone areas
- UNHCR raised concerns about the competition for wood fuels between refugees and the local community

- Implications -

The increasing urbanization rate and associated popularity of charcoal stoves highlights the importance of moving towards improved charcoaling techniques in the short term

Sources:
UN FAO, BEST 2009, WISDOM Report 2011, NASA, interviews and field visits

Content

- Executive Summary
- Project Approach
- Sector Mapping
  - Macro Environment Assessment
  - Social and Environmental Impact Assessment
  - Consumer Assessment
  - Cookstove Industry Assessment
  - Carbon Financing
- Sector Mapping Summary

Assumptions

The customer segmentation in this section is an illustrative example of how the Rwandan market could be grouped. They are based on the following assumptions:

- The customer segmentation is designed to provide a high-level view of the market and strengthen the understanding of the customer base in Rwanda.
- The customer segmentation is based on a preliminary market assessment and has used a combination of both primary and secondary research. Further refinement of customer segmentation and customer profiles may be required for specific programmes and regions.
- The high-level customer segmentation calculations were derived based on the following mathematical assumptions:

    1. National averages being consistent across segment criteria (e.g. fuel distribution across income level and income level by ecological factor)
    2. Regarding the collection/purchase of wood, the average for Kigali Province is representative for urban areas while the average of the other four provinces is representative for rural areas
    3. A high wood fuel deficit and poverty is always present in urban areas

Consumer Landscape in Rwanda

To understand and derive insight on the consumer landscape in Rwanda the population can be segmented based on four key areas

Market
(Rural / Urban / Institutional)

Household fuel type
(Wood / Charcoal / Other)

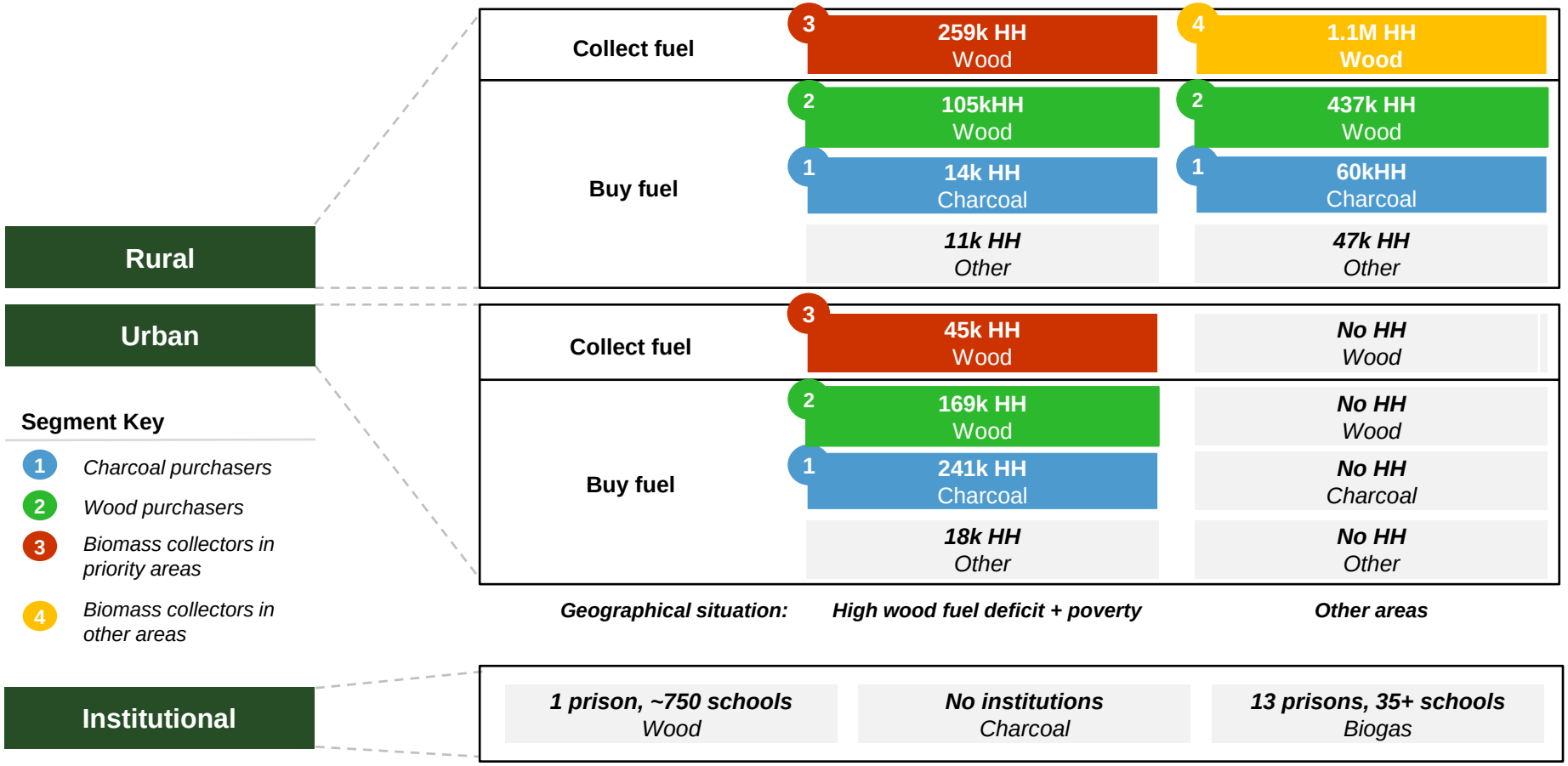
Economic situation
(Collect or buy fuel)

Geographical situation
(wood fuel deficit / surplus)

Note: The attributes of the segmentation are illustrative based on only initial research

Target Market Identification

The largest customer segments are biomass collectors in rural areas and represent 56% of all households



- Implications -

The potential market for a cookstove intervention in Rwanda is approx. 2.4 million households

Sources: WorldBank, National Institute of Statistics, RBESS 2009, FAO

Segment Profiles

The targeted population can be segmented into four groups: 1) People who purchase charcoal for cooking & 2) People who purchase firewood for cooking…

	 **Charcoal purchasers**	 **Wood purchasers**
Size in Households	• 316 k (13% of population)	• 711 k (29% of population)
Profession	• Office workers, well off farmers, business people	• Domestic workers
Household Income	• Greater than $1 a day	• Between $0.50 and $2 a day
Cooking Device & Fuel	• Charcoal stove, traditional or improved • Fuel: Charcoal (sometimes LPG for relatively well-off)	• Traditional stoves, improved wood stoves • Fuel: Firewood
Cooking Location	• Indoors (outdoors if no separate kitchen available)	• Indoors
Cooking Frequency	• Two to three meals per day	• One to two meals per day
IAP Exposure	• Med	• Med
IAP Awareness	• High for wood; low for charcoal smoke	• Medium (for wood)
Environment Impact	• High	• High
Barriers to Switch	• Durability (quality vs. cost) • Fuel affordability (especially for long cooking) • Stove affordability (for industrial stoves)	• Awareness of alternative products • Stove affordability
Willingness to Pay	• High, can afford to pay for simple ICS out of pocket	• Medium, possibly can afford to pay for simple ICS out of pocket
Purchase Drivers	• Fuel Costs (versus charcoal) • Perception of stove and reliability • Ease of use and comfort	• Fuel Costs (versus firewood) • Perception of stove and reliability • Ease of use and comfort

Segment Profiles

…3) people who collect firewood in areas with a large wood fuel deficit and poverty & 4) people who collect firewood in other areas

	Biomass collectors in priority areas	Biomass collectors in other areas
Size in Households	• 305 k (12% of population)	• 1.1 M (44% of population)
Profession	• Subsistence farming, field workers	• Subsistence farming, field workers
Household Income	• Less than $1 a day	• Less than $1 a day
Cooking Device & Fuel	• 3 stone fire, traditional self-made mud stove • Fuel: Collected biomass	• 3 stone fire, traditional self-made mud stove • Fuel: Collected biomass
Cooking Location	• Outdoors during dry seasons • Indoors during rainy seasons	• Outdoors during dry seasons • Indoors during rainy seasons
Cooking Frequency	• One to two meals per day	• One to two meals per day
IAP Exposure	• High	• High
IAP Awareness	• Low (for wood)	• Low (for wood)
Environment Impact	• High (limited availability of biomass results in more illegal cutting)	• Med
Barriers to Switch	• Affordability of stove • Access to financing • Availability of stoves with reliable quality	• No incentive due to cheap availability of fuels • Access to financing • Awareness and availability
Willingness to Pay	• Low due to lack of disposable income, but sometimes do not have a choice due to lack of biomass	• Low, little to no disposable income
Purchase Drivers	• Stove costs and reliability • Fuel availability and cost	• Perception of stove benefits versus costs • Fuel costs (versus free biomass)

