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
  - Indoor Air Pollution Assessment
  - Consumer Assessment
  - Cookstove Industry Assessment
  - Carbon Financing
Sector Mapping

Executive Summary

Macro

- Brazil is a large and diverse country of 191 million people, 86% of which lives in urban areas; however **26% of the population still lives below the poverty line, mainly in the North and Northeast**

- Brazil has a relatively **stable** government but a **slow government decision making process**. The country has adopted a number of progressive energy policies in the past

- The country has **favorable business conditions and a good infrastructure**. It is also rich in energy resources, both fossil and bio fuel

- This study focuses on the **Southeastern state of Minas Gerais** which has a strong tradition of woodstove cooking

- Minas Gerais replicates Brazil's economic and ecological diversity and has **strong manufacturing and distribution capabilities** with easy access to the underdeveloped North and Northeast regions of Brazil

IAP

- IAP in Brazil is caused by solid fuel usage in poorly designed stoves with poor ventilation facilities
  - **30% of the population still uses solid fuels** as either primary or secondary fuels

- **IAP awareness within the Government is low**, mainly because they believe the issue has been addressed by providing 95% of households with access to LPG. Although there is moderate awareness in the population, many households continue to use **fuelwood for economic reasons**

- Two ongoing programs disseminate **stoves in the Northeast region**; some cookstove programs are exploring alternate fuels such as **ethanol and biogas**

- **Several ongoing non-cookstove programs can be made to include cookstoves**, e.g., One Million Cisterns Program, Electricity for All, Family Health, and Forest Management
Sector Mapping

Executive Summary

Consumer

- Minas Gerais is **famous for its woodstove cuisine** which makes woodstove ownership a matter of tradition and pride
- Minas Gerais has a variety of dishes that require a cookstove with multiple burners. Characteristics such as **high heat, hot plate and oven drive up the cost of woodstoves**
- Of the 6.1 million households in Minas Gerais, more than 70% use only LPG. **1.1 million households depend on firewood as a primary cooking fuel** and are targets for a cookstove intervention

Cookstove Industry

- Brazil has a **well-developed cookstove industry** comprising of manufacturers, distributors and retailers, specializing in traditional woodstoves in the South and LPG stoves across the country. Minas Gerais has a notable woodstove component industry and **two efficient woodstove manufacturers**
- LPG has penetrated 95% of households; however LPG is considerably more expensive than **fuelwood, which is abundant and can be foraged easily**. Efficient woodstoves have limited penetration because of their high price
- Ethanol production and prices are linked to the sugarcane harvest and world sugar demand, causing price and supply volatility. The current retail price is unattractive for cooking purposes, however there is a potential for **cooperatives in sugarcane growing areas to produce ethanol for local consumption**
- There is **potential for alternate fuels** such as biogas in the cattle farming regions and sustainable biomass from macauba (native palm) plantations

Conclusion

- Overall Minas Gerais has a favorable environment in terms of doing business and having an existing cookstove supply chain. The macro, IAP and consumer environment are less favorable due to lack of Government interest, high consumer switching cost, moderate awareness, and NGO inactivity to address the IAP issue
## Content

<table>
<thead>
<tr>
<th>Executive Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Approach</strong></td>
</tr>
<tr>
<td>Sector Mapping</td>
</tr>
<tr>
<td>Macro Environment Assessment</td>
</tr>
<tr>
<td>Indoor Air Pollution Assessment</td>
</tr>
<tr>
<td>Consumer Assessment</td>
</tr>
<tr>
<td>Cookstove Industry Assessment</td>
</tr>
<tr>
<td>Carbon Financing</td>
</tr>
</tbody>
</table>
A structured approach was first used to assess the market for a cookstove industry and then the sector mapping output was used to develop the intervention options and operational plan.

**Sector Mapping**

- Module One: Macro Environment
- Module Two: IAP Analysis
- Module Three: Customer Segmentation
- Module Four: Industry Analysis
- Module Five: Carbon Financing

**Project Approach**

- Identify Intervention Themes
- Develop Recommendations
- Develop Operational Plan

**Strategy Development**

- Module One: Macro Environment
- Module Two: IAP Analysis
- Module Three: Customer Segmentation
- Module Four: Industry Analysis
- Module Five: Carbon Financing

**Intervention Options And Operational Plan**
Sector Mapping Approach

Sector Mapping for a cookstove industry was conducted in four dimensions – macro environment, indoor air pollution, cookstove consumer, and current cookstove industry

- **Social**: What are the country demographics and population distribution across regions?
- **Political**: What is the political environment, how stable is government and what political risks will any program face?
- **Economic**: How much money do our potential customers have and what is their economic cycle?
- **Technological**: How sophisticated is the infrastructure in our region and what is the plan for progress?
- **Environmental**: How do ecological conditions impact the success of an IAP programme?

- What is the current IAP exposure profile of our target market? Primary cause of IAP and size of problem?
- What lessons can we learn from historic IAP programs?
- What are the opportunities / threats of current and future IAP programs?
- Who are the key actors involved in IAP programs?
- 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?
- What types of cooking devices are currently owned and used within the region?
- Who are the main cooking device designers & suppliers?
- How attractive is the industry from a commercial perspective and what are likely to be some of the industry challenges?
- What is the attractiveness of the carbon market?
- What current carbon financing projects exist?
Intervention Options Approach

Strategy Development was conducted by using the sector mapping as an input to identify intervention areas, and develop recommendations and an operational plan.

- **Sector Mapping**
  - Catalogue favorable and unfavorable factors contributing to the development of a cookstove industry in the following dimensions:
    - Macro Environment
    - Indoor Air Pollution
    - Consumer
    - Current Cookstove Industry

- **Intervention Themes Identification**
  - Identify possible interventions to promote a clean cookstove industry by:
    - Addressing the unfavourable factors
    - Aligning with the favorable factors

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

- **Operational Plan Development**
  - Develop an operational plan that includes:
    - Detailed immediate next steps
    - Short term (3 - 6 months) activities and milestones
    - Long term (6 months - 2 years) high level directional plan
Acknowledgements

We would like to thank the many organizations which made valuable contributions to this study by sharing their knowledge of Brazil and Minas Gerais and/or their experience in developing clean cookstove initiatives.
## Content

- Executive Summary
- Project Approach
- Sector Mapping
- **Macro Environment Assessment**
- Indoor Air Pollution Assessment
- Consumer Assessment
- Cookstove Industry Assessment
- Carbon Financing
Brazil is the largest country in South America with a population of 191 million. Although 86% is urban, 29 million people still reside in rural areas.

**Population Demographics**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Brazil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Population (2010)</td>
<td>191 M</td>
</tr>
<tr>
<td>Population Growth Rate (2000-2009 CAGR)</td>
<td>1.19%</td>
</tr>
<tr>
<td>Rural / Urban Split</td>
<td>14% / 86%</td>
</tr>
<tr>
<td>Rural Population</td>
<td>29 M</td>
</tr>
<tr>
<td>Total Households</td>
<td>59 M</td>
</tr>
<tr>
<td>Rural Households</td>
<td>9.5 M</td>
</tr>
<tr>
<td>Average Household Size</td>
<td>3.2</td>
</tr>
<tr>
<td>Literacy – Total (%)</td>
<td>90%</td>
</tr>
</tbody>
</table>

**Context**
- Recognized in 1825 as the largest country in South America
- Most populated urban areas are São Paulo, Rio de Janeiro and Salvador
- Official language is Portuguese
- 75% Roman Catholic, 15% Protestant, 10% Other

**Implications**

*Brazil has a large and growing population; therefore even if only a small percentage of the population were targeted by a cookstove program, the potential impact could be significant.*
Brazil is governed by a relatively stable federal government; states are semi autonomous with independent administrative and executive branches

**Brazil District Map**

**Political Environment**

**Structure**
- Democratic republic with a President
- Three distinct political entities: the Federal District, the States, and the Municipalities
- Each municipality has an autonomous local Govt. with a Mayor and legislative body

**Current Government and Related Gov. Program**
- Current Govt. has been led by President Dilma Rouseff since 2011, when he succeeded President Lula
- Bolsa Familia seeks to reduce poverty through a monthly stipend (R$ 68 – R$ 134) to families with per capita income below R$ 140 per month; includes LPG subsidy of R$ 15 every two months
- Ministry of Science and Technology has funds and can be potential investor

**Administrative Map**
- Capital city is Brasilia
- Country is divided into 26 states
- States are subdivided into 5,564 municipalities (municipípios) with an average population of about 34,000 each

- **Implications** -
  Any intervention planning for government participation should carefully consider government priorities and their process of slow decision making

Sources: CIA Country Profile
© 2011 Accenture. All rights reserved – strictly confidential
Brazil is a rapidly growing economy, with a moderately free market offering favorable conditions for new businesses; however, 26% of the population remains under the poverty line.

