Global Alliance for Clean Cookstoves

Guatemala Cookstoves and Fuels Market Assessment

Sector Mapping

Energía Sin Fronteras
Fundación Solar
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July 2013

Introduction

- The “Guatemala Cookstoves and Fuels Market Assessment” was conducted by Energía Sin Fronteras, Fundación Solar and Universidad Politécnica de Madrid, in collaboration with ONGAWA Ingeniería para el Desarrollo Humano, on behalf of the Global Alliance for Clean Cookstoves (“Alliance”).

- It is **one of a series of country assessments** completed by the Alliance to:
  - ✓ Enhance sector market intelligence and knowledge;
  - ✓ Contribute to a process leading to the Alliance deciding which regions/countries it will prioritize;
  - ✓ Support the Alliance in developing its strategy and approach to country level interventions.

- **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.

- This document is meant **to provide a snapshot of the cookstoves sector in Guatemala (*sector mapping*)** in terms of the overall trends in supply and demand, and emerging opportunities and challenges.

- Clean cookstoves, improved cookstoves, efficient cookstoves all refer to cookstoves which are *cleaner* and *more efficient* than open fires. In this document, the term “**improved cookstoves**” (ICS) is used.

The Alliance team directing the project was led by Amy Sticklor. The consortium team was directed by Maryse Labriet (Energía Sin Fronteras).

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Executive summary

Population, Poverty and Diversity of Guatemala

- 14.7 million people, 51% in rural areas.
- 40% of indigenous population with 23 different languages.
- 54% population under the poverty line, of which 13% are in extreme poverty.
- Ease of Doing Business is low.

Fuel usage and cooking practices

- Around 70% of households use firewood for cooking.
- LPG is used by households over the poverty line, for specific uses (breakfast, re-heating food), combined with woodfuel. This niche is still marginal, but robust and could be reinforced.
- Collection of fuelwood is carried out by both men and women.
- Total woodfuel consumers: 2.1 millions of households; total woodfuel buyers: 1.3 millions of households.
- The existence of clean cookstoves and their benefits remain unknown by most of the households.

Burden of solid fuel use for cooking

- The annual wood deficit is more than 5 millions tons of dry wood equivalent.
- Household Air Pollution (HAP) accounts for economic losses equivalent to around 1% of Guatemala's GDP.
- More than 5000 deaths (all ages) were due to HAP in 2010.
- HAP is the second cause of Disability-adjusted life years (DALYs) in 2010.
- Lower respiratory infections are the first cause of DALYs in 2010.
- Emissions related to open fires also contribute to outdoor air pollution.
- Several HAP research projects, such as RESPIRE and CRECER were conducted in Guatemala.

Executive summary

Many projects and studies, no systematization

- Guatemala has a unique experience in ICSs, but lacks systematization of information, follow-up, and information on cookstoves still in place.

Two complementary approaches: Donations and Market

- Most of the past and current projects involve highly subsidized cookstoves.
- For the extreme poverty segment of the population, appropriate strategies, based on highly subsidized cookstoves inserted into larger programs, need to be put in place.
- Willingness-to-pay by households who buy firewood is demonstrated, as soon as savings associated with fuelwood purchases are proven.
- Market-oriented centralized mass-production exists, but highly depends on donation-based programs
- Different mobile models of cookstoves are available: ONIL, NOYA, DONA DORA, ECOCOMAL, etc., as well as several versions of the in situ plancha stove.
- There is no stove certification nor quality requirements in the country.

Potential market

- From 0.7 to 1.4 million households could buy an efficient cookstove, with appropriate financing measures. The willingness-to-pay of the “non-extreme poverty” segment is uncertain.

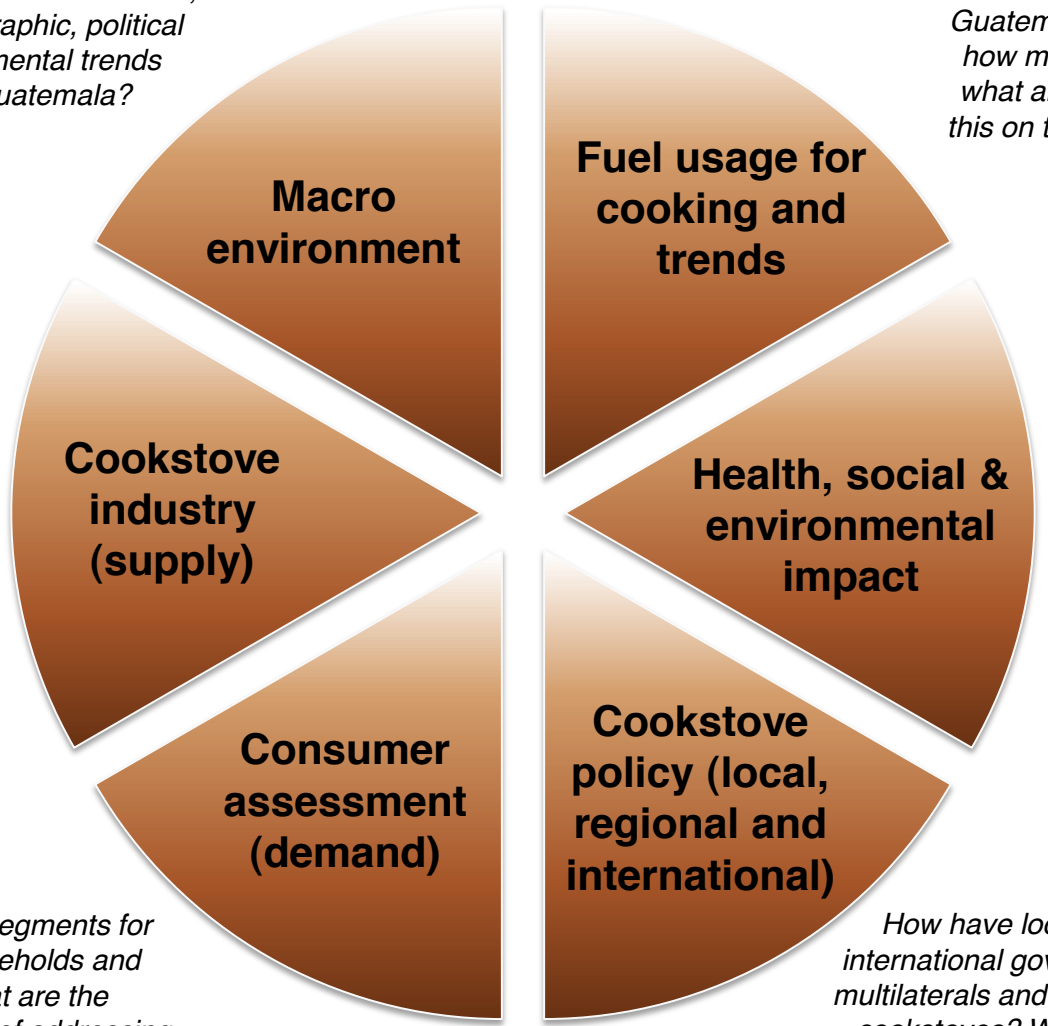
A relevant national policy framework

- The new National Energy Policy (2013-2027) opens the door for new initiatives and strategies to promote clean cooking. This is the first policy that explicitly address the use of domestic firewood, and places the Ministry of Energy and Mines as a main player and leader in the country.
- The regional (Central American) level of energy and market strategies must also be considered.

Study of the Guatemalan cookstove sector across six dimensions

What are the overall economic, social, demographic, political and environmental trends shaping Guatemala?

What types of fuels do Guatemalan consumers use, how much do they use and what are the implications of this on the cookstove sector?



What is the technology landscape for cookstoves in Guatemala? Who are the major players (from supply to end-use)? What are the challenges they face?

What are the primary health, social and environmental impacts of inefficient and unclean cookstoves in Guatemala?

Who are the key customer segments for cookstoves (including households and community needs)? What are the opportunities and challenges of addressing their preferences? What are the conditions for the real use of clean cookstoves?

How have local, regional and international government agencies, multilaterals and donors approached cookstoves? What are their likely future policy priorities? This includes carbon finance.

A combination of primary and secondary research

Rather than re-inventing the wheel, this market assessment consolidates the understanding of the sector by building on existing knowledge and by adding well-focused analysis in order to describe the favorable and limiting factors of the development of a market for cookstoves in Guatemala.

Key sources for the market assessment include:

- Primary data from **national statistics and surveys** including information on household size, demographics, cookstove use, fuel use, etc., key national sources include the third National Survey of Quality of Life of Guatemala, reports by the Ministry of Energy and Mines and National Forest Institute on energy and woodfuel supply and demand. Several reports analyzing past projects or experiences with cookstoves in Guatemala have also been used such as the 2013 report by ESMAP-World Bank on lessons learned in Central America, co-authored by Fundacion Solar.

- Secondary research from **regional and international reports and statistics** (World Bank, CEPAL, OLADE, CIA, etc.), **specialized briefs and reports** (by the Global Alliance for Clean Cookstoves, by the authors, etc.), **academic papers** (on indoor air pollution, etc.).

- **Interviews** with stakeholders and beneficiaries including manufacturers/distributors, academics, experts of the sector, and direct users and beneficiaries of cookstoves.

- Executive summary
- Project approach
- **Sector mapping**
  - **Macro environment**
  - Fuel usage and trends
  - Health, social and environmental impact
  - Cookstove policy environment
  - Consumer assessment
  - Cookstove industry
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- Appendix

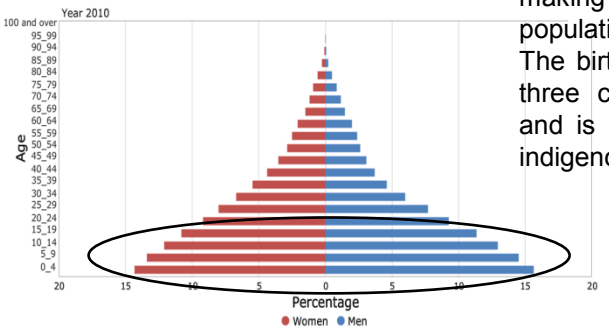
Demographic overview of Guatemala

Demographic data	
Total Population	14 373 472 (2013)
Annual Population Growth Rate	1.95% (2012)
Rural / Urban Split	51% / 49% (2010)
Annual Urbanization Growth Rate	3.4% (est 2010)
Indigenous Population	40% of population (2010)
Average Household Size	4.9
Literacy	male: 75.4% (2002) female: 63.3% (2002)

Guatemala has the highest population growth rate in Latin America

A multi-ethnic country, with different cultures and languages

- **Ethnic Groups:** Mestizo (mixed Amerindian-Spanish) and European 59.4%, K´iche 9.1%, Kaqchikel 8.4%, Mam 7.9%, Qeqchi 6.3%, other Mayan 8.6%, indigenous non-Mayan 0.2%, other 0.1%
- **Official Language:** Spanish (official) 60%, Amerindian languages 40% (23 officially recognized Amerindian languages)
- **Religions:** Roman Catholic, Protestant, indigenous Mayan beliefs



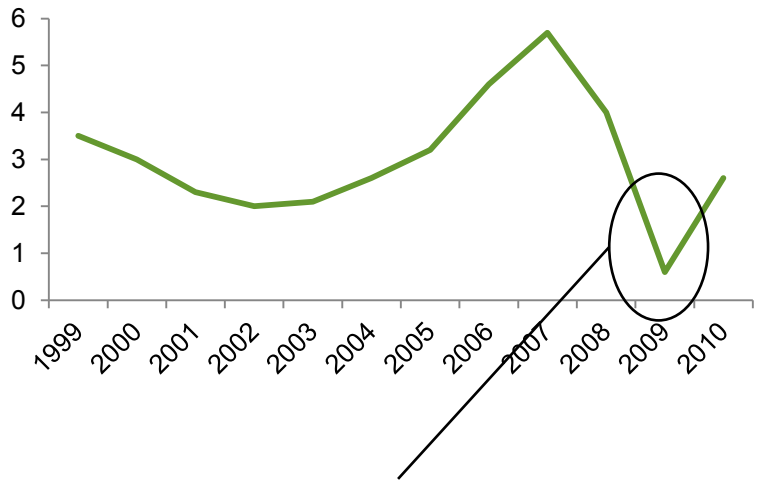
Almost half of the population is under age 19, making it the youngest population in Latin America. The birth rate is more than three children per woman and is higher for rural and indigenous populations.

Guatemala is Central America's most populous country, also characterized by a large and growing youth population and a complex socio-economic structure (23 different languages, several cultural groups). This complexity must be considered when defining projects and programs.

Sources: CEPALSTAT http://interwp.cepal.org/cepalstat/WEB_cepalstat/perfilesNacionales.asp, World Bank http://www.worldbank.org/en/country/guatemala/overview, CIA Factbook https://www.cia.gov/library/publications/the-world-factbook/geos/gt.html, ENCOVI 2011 (2012).

Economic environment

GDP growth rate
(annual %)



World recession: drop of export demand from US and other Central American markets, reduction of foreign investment.
The economy gradually recovered in 2010-12.

Key Indicators	Guatemala
GNI Per Capita (2011)	US$ 4 760
GDP Growth Rate (2012)	3.10%
Inflation Rate (2012)	4%
Unemployment (2011)	4.1%
Poverty Rate (2011)	54% of population lives below poverty line
Labour force - by occupation (2011)	Agriculture: 38% Industry: 14% Services: 48%
Remittances	Inflows serving as a primary source of foreign income (equivalent to nearly two-fifths of exports or one-tenth of GDP)
Agriculture- products	Sugarcane, corn, bananas, coffee, beans, cardamom, cattle, sheep, pigs, chickens
Industries	Sugar, textiles and clothing, furniture, chemicals, petroleum, metals, rubber, tourism
Distribution of family income GINI index (2007)	55.1 (10th rank of countries ranked according to their inequality level)
Household income or consumption: **Lowest 10%** **Highest 10%**	 1.3% 42.4%

The economic growth of Guatemala is strongly dependent on international markets and was deeply affected by the international crisis of 2008-2009. The economic recovery has been moderate. Guatemala is estimated to possibly have a rapidly accelerating economic growth, for example through trade, regional integration, and tourism.
Despite the economic growth of the last decade, Guatemala is one of the Latin American countries with the highest levels of inequality and poverty, especially in rural and indigenous areas.

Sources: World Bank http://www.worldbank.org/en/country/guatemala/overview, Indexmundi http://www.indexmundi.com/guatemala/

Business environment

2013 World Bank "Ease of Doing Business" ranking (out of 185 countries)

Key Indicators	Guatemala	El Salvador	Honduras	Nicaragua	México
Starting a Business	172	139	155	131	36
Dealing with Construction Permits	94	146	65	154	36
Getting Electricity	34	131	117	129	130
Registering Property	20	56	92	123	141
Protecting Investors	158	169	168	100	49
Paying Taxes	124	153	139	158	107
Trading Across Borders	117	80	90	81	61
Enforcing Contracts	96	71	179	55	76
Resolving Insolvency	109	89	133	80	26

Overall rank of Guatemala 93rd out of 185

Microfinance Institutions (MFIs)

Key Indicators	Guatemala
Loans (2011)	198 M USD
# of active borrowers (2011)	367722
Total value of deposits (2011)	461453 USD
# of Micro-Financial Institutions	23
# of funders of MFIs	8

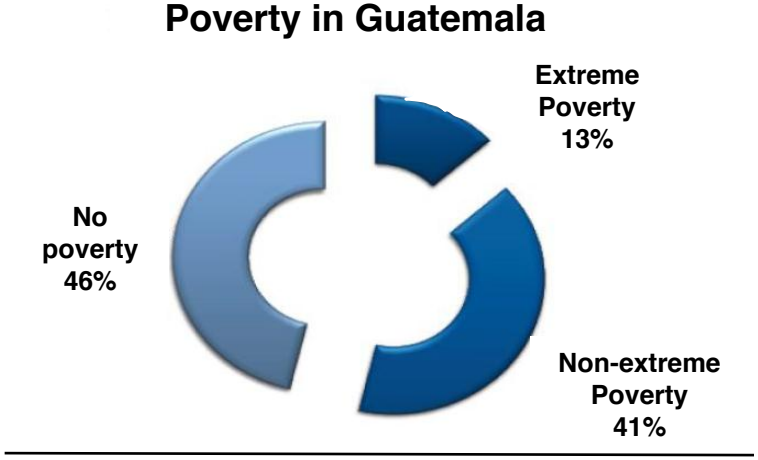
The Guatemalan microfinance market had the largest growth in the Central American region in 2010 with total loan portfolio growth of 40% and total borrower growth of 28%.

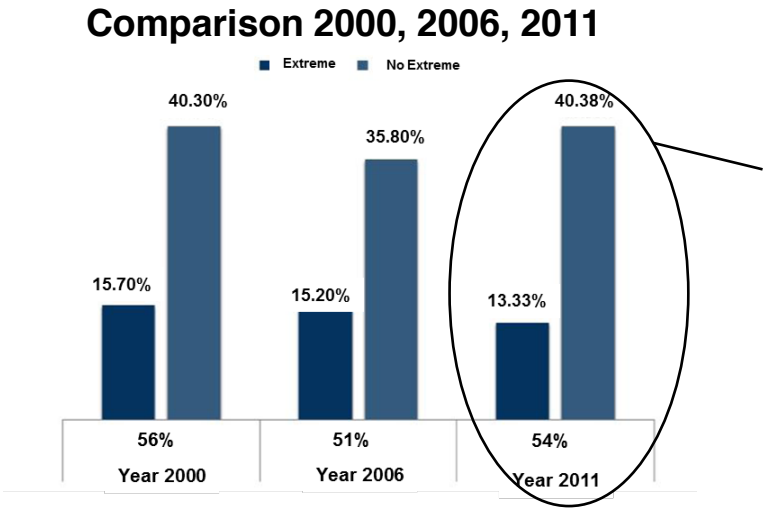
- The microfinance sector faces legislative challenges as MFIs currently operate without any clear regulatory framework.
- Banks and Credit Unions account for more than 80% of the total loan portfolio of MFIs in Guatemala.
- While more than 80% of loans were targeted at supporting micro-enterprises, housing, consumer, and commercial loans also saw significant growth.

The low rankings of Guatemala in terms of "Ease of Doing Business" emphasize the difficulty for new business to start in the country, as well as the low protection of investors (risk of misuse of corporate assets by directors for their personal gain), among other factors. These are barriers to the development of new business in the country. With regards to microfinance activities, they are increasing rapidly, but still face legislative barriers.

Sources: Doing Business, http://www.doingbusiness.org/data/exploreeconomies/guatemala/, Mix Market, http://www.mixmarket.org/mfi/country/Guatemala

Poverty and extreme poverty





- The **extreme poverty line** is defined as the minimum income needed to meet a persons basic nutritional needs: **Q.4380 (around USD 569) per capita per year.**
- The **poverty line** is defined by adding an estimate of the resources needed by a household to satisfy its basic non-nutritional needs: **Q.9,030 (around USD 1172) per capita per year.**
- **Extreme poverty in rural areas:** a high number of workers earn Q.30 to Q.60 per day, below the minimal salary of Q71 per day, with irregular number of working days per month. This results in frequent incomes of less than Q700 per month per family, far below the Q1825 per family per month as defined by the extreme poverty line.

- Despite programs like Social Cohesion, which distributes Q.300 (around USD 38) per family per month, **poverty has risen** since 2007.
- Some of the reasons for such increases are:
  - Regional impact of the global economic recession
  - Loss of formal jobs, reduction in real wages (inflation) and bankruptcy of small businesses.
  - Decrease of remittances of 9.3% in 2009 (Bank of Guatemala).