Customer Segmentation Summary

Segments 1 and 2 who are purchasing fuels can be more easily targeted with a cookstove programme as they have a greater ability and willingness to pay. These segments can also be reached more easily

Customer Segment Characteristics

Segment	Size	IAP Exposure	IAP Awareness	Affordability	Willingness to Pay	Alternative Use	Distribution Access
1) Charcoal purchasers	◔	◕	◔	●	◑	◔	●
2) Wood purchasers	◕	◕	◕	◑	◑	◔	◕
3) Biomass collectors in priority areas	◑	●	◕	○	◔	◔	◔
4) Biomass collectors in other areas	●	●	◕	○	○	◔	◔

Key ○ **Minimal** ◔ **Low** ◑ **Medium** ◕ **Medium-High** ● **High**

Consumer education around IAP caused by charcoal is needed

Financial constraints are a main barrier to adoption of ICS

Lack of collectable biomass in priority areas could increase Willingness to Pay

Last mile distribution on a large scale is a key issue

- Implications -

Different cookstove solutions, tailored to the needs of each segment on variables such as price and consumer messaging, are needed to reach the whole target market

GLOBAL ALLIANCE FOR CLEAN COOKSTOVES

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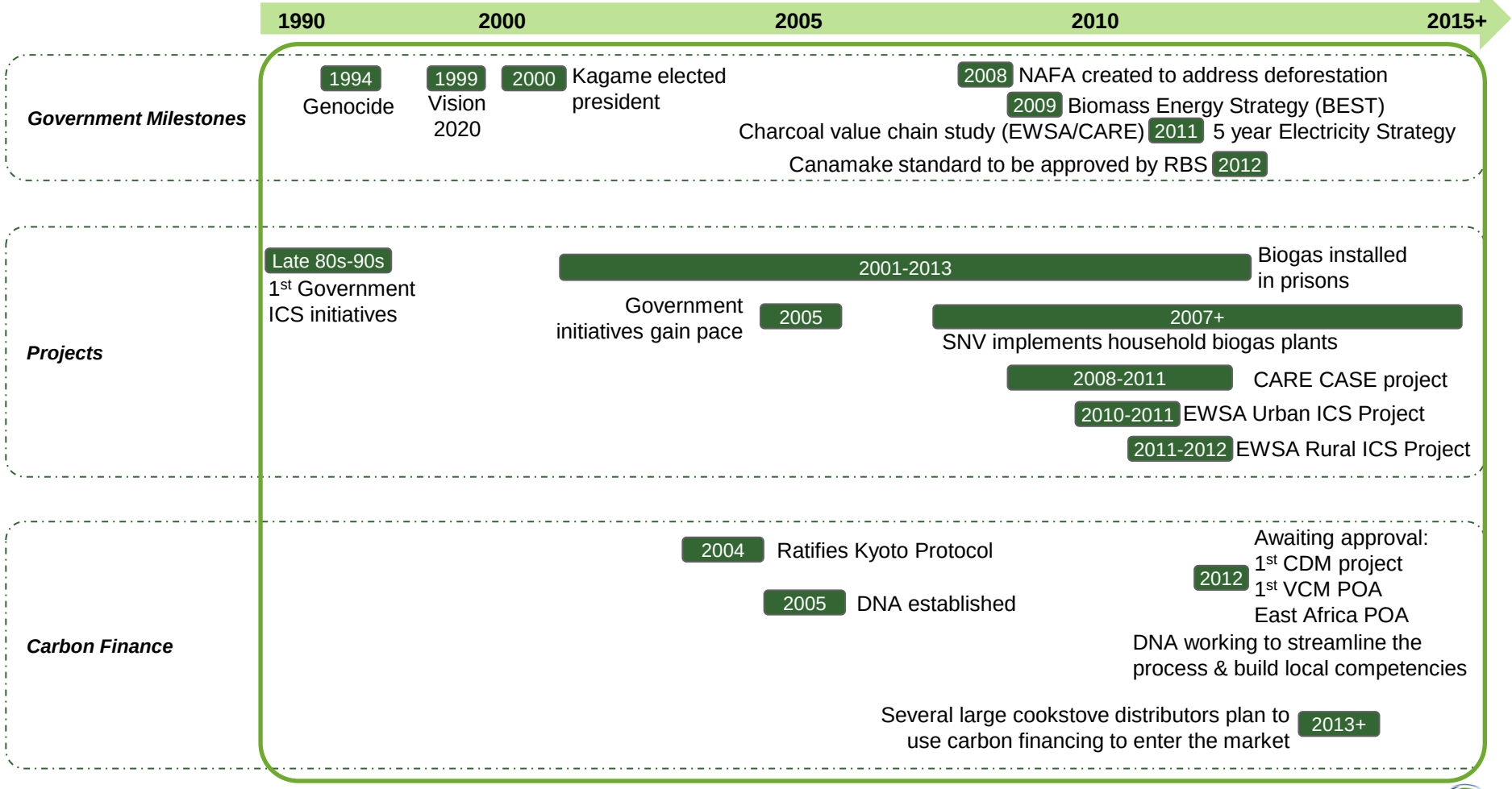
- Sector Mapping Summary

History of Cookstoves in Rwanda

Provoked by rapid deforestation and energy supply concerns, improved cookstoves programs have been in existence since late 1980s, with a recent surge in the sector

Non-Exhaustive



Sources:
Interviews, EWSA, REMA

GLOBAL ALLIANCE FOR CLEAN COOKSTOVES

Government Policy relating to Cookstoves

Government policy relating to cookstoves largely centers around deforestation and energy access, areas of concern due to the considerable environmental and economic implications

Government Policies on Energy

- Policies
  - National Energy Policy and Strategy (MININFRA, 2011)
  - National Forestry Policy (NAFA, 2010)
  - Organic Law No. 04/2005 of 08/04/2005 Determining the Modalities of Protection, Conservation and Promotion of Environment in Rwanda (Central Government, 2005)

- National strategies
  - National Climate Change and Low Carbon Development Strategy (REMA, 2011)
  - Strategic Plan for the Forest Sector 2009-2012 (NAFA, 2010)
  - Biomass Energy Strategy (Ministry of Infrastructure, 2009)
  - Five-Year Strategic Plan for the Environment and Natural Resources Sector 2009-2013 (Ministry of Natural Resources, 2009)
  - Rwanda Decentralization Strategic Framework (MINECOFIN, 2007)
  - Rwanda Vision 2020 (MINECOFIN, 1999)

This list was compiled from interviews with government and non government players in Rwanda. It is by no means exhaustive

Standards & Testing

There is currently no testing facility in Rwanda that can test stoves for emissions; there are no standards for IAP and stoves yet, although the first stove standard is currently being discussed

Limited Testing Facilities

- The government-funded *Kigali Institute for Science and Technology (KIST)* is the only independent testing lab in Rwanda and has collaborated with many recent cookstove projects, e.g. CARE and with the US-based Aprovecho Research Center
- KIST can currently only test the fuel efficiency of stoves; there is no equipment to measure emissions
- Although nothing currently points in this direction, the fact that KIST commercially sells stoves themselves could lead to conflicts of interest

"There are people available at the CITT department that could test stoves for emissions and are keen to do so, but we do not have the money for the equipment"
– KIST manager

"Consumers are not prepared to pay more for an improved stove, as they just do not know what the quality of the stove will be"
– Independent Energy Consultant, Kigali

No Relevant Standards (yet)

- Although there are standards regarding the allowed emissions of companies, there are currently no standards regarding Indoor Air Pollution for institutions or companies
- The *Rwandan Bureau of Standards (RBS)* is currently working on a standard for the canamaké improved charcoal stove upon request of the Ministry of Infrastructure; this standard will not be compulsory
- There are currently no other standards for stoves and/or fuels

- Implications -

Improving testing capabilities and setting standards present major opportunities to create a more enabling environment for the cookstove market

Illustrations from Current Technology Landscape

In rural areas, most people use traditional stoves followed by improved woodstoves, often made of ceramic or mud

Traditional Stoves

- Either 3 stones or a mud construction used as ‘stove’
- Used by about half of all rural households
- Very inefficient and produces a lot of emissions
- Materials readily available and simple to construct; any biomass fuel can be used