**Context**
- Brazil has the seventh largest economy in the world (nominal GDP)
- The South of Brazil is wealthier than the North

**Per Capita Monthly Income (2009)**

**Country Economics**

<table>
<thead>
<tr>
<th>Key Indicators</th>
<th>Brazil</th>
</tr>
</thead>
<tbody>
<tr>
<td>GNI Per Capita (2009)</td>
<td>USD 8,070</td>
</tr>
<tr>
<td>Economic Growth Rate (2010)</td>
<td>7.5%</td>
</tr>
<tr>
<td>Inflation Rate (April 2011)</td>
<td>6.5%</td>
</tr>
<tr>
<td>Unemployment (March 2011)</td>
<td>6.5%</td>
</tr>
<tr>
<td>Poverty rate</td>
<td>• 26% of population (50 M) lives below poverty line</td>
</tr>
</tbody>
</table>

**Occupation (2004)**
- Services (34%)
- Agriculture (21%)
- Commerce & Refitting (17%)
- Industry (15%)
- Construction (6%)

**Trade Restriction**
- Incentives available for export
- Low restrictions on foreign ownership in selected sectors

**Micro finance institution**
- Various microfinance institutions are available with approx. 821K borrowers (2009)

---

- **Implications** -

A development program could include the less developed areas in Northeast of Brazil, which would stand to benefit most from a local industry.
## Brazil – Infrastructure and Resources

Brazil has a good transport network, high electricity penetration, and abundant energy resources, however human activities are threatening the ecological environment.

### Infrastructure

| Transportation | • 70% of all transportation is done via roads  
|                | • 5.5% of 1,751,868 km of Brazilian roads are paved (2004)  
|                | • 32.8% of roads are in fair conditions, 19.8% poor and 4.1% bad (2010 survey)  
|                | • 29,000 km railway network  
|                | • Limited network in Amazonas |

| Telecommunication | • 63.6% current cell phone penetration, up from 20% in 2002  
|                  | • Highest rate of internet access among Latin American countries |

| Energy Access | • 97% of households have access to electricity, ~6M people are without access |

### Resources

| Natural Gas | • 15th largest oil producer in the world  
|            | • Proven gas reserves |

| Natural Forest | • 66% of Brazil covered by forest  
|                | • Over 600,000 km³ of Amazon rainforest destroyed since 1970 |

| Charcoal | • 53% of Brazil’s charcoal production came from native forests (2005)  
|         | • States that produce charcoal are Minas Gerais, Mato Grosso do Sul, Maranhao, Bahia and Goias |

| Ethanol | • Second largest ethanol producer in the world  
|        | • Produced 26.2 billion liters in 2009 (30.1% of world’s total fuel ethanol)  
|        | • World’s largest ethanol exporter, 22% of its production exported (2006)  
|        | • Formed partnerships with Nigeria, South Africa and Japan to introduce ethanol as a fuel source |

| Native Plants | • Variety of native plants (E.g. Macauba, Pequi, Africa palm etc.) could be a source of bio-energy  
|              | • National Program for the Production of and Use of Biodiesel (PNPB) initiated by federal government to promote production of biodiesel from plants |

### - Implications -

**A strong energy distribution network and infrastructure are available. A diverse choice of resources are available to design a cookstove program around alternate fuels**

Sources: World Journal of Agricultural Sciences 7 (2): 206-217, 2011; Renewable Fuels Association, CIA World Factbook

© 2011 Accenture. All rights reserved – strictly confidential
The Government’s effort has improved the state of healthcare in recent years, however respiratory system diseases remain one of the top causes of mortality among the general population and children.

### Key Health Indicators

<table>
<thead>
<tr>
<th>Key Health Indicators</th>
<th>Brazil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life expectancy at birth (2011)</td>
<td>72.5</td>
</tr>
<tr>
<td>Infant Mortality per 1000 live birth (2011)</td>
<td>21.17</td>
</tr>
<tr>
<td>New Tuberculosis cases (2007)</td>
<td>92,102</td>
</tr>
<tr>
<td>Incidence of Tuberculosis per 10,000 population (2007)</td>
<td>48</td>
</tr>
</tbody>
</table>

### Main Mortality Causes (2004)

<table>
<thead>
<tr>
<th>Main Mortality Cause</th>
<th>General Population</th>
<th>Children (&lt;5 yrs old)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circulatory system disease</td>
<td>27.9%</td>
<td>1.1%</td>
</tr>
<tr>
<td>Tumors</td>
<td>13.7%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Respiratory system diseases</td>
<td>10.0%</td>
<td>7.9%</td>
</tr>
<tr>
<td>Nutritional and metabolic endocrine diseases</td>
<td>5.2%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Digestive system diseases</td>
<td>4.8%</td>
<td>0.8%</td>
</tr>
<tr>
<td>Infectious and parasitic diseases</td>
<td>4.5%</td>
<td>8.1%</td>
</tr>
<tr>
<td>Infections originated in the prenatal period</td>
<td>3.0%</td>
<td>48.6%</td>
</tr>
<tr>
<td>Urogenital system diseases</td>
<td>1.7%</td>
<td>-</td>
</tr>
<tr>
<td>Nervous system diseases</td>
<td>1.5%</td>
<td>2.2%</td>
</tr>
<tr>
<td>Congenital malformations, deformities and chromosomal anomalies</td>
<td>13.8%</td>
<td></td>
</tr>
</tbody>
</table>

- **Context**
  - Publicly financed health care system
  - Established 24,600 family health teams in 4,986 municipalities through Family Health programs, covering 44% of the Brazilian population
  - Ranks 14th out of the 22 high burden Tuberculosis countries. Accounts for 31% of all Tuberculosis cases in Latin America

- **Implications**

Cookstove programs could explore opportunities to partner with national health agencies to increase outreach for IAP related health education.

Source: Winrock International, CIA Factbook, Kaiser Family Foundation

© 2011 Accenture. All rights reserved — strictly confidential
This study focuses on the South Eastern state of Minas Gerais as a potential region to develop a clean cookstove and fuel pilot that can be scaled to North East Brazil

- **Why Minas Gerais?**

  - Mimics the economic diversity of Brazil within the state
  - Strong cultural attachment to woodstove cooking
  - High population dependent on solid fuels
  - Strong manufacturing and distribution capabilities
  - Two efficient woodstove companies (Ecofogao and Energer) located in capital city Belo Horizonte
  - Borders North and Northeastern states of Brazil which are high priority areas for cookstove intervention
  - Availability of alternate fuels such as ethanol, biogas and palm oil

- **Implications** -

  **Minas Gerais could be a possible testing ground for a cookstove sector; as interventions might be easily scaled to North Brazil**

Sources: Trading Economics, The World Bank, IBGE

© 2011 Accenture. All rights reserved – strictly confidential
Minas Gerais – Social Environment

Minas Gerais is the second most populated state with 10% of Brazil’s population; 13% of Minas Gerais’s population resides in rural areas in the North and Northeast of the state.