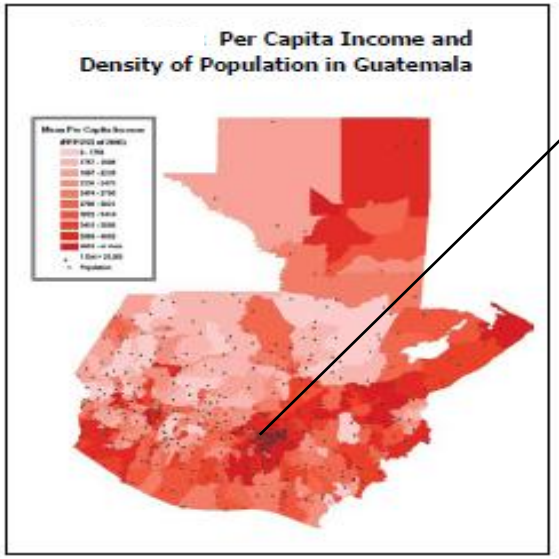
More than half of the population lives below the poverty line, and this share has not significantly reduced since 2000 given the consequences of the international crisis combined with the increase in population. The development of a cookstoves market will have to be supported by specific programs adapted to the economic situation of the poorest in order to promote access to clean cookstoves *for all*.

Sources: ENCOVI 2011 (2012), CABI http://ca-bi.com/

Poverty and extreme poverty at a regional level

Poverty is usually observed in:

- **Areas with low density of population**
- **Remote areas** (distance to a city of 250000+ people)
- Areas with higher demographic proportions of **minority groups**
- Areas with **cold climate**



Most people concentrate around the three main cities of the country —Guatemala, Quetzaltenango, and San Marcos— which enjoy some of the highest levels of income.

Departmental Poverty

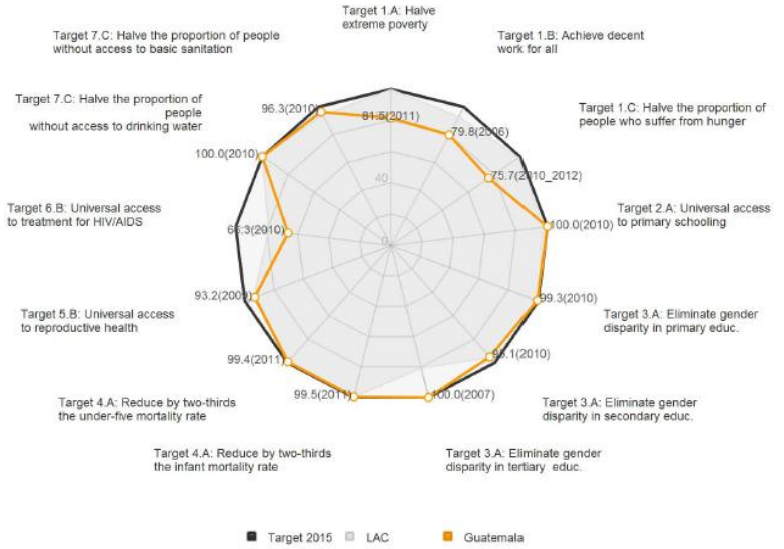
DEPARTAMENTO	Extreme Poverty	Poverty	TOTAL POVERTY	NO POVERTY
Guatemala	0.69	17.95	18.64	81.36
El Progreso	4.07	36.98	41.05	58.95
Sacatepéquez	3.88	37.39	41.27	58.73
Chimaltenango	13.33	52.24	65.57	34.43
Escuintla	2.28	37.37	39.64	60.36
Santa Rosa	11.15	46.61	57.77	42.23
Sololá	17.97	59.51	77.47	22.53
Totonicapán	20.99	52.30	73.29	26.71
Quetzaltenango	10.44	43.28	53.73	46.27
Suchitepéquez	22.58	48.07	70.65	29.35
Retalhuleu	12.67	46.57	59.24	40.76
San Marcos	15.19	53.35	68.54	31.46
Huehuetenango	9.59	50.91	60.50	39.50
Quiché	16.83	55.02	71.85	28.15
Baja Verapaz	23.55	40.46	64.01	35.99
Alta Verapaz	37.72	40.52	78.24	21.76
Petén	16.25	49.42	65.67	34.33
Izabal	19.92	38.74	58.66	41.34
Zacapa	24.96	30.05	55.00	45.00
Chiquimula	28.28	34.41	62.68	37.32
Jalapa	18.35	51.58	69.93	30.07
Jutiapa	13.02	38.52	51.54	48.46
Total Nacional	**13.33**	**40.38**	**53.71**	**46.29**

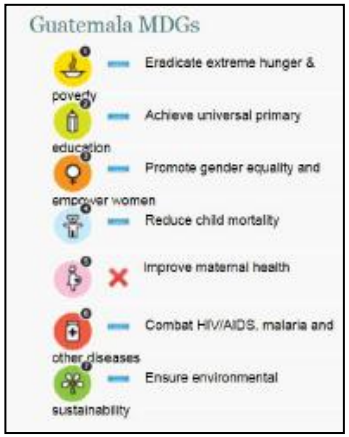
Poverty dynamics are complex, involving geographic, climatic, social and cultural facets. Poverty reduction programs, as well as cookstove initiatives focused on poor segments of population, must address these multiple dimensions simultaneously.

Sources: ENCOVI 2011 (2012), World Bank (2005a), World Bank, (2009a), World Bank, (2009b), CESAC, http://sedac.ciesin.columbia.edu/

Development indices

Degree of compliance with 2015 Targets of the Millennium Development Goals





Human Development Index

- The Human Development Index (2013) ranks Guatemala 133 among 187 ranked countries and in last place in Central America.
- Guatemala is in the lower range of the medium human development category of countries.

- Guatemala is unlikely to meet several of the MDGs. Among them, the extreme poverty MDG appears to be a deep challenge, given the consequences of the international crisis on the economy, but also the country's structural problems, like the enormous gap between rich and poor.
- The implementation of clean cooking relates directly to MDGs 4, 5 and 7, and indirectly to MDGs 1, 2 and 3.

Clean cooking solutions will contribute to several of the Millennium Development Goals (MDGs), related to health, gender, environment, poverty.

Sources: CEPALSTAT http://interwp.cepal.org/cepalstat/WEB_cepalstat/perfilesNacionales.asp, AusAID http://www.ausaid.gov.au/countries/cla/latinamerica/Pages/latinamerica-mdg-progress.aspx), DevInfo http://www.devinfo.org/libraries/aspx/dataview.aspx

Health environment

Guatemala is among the worst performers in terms of health outcomes in Latin America, with one of the highest infant mortality rates, and one of the lowest life expectancies at birth. Major causes of death in Guatemala include diseases such as diarrhea, pneumonia, and malnutrition. Health infrastructure remains insufficient.

Key Health Indicator	Guatemala	Central América
Life expectancy at birth (2012)	71 years	73 years
Infant Mortality per 1000 live birth (2012)	25 deaths	18 deaths
Maternal Mortality per 100,000 live births (2012)	120 deaths	83 deaths
Tuberculosis death rate (2010)	4%	4%

Key Health Indicator	Guatemala	Central América
Health expenditures (2010)	6.9% of GDP	El Salvador 6,9%, Panamá 8,1%, Honduras 6,8%, y Nicaragua 9,1%.

From 1999 to 2010 this percentage increased from 4.7% to 6.9%; the improvement was not nearly sufficient to support the health needs of the country.

Respiratory diseases were the most important cause of morbidity and mortality in Guatemala

Main Mortality Causes (2010)

Main Mortality Cause	% Deaths	World Rank
Influenza & Pneumonia	12.9%	57
Violence	11.7%	1
Diarrhoeal diseases	7.0%	55
Coronary Heart Disease	6.2%	165
Other Injuries	5.6%	8
Diabetes Mellitus	5.4%	57
Low Birth Weight	4.7%	68
Malnutrition	4.0%	2
HIV/AIDS	3.3%	59
Kidney Disease	3.0%	39
Stomach Cancer	2.9%	83
Liver Disease	2.8%	4
Stroke	2.3%	190

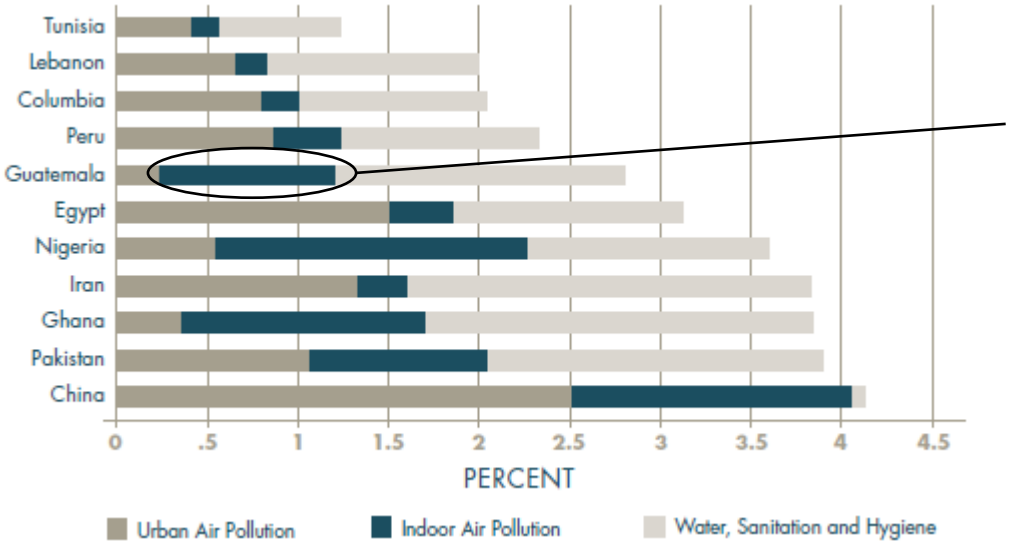
Health performance of the country is poor, with several sources of vulnerability. Respiratory disease is the highest single cause of mortality. Cookstove initiatives, contributing to reductions in indoor air pollution, can significantly help improve health outcomes in Guatemala.

Sources: WHO data, http://www.who.int/countries/gtm/en/, CEPALSTAT, http://interwp.cepal.org/cepalstat/WEB_cepalstat/perfilesNacionales.asp, CIA Factbook, https://www.cia.gov/library/publications/the-world-factbook/geos/gt.html

Burden associated with health

Direct health impacts associated with environmental risk factors cost Guatemala more than 2% of the GDP

Economic burden associated with poor environmental health (as percentage of GDP)



- Household Air Pollution (HAP) accounts for economic losses equivalent to around 1% of Guatemala GDP.
- However, it remains a low priority of the public environmental agenda. Important environmental health issues for the poor may not make it to the policy agenda without an active effort by public officials to involve and hear the voices of these groups.
- Focus groups with women in Guatemala usually show a lack of awareness of the link between HAP (environmental health issue) and acute respiratory infections (health outcome).

Household Air Pollution induces economic losses which contribute to the poor environmental performance of Guatemala. Clean cooking programs will contribute to reduce this economic burden. However, it will require HAP to be recognized as a priority in the public environmental agenda. Moreover, a widespread communication program is necessary to raise awareness of HAP and its correlation with respiratory diseases, eye problems, and other health issues.

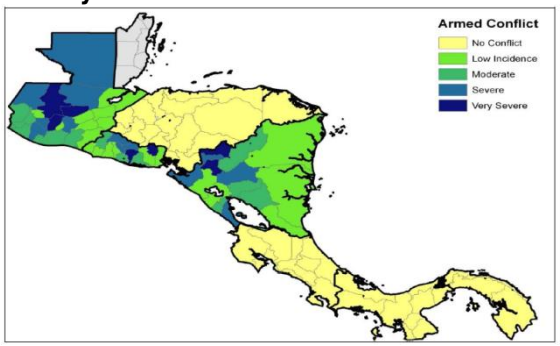
Sources: Joint Agency Paper, (2008), World Bank (2005b).

Other characteristics of the social environment

Violence

- Total Economic Costs of Crime and Violence: 7.7% of GDP in Guatemala (health cost, public security, private security costs)

Intensity of Armed Conflict in Central America



Gender

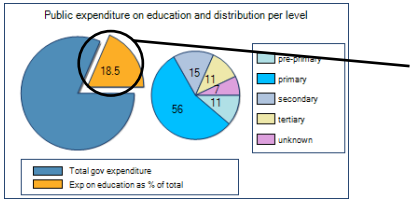
Gender Index	Guatemala (2012)
OECD Social Institutions and Gender Index	35 out of 86
UNDP Gender Inequality Index	114 out of 186
Global Gender Gap Index	116 out of 135

- Around 560 women were murdered in Guatemala in 2012, 631 in 2011, and 695 in 2010, according to official figures.

Indigenous groups

- About 39% of Guatemalans identify themselves as indigenous.
- Recent studies suggest that indigenous people in Latin America perform uniformly worse across MDG indicators
- Higher poverty rates than the average population
- Indigenous people are about 18% more likely than non-indigenous to work in the informal sector.

Education



Guatemala´s public expenditure on education is close to the Central America average of 19%

Communication

- Almost 21 million mobile phones were used in 2011 (Guatemala at the 47th rank of 216 countries), 2.3 million Internet users in 2009
- Mobile phones, associated with pre-paid phone cards, have become a necessity in Guatemala for security reasons, among others.
- Although ICS will probably never be considered as much of a priority as mobile phones, the latter may indicate a monthly capacity to pay for a cookstove, if recognized as crucial for the family.

The main challenges for the government include fostering inclusive growth, addressing social and gender inequalities, improving the levels of citizen security and ensuring revenues to finance public spending on education, health and infrastructure, among others.

Sources: World Economic Forum http://www.weforum.org/issues/global-gender-gap, Hall and Patrinos, 2005, http://www.imf.org/external/pubs/ft/fandd/2005/12/hall.htm, Hall and Patrinos, (2010), World Bank, (2009a), World Bank, (2011), World Bank http://data.worldbank.org/indicator/SE.PRM.ENRL.TC.ZS, UNESCO http://stats.uis.unesco.org/unesco/TableViewer/document.aspx?ReportId=121&IF_Language=eng&BR_Country=3200&BR_Region=40520

Infrastructure

	Roadways	Railways	Waterways	Airways
Current situation	In terms of quality of trade and transport related infrastructure, **Guatemala stands 81st out of 155 countries**, below other Central American countries such as México, Costa Rica and Panama (World Bank)			
	• Within the Central American economies, Guatemala has the poorest road infrastructure • Transport infrastructure has seen progress, with the share of paved roads growing from 25 percent in 1997 to almost 45 percent in 2006 • There have also been efforts to increase connectivity of rural locations	• Although Guatemala still has a network of narrow gauge 3 ft (914 mm) railroads, no passenger or freight trains currently run, except for occasional chartered tourist trains	• Guatemala has 260 km navigable year round, and additional 730 km navigable during high-water season • Guatemala stands 58th out of 162 countries in terms of shipping connectivity • Guatemala stands 60th out of 142 countries in terms of quality of port infrastructure	• Guatemala has 291 airports (stands 24th out of 237 countries), 15 with paved runways and 276 with unpaved runways
Government priorities	• Government aims to recover 100% of the country road network • Government is considering putting routes under private management	• No information	• The government aims recovery of Port Champerico, and the construction of a terminal for bulk solids and liquids at Port Santo Tomas de Castilla	• No information
	The Guatemala Investment Summit was held in May 2013 to promote investment in the country. Projects in railways, an industrial park, port terminals and roads were presented, no concrete results have yet to be obtained. The government is encouraging business models based in public-private partnership.			

Insufficient access to infrastructure is an obstacle to investment and economic development in some regions of Guatemala, including for cookstove initiatives in remote areas.

Sources: UNCTAD (2011), CIA Factbook , World Bank http://data.worldbank.org/country/guatemala, CentralAmericaData http://en.centralamericadata.com/en/tsearch?q=Guatemala, Railway Gazette http://www.railwaygazette.com/news/single-view/view/guatemala-passenger-revival-plan.html, Indexmundi, http://www.indexmundi.com/guatemala,

Political environment

Political Structure

- Guatemala is a presidential representative democratic republic with a multi-party system
- The 1985 Constitution serves as the country's supreme legal document
- The President of Guatemala is both head of state and head of government
- Parliamentary elections are held every four years with the last elections held on 11 September 2011 (next to be held in September 2015)

Administrative Structure

- The country is divided into 22 departments and 333 municipalities
- Guatemala is heavily centralized; transportation, communications, business, politics, and the most relevant urban activity takes place in Guatemala City
- Guatemala City is the largest city with Mixco and Villa Nueva that have merged into one; the second largest city is Quetzaltenango
- The Civil War (ending in 1996) forced many Guatemalans to start lives outside of their country; the majority of the Guatemalan diaspora is located in the United States

Current Government

- In the latest elections, Otto Pérez Molina of the Patriotic Party won the presidential election in a runoff against Manuel Baldizón of the LIDER party, with 53.8% of the vote
- Pérez Molina has created a Ministry of Social Development to implement social policy
- Public expenditure in social programs remains among the lowest in Latin America
- In order to increase revenues, a proposal for fiscal reform was approved in February 2013

Working with the government

- Justice and security sectors need to be supported to guarantee any intervention planning
- There is an urgent need to better align and harmonize international development cooperation with Government policies and local efforts, calling for national professional coordination capacities to be strengthened
- There is an absence of exit strategies: institutional and process conditions often have not been created to maintain the achievements and benefits after the finalization of the intervention
- The surge in small short-term initiatives affected the quality, connectivity, synergy and sustainability of interventions

The political environment is characterized by numerous social, economic and security challenges, but also by the lack of systematization or continuity of successful interventions and synergies between initiatives implemented by the Government.

Sources: CIA Factbook https://www.cia.gov/library/publications/the-world-factbook/geos/gt.html, UNDP (2009), World Bank http://www.worldbank.org/en/country/guatemala/overview

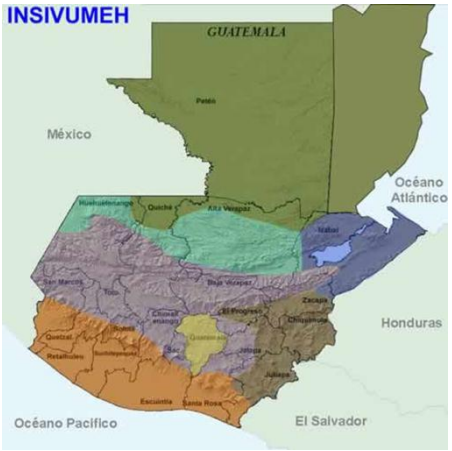
Climatic profile

Climate vulnerabilities

- Climate change will exacerbate droughts or rains, such as the recent tropical storms, alter the quality of natural resources and endanger ecosystem resilience in Guatemala.
- In a country where about 41% of the population lives on about $1 a day, climate change impacts on the availability of natural resources (water, food and wood) would be disastrous.
- 48% of territory is currently under the threat of severe drought.
- The Eastern region of the country has areas with semi-arid or sub-humid and dry climates and the future climate scenarios for Guatemala show an increase in temperature and a reduction in rainfall and an intensification of mid-summer heat.
- The temperature rise and the reduction in rainfall will contribute to the territorial expansion of the semi-arid and sub-humid and dry climates.

On top of a relatively low environmental performance (ranked 76 out of 132 countries, ranking very low on agriculture and forests), Guatemala is exposed to climate vulnerabilities which add to already existing vulnerabilities and may reinforce the existing woodfuel deficit in Guatemala. Clean cooking initiatives would contribute to increased resilience of ecosystems and families by reducing their dependence on scarce resources.