- Market share ●
- Availability ●

Improved woodstove mud

- Tested independently by Aprovecho/KIST with positive results: Considerable reductions in fuel use and emissions possible
- Local artisans need to be trained; quality assurance is severely lacking
- Many variations, typically based on the rocket stove model

- Market share ◕
- Availability ◕

Improved woodstove ceramic

- Produced by local artisans/ cooperatives under strict /standardized guidelines
- Familiar design, relatively cheap to purchase
- Quality improved and standardized by the government
- Efficiency gains are limited

- Market share ◑
- Availability ◕

Key ○ **Minimal** ◔ **Low** ◑ **Medium** ◕ **Medium-High** ● **High**

Illustrations from Current Technology Landscape

Cookstove Industry

In urban areas, charcoal stoves are common and 'improved versions' are increasingly common. A new alternative is the metal woodstove

Improved woodstove metal

- Modern stove, easy to use
- Greatly reduces the quantity of wood required
- Relatively high cost; difficult to get metal in Rwanda
- Some concerns about the safety of the stove (can get very hot)

- Market share ○
- Availability ◑

Charcoal stove

- Limited efficiency charcoal stove, sometimes with a liner
- Used mostly in Kigali and to some extent in other urban areas; very limited in rural areas
- Widely and cheaply available

- Market share ◑
- Availability ●

Improved charcoal stove

- Improved version of a popular stove – high familiarity amongst purchasers
- Quality improved and standardized by the government
- Still requires charcoal - efficiency is limited by the charcoal quality

- Market share ◑
- Availability ◕

Key ○ **Minimal** ◔ **Low** ◑ **Medium** ◕ **Medium-High** ● **High**

GLOBAL ALLIANCE FOR CLEAN COOKSTOVES

Illustrations from Current Technology Landscape

Cookstove Industry

Gasifier and (bio)gas stoves are very clean but not yet widespread

Gasifier stove

- Gasifier stoves are available from various high tech companies
- Very safe and pleasant cooking experience; exceptionally low emissions of carbon and IAP
- Distributed for free using a pellet business model *(see appendix A)*
- Currently not available in Rwanda at a large scale

- Market share ○
- Availability ◑

Biogas stove

- Limited use due to the vast investment needed to install a biogas digester and the reliance on cattle. The government stimulates use, subsidizing half of this investment *(see appendix B)*
- Requires the possession of at least two cows
- Designed to last for 20 years with no costs for fuel

- Market share ○
- Availability ◔

Gas & electric stoves

- Historically not common but use of mainly gas stoves is increasing in urban areas for meals that do not need to cook for a long time
- Little have access to electricity, but for those who do, cooking on electricity is still relatively very expensive

- Market share ○
- Availability ◑

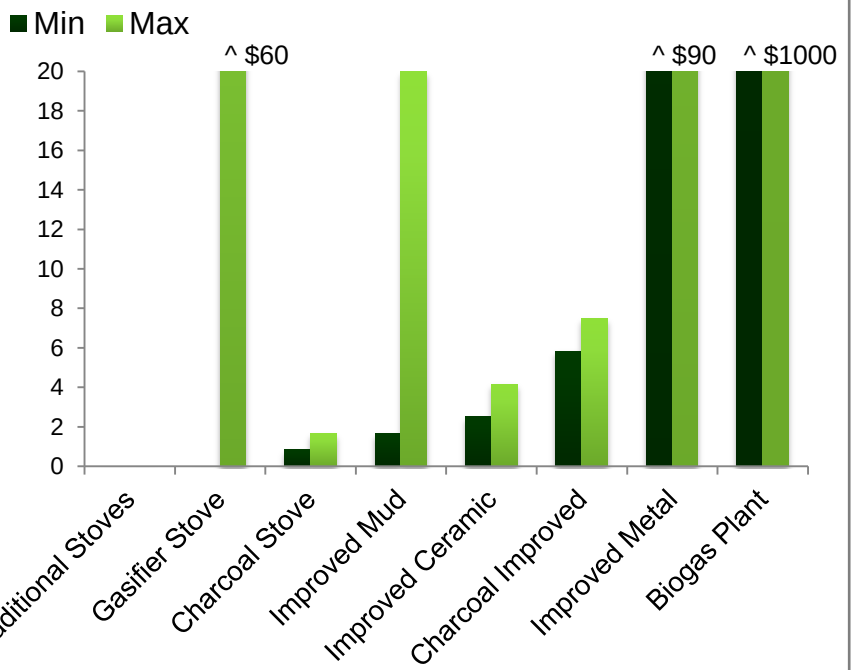
Key ○ **Minimal** ◔ **Low** ◑ **Medium** ◕ **Medium-High** ● **High**

GLOBAL ALLIANCE FOR CLEAN COOKSTOVES

Available Cookstove Cost

The prices of artisan produced ICS range between RwF 2000 – 12,000 ($3 - 20) depending on material and model. Industrially produced stoves are typically much more expensive

Upfront Cost by Product (US$)



Observations

- Traditional stoves can be obtained for free
- Gasifier stoves cost over 30,000 RwF but possibly can be distributed for free; the stove price is paid back by the purchase of the especially produced pellets
- The price of the improved mud stove depends on the numbers of hubs and the inclusion of a chimney
- Payment is almost always in a cash lump sum
- The durability of stoves varies greatly; while traditional charcoal stoves will not last a year, improved stoves will last at least 3-5 years, up to 10 years for the SAVE80 and 20 for biogas plants
- The improved stoves have an short payback periods of a couple of months due to fuel savings
- People on average are prepared to pay $2.50 (rural areas) / $5 (urban areas) for an improved stove

- Implications -

There are cheap improved stoves available, but the more expensive improved stoves have a short payback period due to high fuel savings

Sources: Biomass Energy Strategy 2009, Interviews

Overview of Major Cookstove Initiatives in Rwanda

The government is the most important player in the Rwandan cookstove sector, but many private sector initiatives are emerging. Involvement from academia is limited

Private Sector

Enedom

Inyenyeri

Government

Other NGOs (e.g. Mosaic Foundation)