- **Context**
  - Capital city is Belo Horizonte
  - 853 (15% of total) municipalities in Minas Gerais
  - State is known for its woodstove cuisine

- **Implications**

  A cookstove program may have high demand in Minas Gerais due to its large population and strong use of woodstoves

Key Indicators

<table>
<thead>
<tr>
<th></th>
<th>Brazil</th>
<th>MG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (2010)</td>
<td>191 M</td>
<td>19.6 M</td>
</tr>
<tr>
<td>Growth Rate (2000 – 2005)</td>
<td>1.7%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Rural Population (%)</td>
<td>14%</td>
<td>13%</td>
</tr>
<tr>
<td>Total Rural Population</td>
<td>29 M</td>
<td>2.5 M</td>
</tr>
<tr>
<td>Total Households</td>
<td>59 M</td>
<td>6 M</td>
</tr>
<tr>
<td>Average family size (2005)</td>
<td>3.2</td>
<td>3.2</td>
</tr>
<tr>
<td>Life expectancy at birth in year (2005)</td>
<td>71.9</td>
<td>74.1</td>
</tr>
</tbody>
</table>

Sources: Trading Economics, The World Bank, IBGE

© 2011 Accenture. All rights reserved – strictly confidential
Minas Gerais – Economic & Infrastructure Env.

The service and industrial sectors make up the largest component of Minas Gerais’ GDP. Income inequality exists within the state - the North and Northeast region have a significantly lower GDP.

- **Context** -
- The southern part of the state has several industrial cities, e.g. Juiz de Fora, Varginha, Pouso Alegre and Pocos de Caldas
- The industrial sector is mainly comprised of: metallurgy (23%), food processing (14%), mining (12%), automotive (12%)

- **Key Indicators** -

<table>
<thead>
<tr>
<th>Region Economics and Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minas Gerais</strong></td>
</tr>
<tr>
<td><strong>GDP (2007)</strong> USD 121 B (9% of Brazil GDP)</td>
</tr>
<tr>
<td><strong>GDP Structure (2007)</strong></td>
</tr>
<tr>
<td>• Services: 60% MG; 66% Brazil</td>
</tr>
<tr>
<td>• Industry: 32% MG; 29% Brazil</td>
</tr>
<tr>
<td>• Agriculture: 8% MG; 5% Brazil</td>
</tr>
<tr>
<td><strong>Import/Export</strong></td>
</tr>
<tr>
<td>• Contributes 10% of total Brazil export and 5% of total import (2008)</td>
</tr>
<tr>
<td><strong>Entrepreneurial Activities Support</strong></td>
</tr>
<tr>
<td>• Available through organizations such as FIEMG, SEBRAE</td>
</tr>
<tr>
<td>• 700K+ active companies in FIEMG</td>
</tr>
<tr>
<td><strong>Highway Network</strong></td>
</tr>
<tr>
<td>• Largest highway network</td>
</tr>
<tr>
<td>• Minas Gerais’s road network integrates Brazil’s North/ Center North region with South/ South East region</td>
</tr>
<tr>
<td>• The state will upgrade and expand its road network with $137 million IDB loan (2010)</td>
</tr>
</tbody>
</table>

- **GDP per Capita** -

GDP per capita is the lowest in the North/ Northeast region.

- **Implications** -

**Minas Gerais has a good industrial and business environment that could lend support to the development of a clean cookstove sector. The state is well connected to Northeast Brazil’s distribution system.**

Minas Gerais produces 8% of Brazil’s ethanol, mainly in the western region; cane is planted across the state and there is abundant cattle farming in the North.

- Minas Gerais is the third largest ethanol producing state in Brazil.
- Cane plantations across the state suggest potential for community owned Ethanol Micro Distilleries.
- Strong concentration of ethanol producers suggests potential for a targeted solution for areas in close proximity.

- Byproducts from cattle farming could be a potential source of biogas, an alternative fuel source.
- Biogas plantations could provide value adds such as electricity, fertilizer and income from higher milk yields when combined with milk productivity programs.

**Implications**

A cookstove program might wish to explore solutions that can utilize local agricultural byproducts as an alternative fuel source.

Sources: IBGE
## Content

<table>
<thead>
<tr>
<th>Executive Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Approach</td>
</tr>
<tr>
<td>Sector Mapping</td>
</tr>
<tr>
<td>Macro Environment Assessment</td>
</tr>
<tr>
<td><strong>Indoor Air Pollution Assessment</strong></td>
</tr>
<tr>
<td>Consumer Assessment</td>
</tr>
<tr>
<td>Cookstove Industry Assessment</td>
</tr>
<tr>
<td>Carbon Financing</td>
</tr>
</tbody>
</table>
Solid Fuel Usage in Brazil

While the majority of the population uses LPG for cooking, a significant proportion of the population still uses solid fuels as either a primary or secondary fuel source.

Household Energy Consumption

Brazil (2003)

<table>
<thead>
<tr>
<th>Household Energy Consumption</th>
<th>Urban Households</th>
<th>Rural Households</th>
<th>All Households</th>
<th>All % of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only LPG</td>
<td>39,520 K</td>
<td>2,417 K</td>
<td>41,937 K</td>
<td>70%</td>
</tr>
<tr>
<td>LPG and Solid Fuel</td>
<td>9,464 K</td>
<td>5,274 K</td>
<td>14,738 K</td>
<td>25%</td>
</tr>
<tr>
<td>Only Solid Fuel</td>
<td>1,084 K</td>
<td>1,845 K</td>
<td>2,929 K</td>
<td>5%</td>
</tr>
</tbody>
</table>

Source: IBGE

- Implications -

Considering the number of households, solid fuel usage is significant in urban as well as rural areas; a cookstove program should be considered in both regions.

Mortality from Solid Fuel Use

- 1,360 ALRI deaths (age <5)
- 2,640 COPD deaths (age 30+)
- 80 lung cancer deaths (age 30+)

Morbidity from Solid Fuel Use

- 110K disability adjusted life years

National Disease Share

- 0.3% of national burden of disease attributed to solid fuel use

Sources: 1. Food and Agricultural Association of the United Nations, 2. WHO
In Minas Gerais and Northeast Brazil, IAP is primarily caused by use of traditional open fire woodstoves in poorly ventilated rooms.

### IAP Cause
<table>
<thead>
<tr>
<th>Cooking Fuel</th>
<th>Scenes</th>
<th>Rural and Small Urban Usage*</th>
<th>Comments</th>
</tr>
</thead>
</table>
|               | ![Stove Image](image) | ![Stove Usage Graph](image) | • High emissions from burning large logs  
  • Fuelwood is often-collected from construction debris - increasing toxicity |

### IAP Cause
<table>
<thead>
<tr>
<th>Cooking Device</th>
<th>Scenes</th>
<th>Types of Woodstoves in Use (%)</th>
<th>Comments</th>
</tr>
</thead>
</table>
|               | ![Stove Image](image) | ![Stove Types Graph](image) | • Most stoves have chimneys, but these are often poorly maintained  
  • Open fires provide no protection from smoke |

### IAP Cause
<table>
<thead>
<tr>
<th>Cooking Location</th>
<th>Scenes</th>
<th>Location of Woodstoves (%)</th>
<th>Comments</th>
</tr>
</thead>
</table>
|                  | ![Stove Image](image) | ![Stove Location Graph](image) | • Poor ventilation increases the magnitude of smoke exposure  
  • Outdoor stoves are often attached to homes |

**- Implications -**

Minas Gerais could benefit from a clean cookstove and fuel intervention— which can then be scaled for Northeast Brazil

Sources: Winrock International Study (2007)

*Data available only for these segments*  
Small urban defined as towns with less than 15,000 people
### Indoor Air Pollution Awareness Level

Both the Government and NGOs (with some exceptions) must focus greater attention on IAP as an urgent and significant issue in Brazil.