Climatic zones

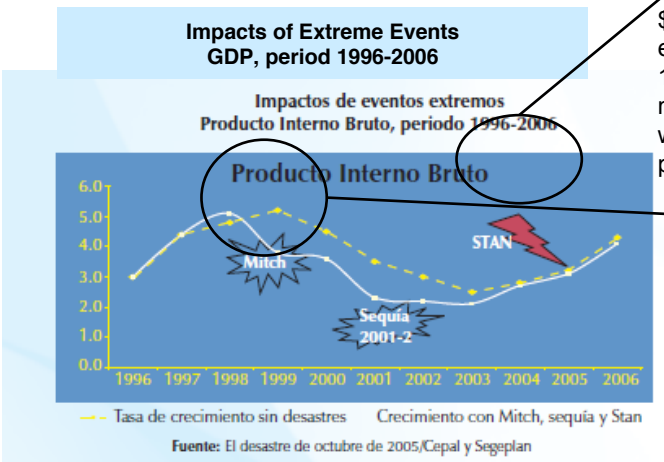


Three geographical regions
The Highlands (mountain area)
The Pacific Coast region
The Petén tropical region

Climate is tropical
Hot, humid in lowlands, cooler in highlands

Natural Disasters and Extreme Events

Guatemala is prone to natural disasters



Tropical Storm Stan caused $989 million USD in economic losses, over 1,400 deaths, and over ½ million victims, 70% of whom were indigenous peoples.

Hurricane Mitch resulted in $748 million USD in economic losses, 77% of which affected production sectors.

Sources: CEPALSTAT http://interwp.cepal.org/cepalstat/WEB_cepalstat/perfilesNacionales.asp, World Bank http://www.worldbank.org/en/country/guatemala/overview, INSIVUMEH http://www.insivumeh.gob.gt/, EPI http://epi.yale.edu/epi2012/rankings

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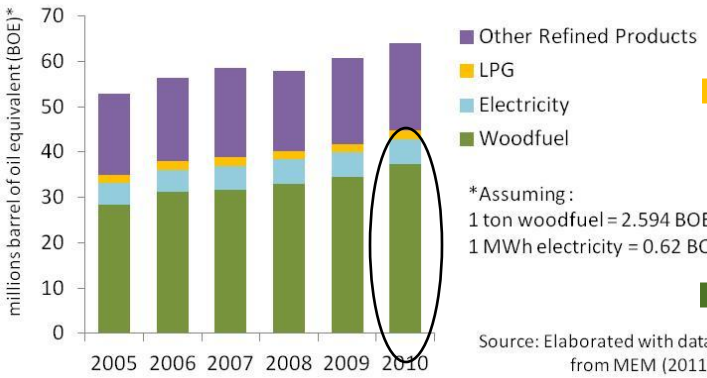
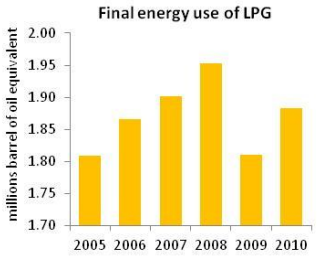
Overview of the energy balance in Guatemala

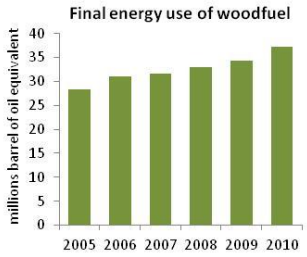
Final energy consumption 2005-2010



*Assuming:
1 ton woodfuel = 2.594 BOE
1 MWh electricity = 0.62 BOE

Source: Elaborated with data from MEM (2011)

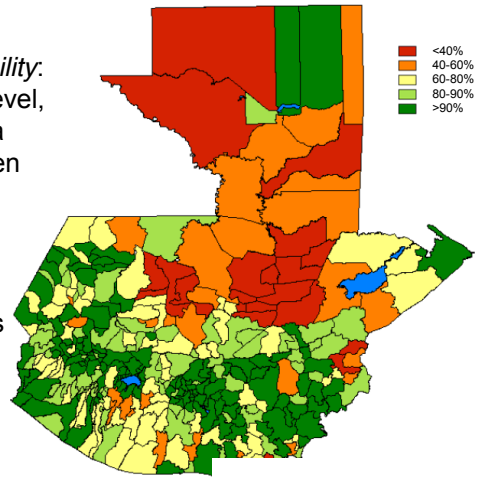




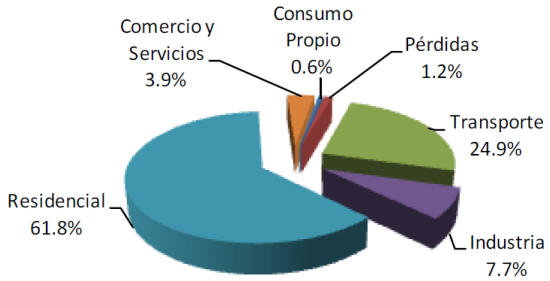
Electricity availability in 2010

Electricity availability: 82% at national level, below 50% in Alta Verapaz and Peten

Supply sources:
Hydro
Petroleum
Bagasse residues
Geothermal

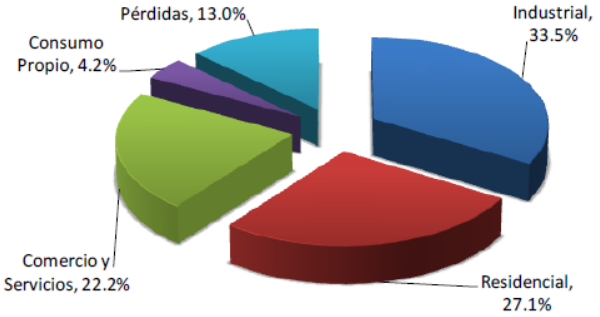


Final energy consumption by sector in 2010



Residential is at the heart of final energy consumption, driven by woodfuel consumption

Electricity consumption by sector in 2010

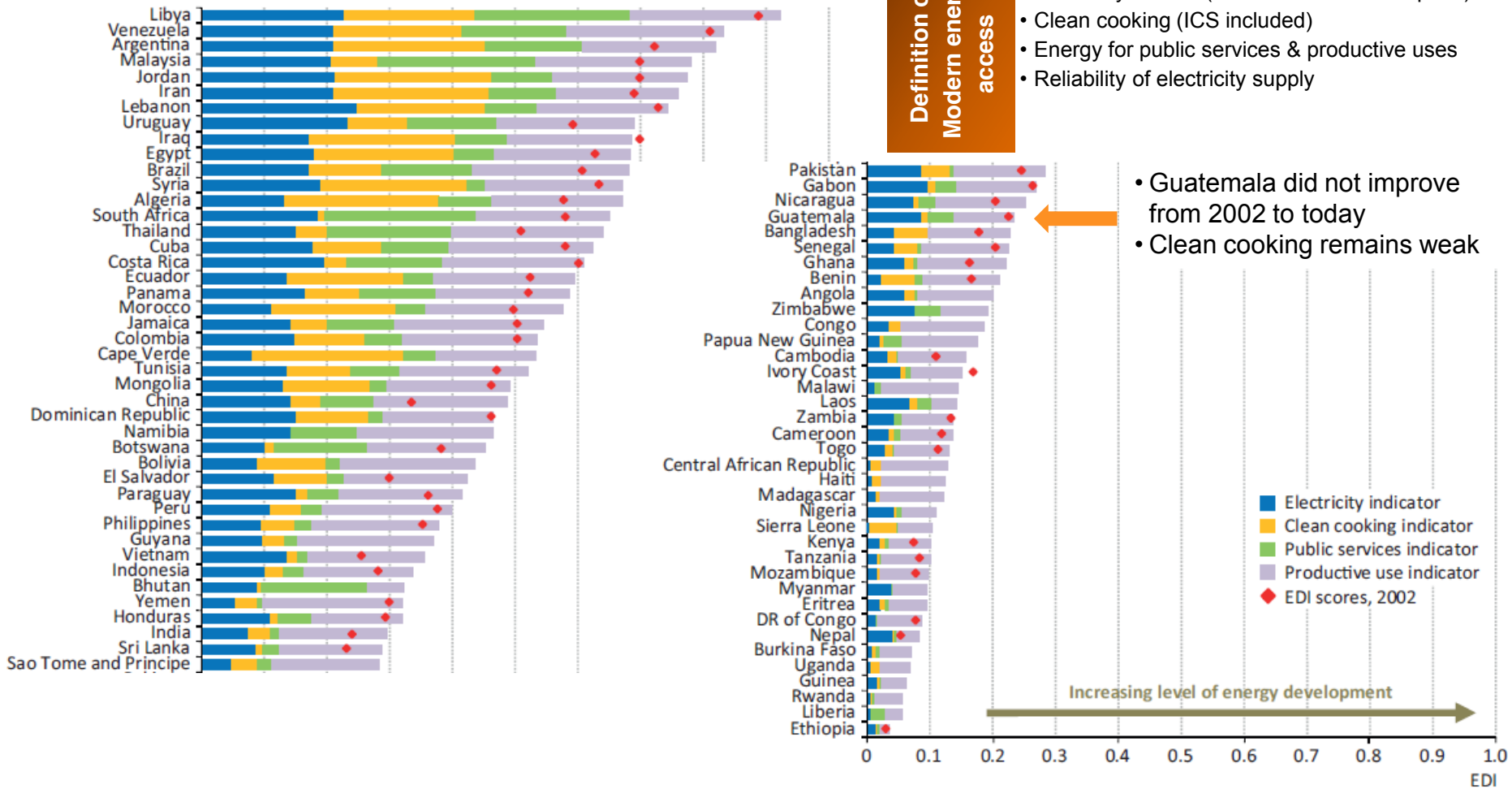


Residential sector is the biggest energy consumer sector, driven by woofuel consumption. Woodfuel remains close to 57% of the total final energy use, and its share continues to increase while LPG is marginal (3%) and its consumption varies with prices.

Sources: Ministerio de Energia y Minas http://www.mem.gob.gt/viceministerio-del-area-energetica-2/direccion-general-del-area-energetica/estadisticas/xxx
Ministerio de Energia y Minas (2012).

The Energy Development Index of the International Energy Agency

Figure 18.9 ▷ Energy Development Index country results, 2010 (and 2002)



Definition of Modern energy access

- Electricity access (connection + consumption)
- Clean cooking (ICS included)
- Energy for public services & productive uses
- Reliability of electricity supply

- Guatemala did not improve from 2002 to today
- Clean cooking remains weak

Clean cooking is now recognized as a crucial parameter of modern energy access, in addition to electricity. Guatemala performs poorly especially in terms of clean cooking.

Sources: International Energy Agency (2013)

Woodfuel: A sustained demand...

Residential uses

Residential consumption of woodfuel in 2010 (tons dry matter)

Departamentos	Demanda Urbana	Demanda Rural	Demanda Residencial
Alta Verapaz	72,781.16	934,889.50	1,007,670.66
Baja Verapaz	26,555,07	362,524.10	389,079.17
Chimaltenango	145.029.84	574,358.85	719,388.69
Chiquimula	13,969.07	374,984.46	388,953.53
El Progreso	12,.036.37	129,482.59	141,518.96
Escuintla	76,336.05	501,063.40	577,399.45
Guatemala	178,755.84	322,487.41	501,243.25
Huehuetenango	233,768.20	2,196,120.30	2,429,888.50
Izabal	11,558.40	292,447.00	304,005.40
Jalapa	54,393.85	294,576.08	348,969.93
Jutiapa	33,771.05	402,598.86	436,369.91
Petén	13,389.47	560,911.04	699,300.51
Quetzaltenango	159,069.14	787,618.43	946,687.57
Quiché	258,255.12	1,343,047.41	1,601,302.53
Retalhuleu	36,121.28	379,600.30	415,721.58
Sacatepéquez	96,410.34	61,477.04	157,887.38
San Marcos	112,078.60	1,765,477.60	1,877,556.20
Santa Rosa	51.017,22	305,320.86	356,338.08
Sololá	136,189.65	454,485.49	590,675.14
Suchitepéquez	94,786.02	556,626.30	651,412.32
Totonicapán	126,482.47	577,693.50	704,175.97
Zacapa	16,571.37	156,117.47	172,688.84
Total general	**2,084,325.59**	**13,333,907.99**	**15,418,233.58**

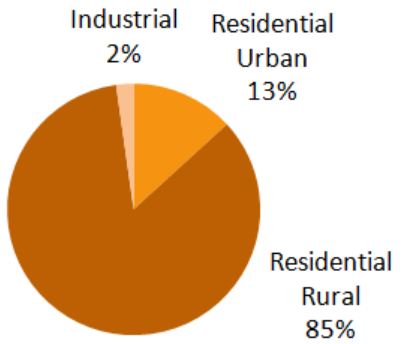
- Several factors must be considered to understand the levels of consumption: cultural preferences, climate, poverty and access to free resources, availability of woodfuel, price, type of wood, ignorance and lack of options
- High consumption per capita in San Marcos, Quiche, Alta Verapaz.

Industrial uses (Bakeries, brickworks, drying of cardamon, sugar factories-)

- Bakeries of urban areas, especially Guatemala, are the dominant consumers.
- Sugar industry consumes mostly sugar cane bagasse and sustainable firewood
- Consumption by cardamon activities is concentrated in Alta Verapaz.
- Total industrial consumption in 2010: 353 kt dry matter

Commercial uses: Unknown

Sectoral consumption (2010)



Annual consumption of woodfuel is around 16 millions tons of dry matter per year, largely dominated by rural residential demand. Many different factors contribute to the levels of woodfuel consumption, and there is no unique consumption pattern.

Sources: INAB, IARNA-URL, FAO/GFP (2012), Ministry of Energy and Mines (2012), ENCOVI 2011 (2012)

... and a deficit in woodfuel supply

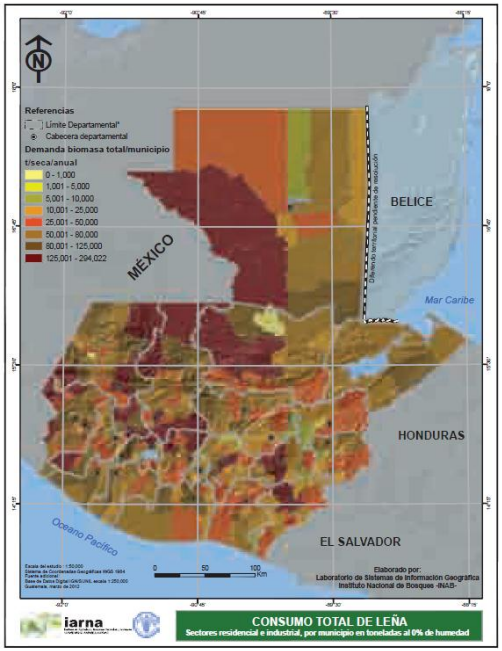
SUPPLY

- **Deforestation:** 1.16% annual (2006-2010). Reduction by 17% of the forest area between 1990 and 2005, 50% since 1950
- **Multiple causes of deforestation**: land-use changes for agriculture or urbanization, fires, diseases, woodfuel
- **Extractions of wood with license:** average of 402 kt of dry matter per year (2006-2010).
- **Sustainable wood productivity** by natural forest: 15 054 kt/yr. 56% of this amount is physically and legally available for energy uses.
- **Average productivity** of woody biomass derived from forest plantations: 1423 kt/yr
- **Byproducts** of the timber industry: 137 kt/yr
- **Estimate illicite** wood extraction (without authorization): ratio of 1 m^3 legal : 391 m^3 illicite

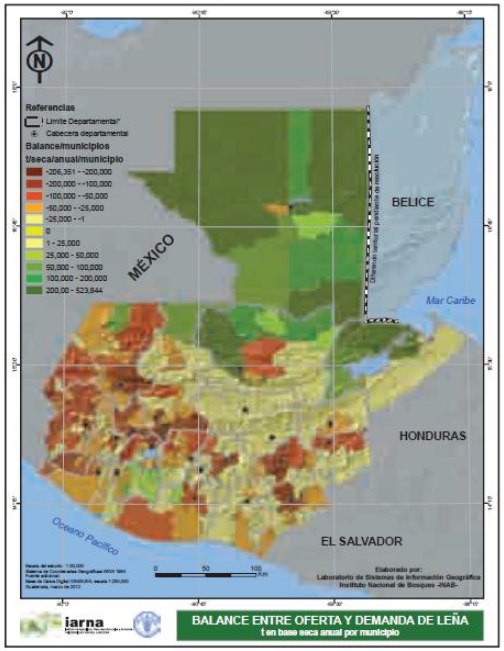
Total supply
10 millions tons dry matter per year

Deficit of almost 6 millions tons per year
in the supply/demand balance

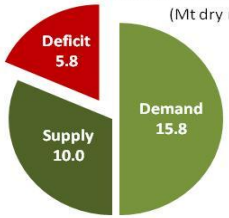
Consumption map (all uses)



Balance supply/demand (all uses)



Annual woodfuel balance
(Mt dry matter)

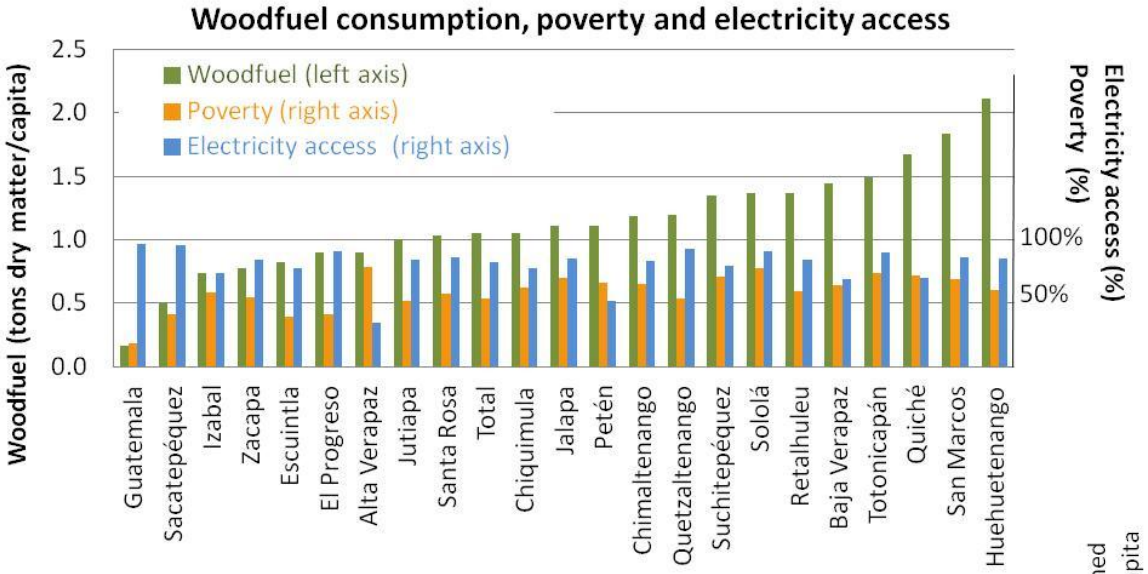


Elaborated with data from INAB, IARNA-URL, FAO/GFP (2012)

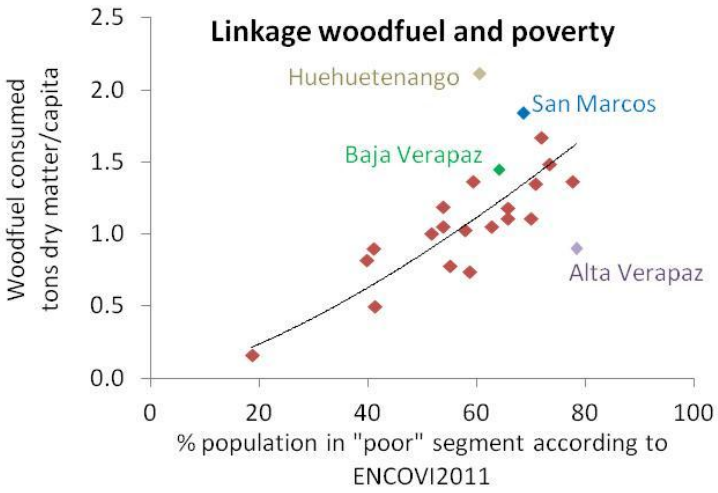
The publication of the estimate of the woodfuel deficit and illicit wood extraction has contributed to the awareness of stakeholders about the issue. This reality, combined with the lack of efficient regulation of the woodfuel market, reinforces the need for an efficient use of woodfuel and the development of sustainable plantations for energy uses and of other energy sources, as mentioned in the national Energy Policy of the country

Sources: INAB, IARNA-URL, FAO/GFP (2012), Funsolar (2011), Wang *et al.* (2013), CEPAL (2011)

Woodfuel, poverty and electricity access



There is not a clear linkage between woodfuel consumption, poverty and electricity access. Although poverty is one of the drivers of the consumption of woodfuel, it is not the only one.