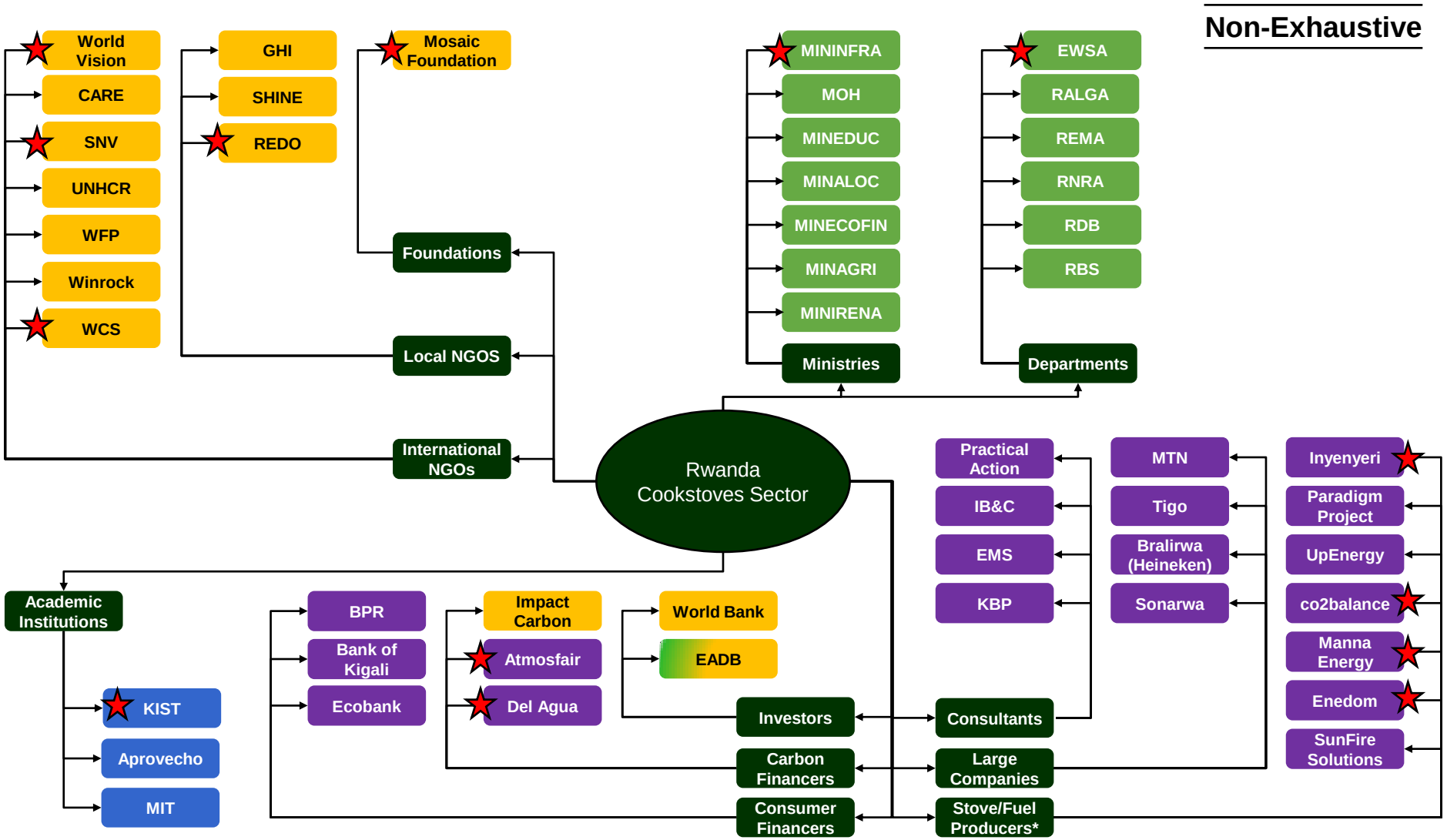
NGOs

Academia

- Implications -

Key opportunities are increasing the involvement of academia and ensuring an environment in which private sector initiatives can blossom

Rwanda Stakeholder Mind Map



Note (*): Spoke to these, many artisans and cooperatives in the market

GLOBAL ALLIANCE FOR CLEAN COOKSTOVES

Existing Markets for Cookstoves and Fuels

Improved cookstoves are acquired through local markets, local authorities, NGO networks or central cookstove projects

'Centralized coordination' ← → **'Decentralized coordination'**

	Projects	NGO networks	Local authorities	Local markets
Channel	• An example is the RPF dissemination of improved stoves more than a decade ago • A recent example is the Biogas Plant project of SNV and the Rwandan government	• NGOs with deep community presence like Care International and World Vision utilize their network to train local artisans and distribute stoves • The Wildlife Conservation Society works with local NGO REDO to distribute stoves and monitor adoption	• This can be part of local plans and initiatives or of a centrally led government initiative utilizing local authorities	• If fuels and traditional stoves are purchased, this usually also happens at markets • Fuels are sometimes even sold door to door
% of current improved stoves	**16%**	**14%**	**22%**	**35%**

- Implications -

Cookstove programs should make best use of the proven distribution channels that are in place: Local markets, local authorities and NGO networks

Sources:
RBESS 2009, Interviews

GLOBAL ALLIANCE FOR CLEAN COOKSTOVES

Major Cookstove Initiatives in Rwanda – Government

The Ministry of Infrastructure and its implementation arm EWSA are currently the key government agencies that deal with cookstoves

	Ministry of Infrastructure	Energy, Water & Sanitation Authority	Rwanda Environment Management Authority	Ministry of Health
Who	The Ministry of Infrastructure is responsible for Energy, the key driver for the Rwandan governments' involvement in cookstoves	The implementation arm of the governments energy sector	Environmental authority. REMA are a powerful government body in Rwanda, they can veto projects which have are deemed to have an unacceptable environmental impact	The Ministry of Health is working to improve the Rwandan population's health situation
What	Determine energy policy (including cookstoves), determine potential tax breaks/subsidies for clean energy technology	Manufacturing and distributing ICS (charcoal and wood) - utilizing local cooperatives. Also working on improved charcoal techniques and opportunities to streamline the charcoal supply chain	Houses the DNA (Designated National Authority) for CDM; in this function the managing authority on two CDM cookstove projects in Rwanda. Would like to get more projects	Working to raise awareness of indoor air pollution and possible mitigations through Community Hygiene Clubs and various other channels
Challenges	Funding	Increasing demand - currently proves difficult to demonstrate the long term cost efficiency and hence justify the increase in upfront expense	Struggling to assist those interested in CDM in accessing local capital and knowledge	Low current awareness of health effects of indoor air pollution and the lack of simple, affordable solutions
Partners	Other Rwandan Ministries, EWSA, REMA, RDB, RBS, RURA	Practical Action Consulting	UNFCC, Ministry of Infrastructure, EWSA	Other Rwandan Ministries, World Vision, UN, USAID, World Bank, Unicef
Scope	All cookstove projects in Rwanda	Implementation of all government cookstove initiatives	Involved in all carbon financing projects	Not directly involved in any initiatives. Can be used to raise awareness/draw on community health relationships

Sources:
Interviews, organization websites

Major Cookstove Initiatives in Rwanda – Private Sector

The private sector is dominated by smaller players, with no larger organization importing or manufacturing stoves at scale yet

	Practical Action Consulting	Inyenyeri	Enedom	Manna Energy
Who	Practical Action provide consultancy solutions in the areas of energy, market development and climate change.	Social enterprise, started two years ago by a successful US serial entrepreneur	Rwandan entrepreneur based in Kigali. Earlier was involved with briquettes, now focussing on CDM	Start-up company of US engineers, based in Kigali
What	Consultancy working alongside EWSA to implement the improved cookstoves projects after winning the RFPs for both the urban and rural project in 2009	Importing and distributing clean gasified stoves which will be used to burn the company's biomass pellets. Capable of implementing the end-to-end project management: research/manufacture/ distribution/monitoring	Importing Save80 stoves from Germany, and assembling/ distributing them in Rwanda. The stoves are subsidized by means of carbon financing	Institutional stove manufacturer/distributer. Looking to enter the household cookstove sector
Challenges	Restricted by available government funding	Needs to build additional pelleting capability to expand - large amount of capital expenditure required. Also needs to build a sizeable infrastructure network to support the business model	Potentially difficult to achieve Government backing since it rivals the EWSA stoves	The institutions are keen to realize the long term cost savings, but lack the capital upfront. Manna Energy cannot provide financing support at present
Partners	EWSA	Philips	Atmosfair	Del Agua
Scope	Independent consultancy heavily involved in the cookstove sector in multiple countries (often alongside gov.)	Very limited at present as the model requires easy access to a local pelleting plant/biomass hub – not yet available	Available to scale up, but too expensive for most rural households despite proven long term savings	Extensive (been contracted to work on a project to distribute ½ million stoves) although the project is in its infancy

Sources:
Interviews, organization websites

Major Cookstove Initiatives in Rwanda – Private Sector (continued)

The private sector is dominated by smaller players, with no larger organization importing or manufacturing stoves at scale yet

	Co2balance	UpEnergy	The Paradigm Project
Who	Established in 2003, offers carbon footprint calculation, management and reduction services through carbon finance projects	Recently started company from US focused on utilizing carbon financing for cookstoves projects	Social enterprise started in US. Purpose of Paradigm is to address poverty in a sustainable way
What	Looking to disseminate improved woodstoves in Rwanda at a very low price by using carbon finance. Aiming to start in 2012 and scale up upon availability of investors	Utilize CDM and Gold Standard to obtain finance for large scale projects Currently starting up a Cookstoves CDM PoA in Rwanda	Managed large scale efficient cookstove distribution projects across Kenya, Guatemala and Haiti (35,000 rocket stoves to date), currently entering the Rwandan market.
Challenges	Ability to start projects depends on carbon markets, which are inherently very volatile. Investors may ask to charge a higher price for the stoves, which can impede rapid dissemination	Yet to identify a partner in country who can scale up sufficiently to manage a large scale carbon finance cookstove project	Extremely difficult to do consumer lending; therefore looking to provide financing at retailer level, that should be structured in such a way that retailer can provide financing options to consumers
Partners	Working on carbon finance with REMA and RDB and with local NGOs on implementation	Impact Carbon, ClimateWedge	Working alongside Rwandan government
Scope	No stoves distributed yet, but looking to start soon with a 15,000 stoves project and scale up to possibly 300,000 stoves	Currently small - previous experience of managing large scale cookstove projects in the region	Currently small - previous experience of managing large scale cookstove projects in the region

Sources:
Interviews, organization websites

Major Cookstove Initiatives in Rwanda – NGOs

Various NGOs are distributing stoves but some of the largest, most influential players are highlighted below