<table>
<thead>
<tr>
<th>Awareness Level</th>
<th>Awareness Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal Government</td>
<td>Low</td>
</tr>
<tr>
<td>• Government does not consider IAP a significant issue in the country because of high LPG penetration</td>
<td></td>
</tr>
</tbody>
</table>

| State / Local Government | Low |
| • Some state governments in the Northeast are funding cookstove programs |
| • In general very limited participation as not a focus area |

| NGOs | Moderate |
| • Several international NGOs are involved in cookstove dissemination |
| • No discernable awareness raising or marketing campaigns |

| Consumer | Moderate |
| • As per Winrock survey, 84% of households are aware that fuelwood cooks are exposed to respiratory illness and burns |
| • No cultural attachment to smoke |

**- Implications -**

*Measuring the impact of IAP and persuading the Government and NGOs to recognize the issue are both essential*

Sources: Winrock International Study (2007)
Cookstove Programs

The few ongoing clean cookstove initiatives are focused in the North and Northeast of Brazil and mainly disseminate efficient wood cookstoves; however, there are recent pilots which focus on alternate fuels.

### Implications

No programs currently focus on the state of Minas Gerais. A cookstove program may benefit from coordination or knowledge sharing with existing programs.

---

**Cooking Fuel**

<table>
<thead>
<tr>
<th>Program</th>
<th>Community</th>
<th>National</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clean</strong></td>
<td>USAID</td>
<td>Ongoing</td>
</tr>
<tr>
<td><strong>LPG</strong></td>
<td>CARE</td>
<td>Planned</td>
</tr>
<tr>
<td><strong>Kerosene</strong></td>
<td>Gaia</td>
<td>Closed</td>
</tr>
<tr>
<td><strong>ICS</strong></td>
<td>Ecofogao</td>
<td>Exploratory</td>
</tr>
<tr>
<td><strong>Advanced Pilots</strong></td>
<td>IDER w/ State Govt.</td>
<td></td>
</tr>
<tr>
<td><strong>Commercialized</strong></td>
<td>Govt. LPG Subsidy</td>
<td></td>
</tr>
</tbody>
</table>

- Ethanol cookstoves
- Pilot in three Minas Gerais communities
- Biogas cookstoves
- 6 single family biogas plants in Piauí
- Improved Woodstoves
- 100 homes in Minas Gerais
- Improved Woodstoves
- 1,000 rural homes in Bahia (NE Brazil)
- Ethanol or Macauba* oil cookstoves
- North & West Minas Gerais
- Subsidy to buy LPG cookstove and fuel
- Nationwide
- Improved Woodstoves
- 1,000+ rural homes in MG and NE Brazil
- Improved Woodstoves
- 20,000 homes in Ceará (NE Brazil)

---

*Native palm tree*
Big challenges faced by most cookstove programs in Brazil include regulation around clean fuels, access to funding for scaling programs, and challenges in engaging with the Government.

<table>
<thead>
<tr>
<th>Partners</th>
<th>IDER</th>
<th>CARE</th>
<th>Project Gaia</th>
<th>Ecofogao</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Government of Ceara</td>
<td>NA</td>
<td>Domestic</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What</th>
<th>IDER</th>
<th>CARE</th>
<th>Project Gaia</th>
<th>Ecofogao</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficient clay stoves</td>
<td>Biodigestors that produce gas, electricity and fertilizer</td>
<td>Ethanol Clean Cookstove by Domestic (2 burner)</td>
<td>Fuel efficient woodstove</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How</th>
<th>IDER</th>
<th>CARE</th>
<th>Project Gaia</th>
<th>Ecofogao</th>
</tr>
</thead>
</table>
| • Train local resources  
• Supply materials and installation | • Use waste from goats and sheep in areas where they are a major source of income  
• Engaging federal govt. to expand under “Energia do Produtor” | • Three communities selected for pilot | • Private manufacturer retails to NGOs and consumers  
• Woodstove has 50% efficiency  
• Prices range from R$ 280 to R$ 1300 |

<table>
<thead>
<tr>
<th>Financing</th>
<th>IDER</th>
<th>CARE</th>
<th>Project Gaia</th>
<th>Ecofogao</th>
</tr>
</thead>
</table>
| • Donor (State Government of Ceara) financed | • Innovation Fund of CARE USA  
• SEBRAE - Piaui | • Pilot stoves provided | • Buyer finances |

<table>
<thead>
<tr>
<th>Challenges</th>
<th>IDER</th>
<th>CARE</th>
<th>Project Gaia</th>
<th>Ecofogao</th>
</tr>
</thead>
</table>
| • Access to funding to scale program  
• Cost of stove is high - R$500 | • Carbon financing is expensive to design, need grant to pay for consultants | • Access to ethanol  
• Lack of clarity around ethanol regulation | • Cost of production high, need economies of scale, current volume does not allow process automation |

<table>
<thead>
<tr>
<th>Lessons Learnt</th>
<th>IDER</th>
<th>CARE</th>
<th>Project Gaia</th>
<th>Ecofogao</th>
</tr>
</thead>
</table>
| • Demonstrated health impact that generated interest from communities | • Maintenance and supervision is key for biogas sustainability  
• Carbon financing for reduced wood usage not sufficient to cover higher cost of stove | • Need a stable ethanol supply chain  
• Engage with Government at all levels  
• 2 burner stoves not sufficient  
• Allow fuel purchase in small quantity | • Design stove around consumer requirements |
Cookstove Program Details (2/2)

Big challenges faced by most cookstove programs in Brazil include regulation around clean fuels, access to funding for scaling programs, and difficulty in engaging with the Government

<table>
<thead>
<tr>
<th></th>
<th>CleanStar Ventures</th>
<th>Perene Institute</th>
<th>USAID</th>
<th>Govt. LPG Subsidy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partners</td>
<td>NA</td>
<td>Natura, Ambiental PV, CARE, Aprovecho</td>
<td>IDER, local state government, Banco de Povo</td>
<td>NA</td>
</tr>
<tr>
<td>What</td>
<td>Ethanol or Macauba* oil based cookstoves</td>
<td>Efficient clay stoves</td>
<td>Improved cookstoves</td>
<td>Subsidy to purchase LPG stove and fuel</td>
</tr>
<tr>
<td>How</td>
<td>• Business based approach</td>
<td>• Woodstove developed with Aprovecho with 50% efficiency</td>
<td>• Stoves provided by Ecofogao</td>
<td>• Government subsidy for purchase</td>
</tr>
<tr>
<td></td>
<td>• Restorative and profitable system for producing food and energy for locals</td>
<td>• Deliver 18,800 tons of VERS</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Explore new products – lower grade ethanol or Oil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financing</td>
<td>• Commercial investors</td>
<td>• Natura (Brazilian private company) via voluntary emissions offset program</td>
<td>• Donor (USAID) financed</td>
<td>• Donor financed</td>
</tr>
<tr>
<td></td>
<td>• Carbon financing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Challenges</td>
<td>• Ethanol price and regulation lowers attractiveness - willing to work with Govt. to introduce new products</td>
<td>• Lack of study on non renewable biomass</td>
<td>• Funding discontinued</td>
<td>• Post subsidy, switch back to fuelwood in urban poor and rural communities</td>
</tr>
<tr>
<td></td>
<td>• Environmental benefit case not compelling enough to drive adoption, has to be an economic, time, convenience and safety argument</td>
<td>• Carbon financing is difficult and expensive process</td>
<td>• Low purchasing power due to low income</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Initially work without Govt. involvement by taking a commercial approach – once proven involve Govt.</td>
<td>• Transportation cost to NE Brazil increased price</td>
<td>• Transportation cost to NE Brazil increased price</td>
<td></td>
</tr>
<tr>
<td>Lessons Learnt</td>
<td>• Design a cheap product that can be easily installed</td>
<td>• Need to first establish credibility for carbon financing institution</td>
<td>• LPG subsidies should be directed to the lowest income families who are the ones most affected by price increases</td>
<td></td>
</tr>
</tbody>
</table>

*Native palm tree
NGOs and the Federal, State, and Municipal Governments have initiated several economic development and sustainability programs in rural areas.