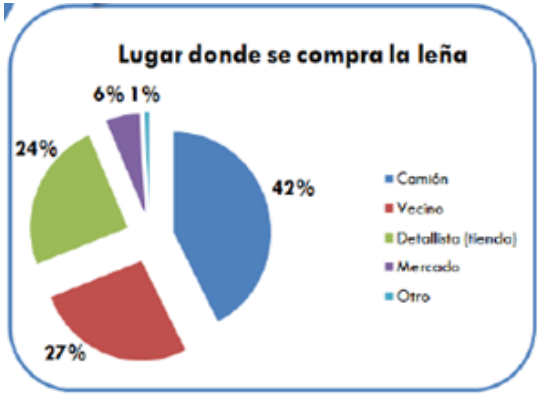
Several factors contribute woodfuel consumption: poverty is one of them, but it is not the only one. Climate, availability of woodfuel, price, ignorance, and lack of options must also be considered.

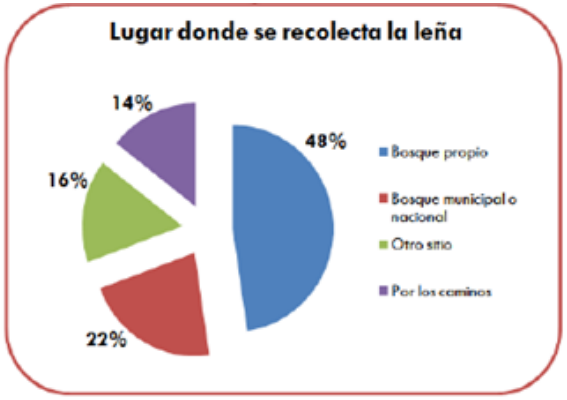
Sources: Elaboration by the authors with data from INAB, IARNA-URL, FAO/GFP (2012), Ministry of Energy and Mines (2012), ENCOVI 2011 (2012)

Woodfuel prices and share in household expenses

- **35% of households** buy all the woodfuel they consume, the rest gather all or part of the woodfuel they need
- 28% and 47% of urban and rural households gather all the woodfuel they consume ⇒ **A high share of consumed woodfuel is considered free** except for time and transport costs (other studies consider that up to 80% of woodfuel is purchased)

- **Relatively wide range of price of woodfuels**, depending on location, specie, size of logs, dryness, etc.
- **Content of a same units** (carga, tarea) is not necessarily the same in all regions
- **Case study** (right table) : monthly woodfuel expenses up to 16% of poor household (considering the upper level of poverty segment: Q3600/month)
- **Increasing prices** will reinforce this burden





Case study (2010) - For illustrative purpose. Data cannot be extrapolated to the whole country

Community	Average dimensions of a *tarea* of fuelwood (m)	Corresponding volume (m3)	Approximate monthly consumption with open fire	Range of prices of a tarea (Quetzales)	Range of cost of transport (Quetzales)	Approximate monthly cost (Quetzales)
Alta Verapaz	3.20 long 0.50 wide 0.84 high	1.34	1.1	Q210 - Q240	Q30 – Q75	Q264 - Q345
San Antonio Seja	3.35 long 0.40 wide 0.84 high	1.13	1.5	Q270	Q60	Q495
Baja Verapaz	2.00 long 0.50 wide 1.00 high	1.00	1.5	Q210 – Q300	Q20 – Q35	Q345 - Q503
San Marcos	3.00 long 0.50 wide 0.84 high	1.26	1.5	Q100 – Q300	Q30 - 75	Q195 - Q563

1 US$ = around 7.7 Quetzales

Reminder: Poverty level = less than Q3600 per month per household

A high proportion of woodfuel is not purchased in rural areas. When woodfuel is purchased, its share of total household expenses remains uncertain but can reach levels higher than the usual 10% share considered to define household energy poverty. Increasing woodfuel prices may raise interest in efficient cookstoves among those who buy woodfuel.

Sources: INAB, IARNA-URL, FAO/GFP (2012), Funsolar (2011), Wang *et al.* (2013), CEPAL (2011), ENCOVI 2011 (2012)

LPG: complementary fuel use but volatile market

A volatile retail market

- Deregulated price, but concentrated market, with 3 wholesale distributors: ZetaGas (57% of 2011 imports), Tomsa (35%), Dagas (rest)
- No subsidies, high price variability, almost no regional difference
- Available cylinders of 25/50/100 lbs
- High up-front and fuel costs, not adapted to families with irregular revenues
- LPG available in principle in all the country. Less easy access in rural areas (additional cost for the user to reach distribution centers)
- Safety issues associated with the cylinders

An appreciated fuel when incomes increase

- Consumed in 24% of rural & 75% of urban households (2010)
- Monthly LPG consumption of 11/12 kg per rural/urban per household using LPG
- Easy to use and fast ⇒ breakfast & re-heating of food are the usual niches
- Most common complement/alternative to woodfuel when incomes allow
- Not suitable for home made tortillas, but suitable for commercial cooking on large LPG comales.

Municipality	Department	Price Cylinder 25 lbs (Quetzales) March 2013	
San Juan Chamelco	Alta Verapaz	Q	99.00
Cobán	Alta Verapaz	Q	99.00
San Bartolomé Jocotenango	El Quiché	Q	100.00
Ixcan Playa Grande	El Quiché	Q	103.00
Salamá	Baja Verapaz	Q	100.00
San Miguel Chicaj	Baja Verapaz	Q	99.00
Antigua	Antigua	Q	100.00
Guatemala	Guatemala	Q	100.00
Livingston	Izabal	Q	100.00
Jutiapa	Jutiapa	Q	99.00
Sanarate	El Progreso	Q	105.00

Precios Promedio de GLP por Compañía
Año 2013 / abril
(Quetzales por cilindro)

FECHA MONITOREO	COMPAÑÍA	25 Lbs.	35 Lbs.	40 Lbs.	60 Lbs.	100 Lbs.
14-Ene-13	ZETA	90.00	126.00	N/V	N/V	360.00
	TOMZA	90.00	126.00	144.00	216.00	360.00
	DAGAS	90.00	126.00	144.00	216.00	360.00
19-Ene-13	ZETA	90.00	126.00	N/V	N/V	360.00
	TOMZA	90.00	126.00	144.00	216.00	360.00
	DAGAS	90.00	126.00	144.00	216.00	360.00
26-Ene-13	ZETA	90.00	126.00	N/V	N/V	360.00
	TOMZA	90.00	126.00	144.00	216.00	360.00
	DAGAS	90.00	126.00	144.00	216.00	360.00
05-Feb-13	ZETA	99.00	139.00	N/V	N/V	396.00
	TOMZA	99.00	138.68	158.40	237.60	396.00
	DAGAS	99.00	138.68	158.40	237.60	396.00
12-Feb-13	ZETA	99.00	139.00	N/V	N/V	396.00
	TOMZA	99.00	138.68	158.40	237.60	396.00
	DAGAS	99.00	138.68	158.40	237.60	396.00
19-Feb-13	ZETA	99.00	139.00	N/V	N/V	396.00
	TOMZA	99.00	138.68	158.40	237.60	396.00
	DAGAS	99.00	138.68	158.40	237.60	396.00
26-Feb-13	ZETA	99.00	139.00	N/V	N/V	396.00
	TOMZA	99.00	138.68	158.40	237.60	396.00
	DAGAS	99.00	138.68	158.40	237.60	396.00
05-Mar-13	ZETA	99.00	139.00	N/V	N/V	396.00
	TOMZA	99.00	138.68	158.40	237.60	396.00
	DAGAS	99.00	138.68	158.40	237.60	396.00
12-Mar-13	ZETA	109.00	153.00	N/V	N/V	436.00
	TOMZA	109.00	152.60	174.40	261.60	436.00
	DAGAS	109.00	153.00	174.40	261.60	396.00
19-Mar-13	ZETA	109.00	153.00	N/V	N/V	436.00
	TOMZA	109.00	152.60	174.40	261.60	436.00
	DAGAS	109.00	153.00	174.40	261.60	396.00
26-Mar-13	ZETA	109.00	153.00	N/V	N/V	436.00
	TOMZA	109.00	152.60	174.40	261.60	436.00
	DAGAS	109.00	153.00	174.40	261.60	396.00
02-Abr-13	ZETA	109.00	153.00	N/V	N/V	436.00
	TOMZA	109.00	152.60	174.40	261.60	436.00
	DAGAS	109.00	153.00	174.40	261.60	396.00

Window of opportunity for the poor

- To offer and promote smaller LPG cylinders (5 or 10 lbs, under development)
- Complementary use with ICS, for faster uses (breakfast, re-heating)
- Favorable new national Energy Policy 2013-2027, which includes the promotion of energy sources other than woodfuel

LPG is the most common alternative to woodfuel. However, for economic and preference reasons, woodfuel will continue to be used for a long time. Therefore, efficient cookstoves and sustainable supply of woodfuel must be high priorities, while LPG represents a relevant complementary fuel.

Sources: Personal communication with gas distributors (2013), Kojima (2011), Wang *et al.* (2013)

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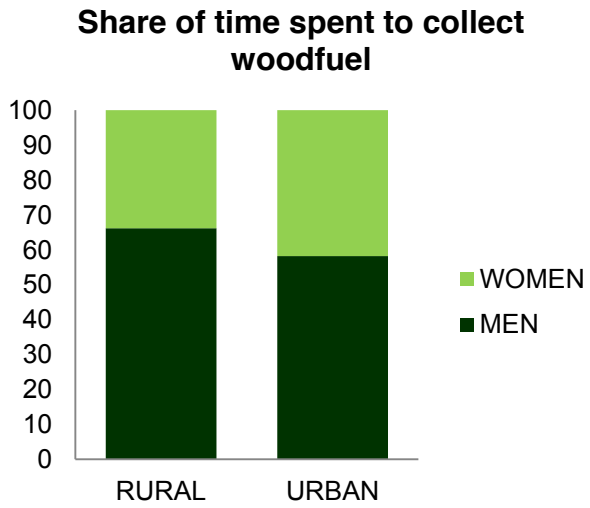
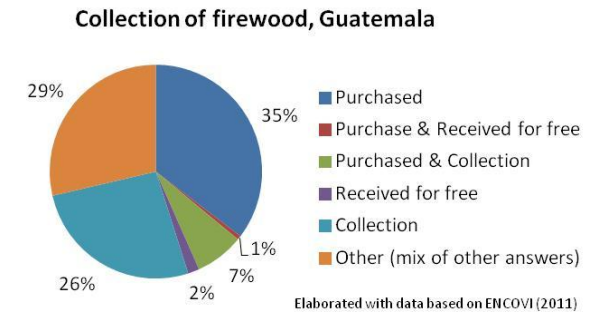
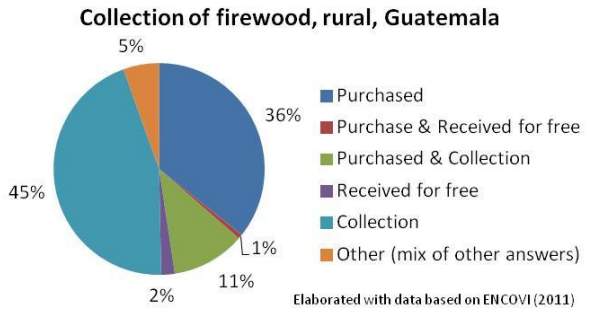
Collection of firewood: who, how much time and where?

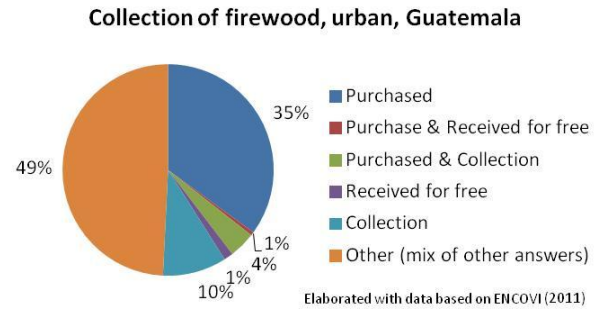
Observations

- In Guatemala, women spend 1.4 and men 2.2 hours a day in urban areas to collect woodfuel.
- In rural areas this time a little bit higher, 1.8 hours a day for women and 2.1 hours a day for men.
- The time spent by women and men is about the same, a little bit more for men.
- A high share of households do not pay for woodfuel (at least 47% in rural areas, 11% in urban areas)









In contrast to other countries, collection of fuelwood is carried out by both men and women in Guatemala. Men's participation is even slightly higher in time than women's participation.

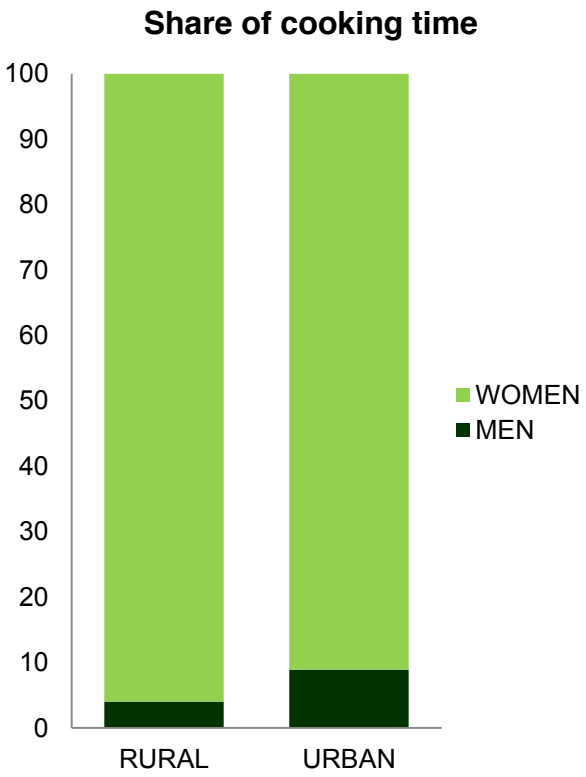
Sources: ENCOVI 2011 (2012)

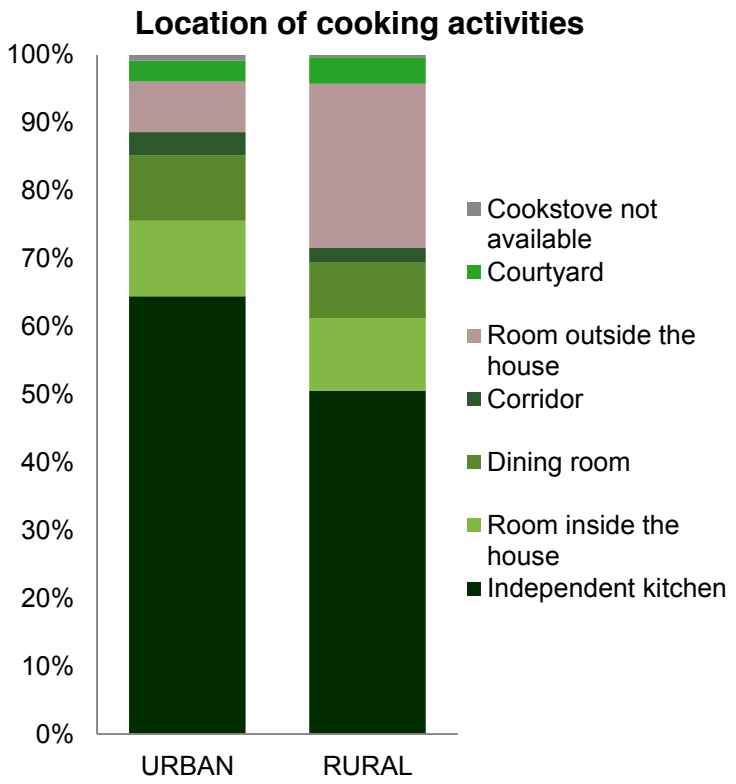
Cooking: who, how much time and where?

Cooking

Observations

- In Guatemala, family spends ~13 hours in urban areas and ~14 hours in rural areas per week for cooking activities.
- This activity is carried out mostly by women, more than 90% => Health impacts derived from indoor air pollution primarily affect women and children.
- Cooking activities are carried out indoors in more than 90% of households.





Cooking activities are carried out mainly by women and indoors. As a consequence, indoor air pollution affects primarily women and children.

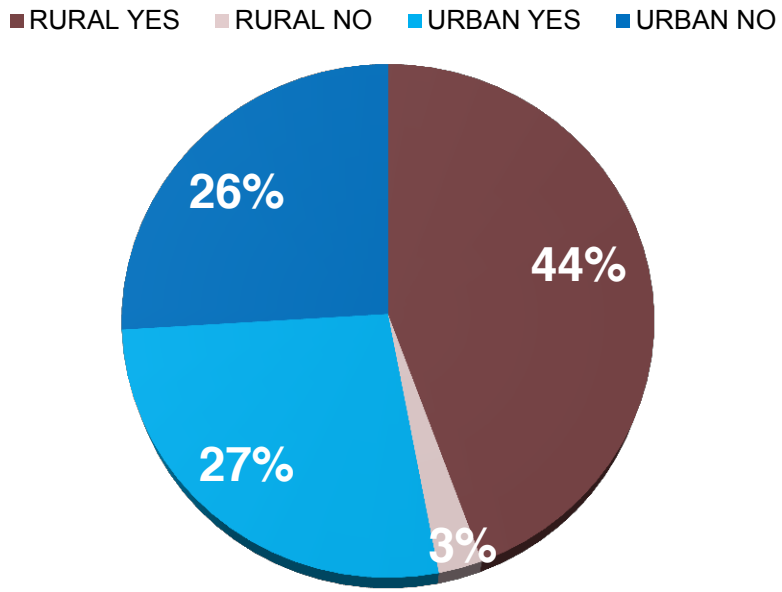
Sources: ENCOVI 2011 (2012), CEPAL (2011).