	CARE International	SNV	UNHCR	Wildlife Conservation Society	World Vision
Who	CARE is a global humanitarian organization fighting poverty with a focus on women and working with communities	SNV were one of the Alliance's founding partners and have been involved in Rwanda since 1980. They have primarily run biogas programs but are now interested in expanding into cookstoves.	The UN Refugee Agency, managing the 3 Rwandan refugee camps – currently there are 55,000 refugees in Rwanda.	The Wildlife Conservation Society, founded in 1895, has the clear mission to save wildlife and wild places across the globe.	World Vision is a Christian relief, development and advocacy organization working with communities to overcome poverty and injustice.
What	Work with local communities to train artisans how to produce more efficient stoves	Working with the Rwandan government to distribute biogas plants	Looking to reduce fuel costs via stoves with increased efficiency, and have started a pilot	Provide improved stoves to people close to Nyungwe forest, educate on use and monitor adoption.	Train community members on stove use and installation, and install stoves in vulnerable households
Challenges	Funding and quality control	Biogas plants are very expensive and require at least two cows. Also, limited funding to research/promote biogas opportunities	Funding	Just started	Unknown
Partners	KIST, Aprovecho Research Centre	Rwandan government, Dutch government (until 2011)	WFP	Ministry of Infrastructure	Unknown
Scope	Large. Very strong, trusted relationship at the local community level	Medium. Most effort is focused on biogas - much slower uptake than desired	Large. Opportunity to perform controlled pilot studies and improve lives for the most needy	Small. Only indirectly involved in small project in the South	Medium. Seem to have various local projects

Sources:
Interviews, organization websites

Major Cookstove Initiatives in Rwanda – Academic

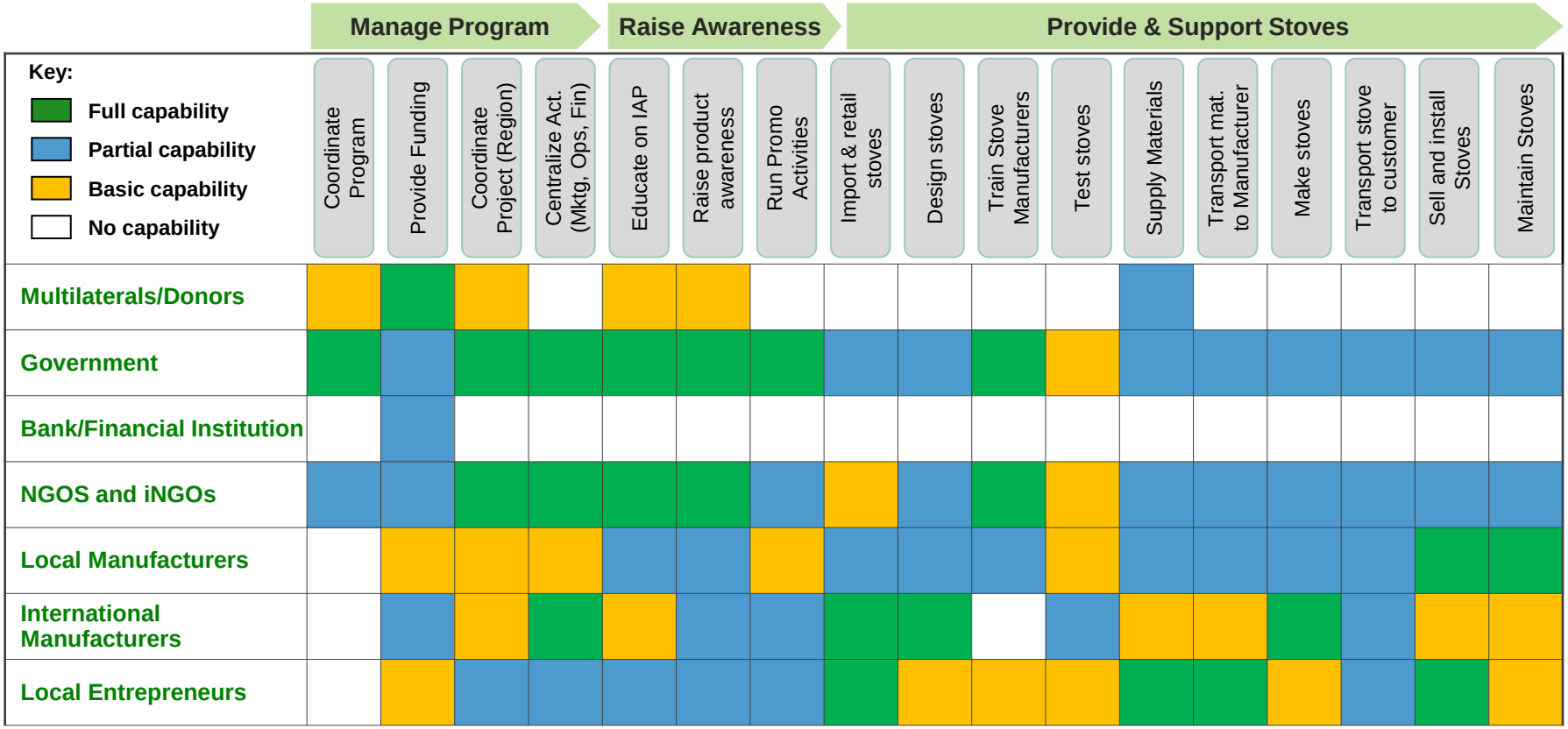
The Kigali Institute for Science and Technology is the only academic institution in Rwanda that is involved in cookstoves and has limited resources

	Kigali Institute for Science and Technology	MIT D-lab
Who	Research institution linked to the government. Well placed to act as an independent test center/hold knowledge capital gained in the sector	D-Lab is a program at the Massachusetts Institute of Technology (MIT) that fosters the development of appropriate technologies and sustainable solutions within the framework of international development.
What	KIST has developed a cookstove testing facility which has been used by various sectors of the Rwandan Cookstove Market – large and small players (CARE, Practical Action, Mosaic Foundation etc.)	D-Lab have pursued technical solutions to the issue of inefficient cookstoves in Rwanda. Developed improved charcoaling techniques, using agricultural waste; looking to use this technique commercially in Rwanda
Challenges	No funding available to maintain the testing laboratory/invest in technology to perform the emissions tests. No relationship with other independent research centers/testing labs in East Africa	Limited connections to in-country companies/institutions
Partners	Ministry of Education, CARE International, Aprovecho Research Centre	-
Scope	Not currently utilized. Large potential to act as a centre of excellence/independent test centre/research facility	Large impact potential for deforestation. If the agricultural charcoal has lower emissions the health impacts could also be considerable

Sources:
Interviews, organization websites

Cookstove Industry Value Chain

Rwanda has basic capabilities across the value chain; stove testing and last mile distribution are key gaps



- Implications -

Cookstove programs should take advantage of the many competencies of the different players across the value chain; stove testing and last mile distribution capabilities should be strengthened