### Programs

<table>
<thead>
<tr>
<th>Focus</th>
<th>Participants</th>
<th>Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development in semi-arid areas</td>
<td>ASA</td>
<td>P1MC – 1 Million Cisterns Program provides clean water for cooking and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>drinking by collecting rain water in cisterns built by local people who</td>
</tr>
<tr>
<td></td>
<td></td>
<td>are educated and trained by the program</td>
</tr>
<tr>
<td></td>
<td>Ministry of Environment</td>
<td>Focuses on Cerrado and Catinga regions</td>
</tr>
<tr>
<td></td>
<td>Ministry of Health</td>
<td>Allocates funds for social and environmental projects</td>
</tr>
<tr>
<td></td>
<td>Ministry of Health</td>
<td>Interest in investing in the cookstove sector</td>
</tr>
<tr>
<td></td>
<td>Electricity Access</td>
<td>Creates multidisciplinary healthcare teams responsible for monitoring</td>
</tr>
<tr>
<td></td>
<td></td>
<td>families in a geographical area</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Team develops actions for maintaining the health of their community</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provides electricity to all by 2011</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Includes grid expansion, decentralized generation systems and individual</td>
</tr>
<tr>
<td></td>
<td></td>
<td>generation systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Installed 300 cookstoves from Energer that co-generate electricity</td>
</tr>
</tbody>
</table>

### Implications

A cookstove program could be built into existing development programs to disseminate stoves and create awareness.
## Related programs (2/3)

**NGOs and the Federal, State, and Municipal Governments have initiated several economic development and sustainability programs in rural areas**

<table>
<thead>
<tr>
<th>Focus</th>
<th>Participants</th>
<th>Programs</th>
<th>Capitao Eneas Program</th>
<th>- Implications -</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Community kitchens</td>
<td>• University of the Jequitinhonha and Mucuri</td>
<td>• Generate employment opportunities in food processing business</td>
<td>• Rural poverty reduction</td>
<td>• Objectives include: reduce environmental impact and eliminate physical hazards in the collection of firewood</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Rural poverty reduction</td>
<td>• State Government - MG</td>
<td>• Seeks infrastructure, economic and social projects</td>
<td>• State Government - MG</td>
<td>• Distributed 50,000 pamphlets on improved cookstove design</td>
</tr>
<tr>
<td></td>
<td>• World Bank (IBRD)</td>
<td>• Reduce rural poverty and consequences by improving rural welfare, fostering social capital, improving governance and integrating public policies with municipality</td>
<td>• Emater-MG</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Emater-MG</td>
<td>• • Municipality of Capitao Eneas</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• CEDRS / CMDRS</td>
<td>• Municipal Secretariat of Environmental and Economic Development</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Bank of Brazil</td>
<td></td>
<td>• Technical assistance to small farmers and rural families</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Community Associations</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**- Implications -**

*A cookstove program could be built into existing Government programs for rural development and sustainability*
## Content

<table>
<thead>
<tr>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Summary</td>
</tr>
<tr>
<td>Project Approach</td>
</tr>
<tr>
<td>Sector Mapping</td>
</tr>
<tr>
<td>Macro Environment Assessment</td>
</tr>
<tr>
<td>Indoor Air Pollution Assessment</td>
</tr>
<tr>
<td><strong>Consumer Assessment</strong></td>
</tr>
<tr>
<td>Cookstove Industry Assessment</td>
</tr>
<tr>
<td>Carbon Financing</td>
</tr>
</tbody>
</table>
Consumer Cooking Habits

Minas Gerais’ cuisine is famous for being prepared on woodstoves, and consists of a minimum of three dishes which requires the use of large oven stoves.

Typical Meals in Minas Gerais
• Bread, corn dish and coffee for breakfast
• Beans, rice, vegetables and meat for lunch and dinner
• Traditional baked cheese bread
• Strong preference for slow-cooked and woodstove-prepared meals

Typical Meals in Northeast
• Varies based on states – generally smaller meals because of lower affordability
• Maranhao and Piaui use charcoal

Cookstove Requirements
• Multiple burners for multiple dishes, hot plate and oven
• Pot holes for high intensity heat
• Table mounted stoves
• LPG for fast preparation – breakfast, reheating, or baking
• Connected water heating system

Cookstove Requirements
• Smaller two-burner stoves suffice
• Charcoal stoves in some states

- Implications -
While it will be difficult to displace a woodstove given the cooking culture in Minas Gerais, their use could be reduced and made more efficient. Any stove design should incorporate local preferences and needs.
Households in Northeast Brazil and Minas Gerais can be divided into 5 cookstove segments

### Segmentation Criteria

<table>
<thead>
<tr>
<th>Per Capita Monthly Wage</th>
<th>&gt; 1.5*Min Wage = 6.5M</th>
<th>0.25-1.5*Min Wage = 13.5M</th>
<th>&lt; 0.25*Min Wage = 3.1M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural vs. Urban</td>
<td>Urban = 11.5M</td>
<td>Rural = 2.0M</td>
<td></td>
</tr>
</tbody>
</table>

#### 2010 Minimum Wage = $545/mo

#### Primary Fuel Type

<table>
<thead>
<tr>
<th>LPG</th>
<th>Firewood</th>
<th>Charcoal</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPG = 10.2M</td>
<td>Firewood = 1.1M</td>
<td>Charcoal = 0.2M</td>
</tr>
<tr>
<td>LPG = 0.5M</td>
<td>Firewood = 1.1M</td>
<td>Charcoal = 0.4M</td>
</tr>
</tbody>
</table>

Charcoal use is limited to Maranhao and Piaui

### Total Market

- Segment 1: Firewood Primary = 2.04M
- Segment 2: Firewood Only = 0.16M
- Segment 3: Charcoal = 0.6M
- Segment 4: Extreme Poor = 3.1M
- Non-Target Segment: High Income & LPG Primary = 17.2M

**Total Market = 5.9M**

---

- **Implications** - Each segment has distinctive characteristics; differentiated cookstove program designs are required tailored to the needs of the segments
Firewood is the dominant fuel in Minas Gerais and most Northeast Brazilian states. Some users supplement firewood with LPG while others rely solely on firewood for their fuel needs.

### Consumer Segments (1/3)

**Segment 1: Firewood Primary**
- No. of households: 2.04M
- Income: 0.25 times to 1.5 times per capita minimum wage
- Urban/Rural: Rural and urban MG and NE (except Maranhao and Piaui)
- Willingness to pay: Moderate
- IAP awareness: Moderate
- IAP exposure: Moderate
- Fuel Choice/Woodstove: Primary choice: Firewood, Secondary choice: LPG, Has both LPG and firewood stove, Firewood stove may vary in sophistication

**Segment 2: Firewood Only**
- No. of households: 0.16M
- Income: 0.25 times to 1.5 times per capita minimum wage
- Urban/Rural: Rural and urban MG and NE (except Maranhao and Piaui)
- Willingness to pay: Low
- IAP awareness: Moderate
- IAP exposure: Moderate to High
- Fuel Choice/Woodstove: Primary choice: Firewood, Has only firewood stove, Firewood stove may vary in sophistication

### Implications

Firewood users should be treated as their own segment with an important distinction drawn between those who supplement firewood use with LPG and those who rely solely on firewood for cooking.
Maranhao and Piaui exhibit high charcoal usage, which is often purchased at a cost higher than LPG but in smaller quantities. The segment of the extremely poor relies on solid fuels and has little willingness/ability to pay for modern fuels.