Cookstoves and household air pollution (HAP) in Guatemala

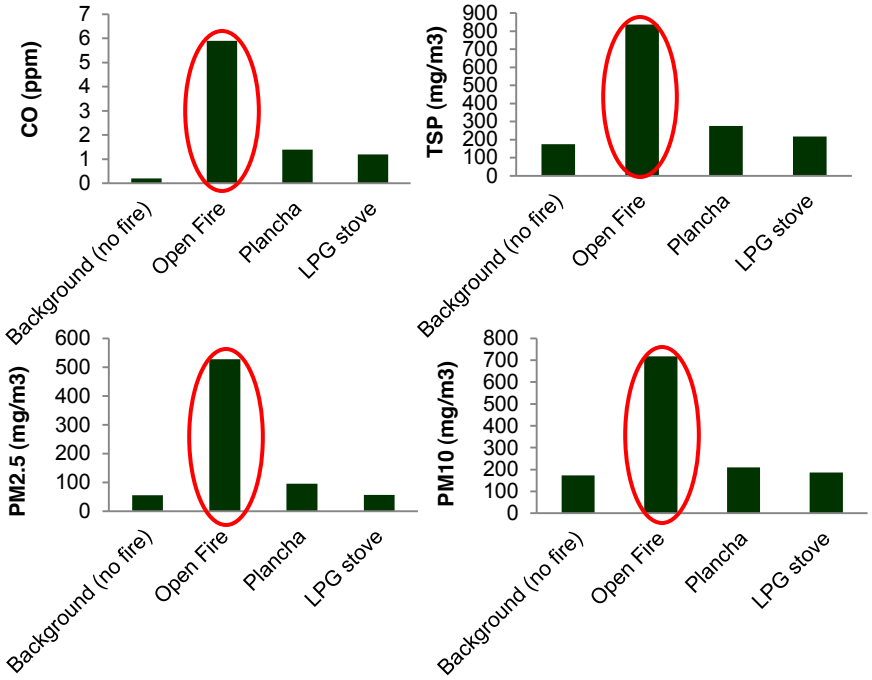
Around 70% of households in Guatemala use firewood for cooking => Around 2 millions of households possibly concerned by HAP

Despite a high level of uncertainty about the emissions of different types of cookstoves, there is no doubt about the high contribution of open fire to HAP levels

% of households using woodfuel for cooking



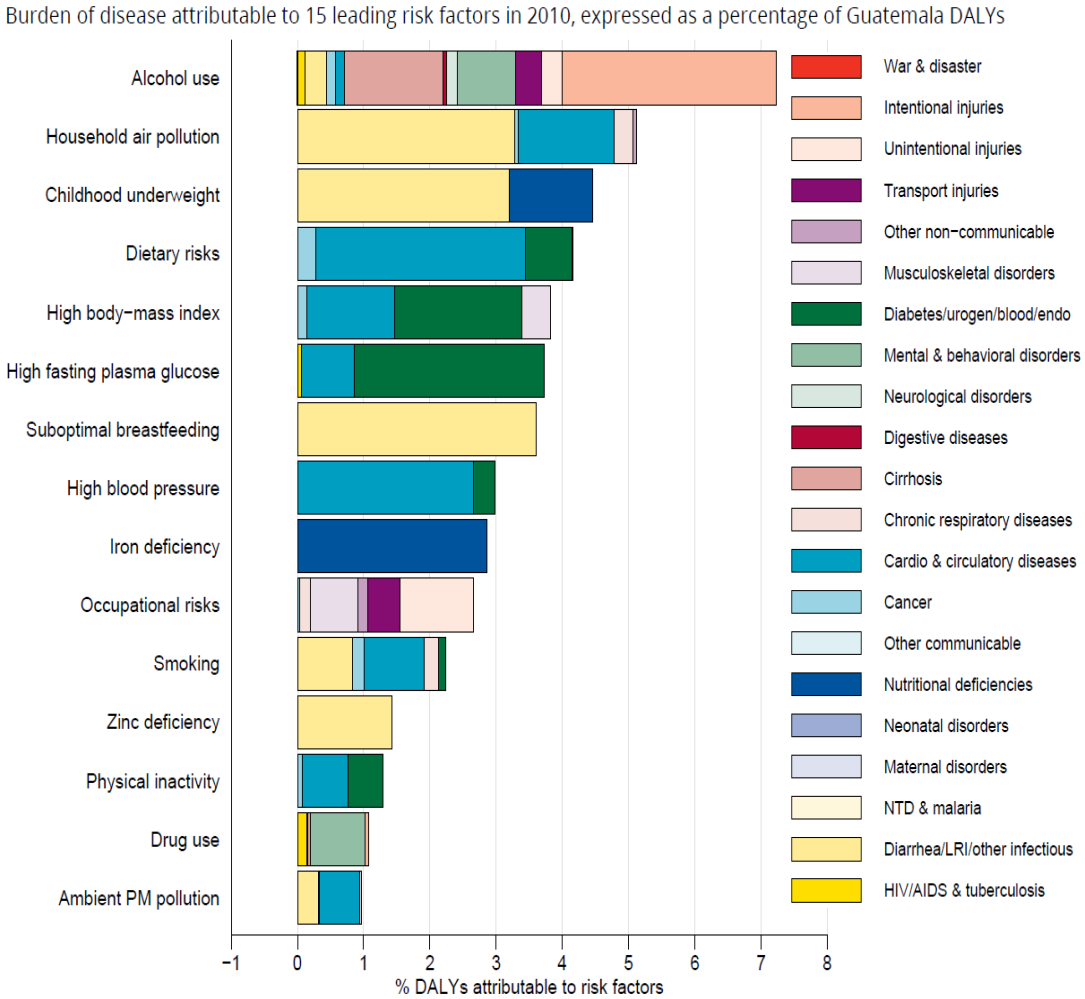
Level of pollutants in kitchens with different types of stoves (Guatemala)



The use of woodfuel, especially in open fires, produces HAP levels much higher than WHO recommendations.

Sources: ENCOVI 2011 (2012), Naeher et al. (2000a)

Health Impacts of the current cooking practices

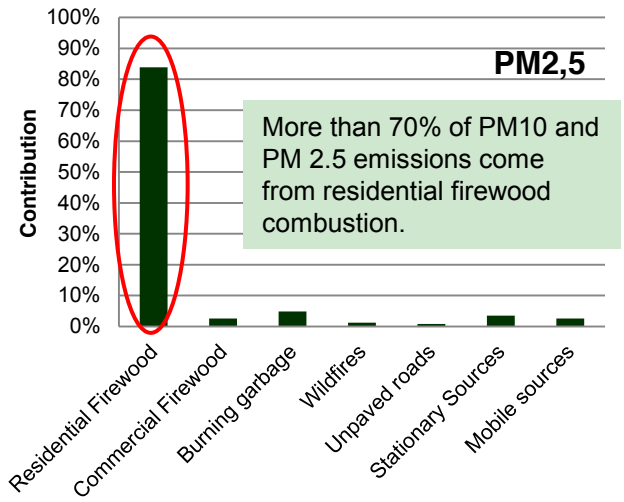


- **Around 5000 deaths** attributable to HAP in Guatemala in 2010, **1775 of them of children under 5**. This make HAP the 5th and the 3rd cause of death respectively (all age / under 5).
- **487000 years of life lost** (YLLs) due to Lower Respiratory Infections in Guatemala in 2010.
- **Lower back pain and neck pain** are among the top five leading causes of years lived with disability (YLDs) in Guatemala in 2010. These causes are very related to carrying loads of firewood.
- The first cause of Disability-adjusted life years (DALYs) in Guatemala in 2010 was lower respiratory infections. **21000 DALY´s in children under 5** due to pneumonia and 900 DALYs in adults above 30 due to COPD.
- The **three risk factors** that account for the highest disease burden in Guatemala in terms of DALYs are: alcohol use, **household air pollution from solid fuels** and childhood underweight.
- **Several other risks are related to HAP**: Lower birth weight in women that use open fires during pregnancy[a], higher blood pressure in people who use open fires than people who use a chimney stove[b], increase of pneumonia for people who use open fires over people using clean cookstoves[c].

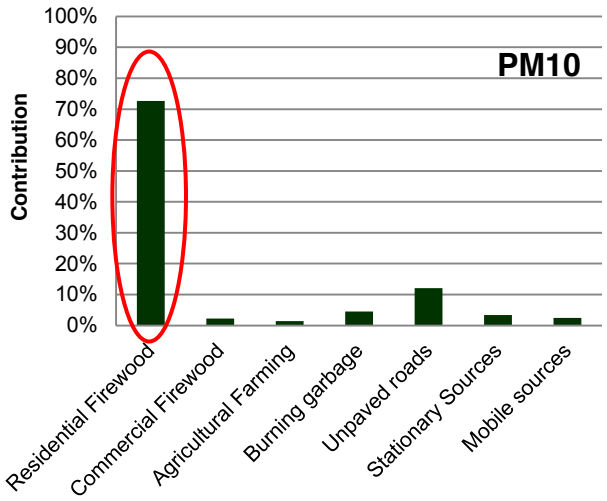
HAP has a strong impact in Guatemala, being among the principal burdens of disease and death causes. HAP is one of the most important health problems in the country and it must be a priority in terms of health issues.

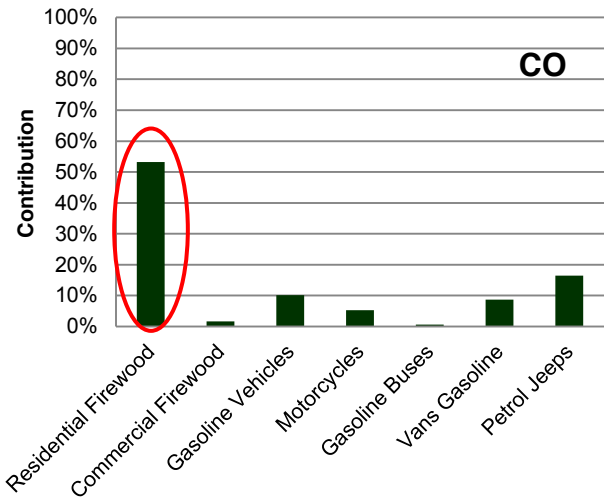
Sources: WHO (2009), UNDP and WHO (2009), Institute for Health Metrics and Evaluation http://viz.healthmetricsandevaluation.org/gbd-compare/ , Ref a - Boy et al. (2002), Ref b - McCracken et al. (2007), Ref c - Respire.

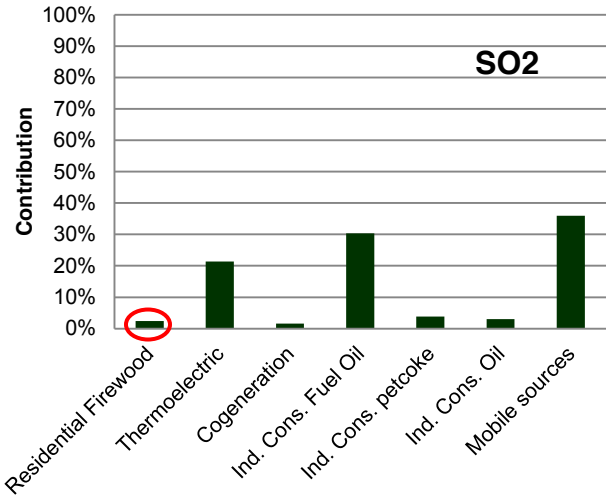
Firewood and outdoor emissions in Guatemala

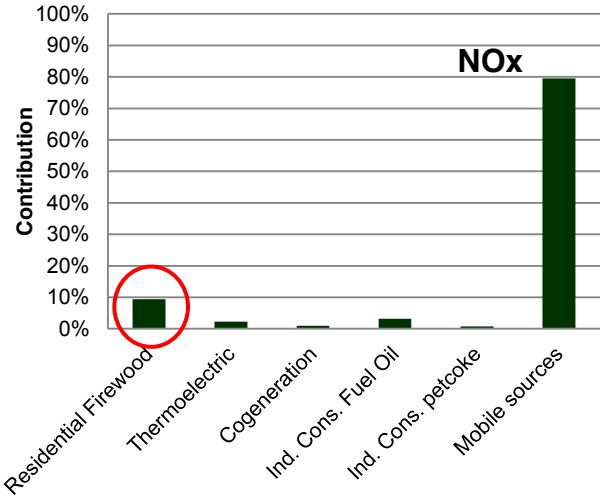


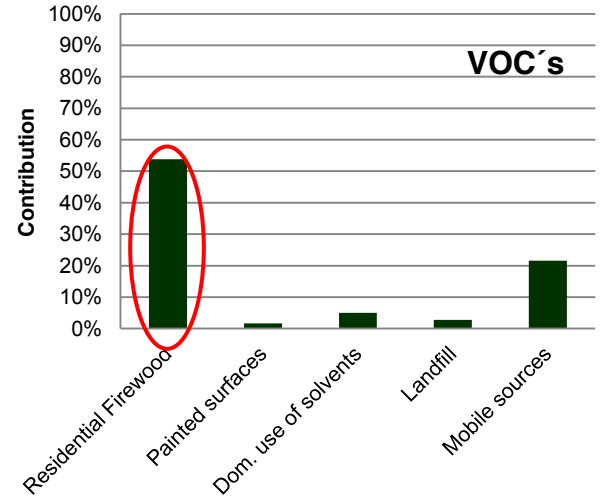
More than 70% of PM10 and PM 2.5 emissions come from residential firewood combustion.











The use of firewood is responsible for most of the emissions in Guatemala. Outdoor air pollution, with main sources being residential and transportation sectors, was directly responsible of about 1400 deaths in Guatemala in 2010.

Sources: Inventario de Emisiones de Contaminantes (2009). WHO (2009)

Black carbon (BC) and organic carbon (OC) emissions associated with energy use by households

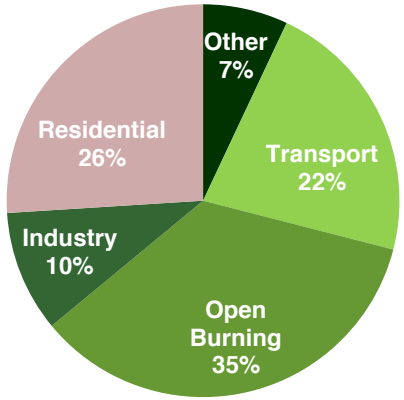
Black carbon (BC) is known to have significant adverse health effects when inhaled, and is recognized as an important agent of climate change.

Global inventories **indicate that residential sources account for more than 25% of BC emissions**, mainly from residential solid fuels such as wood and coal, burned with traditional technologies.

Biomass combustion also produces large quantities of **organic carbon (OC) particles, a cooling agent that tends to offset BCs warming effect**. Scientific understanding of the net climate effect of BC and OC remains limited, much research is being conducted in this challenging area.

According to UNEP (2011), the use of improved cookstoves and the switch from biomass to modern fuels would contribute to reduce short-lived climate forcers, specifically black carbon, by 2050 in a 25%, and to a 0.1ºC reduction by 2050.

Estimated share of global emissions of Black Carbon by sector



	Cooling Particles EF OM (g/kg) (MacCarty et al. 2007)	Warming Particles EF EC (g/kg) (MacCarty et al. 2007)	Warning Particles EF EC (g/kg) (Drew Hill, L., 2012)
3 Stone	1.45	0.88	0.174
Rocket	0.55	1.16	0.159
Charcoal	1.54	0.20	-

EF OM = Emission Factor of Organic Matter
EF EC = Emission Factor of Elemental Carbon (black carbon)

Studies of BC and OC emissions by cookstoves are not conclusive, with large variations of emissions factors.

Type of stove plays a substantial role, but local practice, wood species and conditions are important in EC and OM emissions. (MacCarty et al. 2007)

Black carbon (BC) is recognized as an important contributor to climate change. It is expected that clean cooking will reduce BC emissions, although the overall contribution of woodfuel to BC emissions is uncertain.

Sources: World Bank (2011). MacCarty et al. (2007), Aprovecho Research Center (2012).

Available studies on HAP and cookstoves in Guatemala: Certainties

RESPIRE: RESPIRE Guatemala - Randomized exposure study of pollution indoors and respiratory effects.

"RESPIRE is the first randomized controlled trial ever performed on HAP.

"Our analysis of the 504 women part of the study confirmed that the plancha significantly reduced their CO exposure by 62%."

"Among young women, it significantly reduced the prevalence of both respiratory (wheeze and number of symptoms) and non-respiratory symptoms (headache and eye discomfort)."

"Daily average PM(2.5) exposures were 264 and 102 microg/m(3) in the control and intervention groups, respectively. The results shows that systolic (SBP) and diastolic blood pressure (DBP) were lower for intervention group."

"Although the chimney stove reduced exposure to HAP, exposures remained high for many women and infants. Exposure reduction through well-operating chimney stoves would not only improve the quality of life of the cook and her family but also reduce Low Birth Weight prevalence, based on evidence from ambient and HAP studies."

"In a population heavily exposed to wood smoke from cooking, a reduction in exposure achieved with chimney stoves did not significantly reduce physician-diagnosed pneumonia for children younger than 18 months. The significant reduction of a third in severe pneumonia, however, if confirmed, could have important implications for reduction of child mortality."

Indoor and outdoor PM2.5 and CO in high and low density Guatemalan Villages. Naeher, L.P. et al. Journal and Exposure Analysis and Environmental Epidemiology (2010) 10, 544-551

"For both PM2.5 and CO, levels measured in homes with the plancha lorena or open fires were significantly higher than levels in the street."
"The variation of indoor levels of PM2.5 and CO in home with planchas demonstrate that some planchas produce indoor levels intermediate between gas stoves and open fires."

Carbon Monoxide As a Tracer for Assessing Exposures to Particulate Matter in Wood and Gas Cookstove Households of Highland Guatemala. Naeher, L.P. et al. Environ. Sci. Technol. 2001, 35, 575-581

"The results show strong correlations between daily average area concentrations of PM2.5 and CO. They also clarify some of the limitations of the ability for CO to serve as a proxy for PM2.5 exposures."

CRECER: Chronic Respiratory Effects of Early Childhood Exposure to Respirable Particulate Matter (Results of CRECER program here referred come from various scientific articles)

"The use of passive diffusion monitors to measure CO exposures in settings where the majority of CO and PM emissions is from single source is a reliable if not perfect proxy for PM2.5 exposure estimates. For large-scale epidemiology studies where measuring personal PM2.5 from wood smoke would be impossible, CO as a proxy is a good option."
"Our study indicates that the use of open fires for cooking may be an important risk factor for asthma symptoms and severity, which needs to be studied further."

Many research studies have been carried out in Guatemala showing that HAP and health problems are widely reduced by the use of clean cookstoves.

Available studies on HAP and cookstoves in Guatemala: Uncertainties

Health effects of an efficient vented stove in the highlands of Guatemala. *Steven A. Harris , James B. Weeks , Juan Perez Chen & Peter Layde (2011) Global Public Health: An International Journal for Research, Policy and Practice, 6:4, 421-432*

"Placement of the ONIL stove, an efficient vented stove, in a village previously using non-ventilated indoor open fires was associated with a 26% decrease in clinic visits for both acute upper- and lower-respiratory illness combined, and a 45% decrease in clinic visits for acute lower-respiratory illness. The decrease is even greater in those under 1 year of age, the most vulnerable to lower-respiratory infection in the population. While this is not a randomised clinical trial and cannot prove causation, it does give a unique perspective on the outcome of stove placement over time in an isolated mountain community."

TURBOCOCINA Field Assessments In Schools. San Lorenzo Guatemala. *Northcross, A. L. et al, 2012. Household Energy, Health & Climate Change Research Group , School of Public Health, UC Berkeley*

"The Turbococina shows significant promise for reducing the fuel requirements for schools. Evidence that the TC will reduce kitchen and persona exposures to PM2.5 and CO compared to the Plancha was inconsistent."

Assessing the climate impacts of cookstoves projects. *Stockholm Environment Institute, Working Paper 2013-01*

"There is considerable room for improvement in how offset methodologies account for the climate benefits of improved cookstoves."
"Needs and potential directions for future research:
- Require accounting of uncertainty in estimates of emission reductions
- Develop additional default factors for biomass consumption from baseline stoves.
- Track the application, and review the integrity, of the new CDM default factors.
- Refine approaches to incorporate the use of data loggers in project monitoring.
- Revisit the use of fossil fuel CO2 emission factors as surrogates for biomass combustion.
- Consider non-CO2 greenhouse gas emissions.
- Develop approaches to incorporate black carbon

Conditions of cookstove use and type of wood are important drivers of the reduction of indoor air pollution associated with cookstoves. Monitoring and follow-up of clean cookstove initiatives are crucial to guarantee their full benefits.