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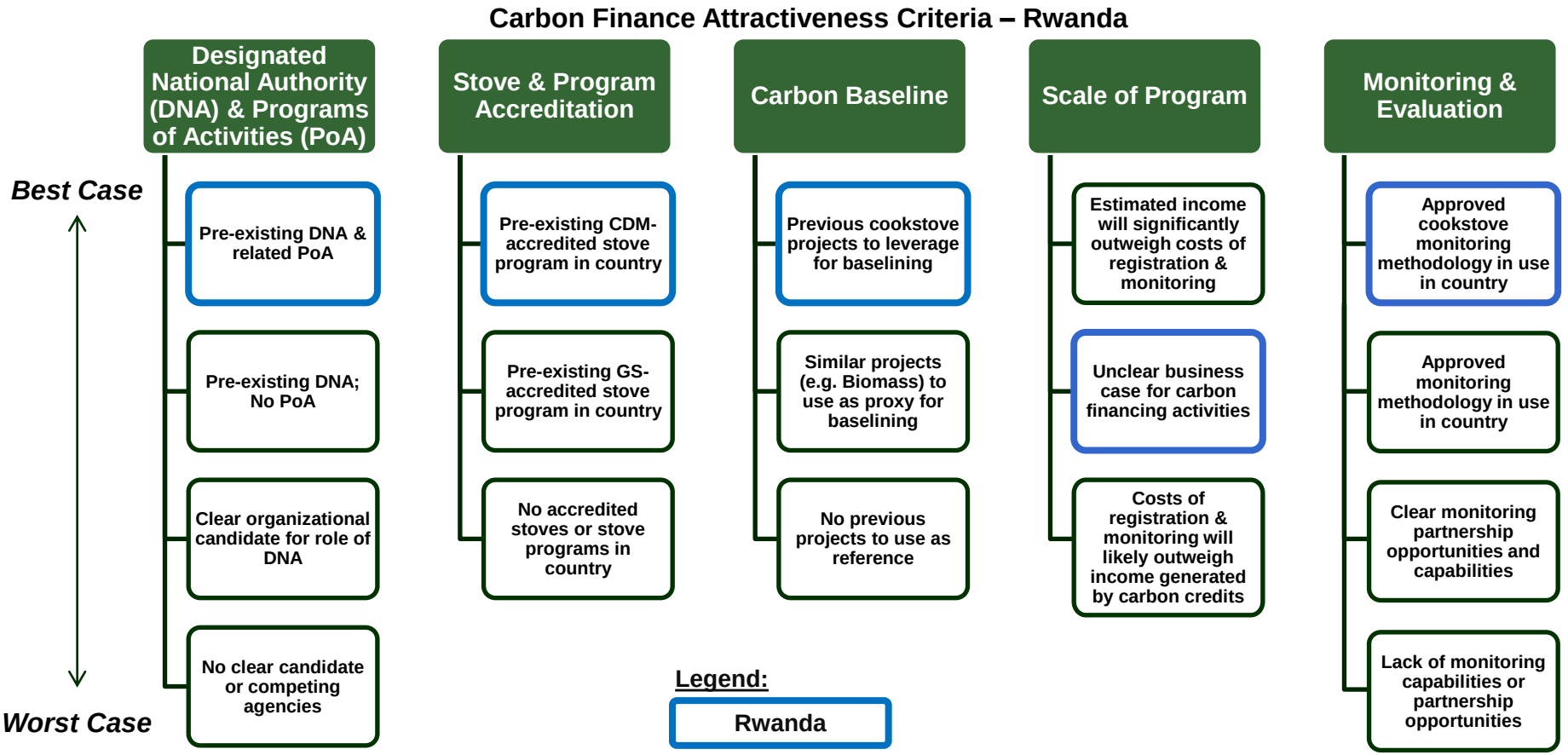
  - Social and Environmental Impact Assessment
  - Consumer Assessment
  - Cookstove Industry Assessment
  - Carbon Financing
- Sector Mapping Summary

Carbon Finance Market Attractiveness

The government is proactively seeking carbon financing within the wider energy sector[1]



- Implications -

Rwanda ranks highly on the market attractiveness criteria for cookstove programs. Companies with large carbon financed cookstove projects elsewhere are actively looking to enter the market and build on in-country precedents

Sources:
[1]National Energy Policy and Strategy (MININFRA, 2011)

Carbon Finance Landscape

The Designated National Authority, positioned within REMA, is looking to incorporate additional cookstove PoAs and is working to design a framework to streamline the process

Carbon Financing Landscape – Rwanda

Area	Data	Comments
Designated National Authority	REMA (Rwanda Environment Management Authority) Contact: Mr. Jean Ntazinda, National Project Coordinator	DNA are proactively building local capabilities to reduce costs/time as well as developing a streamlined framework
Current CDM Projects/PoA	0 stove projects registered 2 PoAs awaiting validation (Atmosfair, East African Carbon Bureau)	UpEnergy (experienced player within the carbon financed cookstove sector) is looking to implement a CDM PoA. Del Agua is accessing the viability of an ICS/water purification CDM PoA in partnership with Manna Energy
Gold Standard Projects/PoA	0 stove projects registered 1 PoA awaiting validation (CO_2 balance)	DNA take a supporting role in establishing VCM projects e.g. acting as a signposting service. CO_2 balance are also accessing CDM opportunities
Accredited Cookstove Programs	No	No programs accredited to date
Current approach	Projects in Rwanda are selling credits in advance to fund price reductions for the stoves, increasing accessibility	This is the current status from the interviews conducted. Other parties may intend to use the credits to ensure the project is sustainable e.g. maintenance
Other Mechanisms	None	-

Selected Carbon Finance PoAs

Although there are no cookstove projects utilizing carbon finance at present, there are 3 PoAs currently awaiting validation and more in the pipeline

	think • go climate conscious atmosfair	co2balance.com	UGANDA CARBON BUREAU
	• Improved cookstove program for Rwanda	• Parc de Volcan	• Improved Cook Stoves for East Africa (ICSEA)
Overview	• Project Owner: Atmosfair Gmbh • Implementer: Enedom • Certification: CDM • Status: Awaiting Validation • Crediting Period: 10 years	• Project Owner: CO2 Balance • Implementer: CO2 Balance • Certification: VCM GS • Status: Awaiting Validation • Crediting Period: 7 years x 3	• Project Owner: UCB • Implementer: UCB • Certification: CDM • Status: Awaiting Validation • Crediting Period: 7 years x 3
Description	• Aim to distribute more than 8,000 SAVE80 cookstoves across Rwanda over 10 years • The 'cooking package' contains 1 SAVE80, 2 pots and a wonderbox to decrease cooking time	• Looking to install 500 stoves a week produced centrally in country to avoid import costs/ transport emissions and ensure quality assurance • Utilize the local NGO network • $2 for installation (split between the local NGO and used to fund the follow up), ensures buy-in • Risk that the 'free' stove could distort the market and IAP concerns, moving the stove indoors without a chimney	• Looking to implement stoves across 6 countries in East Africa • Multi-lateral approach, working closely with organizations such as GIZ, CARE, DFID • Aiming to distribute the Okelo Kuc charcoal ICS (in 3 sizes) • Aiming to expand to PoAs covering renewable energy, domestic biogas, energy efficiency amongst others

Overall CF Market Attractiveness

Rwanda has a unique opportunity to leverage existing carbon financing activities to support clean cookstove programs; however, there are a few risks

Highlighted Market Strengths

- **Existing Designation National Authority. CDM and VCM PoAs awaiting verification**
- **High fraction of non-renewable biomass: large potential return for credits**
- **Several organizations with a proven carbon credit background are looking to start projects in Rwanda e.g. Paradigm Project, UpEnergy**
- **The DNA is actively building local CDM process/documentation capabilities to reduce costs/dependence. 30 local consultants trained to date**
- **DNA actively looking for synergies with other East African countries**

Ideal Market Conditions for Cookstove Program Carbon Financing in Rwanda

Potential Risks

- Reliance on laborious monitoring and evaluation processes (*DNA is working to close this gap)*
- CDM and VCM still viewed as complex, time-consuming and costly
- No credits claimed in Rwanda for ICS to date – there may be risks/issues which are not yet visible
- Additionality could be difficult to prove since many people with ICS continue to use charcoal for staple food
- Access to capital is very limited in country – most projects would need external funding

"The DNA is very good in Rwanda, we had no major issues ... although REMA and RDB sometimes conflict, causing minor delays"
– Carbon Finance Enterprise

- Implications -

There is considerable potential in Rwanda for carbon financing and the government is trying to standardize the process and reduce costs; however, access to capital is still a major concern

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Cookstove Industry Summary

Sector Mapping Summary

The Rwanda cookstove sector has significant potential with a strong case for the use of ICS, a supportive government and quickly growing cookstove sector

Macro

- \+ Strong government supports and drives adoption of ICS
- \+ Relatively high primary school attendance
- \+ High deforestation rate presents strong case for national adoption of ICS
- − High poverty levels harden selling of stoves
- − Little industry present, import is hindered by lack of seaports and railroads
- − Relatively small market

Moderately Favourable

Social Impact

- \+ Number of IAP related health problems creates a strong case for change
- \+ Huge reliance on biomass fuel means almost entire population belongs to target market
- \+ ICS can save many people a lot of money or time

Favourable

Consumer

- \+ Relatively high awareness of improved stoves
- \+ Consumer segments are fairly similar, enabling large scale interventions
- − Awareness of IAP and last mile availability of good stoves remain an issue in rural areas
- − Very low affordability amongst those with the greatest need; little financing options available

Moderately Favourable

Cookstove Industry

- \+ Government and NGOs are heavily involved in cookstove sector
- \+ Many new private sector initiatives currently starting up
- − Limited capability to reach last mile customers
- − No in-country production at large scale
- − Quality control is an issue; no testing facilities and standards

Moderately Favourable

Carbon Finance

- \+ Very attractive CF market characteristics
- \+ CDM and VCM projects in country
- \+ High fraction of non renewable biomass
- \+ Strong governance
- − The current projects are still in their infancy
- − High upfront costs combined with limited availability of credit is a substantial barrier
- − Small market size could restrict large scale projects