**Segment 3: Charcoal**

- No. of households: 0.6M
- Income: 0.25 times to 1.5 times per capita minimum wage
- Urban/ Rural: Rural and Urban Maranhao and Piaui
- Willingness to pay: High (already pays for charcoal)
- IAP awareness: Moderate to low
- IAP exposure: Moderate
- Fuel choice/ Fuel or woodstove acquisition behavior: Primary choice: Charcoal, Secondary choice: LPG, Has both LPG and charcoal stoves, Already pays for charcoal, sometimes more than for LPG

**Segment 4: Extreme Poor**

- No. of households: 3.1M
- Income: Less than 0.25 times per capita minimum wage
- Urban/ Rural: Urban and rural
- Willingness to pay: None
- IAP awareness: Low
- IAP exposure: Moderate to High
- Fuel choice/ Fuel or woodstove acquisition behavior: Firewood or Charcoal in Maranhao and Piaui, No secondary fuel

**Implications**

As charcoal users tend to pay high prices for cooking fuel they represent a unique segment. The extremely poor may require an alternative approach due to their limited ability to pay.
Certain segments are unique in their access to alternate fuel sources and may have additional options at their disposal which are not available to the broader population

**Segment 5: Niche**

<table>
<thead>
<tr>
<th>No. of households</th>
<th>• Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td>• 0.5 times to 1.5 times per capita minimum wage</td>
</tr>
<tr>
<td>Urban/ Rural</td>
<td>• Rural</td>
</tr>
<tr>
<td></td>
<td>• Proximity to sugarcane, cattle or native bio-energy plants</td>
</tr>
<tr>
<td></td>
<td>• Belong to or can organize into cooperatives</td>
</tr>
<tr>
<td>Willingness to pay</td>
<td>• Moderate</td>
</tr>
<tr>
<td>IAP awareness</td>
<td>• Moderate</td>
</tr>
<tr>
<td>IAP exposure</td>
<td>• Moderate</td>
</tr>
<tr>
<td>Fuel choice/ Fuel or woodstove acquisition behavior</td>
<td>• Primary choice: Firewood or Charcoal</td>
</tr>
<tr>
<td></td>
<td>• Secondary choice: LPG</td>
</tr>
</tbody>
</table>

**Implications**

A unique strategy could be employed to provide small scale solutions to those consumers with access to alternative fuels such as biogas, ethanol micro-distilleries, and macauba biomass
A summary view of the five consumer segments illustrates the unique characteristics of each

### Customer Segment Characteristics

<table>
<thead>
<tr>
<th>Consumer Segment</th>
<th>Size (Number of HH)</th>
<th>IAP Exposure</th>
<th>IAP Awareness</th>
<th>Affordability</th>
<th>Willingness to pay</th>
<th>Access to alternative clean fuel source</th>
<th>Alternative Use</th>
<th>Distribution Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firewood Primary</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Firewood Only</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Charcoal</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Extreme Poor</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Niche</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
</tbody>
</table>

### Legend:
- Minimal
- Moderate Low
- Moderate High
- High

- **IAP exposure** is moderate to high in lower income households due to limited or poorly maintained chimneys.
- **General awareness** exists; however, households may not directly associate smoke with diseases.
- **Income level** drives willingness to pay and influences the type of fuel used.
- **Physical location** where the families reside may determine the types of alternative fuel source available.
- **Alternate use** for water heating is quite common among low income families.
- **General distribution access** is good; however, transportation cost may increase in remote areas.

### Implications

**A one size fits all cookstove program design will not be effective; the needs of each consumer segment should be met in a specific and targeted manner.**

Note: No. of households estimated based on data from IBGE, Winrock International Report, World Bank, FAO
LPG stoves and locally assembled wood-fired cookstoves are the prevalent cookstove technology. Clean and efficient stoves are available but penetration is low; prices are high due to preference of consumers for multiple burners.

**Available Cookstove Usage and Cost**

- **A traditional woodstove** is purchased in parts and assembled at home; chimneys are optional and no efficiency is built into the design; stove life is 7-8 years.
- **Traditional stoves** sometimes fuel water heating systems.
- **Metal woodstoves**, popular in South Brazil, have not penetrated the North and Northeast due to the strong existing preference for traditional stoves; while cleaner in design, they are inefficient and pose IAP risk if not maintained.
- **Efficient woodstoves** are very nascent and expensive, and have not reached critical volume for economies of scale.
- **Charcoal stoves** are smaller (1-burner) and have a life of less than 5 years.
- **95% of households** have four burner LPG stoves and access to LPG fuel, but usage may be limited in poor and rural homes for economic reasons.
- **Currently ethanol stoves** are not used widely or manufactured in Brazil.

**Implications**

A cookstove program could explore the option of leveraging existing stove penetration. Cookstoves could be designed to be cheap and long lasting to provide economic benefits.

Sources: Winrock International Study (2007), field visits

© 2011 Accenture. All rights reserved – strictly confidential
A large percentage of woodstoves, used by primary woodstove users, are either self assembled or made by local craftsmen.

Sources of Woodstoves among Primary Woodstove Users

- **Self assembled**: 87%
- **Assembled by craftsman**: 55%
- **Partly purchased in store and assembled by craftsman**: 11%
- **Wholly purchased in store**: 4%
- **Chimney/Griddle/Chamber purchased in store**: 17%
- **Not bought readily available in house**: 6%
- **In store purchase**: 2%

Majority of the cookstoves may involve procurement of individual components from local stores.

**Basic Components of a Woodstove and Average Prices**

- **Griddle**: R$ 40-60
- **Chimney**: R$ 27-37
- **Rocketstove Chamber**: Currently unavailable
- **Bricks and Cement**: R$ 10-80
- **Oven**: R$118-160
- **Water Heater**: N/A

*Figure may not add up to 100% due to rounding error

**Implications**

*A cookstove program should explore the opportunity of increasing the accessibility of cookstoves to the lowest income group by reducing the cost of individual parts.*

Sources: Winrock International Study (2007), stakeholder interviews
Efficient woodstoves are in production in some areas of the Northeastern state of Ceara and Minas Gerais; metal woodstoves are in production in areas of South Brazil and charcoal stoves in areas of the Northeast.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Ecofagao (MG)</th>
<th>IDER (Ceara)</th>
<th>ENERGER (MG)</th>
<th>Petricosky, Maestro, Venax, etc. in S. Brazil</th>
<th>Local entrepreneurs in Maranhao and Piaui</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost Range</td>
<td>R$ 280 - R$1,260</td>
<td>R$ 500</td>
<td>R$ 2,300</td>
<td>R$170 - 367</td>
<td></td>
</tr>
<tr>
<td>Efficiency</td>
<td>40% efficiency</td>
<td>In test</td>
<td>50% efficiency</td>
<td>No efficiency</td>
<td>No efficiency</td>
</tr>
</tbody>
</table>
| Key Features          | • 2-4 burners, oven & water heater optional  
                          • Cast Iron hot plate  
                          • Metal or ceramic | • 3 burner brick and cement cookstove | • 1-burner wood stove, cast iron top  
                          • Generates electricity | • Metal woodstoves  
                          • 1-2 burners with or without oven | • 1-3 burner charcoal stoves |
| Production Capacity    | • Demand driven, produced 250 units in 3 months | • Demand driven | • Installed 300 cookstoves in Amazonas region | • 190K units per year (combines) | • Unknown |
| Key Challenges         | • Low consumer awareness on improved cookstove  
                          • High cost of production, relatively small market to realize economies of scale | • Low IAP awareness among Government officials  
                          • Slow process to obtain subsidy due to government bureaucratic issue | • Relatively more expensive solution, target households will not be able to afford it - subsidy needed from government | • Limited market – MG prefers locally made ceramic or concrete model  
                          • Limited demand and reliable distribution network in the Northeast region |

**Implications**

Consumer demand drives production capacity; a cookstove program could evaluate how best to use economies of scale to reduce the cost of production and subsequently prices, to drive demand.
Available Fuel Cost

The majority of fuelwood is collected and therefore creates little/no costs to consumers; while fuelwood substitution options are available, they remain either high in cost (LPG) or not easily available (ethanol).