- Executive summary
- Project approach
- **Sector mapping**
  - Macro environment
  - Fuel usage and trends
  - Health, social and environmental impact
  - **Cookstove policy environment**
  - Consumer assessment
  - Cookstove industry
- Sector mapping summary
- Appendix

Overview of the history of cookstove programs in Guatemala

Previous models before 1976	Technological innovation 1976-1980	Technological diversification 1980-1986	Research and studies 1986-1993	Commercial promotion 1993-2001	Commercia-lization 2001-present
The three stove cooking fire dominates in the poor households in mainly in rural areas. In urban areas and higher income segments, LPG and electricity were used, but in many households firewood was still used in in-situ or built in place stoves.	Lorena stove is launched by Ing. Manuel Tay. Learning from the Lorena, multiple plancha stoves are developed. For example, the Mexican patzari is a Lorena that has been highly improved. Increasing number of organizations working on ICSs, plancha type, built in place.	MEM coordinates and promotes ICSs. About 30 organizations work on the topic. The ICSs National Group is created in 1982 and develops models, promotes commercialization and dissemination of ICSs. National Plan for the diffusion and dissemination (by MEM) and 12 programs implemented in San Pedro Ayampuc with the participation of various experts and institutions. Large-scale programs based on the Lorena model. CETA model and variants are created . ICSs are donated but families participate in the programs.	National Inquiry on ICSs (1985) showed that most ICSs installed were of the Lorena model. Technical deficiencies or lack of supervision and training are underlined. Most ICSs were donated. Some required participation of beneficiaries. LPG stoves start taking a more relevant participation. There were 8 models available in the metropolitan area of Guatemala in 1990 but due to the lack of demand they disappear. In 1993, 1st study on HAP by Dr. Kirk Smith. Lack of use of ICS is detected. Importance of standardization and commercialization is recognized.	Production of plancha models (metal top to place over the open fire) and demand increases, however there are not controls to assure quality. Planchas for tortillas fueled by LPG for business start. Still in use for industrial tortillerias. Various prototypes developed. In 1994-1995, MEM implements a program to train manufacturers of built-in plancha stoves.	Mass production models start with the objectives of quality of life improvement and cost reduction thanks to better efficiencies in burning firewood . Commercial models develop, Onil stove made of concrete, improved plancha stoves (Plancha INTECAP as model used by the Government of Guatemala), metal box stoves, such as the Noya enter the market. Variations of all models are introduced, with slight to considerable changes, and new names. Multiple and isolated Government programs, such as (FIS, FONAPAZ, FODIGUA) without final information, no systematization, donating the stoves with minimum participation of beneficiaries.

Guatemala has unique experience in ICSs in Latin America, but without systematization of information.

Sources: Arriaza (2005), Díaz Jimenez R (2010), Ekouevi and Tuntivate (2012), experience of the authors.

Government programs and policies

COOKSTOVE PROGRAMS

Social Investment Fund (Fondo de Inversion Social, FIS)

- It has been the largest and most extended ICS program in Guatemala. Around 160 000 stoves (exact number unknown) were installed throughout the country from 1996 to 2008 (plancha model).
- FIS was a governmental organization to carry out infrastructure projects and had offices in all departments.
- The cost of the cookstove was around USD 155, the users contributed to around 10% of this cost (local materials and unskilled labor)
- FIS closed in 2008, there is no systematization of the complete process.

Other programs

- There have been multiple firewood stove programs carried out by the Government, guided by rural development, peace and poverty alleviation. For example: Fondo Nacional para la Paz (FONAPAZ), recently closed, Programa Nacional de Desarrollo Rural (ProRural), Fondo para el Desarrollo Indígena de Guatemala (FODIGUA) and Desarrollo Integral de Comunidades Rurales (DICOR).
- SEPREM , the Secretariat for Women, has also carried out several projects for womens heath.
- There is no integration and no systematization of these experiences. Total number of cookstoves implemented by these programs is not known.

POLICIES

Although there was never policy directly focused on ICS until now, some other policies indirectly relate to the subject, such as policies in the forestry area, social development, indoor and outdoor air pollution, health, climate change, gender, education, etc.

- Law on Protection and Environmental Improvement (1986).
- Forestry Policy (1996).
- Policy on Social Development and Population (2002).
- National Policy on Climate Change (2009).
- Policy for Food and Nutrition Security (2008).
- Integrated Rural Development Policy (2009).

PROPOSALS OF WOODFUEL POLICIES

Proposal of a National Policy on Woodfuels (CEPAL 2011)

- Develop an institutional framework.
- Promote a program for efficient use of firewood.
- Implement energy efficiency and appropriate technology for firewood use at domestic and small industry levels.
- Design forestry programs for the production and use of firewood.

Proposal of a National Strategy for the Sustainable Production and Consumption of Woodfuels 2013-2024 (INAB, 2012)

- Establish and manage at least 48,000 hectares of plantations and agroforestry systems => sustainable supply of 1.2 million cubic meters of woodfuel per year
- Provide technical and financial assistance to implement and monitor 100,000 ICSs.
- Expected results: reduce by 25 % the level of fuelwood deficit
- It was one of the documents used to issue the new energy policy.

Several large government initiatives were implemented, and several policies could directly or indirectly affect woodfuel related issues. However, efforts remain isolated. There is a strong need for a focal point.

Sources: Aché Ortiz (2006), Ahmed et al. (2005), Alvarez et al. (2004), Berrueta (2011), Díaz Jimenez (2010), Guerra Samayoa (2009), INAB, IARNA-URL, FAO/GFP (2012), SEGEPLAN (2002), SIFGUA (2012), and interviews

National Energy Policy 2013-2027

One of the five specific objectives of the National Energy Policy (2013-2027) addresses the reduction of the use of woodfuels in the country.

It is the **first time that firewood and improved cookstoves have been included as a main item in the Guatemalan energy policy, opening the door to new initiatives and** regulations.

It includes long-term goals (2027), with clear targets such as :
- the installation of 100,000 clean biomass stoves,
- the training on efficient use of firewood,
- the reduction of 15% of industrial firewood consumption,
- the increase of 10% in energy plantations,
- the substitution of firewood by other energy sources in 25% of households.

All these efforts will require collaborations among different government organizations, coordination with NGOs, private manufacturers and civil society.

Government organizations are clearly identified, such as Ministries of Energy, Environment, Agriculture, Forestry, Education and Health.

The new National Energy Policy (2013-2027) opens the door for new initiatives and strategies to promote clean cooking.
It is particularly important given national, regional and international contexts, such as the Central American Sustainable Energy Strategy and the Sustainable Energy for All initiative.

Sources: Ministerio de Energia y Minas (2013).

QUINTO EJE:
REDUCCIÓN DEL USO DE LEÑA EN EL PAÍS

OBJETIVOS OPERATIVOS	METAS DE LARGO PLAZO	ACCIONES	INSTITUCIONES PÚBLICAS Y PRIVADAS RELACIONADAS
Incrementar el uso de estufas ahorradoras de leña.	Poner en funcionamiento de 100,000 estufas ahorradoras y enseñar a utilizar la leña de forma eficiente y adecuada	• Crear la normativa para el uso y certificación de estufas ahorradoras de leña. • Apoyar programas de microcréditos para adquirir estufas ahorradoras de leña. • Brindar asistencia técnica para el uso de estufas ahorradoras de leña. • Coordinar el desarrollo e implementación de un plan nacional para el uso de estufas eficientes de leña, con enfoque en la reducción de la contaminación y mejora de la salud humana.	MEM, MSPAS, INAB, MIDES, MINECO, Municipalidades, autoridades de cuencas, Sector privado organizado.
Disminuir el uso de leña en industrias.	Reducir en un 15% el consumo de leña en el sector industrial.	• Elaborar estudios técnicos para la caracterización de la demanda de leña para usos industriales. • Normar el uso de leña en actividades industriales. • Brindar asistencia técnica para el manejo de bosques energéticos.	MARN, MEM, INAB, Sector privado organizado.
Fomentar el uso de plantaciones energéticas o bosques energéticos para fines industriales.	Incrementar en un 10% los bosques energéticos del país	• Implementar una estrategia para la incorporación de bosques energéticos en la oferta de leña, con base en estudios de prefactibilidad. • Fomentar la creación de un fondo de incentivos para plantaciones con fines energéticos de uso industrial. • Fortalecer mecanismos de coordinación interinstitucional.	INAB, MEM, MAGA, Sector privado organizado.
Sustituir el uso de leña por otras fuentes energéticas en los hogares.	Sustituir el uso de la leña por otro energético en un 25% de los hogares.	• Implementar campañas de concienciación e información sobre el uso racional de la leña. • Impulsar el uso de energéticos alternativos y más eficientes para sustituir el consumo de leña. • Promover el uso de fuentes alternativas (GLP, gas metano, entre otros) en sustitución de leña.	MEM, MINEDUC, INAB, MSPAS, Sector privado organizado.

A regional perspective

GUATEMALA
- 70% of the population use woodfire.
- Country where the Lorena was developed in the mid-1970s.
- In situ built ICS with a plancha and a chimney have been dominating,
- Industrial models are increasing: Noya, Onil, Dona Dora, Ecocomal etc.

HONDURAS
- 69% of the population relies on fuelwood for cooking.
- Program "Scaling-up Renewable Energy in Low Income Countries" of the Climate Investment Funds.
- Example of project and cookstove: Mirador (Justa 2x3 cookstove), registered under the Gold Standard.

EL SALVADOR
- 30 % of the population relies on fuelwood for cooking
- LPG was highly subsidized, now controlled subsidy.
- More than 8000 ICSs installed by various organizations, no coordination.
- Several ICS models: Turbococina, Ecocina, the new Mimosa (charcoal) and Consentida (mini fuelwood logs).

CENTRAL AMERICA

NICARAGUA
- 67 % of the population relies on fuelwood for cooking
- Little experience with ICs.
- Only country of the region with a National Strategy for Fuelwood and Charcoal is ready.
- Two main ICS models: Ecofogón and Mifogón.

COSTA RICA
- 9% of population uses firewood.
- Firewood used for cooking in rural areas, modern fuels such as electricity and LPG used quite frequently.
- Limited experience with ICSs.
- Woodfuel remains a high share of final energy.

PANAMÁ
- 16% of the population use uses fuelwood for cooking.
- Little attention to ICSs.
- Example of ICS: Ecojusta.

Each country has had its own developments. However, ICSs have not had massive diffusion in any particular country. No government has institutionalized ICSs programs.

Sources: Berrueta (2011), Díaz Jimenez (2010), Arriaza (2005), Energía sin Fronteras et al. (2012), Sanchez (2011), Wang et al. (2013)

Regional targets and studies

SICA - Central American Integration System
Matrix of Actions for the Integration and Energy Development of Central America, 2020 Central American Sustainable Energy Strategy

The Central American Integration System (SICA) is the institutional framework of Regional Integration in Central America, created by the States of Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama. SICAs General Secretariat headquarters are located in the Republic of El Salvador. It was designed taking into account past attempts for regional unification region, establishing the fundamental objective of realizing the integration of Central America.

The 2020 Central American Sustainable Energy Strategy was approved in Guatemala in 2007 and ratified by the Heads of State and Government of SICA at the end of 2007.

The general objective for the approval of the integration and energy development was the sustainable development of local energy resources to create a more independent energy model, making more efficient use of fuels and lowering emissions of GHGs, contributing to the sustainable energy access of the region.

Amongst the specific objectives: the reduction of woodfuel consumption by 10% by promoting the use of ICSs in one million of households in Central America, and the promotion of public-private funding.

BUNCA-HIVOS: Programa Regional de Energía y Pobreza en Centro América (PREPCA)

Recently published a study in Spanish “Improved Firewood Stoves in Central America- starting-up markets “ which concludes in four main actions: saving firewood, gender equality, social work (related to HAP) and respect for cultural diversity. To create a market for ICS in the region, it recommends improved policies, market sustainability (subsidies are recommended for start up), adapted development (actions related to choice of several models adapted to users needs), and production and marketing.

Trade barriers

Central American products can be freely traded in the region. However, manufacturers of stoves with a high steel component (for example, the Turbococina) have expressed concern related to the definition of a Central American product: since it implies to demonstrate the local value content, cookstove with a high content of steel imported from outside the region could not easily qualify. However, recent developments around the rules defining Central American may make cookstoves with high steel content candidate for free trade classification (*Reglamento Centroamericano sobre el Origen de las Mercancías*)

Energy and commercial strategies must consider the regional level. A cookstove market at the regional level is of high interest.

Sources: CEPAL-SICA (2007), Secretariat of Central American Economic Integration) http://www.sieca.int , interviews

Carbon finance in Guatemala

- Ratification of the Kyoto Protocol — 03/06/1999
- CDM projects — 16 registered + 12 in the pipeline
- CDM programs of activities — 3 registered (including ONIL cookstove) + several in the pipeline
- Gold Standard projects — 2 registered

Registered Project / Program	Installed capacity (MW)	Emission reduction (ktCO2/yr)	Registration	Region
"Las Vacas" Hydroelectric project	45.0	90.4	2006	Guatemala
Matanzas Hydroelectric Plant	11.7	38.5	2006	Baja Verapaz
San Isidro Hydroelectric Plant	3.9	13.4	2006	Baja Verapaz
Candelaria Hydroelectric Project	4.3	18.9	2006	Alta Verapaz
El Canadá Hydroelectric Project	31.0	118.5	2006	San Marcos
Biogas energy plant from palm oil mill effluent	1.6	30.3	2008	Izabal
Amatitlan Geothermal Project	25.2	83.0	2008	Escuintla & Guatemala
Xacbal Hydroelectric project	94.0	311.4	2008	Quiché
Bioenergia Anaerobic Digestion and Biogas Generation Project	-	100.0	2009	Escuintla
Co-composting of Empty Fruit Bunches (EFB) and Palm Oil Mill Effluent Project	-	22.9	2009	Izabal
Biogas Project, Olmeca III, Tecún Uman	2.1	37.4	2009	San Marcos
Palo Viejo Hydroelectric Project	88.3	258.4	2012	Quiché
Bus Rapid Transit (BRT) in Guatemala City	-	536.1	2012	Guatemala City
San Antonio El Sitio Wind Power Project	48.0	82.9	2012	Guatemala
Canbalam I Hydroelectric Project	5.0	26.8	2012	Huehuetenango
Montecristo Hydroelectric Project	13.1	33.0	2012	Quetzaltenango & Retalhuleu
Hydro Alliance Programme of Activities (El Ixtalito Hydroelectric Project)	Ixtalito: 1.6 MW	3.6	2012	San Marcos
Ecoener Small Hydro Programme of Activities	**12**	**24.1**	**2012**	**Retalhuleu & Quetzaltenango**
Distribution of ONIL stoves	**-**	**42.7**	**2012**	**-**

Experience in CDM (Clean Development Mechanism) projects and programs is available in Guatemala: 16 projects and 3 programs are registered, 12 projects at validation. Hydropower is dominating, but other sectors remain present. ICS programs are emerging.

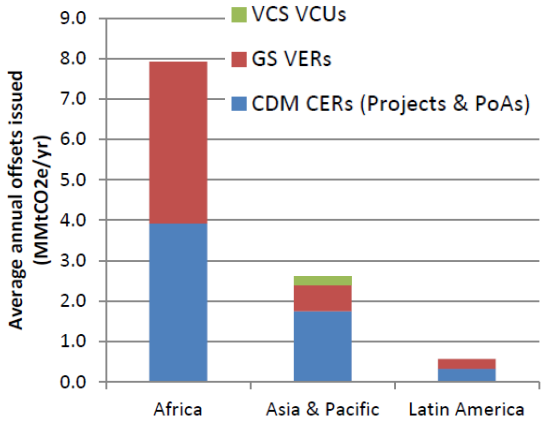
Sources: Ministry of Environment and Natural Resources of Guatemala (direct communication), UNEP Risoe CDM/JI Pipeline Analysis and Database, March 1st 2013 http://www.cdmpipeline.org/ , UNFCCC registry of CDM and PoA http://cdm.unfccc.int/

Carbon finance and cookstoves

Examples of registered projects and programmes in the region (Clean Development Mechanism & Gold Standard)

Name	Distribution of ONIL Stoves	Qori Q'oncha	Mirador Project	Turbococina	And also...
Country	Guatemala	Peru	Honduras	El Salvador	20 other CDM projects and 7 other PoA in Asia/Africa already registered
Carbon finance	CDM program	Gold Standard PoA (was the 1st program registered under the GS)	Gold Standard Project	Gold Standard and CDM Project	
Cookstove	ONIL	Different models	Justa 2x3	Turbococina	

Registered / at validation stage cookstove projects in the World



Under development in the region (Clean Development Mechanism & Gold Standard)

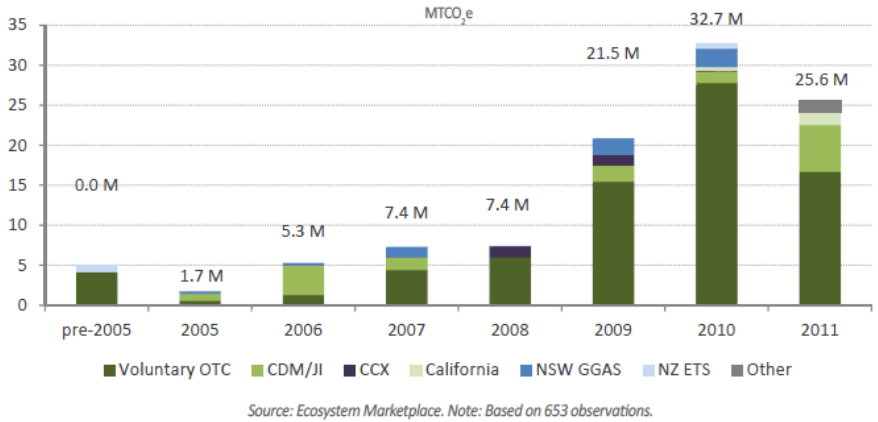
UpEnergy Open Access Improved Cookstoves Program in Latin America	Vida Mejor con Ecofogones de Alto Rendimiento	Stove Capital Guatemala Improved Stoves and Water Purification Project
Guatemala , Honduras, Mexico, Nicaragua, El Salvador (UpEnergy)	Honduras (Envirofit International)	Guatemala (Paradigm project)
 Primeras etapas con la Ecocina. Otras estufas en el futuro.		 Diferentes modelos. Primeras etapas con la plancha de CEMEX.

Increasing market for ICS, especially within the possibility of Programs of Activities. Africa and Asia are dominating. This market remains complex, expensive and uncertain.

Sources: UNFCCC website, Gold Standard website, Lee et al. (2013)

Carbon finance and forestry activities: another opportunity to explore

Historical Transaction Volumes by Forest Carbon Market



Source: Ecosystem Marketplace. Note: Based on 653 observations.

- **Forestry activities** may benefit from carbon markets
- **Voluntary markets** are dominating, and within them, afforestation and forestry projects are the most frequent
- **The Gold Standard** Foundation is expanding its project scope areas into land use and forests. A Land Use and Forests Framework is expected by mid-2013.

REDD+ in Guatemala

The R-PP (Readiness Preparation Proposal) was published in April 2013. This is the roadmap for the next 4 years that will allow Guatemala to be ready for a REDD+ regime.

In parallel, the National Strategy for Reducing Deforestation is being discussed and will include actions needed to design and implement REDD+ activities within the country

REDD+ pilot-projects in Guatemala

- A forest concession project in the Maya Biosphere Reserve , promoted by ACOFOP and Rainforest Alliance.
- A project in Sierra del Lacandón National Park, promoted by Fundación Defensores de la Naturaleza, Oro Verde and Rainforest Alliance.
- A project in Lachuá National Park, promoted by Fundación Lachuá and IUCN.

Woodfuel production by means of energy forest plantations could benefit from climate finance. Such actions would deserve more attention.

Sources: Espinosa, Cabrera, Dunning (2011), FAO (2010), FCPF (2013), Peters-Stanley et al. (2012)

Can carbon finance facilitate access to ICS for the poor?

Carbon markets:
An additional source of funding

- **For users:** Subsidized and affordable price, quality guarantee, warranty system, marketing and educational component, transportation.
- **For suppliers and implementers:** Credit mechanisms for entrepreneurs and distributors (to purchase advance inventory of in large amounts), capacity-building, improved technology, scaling-up.
- **Programmes of Activities** facilitate the access by small projects to carbon markets.
- **European Union Emissions Trading** accepts credits from CDM projects hosted in Least Developed Countries. Guatemala is not part of the LCDs.
- **Forestry projects** represent another opportunity and could be associated with cookstove activities**.**

But

- **Uncertainty of the markets**: cost of emission reductions $5-$8/tCO2e, including verification and monitoring costs ⇒ offset prices must be near or above $10/tCO2e to be attractive.
- **Complexity** of the methodology and transaction **cost.**
- **Uncertainties in the emission reductions**: Biomass fuel consumption? Fraction of non renewable biomass? Emission factors? Black carbon?
- **Importance of in-place tests** (Kitchen Performance Test or Controlled Cooking Test) vs cookstove tested in laboratory (Water Boiling Test) in order to guarantee the efficiency and emission results.