Favourable

- Implications -

There is significant potential for market growth if consistent quality, last mile distribution and economic accessibility can be ensured and consumer awareness can be increased

GLOBAL ALLIANCE FOR CLEAN COOKSTOVES

Glossary of Terms

Below is a list of commonly used acronyms used throughout the report and presentation:

AIDS	Acquired Immunodeficiency Syndrome
ALRI	Acute Lower Respiratory Infection
BEST	Biomass Energy Strategy
CDM	Kyoto Clean Development Mechanism
CF	Carbon Finance
DALY	Disability Adjusted Life Year
DNA	Designated National Authority
EWSA	Energy, Water & Sanitation Authority
GDP	Gross Domestic Product
HH	Household(s)
HIV	Human Immunodeficiency Virus
IAP	Indoor Air Pollution
ICS	Improved Cookstove
ICT	Information and Communication Technologies
iNGO	International Non-Governmental Organization
KIST	Kigali Institute for Science and Technology
LPG	Liquid Petroleum Gas
M&E	Monitoring and Evaluation
MFI	Microfinance Institution
MININFRA	Ministry of Infrastructure
MOH	Ministry of Health
NGO	Non-Governmental Organization
PoA	Programme of Activities
RBESS	Rwanda Biomass Energy and Stoves Survey
RFP	Request for Proposal
Rwf	Rwandan Franc
SME	Small to Medium Sized Enterprise
UN	United Nations
UNHCR	United Nations High Commission for Refugees
USD	US Dollars
VCM	Voluntary Contribution Mechanism
WHO	World Health Organization

GLOBAL ALLIANCE FOR CLEAN COOKSTOVES

Glossary of Stakeholder Abbreviations

- **BPR- Banque Populaire du Rwanda**
- **EADB- East African Development Bank**
- **Enedom- Energie Domestique**
- **EMS- Entreprise Multiservices**
- **EWSA- Energy, Water and Sanitation Authority**
- **GHI- Gardens For Health International**
- **IB&C- Inclusive Business & Consultancy**
- **KBP- Karisimbi Business Partners**
- **KIST- Kigali Institute for Science and Technology**
- **MINAGRI- Ministry of Agriculture**
- **MINALOC- Ministry of Local Government**
- **MINECOFIN- Ministry of Finance and Economic Planning**
- **MINEDUC- Ministry of Education**
- **MININFRA- Ministry of Infrastructure**
- **MINIRENA- Ministry of Natural Resources**
- **MOH- Ministry of Health**
- **MIT D-Lab- Massachusetts Institute of Technology Development Lab**
- **MTN- Mobile Telephone Networks**
- **REMA- Rwanda Environment Management Authority**
- **RDB- Rwanda Development Board**
- **RNRA- Rwanda Natural Resources Authority**
- **RBS- Rwandan Bureau of Standards**
- **RALGA- Rwandese Association of Local Government Authorities**
- **SNV- Netherlands Development Organisation**
- **UNHCR- United Nations High Commissioner for Refugees**
- **WCS- Wildlife Conservation Society**
- **WFP- World Food Program**

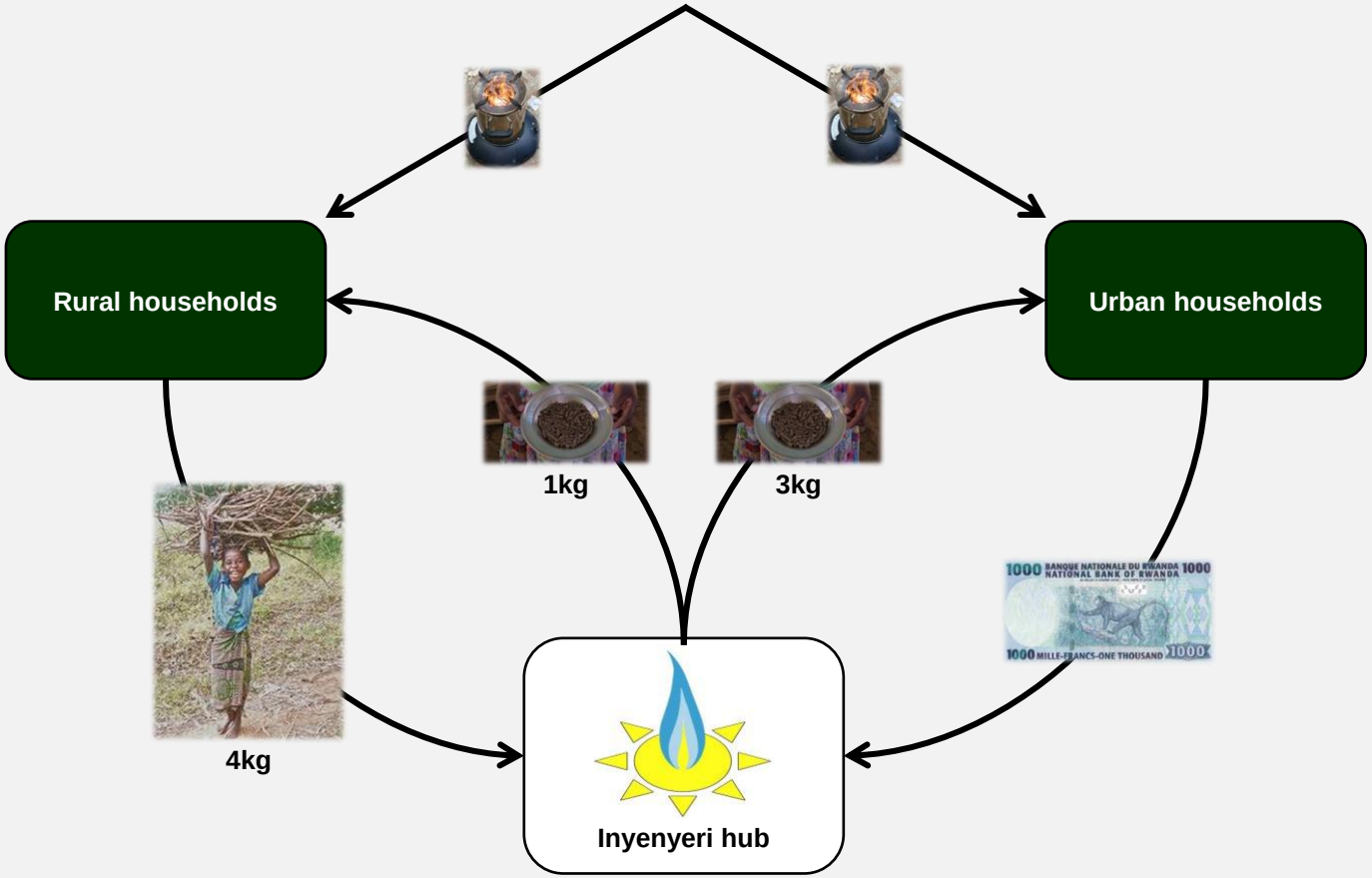
Case Study A: Inyenyeri business model (1/2)

- **Organization :** Inyenyeri
- **Region:** Gisenyi
- **Stove:** Philips Gasified Stove; other stoves to be added
- **Fuel:** Biomass Pellets
- **Price:** Distributed for free; *price is around $60*
- **Funding:** *(see the next slide for a visualisation)*
  - ✓ Biomass is crowd sourced by rural communities. The biomass is used to create high density pellets, which are four times as efficient as traditional wood fuels. The pellets are then distributed to the biomass collectors for free and sold to those who would rather pay for fuel (typically those in urban areas). For all customers, the stoves will be distributed for free and the fuel will be sold for a price lower than charcoal
- **Stoves Distributed:**
  - ✓ In pilot, RCT are being used to gather detailed information regarding cooking practice, consumer feedback, Willingness To Pay for fuel etc.
- **Best Practices:**
  - ✓ The stoves are consistently very high quality since they are mass produced by Philips
  - ✓ The efficiency is impressive (¼ of biomass is required)
  - ✓ The carbon and IAP emissions are drastically reduced (meeting European and American standards)
  - ✓ The cooking experience is familiar, with greater control over fuel use/temperature – the stove is hotter than traditional methods

GLOBAL ALLIANCE FOR CLEAN COOKSTOVES

Case Study A: Inyenyeri business model (2/2)