**Fuel Cost per Week (in USD)**

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Purchase Unit</th>
<th>Usage</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood (collected)</td>
<td></td>
<td>1 month</td>
<td>$0.0</td>
</tr>
<tr>
<td>Wood (purchased)</td>
<td>1 wagon</td>
<td>1 month</td>
<td>$2.3</td>
</tr>
<tr>
<td>Charcoal</td>
<td></td>
<td>2 hours per week</td>
<td>$8.6</td>
</tr>
<tr>
<td>LPG Primary</td>
<td>13 kg bottle</td>
<td>1 month</td>
<td>$6.2</td>
</tr>
<tr>
<td>LPG Secondary</td>
<td>13 kg bottle</td>
<td>5 months</td>
<td>$1.2</td>
</tr>
<tr>
<td>Ethanol (purchased)</td>
<td>1 litre</td>
<td>1 day</td>
<td>$5.4</td>
</tr>
<tr>
<td>Ethanol (EMD produced)</td>
<td>1 litre</td>
<td>1 day</td>
<td>$3.0</td>
</tr>
</tbody>
</table>

**Assumptions**

- As per the Winrock survey, 76% households collect while 24% purchase fuelwood; avg. consumption is 10kg per day and avg. time spent collecting is 2 hours per week.
- Select states in the Northeast pay R$60 per month for charcoal, making it more expensive than LPG; barrier to adopt is a high upfront cost for LPG.
- LPG cash subsidy of $7.50 per month for low income families has little impact on cost; in many low income households LPG is stretched to last for 5-6 months.
- Ethanol fluctuates in price and may not always be cost effective; ethanol supply depends on price of sugar in international market.
- There are collateral benefits to modern fuel:
  - Time saved in collecting fuelwood.
  - Ethanol from EMD can be used for personal vehicles (cars, tractors, etc.).

**Fuel Usage**

- **USD $1 = R $1.62**

*Note we are still awaiting fuelwood purchase price data.
While the Universal LPG subsidy drove penetration to 95% households, current LPG subsidies have not kept up with LPG’s retail prices

- **Subsidy estimated at 30% off ex-factory price and 18% off retail price**
- LPG penetration rose to 95% of households

- **R$15 every two months, fixed in 2002**
- LPG was R$24 per bottle* in 2002 and R$40 in 2011, subsidy unchanged

- **Freeze on ex-refinery price of LPG**
- Retail price increase due to increase in distributor and retail margin

**Resulting Impact**

- Poor families in both urban and rural areas switched to fuelwood as their primary cooking fuel
- LPG subsidies collected every two months by poor families but LPG bottle is stretched to last 5-6 months

**Bottled LPG Sales per Year**

- End of Universal Subsidy
- Population between 2000 and 2010 has grown steadily at 1.17% CAGR

- **Implications** -

A cookstove program needs to address those segments excluded from LPG usage due to rising LPG retail prices


© 2011 Accenture. All rights reserved – strictly confidential

*LPG is sold in 13kg bottles, not verified if cash subsidy is used for LPG
**Assuming consumption is one bottle per month
While ethanol is easily available and cheaper than LPG, price fluctuations and unclear regulation contribute to an unstable supply chain for cooking fuel.

### Production
- Production mainly in Central and Southeast Brazil – Sao Paulo (60%), Parana (8%), Minas Gerais (8%) and Goias (5%)
- Production and price depend on sugarcane harvest and sugar demand
- Producers cannot sell to consumers directly

### Regulation
- ANP is the regulating agency
- In 2002, Govt. prohibited the sale of liquid alcohol in supermarkets and pharmacies*, law was challenged and retailers continue to sell
- Containers for packaging ethanol must be certified by INMETRO
- Law prohibits transport of liquid fuel on public transport and storage of liquid fuel at home

### Retail
- Retailed in two ways –
  1. Alcohol gel and liquid, in certified containers of 500ml and 1,000 ml, in pharmacies and supermarkets
  2. At gas stations, as transport fuel
- Alcohol sold in supermarkets and pharmacies is twice the price at gas stations
- Available in smaller quantities

### Ethanol Price Composition
- Price at gas station at time of study = USD 0.75 per liter
- Production cost = USD 0.25 per liter
- Taxes = 15% to 30% (USD 0.11 to USD 0.23 per liter), depending on state
- Rest is retail and distribution cost

### Supply
- In early 2011, Brazil had to import Ethanol to make up supply shortages caused by a poor sugarcane harvest

### - Implications -
An ethanol cookstove program could work with the Government and producers to stabilize supply and make ethanol available at a cost-effective price point

© 2011 Accenture. All rights reserved – strictly confidential

Sources: 1. Project Gaia, 2. SIAMIG  *For safety reasons
Certain organizations are investigating technology and models that can make ethanol (cooking usage) feasible, if not domestically, then at least internationally.

**Ethanol Micro Distillery (EMD)**
- Communities/households can produce up to 30,000 liters per month for local consumption (cooking and transport) without regulation.
- EMDs produce between 400 to 5,000 liters per day at R$ 0.65 (USD 0.40) per liter.
- EMDs cost USD 80K onwards.
- Cachaca producers can fit an ethanol processing module and can potentially use corn waste materials.

**Last-Mile Distribution**
- Current domestic ethanol stoves have fiber lined canisters to store ethanol, minimizing spillage or leakage.
- Possibility of creating distribution model similar to LPG – exchange empty canister for a filled one.
- Project Gaia is working with the Government to further understand and address last-mile distribution constraints.

**Ethanol for Domestic Use Initiative (EDUI)**
- Project designed by Brazil and Italy, aimed at sustainably increasing the use of ethanol as a cooking fuel in developing countries.
- Ethanol donations from Brazil and Italy have enabled EDUI to restore Ethiopia’s ethanol cookstove program.
- Future phases envision building technical capacity for local bio-fuel production and implementing a bio-fuel production chain.

**- Implications -**

*Community-owned EMD could be a potential solution for sugarcane growing regions; there is potential for ethanol to become a major fuel in the clean cooking sector*
Brazil Macauba Story

Macauba is a native palm tree that can yield renewable biofuel for diesel and biomass for cooking; several pilot programs are currently exploring its potential commercial value

**Context**

- Native Brazilian palm tree abundant in Minas Gerais
- Sustainable plant oil source for biodiesel - has potential of yielding 6.5 tons of oil per hectare
- Oil from kernels can be used for cosmetics
- Mesocarp/husk from oilseeds can be used as cooking fuel to replace wood/charcoal

**Macauba Investments**

- Minas Gerais' State Secretariat for Agriculture has two pilots to test commercial viability
  - Local farmers to harvest Macauba from existing native trees and/or commercial plantations
  - Fruit sent to a processing facility for oil extraction
  - Oil purchased as base for biodiesel
  - Potential to distribute byproduct to plantation workers and surrounding communities for fuel use
- Petrobras granted R$ 4.7 million to University of Vicosa for Macauba research; committed to purchase oil from Government pilots for biodiesel
- Entaban* plans to process Macauba oil based biodiesel in Lima Duarte, Minas Gerais; Currently has 1.5 million plant seedlings and plans to cultivate ~12,000 hectares

**Implications**

A cookstove program could also explore the opportunity of utilizing Macauba oil as an alternative cooking fuel source

Sources: PETROBRAS, World Journal of Agricultural Sciences
© 2011 Accenture. All rights reserved – strictly confidential
Although a detailed technical study was not conducted, ratings were made against a list of high-level product attributes.

### Product Attractiveness

<table>
<thead>
<tr>
<th>Rating:</th>
<th>High - 4</th>
<th>Medium - 3</th>
<th>Low - 2</th>
<th>Minimal - 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low Cost</strong></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
</tr>
<tr>
<td><strong>Availability</strong></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
</tr>
<tr>
<td><strong>Secondary Uses</strong></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
</tr>
<tr>
<td><strong>Usability</strong></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
</tr>
<tr>
<td><strong>Housing Structure</strong></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
</tr>
<tr>
<td><strong>Aesthetics</strong></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
</tr>
<tr>
<td><strong>Cleanliness</strong></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
</tr>
<tr>
<td><strong>Health Benefits</strong></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
<td><img src="image" alt="Rating Symbol" /></td>
</tr>
</tbody>
</table>

**Rudimentary Woodstove**

| | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) |
| **Traditional Woodstove** | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) |
| **Metal Woodstove** | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) |
| **Efficient Cook Stove** | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) |
| **Liquid Petroleum Gas (LPG) Stove** | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) |
| **Ethanol Cook Stove** | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) |
| **Biogas Stove** | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) | ![Rating Symbol](image) |

**- Implications -**

*Consumers will be willing to adopt modern fuels if they are made accessible in a cost-effective manner.*
Cookstove Industry Value Chain

A commercial cookstove supply chain already exists in Brazil; but currently focuses primarily on LPG and woodstove cookstoves.