Climate finance and NAMAs

- The opportunity to insert ICS in **Nationally Appropriate Mitigation Action** (NAMAs) may deserve more attention.
- Example: **Scaling-Up Renewable Energy Program in Low Income Countries (SREP)**, Climate Investment Funds => project in Honduras.

Carbon markets offer finance opportunities, which remain complex and uncertain given the current low carbon prices. Other climate finance opportunities associated with the definition of Nationally Appropriate Mitigation Actions (NAMAs) deserve more attention.

Sources: Wang et al. (2013), experience by Energia sin Fronteras

- Executive summary
- Project approach
- **Sector mapping**
  - Macro environment
  - Health, social and environmental impact
  - Fuel usage and trends
  - Cookstove policy environment
  - **Consumer assessment**
  - Cookstove industry
- Sector mapping summary
- Appendix

Preferences and constraints

Cooking habits: *la tortilla*

- Dominant cooking practices: Tortillas, beans, tamales, rice, eggs, coffee, meat, chicken, potatoes, grains, bananas, corn, atole
- The average family eats 3 kg of tortillas per day

- A flat pan (comal) is needed to prepare tortillas
- Making tortillas results in high exposure to smoke since women need to stay close to the fire

Comal on U-shaped fire
Photo: Energia sin Frotnteras

- Preparation of the nixtamal (tortilla dough) requires corn to be cooked slowly in large pots during several hours.
- Metal plancha market already exists in Guatemala (large square or rectangular flat iron griddles placed on top of fires)

Co-benefits of fire

- Source for light
- Social gathering place
- Space heating (for example in highlands, where kitchens are usually closed - with roof and walls)
- Clothes drying (in wet areas)
- Way to keep bugs away
- Symbolism of fire: one of the four elements of life: water, earth, air and fire.

- People to leave behind some co-benefits and ancestral cultural practices, with which they have lived for generations.
- Importance to explain the reasons why is needs to be done, and let them make the decision.

The goal of reducing the negative impacts of open fires can be reached only if clean cookstoves are used. Satisfying user needs is indispensable (size of the family, type of cooking). Changes in habit must be acknowledged. Users must perceive the new cookstove as better than the open fire or the other stove it replaces.

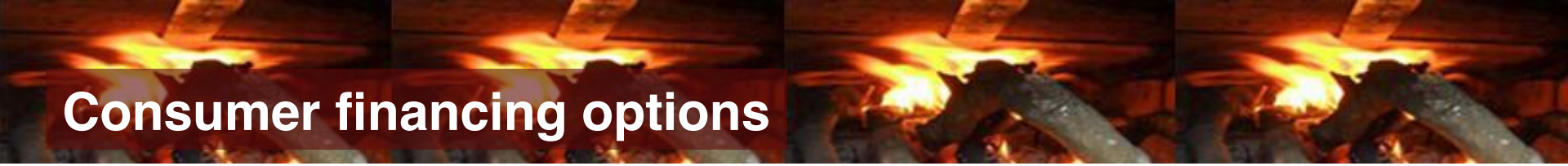
Sources: Wang *et al.* (2013), interviews with users, field experience of Funsolar/Energia sin Fronteras.

Consumers willingness to pay

"Willingness to pay" drivers	Likely target audience
Economic accessibility and savings: economic savings when woodfuel is purchased, purchase cost must be repayable in a adequate time frame, it must remain accessible to people with limited incomes	• Family members with economic power decision • Commercial/institutional buyers • Social Responsibility (SR) programs in industry
Time savings: collecting firewood when applicable, cooking time (several plates cooked at the same time). Time to be used as men and women want!	• Wood collectors (men and women) • Women (more time available for the children)
Credit access: reduction of the up-front cost barrier by the access to affordable credit from bank or MFI, possibility to get a credit from company or industry where people work	• Banks and MFI, cooperatives • Large industry and companies, to comply with SR • Government offices.
Health concerns: elimination of smoke from the kitchen, healthier children, reduced danger of burns, reduced eye irritation, breathing, better position of the women when cooking , reduce expenses in doctors and medicine.	• Female consumers (caretakers of house and children) • Ministry of Health (to reduce health expenses) • Donor agencies and "mission-driven" institutional purchasers
Cleanliness: improving the look and overall cleanliness of the kitchen, utensils and home, reduction of smells (clothes) and hair.	• Female consumers (main cook, presence in the kitchen)
Aspirational technology: improving the look and overall cleanliness of the kitchen, cookstove appearance that is attractive to potential customers	• Female consumers (main cook, presence in the kitchen) • Suppliers
Acceptability, quality and guarantee: size adapted to the family needs, a cooking surface that allows the preparation of tortillas, durable stove, solid guarantee and maintenance (trust builder)	• Female consumers (main cook) • Certification Centers • Suppliers
Demonstration: to give the opportunity of users to be exposed to cookstoves and see them functioning (trust builder)	• Women looking to purchase an ICS • Municipalities • Cooperatives • Manufacturers • Financing Institutions

People with a steady income can purchase a clean cookstove if they know that such cookstoves exist, see it working, and trust its use and benefits. Demonstration as well as guarantee and technical support are key trust builders.
The door to the development of a market is to inform populations about the existence of efficient cookstoves, the benefits of clean cooking, ways to acquire these cookstoves, and means to enhance the supply of cookstoves.
Access to an affordable credit or payment method (banks, MFIs, employers) helps, but needs to be promoted.

Sources: Guerra Samavoa (2009), OLADE (2010), von Ritter Figueres (2010), interviews with users, field experience of Funsolar/Energia sin Fronteras



Consumer financing options

Highly subsidized model
(material, manpower, services)

Challenges
- Good will of international donors, but high risk of market distortion if poorly designed.
- Importance of integrated programs, where cookstoves are only one part of the activities (education, health, household quality, forestry, etc.).

Examples
- Prevalent in Guatemala with in-situ cookstoves.
- Government programs, such as FIS, work with such a highly subsidized model.
- Cooperatives also work with such a highly subsidized model.

Microfinance

Challenges
- Microfinance is centered on business in Guatemala. Many people prefer saving money until they can pay cash.
- High transaction costs, MFI have high interest rates due to collection, supervision, training travel, etc., easier if banks have many local/rural offices.
- Tax ID number (Numero de Identificacion tributaria) may be required, and some people don't have it, especially the poor.
- Need for financial information and education of citizens.
- Importance of the stability of the revenues (not always the case in rural areas).

Examples
- Banrural offers loans to buy the Onil stove.
- GENESIS Empresarial offers loans to buy the Dona Dora stove

Corporate and institution financing

Challenges
- Interesting model for landowners, coffee and other agricultural plantations, where owners can purchase the stoves, and then debit from employee salaries a pre negotiated monthly quota.
- Need to sensitize private land owners (palm, coffee, rice, sugar, cattle, etc) as well as industrial private companies and prepare interesting packages as part of social responsibility programs.

Examples
- Banrural.

Carbon finance

Challenges
- Carbon market: Expensive and complex, dependence on unstable carbon markets.

Possibilities
- Programmatic CDM and regional approaches.
- Other climate funds, focused for example on the National Appropriate Mitigation Action Plan.

Examples
- No stove available in the Guatemalan market currently receives carbon funding.
- Several stoves in the certification process: Onil (HELPS International), Ecocina (Ecocomal), Eko-stove (CEMEX).
- A regional project is under assessment: UpEnergy.

Revolving fund

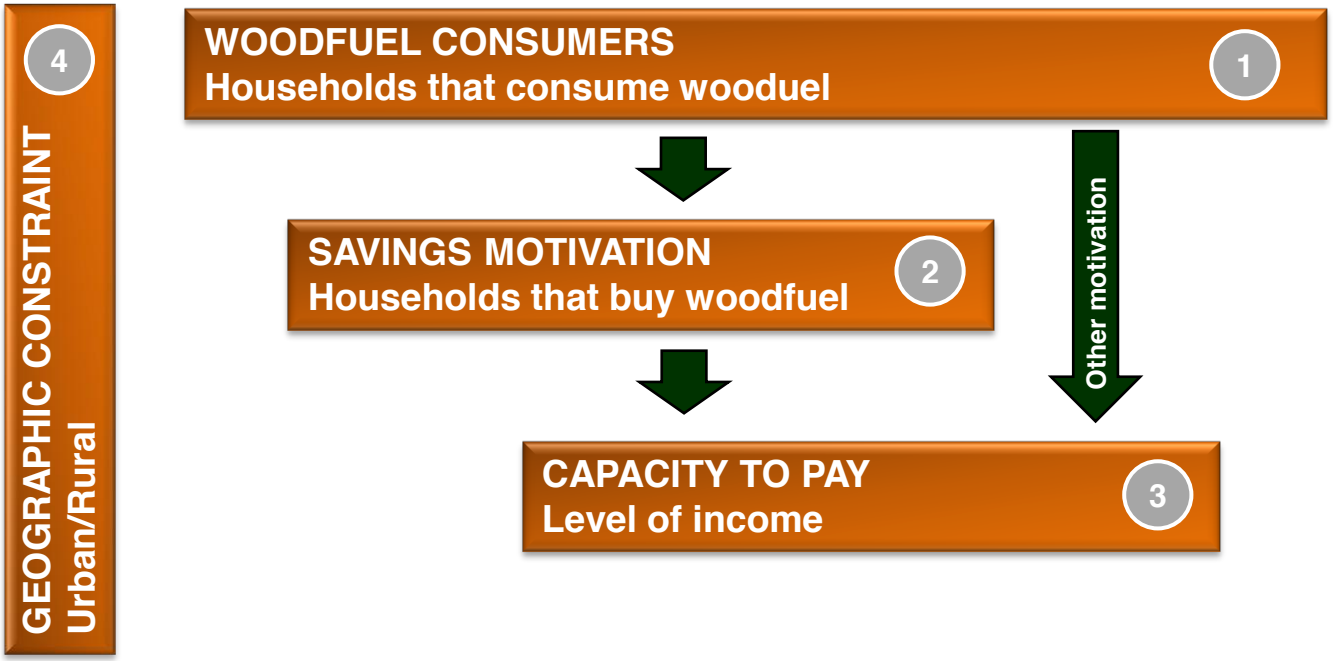
Challenges
- The availability of revolving funds is scarce, and applied more at the intermediate level (distributors) than at the user level.
- Administrative costs and risks may be quite high.

Examples
- Funds granted to Fundacion Solar from IDB for the pilot on energy efficiency of ONIL stoves for CNEE. UNDP financed the counterpart of loan and administration of fund.

Consumer financing options are starting to be available, but most remain at a very first stage of development. New products and schemes need to be put into place, supported by a communication campaign.

Sources: Interviews

Three complementary views of the potential market of cookstoves



- All woodfuel consumers (❶) are potential users of cookstoves.
- Purchase strategies will be driven by motivations of the households for using a cookstove and by their capacity to pay: fuel saving is a key driver for households that buy woodfuel (❷) but the overall capacity to pay for a cookstove must be also considered (❸). These two indicators are strong pillars of the consumer segmentation for market development. Households that don't pay for woodfuel may be willing to buy a cookstove for other reasons (health motivations), but the capacity to pay is a strong limiting factor in this case.
- Rural areas (❹) may present additional constraints related to accessibility and insufficient volumes of sales in the case of remote and/or lower density areas, indeed, the logistics alone of reaching dispersed rural and underserved communities may be a significant barrier.

Market views 1 and 2: Woodfuel users and buyers

WOODFUEL CONSUMERS
Households that consume wooduel

1

	RURAL				URBAN			
	YES	NO	YES	NO	YES	NO	YES	NO
	Households		Woodfuel consumers / All		Households		Woodfuel consumers / All	
Guatemala	63614	24026	73%	27%	161732	496057	25%	75%
El Progreso	18958	2771	87%	13%	9401	5188	64%	36%
Sacatepéquez	8852	1191	88%	12%	31979	25467	56%	44%
Chimaltenango	51847	191	100%	0%	49169	12427	80%	20%
Escuintla	64396	11006	85%	15%	45897	37282	55%	45%
Santa Rosa	42980	1507	97%	3%	27035	4804	85%	15%
Sololá	35301	564	98%	2%	36761	2810	93%	7%
Totonicapán	44432	1431	97%	3%	39128	3025	93%	7%
Quetzaltenango	58129	3688	94%	6%	67492	33531	67%	33%
Suchitepequez	50263	3159	94%	6%	29748	17570	63%	37%
Retalhuleu	34368	1476	96%	4%	16713	8166	67%	33%
San Marcos	127073	3227	98%	2%	42546	11701	78%	22%
Huehuetenango	136902	2382	98%	2%	47091	18373	72%	28%
Quiché	109511	1307	99%	1%	47404	7739	86%	14%
Baja Verapaz	36725	1351	96%	4%	14809	3717	80%	20%
Alta Verapaz	139885	1577	99%	1%	36676	10015	79%	21%
Petén	78081	2732	97%	3%	28954	12381	70%	30%
Izabal	46527	6328	88%	12%	18809	19555	49%	51%
Zacapa	25014	3571	88%	12%	12148	9557	56%	44%
Chiquimula	51030	1452	97%	3%	9233	11756	44%	56%
Jalapa	39939	1360	97%	3%	11808	9946	54%	46%
Jutiapa	61008	1825	97%	3%	21233	13753	61%	39%
Total	*1324835*	*78122*	*94%*	*6%*	*805766*	*774820*	*51%*	*49%*

SAVINGS MOTIVATION
Households that buy woodfuel

2

	RURAL			URBAN		
	Purchase all or part of woodfuel			Purchase all or part of woodfuel		
	Households	Buyers / All	Buyers / Consumers	Households	Buyers / All	Buyers / Consumers
Guatemala	45076	51%	71%	144103	22%	89%
El Progreso	6225	29%	33%	5190	36%	55%
Sacatepéquez	6441	64%	73%	24803	43%	78%
Chimaltenango	29352	56%	57%	39236	64%	80%
Escuintla	33828	45%	53%	37266	45%	81%
Santa Rosa	21453	48%	50%	18724	59%	69%
Sololá	16882	47%	48%	26747	68%	73%
Totonicapán	26398	58%	59%	30152	72%	77%
Quetzaltenango	41518	67%	71%	54339	54%	81%
Suchitepequez	34088	64%	68%	25497	54%	86%
Retalhuleu	22378	62%	65%	13439	54%	80%
San Marcos	80451	62%	63%	36007	66%	85%
Huehuetenango	82797	59%	60%	27441	42%	58%
Quiché	60906	55%	56%	40186	73%	85%
Baja Verapaz	15138	40%	41%	10925	59%	74%
Alta Verapaz	42366	30%	30%	27911	60%	76%
Petén	22717	28%	29%	19418	47%	67%
Izabal	15765	30%	34%	13126	34%	70%
Zacapa	6736	24%	27%	5473	25%	45%
Chiquimula	13879	26%	27%	6387	30%	69%
Jalapa	15411	37%	39%	6079	28%	51%
Jutiapa	28348	45%	46%	13333	38%	63%
Total	*668153*	*48%*	*50%*	*625782*	*40%*	*61%*

❶ Woodfuel consumers: 2.13 million households (1.32 million in rural areas, 0.81 million in urban areas)
❷ Woodfuel buyers: 1.29 million households (0.67 million in rural areas, 0.63 million in urban areas)

Sources: Elaborated by the authors, based on ENCOVI 2011 (2012)

Market views 1 and 2: Woodfuel users and buyers (summary)

Millions households

	Extreme poverty	Non-extreme poverty	No poverty	Total	
Rural	0.13	0.34	0.20	0.67	*Buy woodfuel* ❷
	0.28	0.66	0.38	1.32	*Consume woodfuel* ❶
	0.30	0.70	0.40	1.40	*Total*
Urbain	0.04	0.21	0.37	0.63	*Buy woodfuel* ❷
	0.05	0.28	0.47	0.81	*Consume woodfuel* ❶
	0.08	0.47	1.03	1.58	*Total*
Total	0.17	0.55	0.57	1.30	*Buy woodfuel* ❷
	0.33	0.94	0.85	2.13	*Consume woodfuel* ❶
	0.38	1.18	1.43	2.98	*Total*

- From the almost 3 million households in Guatemala:
  - ❶ Woodfuel consumers: 2.13 million households (1.32 million in rural areas, 0.81 million in urban areas)
  - ❷ Woodfuel buyers: 1.29 million households (0.67 million in rural areas, 0.63 million in urban areas)
- Households who buy woodfuel and who are part of the “no poverty” segment **(0.57 million)** have the capacity-to-pay for an ICS. Among them, urban households (0.37 million) are certainly the easiest to reach.
- Households who buy woodfuel and who are part of the “non-extreme poverty” segment **(0.55 million)** may have the capacity-to-pay for an ICS, under adequate payment conditions. This segment would deserve a more detailed analysis to characterize their needs, preferences and willingness-to-pay.
- Households who consume woodfuel but don’t pay for it may be willing to buy an ICS for non-economic reasons. These households would deserve a more detailed analysis to characterize their possible willingness-to-pay.
- Integrated programs with subsidized ICS are better adapted for households who are part of the “extreme poverty” segment.

Sources: Elaborated by the authors, based on ENCOVI 2011 (2012)

Market view 3: Level of income

	RURAL HOUSEHOLDS			URBAN HOUSEHOLDS		
	Extreme Poverty <Q1800	Poverty Q1800-Q3700	No poverty > Q3700	Extreme Poverty <Q1800	Poverty Q1800-Q3700	No poverty > Q3700
Guatemala	1516	25959	60165	3552	106759	547478
El Progreso	1328	8294	12107	142	5132	9317
Sacatepéquez	1145	5096	3802	1356	19922	36168
Chimaltenango	8519	32430	11095	6363	26074	29160
Escuintla	2292	33426	39684	1273	25336	56578
Santa Rosa	6348	21505	16634	2035	14000	15802
Sololá	5226	25073	5566	8318	19853	11400
Totonicapán	11236	25711	8911	7196	20280	14673
Quetzaltenango	10701	30921	20196	5627	38904	56492
Suchitepequez	15776	27219	10428	5929	20773	20616
Retalhuleu	5391	19202	11248	2232	8867	13780
San Marcos	24405	75196	30712	3054	22534	28659
Huehuetenango	15697	78459	45142	3594	24634	37242
Quiché	22330	62889	25599	5123	28173	21848
Baja Verapaz	10395	17226	10456	2818	5524	10184
Alta Verapaz	65992	60730	14740	3446	15095	28150
Petén	15993	44738	20090	3513	15062	22763
Izabal	15275	21248	16332	1450	13849	23064
Zacapa	10496	9982	8107	1995	5103	14607
Chiquimula	19418	22032	11032	903	2855	17232
Jalapa	9396	22545	9358	2019	9865	9870
Jutiapa	10223	27584	25026	2092	9390	23504
Total	*289097*	*697462*	*416430*	*74026*	*457985*	*1048588*

Potential market	NO	?	YES	NO	?	YES

Sources: Elaborated by the authors, based on ENCOVI 2011 (2012) and interviews with users.

CAPACITY TO PAY
Level of income

3

- **Estimated income thresholds for considering the purchase of a cookstove (based on consumer interviews)**
  Threshold 1 (under appropriate conditions, such as credit): Q2000 per household per month, with a stable source of income and special payment conditions
  Threshold 2 (easier penetration): Q3700 per household per month, with a stable source of income, possibility to save money and pay cash, or short term credit

- Non-market based strategies are relevant for **the extreme poverty segment** of the population. They must be well defined to avoid any distortion of the market based strategies
- **The no poverty segment** of the population is definitively part of a possible market-based strategy
- **The non-extreme poverty segment** is the one which deserves better understanding: the willingness to pay of households with incomes between Q2000 and Q3700/month will depend on the stability of incomes of the households, payment options, estimated savings and priority given to air pollution.