1 Stove of choice (currently only Philips gasifier stove) is provided for free to rural and urban households

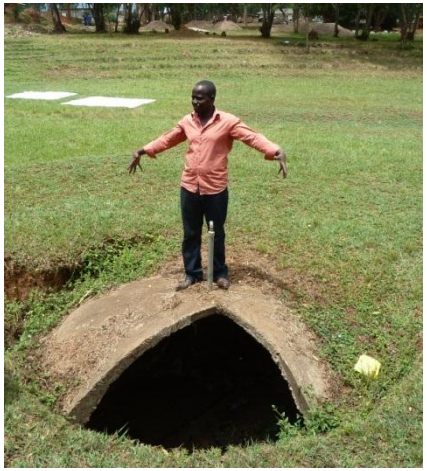


2 Households obtain the biomass pellets from the Inyenyeri hub in return for collected biomass (rural areas) or money (predominantly urban areas). The high efficiency of the pellets allows 4 households to cook on the biomass collected by 1 household

GLOBAL ALLIANCE FOR CLEAN COOKSTOVES

Case Study B: Biogas plants

- **Organization :** SNV, MININFRA (Household), *Central Government* (institutions)
- **Region:** Nationwide, although most concentrated in Kigali district
- **Stove:** Ecocina
- **Price:** Cheapest household plant: 650,000 RWF (1,100 USD)
- **Funding:**
  - ✓ Government subsidy: 300,000 RWF (500 USD)
  - ✓ Scheme is not accessible for the bottom of the pyramid; to qualify, the household must have at least 2 cows
- **Stoves Distributed:** 2,000 household biogas plants. 13 prisons use biogas
- **Best Practices:**
  - ✓ The cooking experience is very pleasant – simple to use, clean flame, easy to control, high temperatures easily obtained
  - ✓ Emissions are dramatically reduced
  - ✓ The slurry can be used as a high quality fertiliser
  - ✓ The biogas can also be used to provide lighting
  - ✓ Using biogas in the prisons has resulted in dramatic cost savings ($1.7 million USD/year) and a reduction in deforestation
  - ✓ The households have readily adopted the new cooking style – raised stoves (less likely to result in back problems when cooking for prolonged periods)



Case Study C: Improved Charcoal Stove: Canamake

- **Organization :** EWSA /Practical Action
- **Region:** Several districts (selection criteria – availability of raw materials/skills), plan to become national.
- **Stove:** Improved charcoal stove - Canamake
- **Price:** 4,000 RWF (6.5 USD)
- **Funding:**
  - ✓ Driven by market forces, stoves aren't subsidised
  - ✓ The stoves are produced by local cooperatives (in-built QA processes)
  - ✓ EWSA/Practical Action help establish the cooperatives, train the staff and provide the kilns/moulds (although these costs are partly recovered once the cooperative is established)
- **Stoves Distributed:** 1,200 canamake stoves distributed
- **Best Practices:**
  - ✓ 35% reduction in IAP, 40% reduction in charcoal
  - ✓ Builds skills of local artisans
  - ✓ The stoves look similar to traditional charcoal stoves, but are Quality Assured. As such, there is a registered trademark in country which is displayed on the stove and in corresponding marketing/training material. The consumers are aware of the benefits regarding emissions and efficiency
  - ✓ Not reliant on subsidies/donors –more sustainable
  - ✓ Demonstrates that a market is available

Pictures taken from:
Dissemination of Improved Cook Stove in Urban Rwanda, Project Progress Brief, 2011.

Case Study D: CARE - artisan woodstoves

- **Organization :** Care
- **Region:** 24/400 sectors of Rwanda (funding limitations)
- **Stove:** Improved wood stove
- **Price:** 3 stove types: 1000-2000 RWF; 3000 RWF; 12,000 RWF (with chimney)
- **Funding:**
  - ✓ The stoves are not subsidised – uses a 'train the trainer' model to enable local artisans to produce higher quality stoves
  - ✓ The initial training/monitoring is expensive and funding is no longer available
- **Stoves Distributed:** Trained 1,200 artisans first hand to be able to train 8,000 in total, aims to reach 24,000 households
- **Best Practices:**
  - ✓ Builds skills of local artisans
  - ✓ Worked with several major players in Rwanda and internationally including Aprovecho (who speak highly of the stove improvements) as well as local educational institutions e.g. KIST
  - ✓ Proactively focused on training women and ensuring they were involved with all stages of the project
  - ✓ Utilized a very strong grass roots presence in the poorest communities to understand consumer desires and establish buy-in from the community

Picture taken from:
http://praktiblog.files.wordpress.com/2011/08/rwanda.jpg

Case Study E: Enedom – cooking 'package'

- **Organization :** Enedom
- **Region:** District of Kigali
- **Stove:** Save80 + 2 pots + 'wonderbox'
- **Price:** 55,000 RWF (92 USD)
- **Funding:**
  - ✓ The stoves are sold in the market at a price reduced by carbon credits, no additional subsidies
  - ✓ Atmosfair are the implementing partner. Without carbon credits, the cooking package costs in excess of 100,000 RWF
- **Stoves Distributed:** 270 stoves sold since August 2011
- **Best Practices:**
  - ✓ Split manufacture: the parts are mass produced in Germany (high levels of quality control) and assembled in Rwanda (supporting the local economy)
  - ✓ Provides a holistic cooking package, ensuring the pans are a perfect fit for the skirt
  - ✓ The wonder bags reduce cooking time for all stove types and Enedom stressed that these have been very popular
  - ✓ Innovative distribution model – works with local factories to set up an installation payment scheme

Case Study F: Charcoal supply chain

- **Organization :** CARE/EWSA
- **Region:** Country-wide
- **Stove:** N/a
- **Price:** N/a
- **Funding:**
  - ✓ Project funded by the central government: EWSA/MININFRA – funding has expired
- **Stoves Distributed:** N/a
- **Best Practices:**
  - ✓ EWSA and CARE worked together to perform primary research into the charcoal value chain. Charcoal is currently unregulated, with quality and price differing considerably by region. Low quality charcoal can contain a high proportion of dust, in addition to poorly carbonised charcoal producing additional harmful emissions when burnt
  - ✓ The charcoal is typically produced in an inefficient manner, resulting in an excess of trees being unnecessarily deforested
  - ✓ The project looked into improved carbonisation techniques (halving the quantity of wood needed to produce the charcoal), developed by a local consultant – the technique was awarded the SEED Award
  - ✓ Aimed to cleanse the supply chain, increasing transparency thus lowering cost in urban areas and ensuring a fairer price for the producers
  - ✓ Official trademarks/brands were to be introduced to ensure the end consumer could have confidence in the quality of the charcoal
  - ✓ This project, if re-ignited, could benefit all charcoal stove projects and severely reduce deforestation

Case Study G: Agricultural charcoal

- **Organization :** MIT D-Lab
- **Region:** Based at MIT, US
- **Stove:** N/a
- **Price:** N/a
- **Funding:**
  - ✓ Private
- **Stoves Distributed:** N/a

Fuel from the fields - background.xps

- **Best Practices:**
  - ✓ Developed a technique to produce briquettes from agricultural waste
  - ✓ Can be produced locally and cheaply using readily available materials. Turning waste into a potential income stream for some of the poorest in society
  - ✓ Addresses the issue of deforestation for fuel wood
  - ✓ Considerably reduces household emissions compared with burning wood
  - ✓ Since charcoal stoves are likely to remain popular in the immediate future, this could be an immediate game changer with regard to boosting the income of rural households (currently an issue with regard to ICS) and tackling deforestation
  - ✓ Pilot studies could be executed very cheaply (minimal start up costs) – the guide to manufacture is available here
  - ✓ 1000 local producers have been trained globally to date – across 20+ countries
  - ✓ One of 22 winners (out of more than 2,000 entries) in the 2007 World Bank Development Marketplace Competition

Case Study H: Del Agua Health Rwanda Program

- **Organization:** Del Agua/Manna Energy
- **Region:** PoA is designed to include rural Rwanda and several other countries (TBC)
- **Stove:** High-efficiency cookstove (TBC)
- **Price:** TBC
- **Funding:**
  - ✓ Private
  - ✓ Water treatment and improved cookstove project, funded by carbon credits using a CDM PoA and CPA
- **Stoves Distributed:** N/a – project will start in 2013
- **Best Practices:**
  - ✓ Planning to distribute point of use water treatment and high efficiency cookstoves to approximately 2 million residents in Western Rwanda
  - ✓ Utilizing carbon financing
  - ✓ Working in partnership with the Ministry of Health and REMA
  - ✓ Long term strategy looks to expand the PoA into several countries