### Sector Mapping

A clean cookstove program could leverage Brazil’s mature cookstove market, strong existing manufacturing sector, distribution network, and retail facilities to shorten the time to market.
## Content

<table>
<thead>
<tr>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Summary</td>
</tr>
<tr>
<td>Project Approach</td>
</tr>
<tr>
<td>Sector Mapping</td>
</tr>
<tr>
<td>Macro Environment Assessment</td>
</tr>
<tr>
<td>Indoor Air Pollution Assessment</td>
</tr>
<tr>
<td>Consumer Assessment</td>
</tr>
<tr>
<td>Cookstove Industry Assessment</td>
</tr>
<tr>
<td>Carbon Financing</td>
</tr>
</tbody>
</table>
Before undertaking a carbon financing program, a number of criteria could be evaluated to rate the attractiveness of the country context for potential carbon financing activities.

### Carbon Finance Attractiveness Criteria

**Designated National Authority (DNA) & Programs of Activities (PoA)**
- Pre-existing DNA & related PoA
- Pre-existing DNA; No PoA
- Clear organizational candidate for role of DNA
- No clear candidate or competing agencies

**Stove & Program Accreditation**
- Pre-existing CDM-accredited stove program in country
- Pre-existing GS-accredited stove program in country
- No accredited stoves or stove programs in country

**Carbon Baseline**
- Previous cookstove projects to leverage for baselining
- Similar projects to use as proxy for baselining
- No previous projects to use as reference

**Scale of Program**
- Estimated income will significantly outweigh costs of registration & monitoring
- Unclear business case for carbon financing activities
- Costs of registration & monitoring will likely outweigh income generated by carbon credits

**Monitoring & Evaluation**
- Approved cookstove monitoring methodology in use in country
- Approved monitoring methodology in use in country
- Clear monitoring partnership opportunities and capabilities
- Lack of monitoring capabilities or partnership opportunities
Carbon Finance Market Attractiveness

Other criteria, such as utilizing pre-certified stove models or program eligibility for deforestation credits, could be evaluated once the project is in the planning stages.

Additional Carbon Finance Factors – Planning Stage

**CF Factors in Fuel & Product Choice**
- Product already accredited (e.g. Save80)
- Product can leverage existing accreditation documentation
- Emissions reductions tested and verified
- Size of CO2 reduction
- Variability in emissions reductions

**Additional Deforestation Credits**
- Program reduces deforestation
- Deforestation avoidance complies with REDD or other accredited mechanisms
- Scale of avoided deforestation

**Partnership Opportunities**
- Microfinance Institutions
- Technological partners (e.g. MicroEnergy Credits) to reduce costs
- Other potential sponsors
Brazil ranks well against the high-level market attractiveness criteria and may support a potential cookstove program with carbon financing revenues.
Carbon Finance Landscape

Brazil has a Designated National Authority for CDM projects, almost 200 registered CDM & GS projects, and a cookstove program which has undergone Gold Standard certification

Carbon Financing Landscape – Brazil

<table>
<thead>
<tr>
<th>Area</th>
<th>Data</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Designated National Authority</strong></td>
<td>Comissão Interministerial de Mudança Global do Clima</td>
<td>Contact: Mr. José Domingos Gonzalez Miguez</td>
</tr>
<tr>
<td><strong>CDM Projects</strong></td>
<td>191 registered CDM projects</td>
<td></td>
</tr>
</tbody>
</table>
Carbon Finance Programs

Several programs with carbon financing components have been started in Brazil, including the Perene Institute’s cookstove program in Bahia which has successfully sold over 120,000 VER credits.

<table>
<thead>
<tr>
<th>Focus</th>
<th>Participants</th>
<th>Description</th>
</tr>
</thead>
</table>
| Improved cookstove program | • Perene Institute, Ambiental PV (Implementer)  
| Recôncavo region of Bahia, Northeastern Brazil | • Natura (Funding & VER purchase)  
|                       | • CARE Brazil  
|                       | • Gold Standard (Certification)  
|                       | • Aprovecho (Design)  
|                       | • Metareilá Indigenous Association of the Surui people  
|                       | • Brazilian Biodiversity Fund  
|                       | • Amazon Conservation Team  
|                       | • Forest Trends  
|                       | • Idesam  
|                       | • Conceived in 2006  
|                       | • Partnered with Brazilian beauty-products company  
|                       | • 120,000 VERs sold  
|                       | • Monitoring includes:  
|                       | o Individual contracts  
|                       | o Stove installation record  
|                       | o GPS location of each stove  
|                       | o Monitoring visits  
|                       | • Conducts monitoring and protection activities, sustainable production and improvement of local human resources  
|                       | • Contributes to environmental conservation and avoidance of deforestation  
|                       | • Aims to return funds to the Suruí people through carbon financing  
|                       | • Conceived in 2007  
|                       | • BNDES called for proposals for investment in two carbon funds in Brazil, in which it will invest up to 40%  
|                       | • Project was cancelled due to challenges and did not pass the design phase  
|                       | • Creation of ‘Social Carbon Fund’ to allow poor communities access to carbon trading benefits  
|                       | • Conceived in 2006  
|                       | • Partnered with Brazilian beauty-products company  
|                       | • 120,000 VERs sold  
|                       | • Monitoring includes:  
|                       | o Individual contracts  
|                       | o Stove installation record  
|                       | o GPS location of each stove  
|                       | o Monitoring visits  
|                       | • Conducts monitoring and protection activities, sustainable production and improvement of local human resources  
|                       | • Contributes to environmental conservation and avoidance of deforestation  
|                       | • Aims to return funds to the Suruí people through carbon financing  

Participants

- Suruí Carbono Project
- Forest preservation and protection
- Brazilian Federal Development Bank (BNDES)
- CARE Brasil
- CantorCO2e (Fund creation)
- Instituto Ecologica
- Climatempo (private company)
Overall CF Market Attractiveness

As a result of these conditions, the country represents an attractive opportunity for potential carbon financing activities in support of a clean cookstove program; however, some risks still remain.

Highlighted Market Criteria

- Existing Designation National Authority
- Existing Gold Standard Accredited Cookstove Program
- Existing CDM Program of Activities
- Carbon Funds Established or Being Established

Potential Risks

- Insufficient geographic scale to justify accreditation costs within Minas Gerais alone
- Portfolio solution approach may result in reduced scale per solution, increasing costs and scale requirement for overall program
- Differing baselines for each consumer segment
Glossary of Terms

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

ALRI – Acute Lower Respiratory Infection
ANP - Agência Nacional de Petroleo, Gas and Biofuels
BM - Biomass
CDM – Kyoto Clean Development Mechanism
CF – Carbon Finance
CEDRS - State Council for Sustainable Rural Development
CMDRS - Municipal Council for Sustainable Rural Development
COPD - Chronic Obstructive Pulmonary Disease
Emater – State Agency for Technical Assistance and Rural Extension
EMD – Ethanol Micro Distillery
GACC – Global Alliance for Clean Cookstoves
HH – Household(s)
IAP – Indoor Air Pollution
IBGE - Instituto Brasileiro de Geografia e Estatística
IBRD - International Bank for Reconstruction and Development
ICS – Improved Cookstove
IDENE – Institute for Development of the North and Northeast Minas
IDER - The Institute for Sustainable Development and Renewable Energy
iNGO – International Non-Governmental Organization
LPG – Liquid Petroleum Gas
LU – Large Urban
MFI – Microfinance Institution
MG – Minas Gerais
NE – Northeast
NGO – Non-Governmental Organization
SEBRAE - Brazilian support service for micro and small businesses
SEDVAN – Secretary of State for Extraordinary Development for the Jequitinhonha and Mucuri valleys and North Minas
SIAMIG – Association of Sugarcane and Ethanol Producers
USAID – United States Agency for International Development
USD – US Dollars
WHO – World Health Organization