Sensitivity analysis on the share of the poor segment that would buy a cookstove

Market view 3: Level of incomes (sensitivity analyses)

WOODFUEL CONSUMERS
Households that consume wooduel 1

+

CAPACITY TO PAY
Level of income 3

Default assumption
Due to the lack of detailed data, the same % of households that consume woodfuel is applied to each category of income, at each department level

Sensitivity analysis
Share of the poor segment which could buy a cookstove from 20% to 70%

Results
- Between 1.0 and 1.4 million households consume woodfuel (purchased or not) and have the capacity to pay for a cookstove.
- Among those, between 0.1 and 0.6 million households are part of the poor segment.
- Between 0.7 and 1.2 million households consume woodfuel but don't have capacity to pay for a cookstove

SAVINGS MOTIVATION
Households that buy woodfuel 2

+

CAPACITY TO PAY
Level of income 3

Default assumption
Due to the lack of detailed data, the same % of households that buy woodfuel is applied to each category of income, at each department level

Sensitivity analysis
Share of the poor segment which could buy a cookstove from 20% to 70%

Results
- Between 0.7 and 1.0 million households buy woodfuel and have the capacity to pay for a cookstove.
- Among those, between 0.1 and 0.4 million households are part of the poor segment.
- Between 0.3 and 0.6 million households buy woodfuel but don't have the capacity to pay for a cookstove

The extreme poverty segment of the population will deserve non-market based strategies, the no poverty segment of the population is definitively part of a possible market-based strategy, while the non-extreme poverty segment is more uncertain. From 0.7 to 1.4 million households could buy an efficient cookstove, under relevant conditions of payment.

Sources: Computation by the authors.

Role of women

Women have a crucial role in the cookstove sector

- **As decision makers:** Women are in charge of cooking
- **As beneficiaries:** Women want a working cookstove, a cleaner kitchen and better quality environment for their family, especially the children.
- **Stakeholders:** Knowledge is power, and once women understand the risks involved if smoke exposure both for them and their children, they can start asking for solutions. And giving priority to ICS.

Several barriers prevent their increased involvement

- Lack of information, resulting in ignorance of the risks associated with open fires
- Many women have never heard of efficient cookstoves
- Lack of financially and geographically accessible offer in solutions

Men are involved too

- They participate in woodfuel collection
- They usually control cash flows of the household

- **Champions:** Wives of mayors in Municipalites can be more involved in programs to help women, specially in heath issues relating to smoke inhalation and related respiratory diseases to children. The Women Secretariat can play an important role in supporting efforts in the ICS field. Also, the new Ministry of Social development can play an important role in training and communications.
- **Active stakeholders:** Women can teach other women on ICS, share the knowledge and the experience. Demonstration is key to the penetration of ICS.
- **Knowledge is power of change**: Once women understand the risks involved if smoke exposure both for them and their children, they can start asking for solutions. And giving priority to ICS.
- **User focus and responsibility of the choice**: Women are willing to adapt if they understand the benefits of a new cookstove and if the cookstove is adapted to the cooking needs. If women can choose amongst several cookstove models (size, price, aesthetic), their commitment will be higher.
- **Men, as income provider,** have the capacity of influencing the change (promoting or rejecting it)

Women have a crucial role to play as champions, active stakeholders in information and experience transmission, and beneficiaries. Given the economic power of men, any cookstove initiative promoting ICS should tailor its design to the interests and concerns of both women and men.

Source: Interviews, field experience of Funsolar, Energia sin Fronteras (2012)

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ICS technology landscape *(1/5)*

	ONIL	NIXTAMAL STOVE	NOYA	DOÑA DORA
Supplier	HELPS International	HELPS International	Ing. Manuel Tay	Estufa Doña Dora
Type of supplier	NGO	NGO	Private	Private
Estimated number of stoves in Guatemala	More than 90,000 since 2002	More than 21,600	6500 since 1998	260 since 2012
Capacity of production	Up to 60000 per year	Up to 48000 per year	Up to 5000 per year	Target: 2000 per year Current: 30 per month
Technical description	Mobile. Made of concrete. Galvanized metal chimney. Rocket type combustion chamber. Two cooking rings. Can be used to cook tortillas.	Mobile. Made of lower half of 55-galon drum. Insulated with white sand (pumis) sand, rocket type combustion chamber. Fits a large pot to cook nixtamal corn to make tortillas or big portions of food like beans. No chimney.	Mobile. Metal box, insulated with sand and bricks. Bricks on sand make fire bed solid. Galvanized metal chimney. Rocket type combustion chamber. Two cooking rings. Can be used to cook tortillas.	Mobile. Metal box, insulated. Galvanized metal chimney. Fixed fire bed. Rocket type combustion chamber. Three cooking rings. Can be used to cook tortillas. Attractive.
Cost	US$ 125 (Q970)	US$ 37 (Q285)	US$ 155 (Q1200)	US$ 193 (Q1500) + shipping depends on location and quantity
Target	Families up to 5 persons	Tortilla and tamal business, or very large families.	Families 5+ persons	Families 7+ persons
Lifetime	10 years	5 years	15 years	10 years with maintenance
Gain over open fire: energy / CO and PM emissions	66% / 99%	66% / 99%	More than 50% / 99%	67% /98%
Maintenance	Chimney (weekly cleaning of soot + change after 1 or 2 years, depending on care and type of wood used)	-	Chimney (weekly cleaning of soot + change after 1 or 2 years, depending on care and type of wood used)	Chimney (weekly cleaning of soot + change after a few years, depending on care and type of wood used)
Technical certification	Zamorano and Aprovecho centers	No	No	No
Carbon Accreditation	CDM in progress	No	No	No
Main dissemination mode	Sales with bank support (micro-credit provided by Banrural), direct sales, work upon order	Donations, sometimes as part of combo deals, direct sales.	Word of mouth, work upon order	Starting with direct sales, word of mouth, sales with bank support from micro-finance partner
Contact	Richard Grinnell http://www.onilstove.com/	Richard Grinnell http://www.onilstove.com/	Manuel Tay	David Evitt http://www.alterna-la.org/en/projects/stoves
				

Sources: Suppliers

ICS technology landscape *(2/5)*

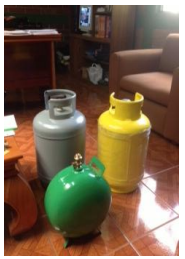
	ECOCINA	ECOCOMAL	ECOPLANCHA II/III
Supplier	**Ecocomal**	**Ecocomal**	**Ecocomal**
Type of supplier	Private	Private	Private
Estimated in Guatemala	More than 3000 since 2009	More than 500 since 2008	More than 7,000 since 2007
Technical description	Mobile (outside use). Easy to transport. Supplied in one piece, ready to use. Cylinder of concrete 19 inch metal plancha. Rocket type combustion chamber. Removable plancha to cook tortillas. No chimney	Mobile. Concrete Cylinder with 22 inch metal plancha. External wall of metal. Small rocket type combustion chamber. One cooking ring. Can be used to cook tortillas. Galvanized metal chimney.	Ecoplancha II: Rectangular structure. Provided with lateral tables. Rocket type combustion chamber. Two cooking rings. Can be used to cook tortillas. Galvanized metal chimney. Ecoplancha III: Rectangular structure. Rocket type combustion chamber. Three cooking rings. Can be used to cook tortillas. Galvanized metal chimney.
Cost	US$60 (Q500)	US$ 120 (Q900)	US$ 130 (Q875)
Target	Good for warm and hot climates. Generally cooking is done outside of home.	Good to cook large amounts of food, made for nixtamal (corn for tortillas and tamales)	Regular plancha for families of 5 + Very similar to Onil
Lifetime	5 years	6 years	5 years
Gain over open fire: energy / CO and PM emissions	60%/ 70-75% (CO)	60%/ 95-99% (CO)	60% / 95-99% (CO)
Maintenance	None	Chimney (weekly cleaning of soot + change after 1 or 2 years, depending on care and type of wood used). Cleaning plancha at least once every ten days and checking levels of insulation.	Chimney (weekly cleaning of soot + change after 1 or 2 years, depending on care and type of wood used). Cleaning plancha at least once every ten days and checking levels of insulation.
Technical certification	Aprovecho y Zamorano Centers	No	No
Carbon Accreditation	Gold Standard in progress	No	No
Main dissemination mode	Support form Rotary club, NGOs, Government requests. When people see it work, it can result in direct sales.	Sales to NGOs, Government, municipalities. When people see it work, it can result in direct sales	Sales to NGOs, Government, municipalities. When people see it work, can result in direct sales
Contact	http://www.ecocomal.com.gt/	http://www.ecocomal.com.gt/	http://www.ecocomal.com.gt/
			

Sources: Suppliers

ICS technology landscape *(3/5)*

	JUSTA	IMPROVED PLANCHA MEJORADA (many variations)	LPG
Supplier	NGO	NGOs, Governments, private	Commercial stores
Type of supplier	ARCAS and Rotary Club	Built in situ by many NGOs and masons.	Private
Estimated in Guatemala	800 stove since 2005	Over 100000	Unknown
Capacity of production	Current : 2000 per year. Possible: 10000 per year	Depends on project, and financing availability. Can contract independent masons.	Industrial manufacturers, can be local, regional of important LPG stoves
Technical description	Square Justa model, with metal plancha and chimney on blocks or existing structure.	Built in place improved plancha stoves. Rocket elbow (when well built) and chimney. Built of brick, block, stones, mud or cement, bases are made to medium height of women.	Metal stove that uses LPG as fuel
Cost	US$134 (Q1045)	From US$130 to $270	Stove with 2 burner: > US$45 (Q350). Cylinder (25 lb): US$14 (Q109)
Target		Big plancha to cook food, tortillas, keep food warm. Used in homes with many people and businesses.	Fast cooking (breakfast), re-heating, use complementary to woodfuel cookstove. Not used for tortilla.
Lifetime	5 years	10 years, depends on quality	Stove: 10 years, depends on care Cylinder: 7 to 10 years
Gain over open fire: energy / CO and PM emissions	70% if used correctly.	In principle 50% /97% reduction of IAP	NA
Maintenance	Clean plancha every week, chimney, weekly cleaning of soot. Change needed after one or two years, depending on care and type of wood used.	Clean plancha every week, chimney, weekly cleaning of soot. Change needed after one or two years, depending on care and type of wood used.	Stove: regular cleaning, Cylinder: gaskets need to be checked at least every 10 years by specialized technicians.
Technical certification	No (but Justa 2 x 3 in Honduras is certified)	No. Mason built plancha stoves can be very inefficient. Problems with quality control for efficient burning	Date of maintenance must be indicated on the cylinders.
Carbon Accreditation	No	No	No
Main dissemination mode	Mainly donations. Municipality and groups of more than 10 people who want a stove.	Mainly donations.	Direct sales
Contact	Colum Muccio	Variable	Stoves: local stores. Cylinder: Giovanni Nistal (Industrias Nivi)

See examples slide 5/5



Sources: Suppliers

ICS technology landscape *(4/5)*

Other models

In-situ stove by Utz Che (USD70-80)

Lola (USD142)

Stove by Soluciones Comunitarias (USD180)

Ekostove (price unknown)

Proposed in the Paradigm Project, not started yet.

Turbococina (USD150)

Produced in El Salvadaor. Used in a pilot-project in Guatemala

Ecostufa (USD200)

Produced in Mexico. Used in a pilot-project in Guatemala

Biogas

Around 50 stoves installed by Biotectura Agropecuaria

Electric

Solar

"HotPot" by Solar Household Energy used in El Salvador. Activities in Guatemala several years ago, stopped for lack of funding and support.

Ecological biomass briquettes Ecoleña

Proposed by Fundacion Progresar and Legacy Foundation

Sources: Suppliers

ICS technology landscape *(5/5)*

Examples of plancha stoves

INTECAP plancha

Plancha BDP

Plancha AMI

Plancha AMSA

General assessment of cookstoves

High performance ●
Medium performance ◕
Low performance ◑
Minimal performance ◔
Nil ○

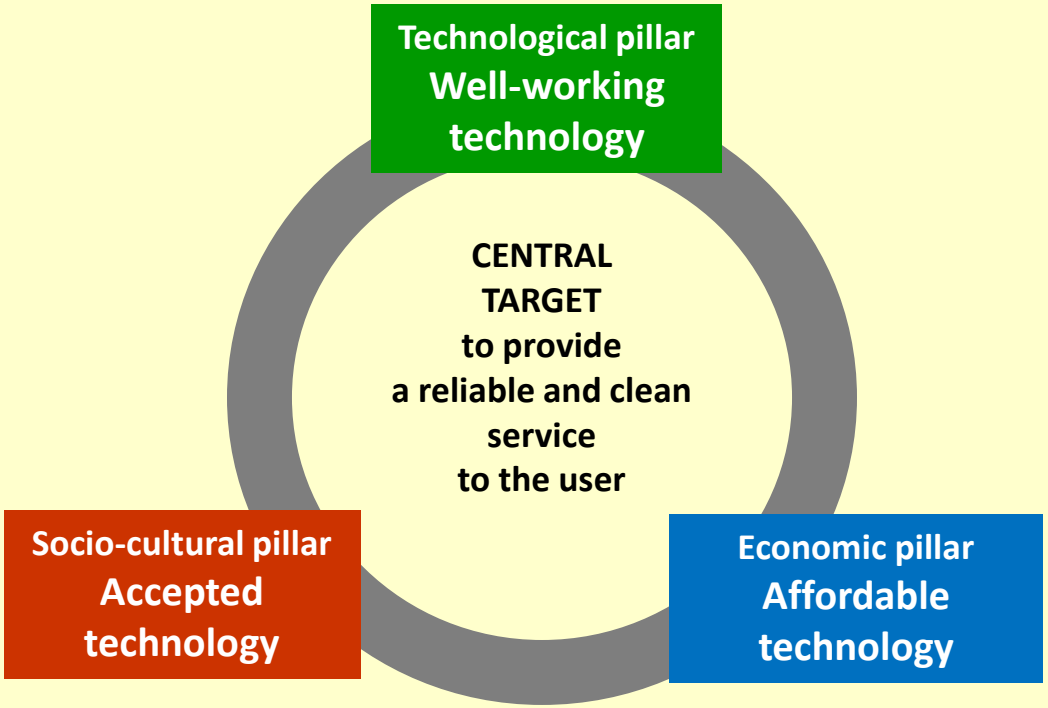
	Low Cost, including fuel	Capacity of production (stove supply)	Fuel availability	Secondary Uses	Usability	Efficiency gain over open fire	Maintenance requirement	Housing Structure	Aesthetics	Health Benefits at the final use
ONIL	◕	●		○	◕	●	◕	●	◕	●
NIXTAMAL	●	●		○	◕	●	●	●	◕	●
NOYA	◑	●		◑	●	●	◕	●	◕	●
DONA DORA	◑	●		◑	●	●	◕	●	●	●
ECOCINA	●	●		○	◑	●	●	●	◕	●
ECOCOMAL	◕	●	Depends	○	●	●	◕	●	◕	●
ECOPLANCHA II/III	◕	●		○	●	●	◕	●	◕	●
LOLA	◑	●	on	○	●	●	◕	●	◕	●
EKOSTOVE (CEMEX)	Unknown	●		○	●	●	◕	●	◕	●
JUSTA	◑	●	region	○	●	●	●	●	◕	●
ESTUFA UZT CHE	●	◕		○	●	●	◑	◕	○	●
PLANCHA MEJORADA	●	●		○	●	◕	●	●	◑	●
GAS STOVE	◑	●		○	◕	NA	●	●	◕	●
BIOGAS	●	◑		○	◕	NA	●	●	◕	●
ELECTRICITY	○	●		○	◕	NA	●	●	◕	●

The target is to provide a relevant service to the user. A unique cookstove won't satisfy the needs and preferences of all households (nor a unique supplier, given the size of the market), hence the interest in a diversified supply of cookstoves.

Sources: Elaboration by the authors

What would be a winning ICS program?

National, regional and international framework



The first target is **to provide an adequate, reliable and clean service to the user**: the goal of providing a product that will mitigate the social costs of cooking with open fires will not be reached if the product is not used by the target market.

Any new technology must be perceived by the user as "better" than the one it replaces.

The success of programs and projects needs to be measured by the ICS that are **being used** rather than by the number of installed stoves.

Sources: Elaboration by the authors, Wang et al. (2013)

Standards and testing

Regional: Zamorano Center in Honduras

- **The first and so far only certification center** for wood-burning cookstoves in Central America was established in 2009 at Zamorano University in Honduras (Certification Center for Improved Cookstoves), with the support of TPW Energy Collaborative and the Aprovecho Institute. Tests thermal efficiency, levels of emissions, and pollution and particulate.
- **Uses standard protocols**
  - ✓ *Water Boiling Test (WBT): laboratory test that evaluates stove performance while completing a standard task (boiling and simmering water) in a controlled environment to investigate the heat transfer and combustion efficiency of the stove.*
  - ✓ *Controlled Cooking Test (CCT): field test that measures stove performance in comparison to traditional cooking methods when a cook prepares a local meal. The CCT is designed to assess stove performance in a controlled setting using local fuels, pots, and practice. It reveals what is possible in households under ideal conditions but not necessarily what is actually achieved by households during daily use.*
  - ✓ *Kitchen Performance Test (KPT): field test used to evaluate stove performance in real-world settings. Expensive.*
- **Different ICS** models have been tested: Justa Tradicional (Honduras), Justa 2x3 (Honduras), Ecofogón (Brasil), Onil (Guatemala), Inkahuasi (Peru), Malena (Bolivia), Patsari (Mexico), etc. (total of 13).
- **ICS certification is not mandatory** => Zamorano Center provides a certification that reports results of the tests, but there is no requirement for testing in the region. Mandatory or voluntary standards are needed by national governments to increase the commercialization and marketing of efficient, durable, and clean stoves.

At the national level

- ONIL and ECOCINA stoves have been tested in the Zamorano Center in Honduras.
- Universities del Valle and San Carlos have carried out individual testing, but there is no recognized centre to do so.
- The idea of certified builders may deserve some attention. For example, a national network of Certified Patsari Stove Builder Organizations exists in Mexico, and the Zamorano center has implemented a network of Justa Stove Builder in Honduras.

Benefits of standards

- Quality control standards encourages investment in high-quality ICS at a larger scale.
- Needed to establish confidence of users on efficiency, lifetime, maintenance requirements and availability of spare parts
- Catalyst to increase the commercialization and marketing of efficient, durable, and clean stoves.
- Support confidence of MFI, providing the stove as guarantee.

Stove certification has to be mandatory to secure quality, guarantees, and availability of spare parts to the buyers. It will also support cookstove initiatives as a “trust building mechanism.”

Sources: Wang et al. (2013), Interviews.

Stakeholders

Government

Gobierno de Guatemala – Ministerio de Energía y Minas
Gobierno de Guatemala – Ministerio de Ambiente y Recursos Naturales
Gobierno de Guatemala – Ministerio de Salud Pública y Asistencia Social
Gobierno de Guatemala – Ministerio de Desarrollo Social
Gobierno de Guatemala – Ministerio de Agricultura, Ganadería y Alimentación
Gobierno de Guatemala – Ministerio de Educación
Gobierno de Guatemala – Ministerio de Relaciones Exteriores
Gobierno de Guatemala – Secretaría de Planificación y Programación de la Presidencia - Segeplan
inab
infom
ICTA
CONCYT
SENACYT – Secretaría Nacional de Ciencia, Tecnología e Innovación
SEPREM
CNEE – Comisión Nacional de Energía Eléctrica, República de Guatemala
Procurador de los Derechos Humanos
PRONACOM – Mejorando para Competir

Manufacturers and implementers (private or NGOs)

Private

Ecocomal – Tecnología para el cambio
NOYA – Ing. Manuel Tay
Doña Dora
GenteGas
Ecostufa
Industrias NIVI – www.gruponivi.com
CEMEX
HASA
Technologias Ecologicas Centroamericanas (El Salvador)
delher.
ENVIROFIT – making the world fit for humanity

NGOs

Helps International
ONIL
BPD
CEDEC
AMMI
Fundación Solar
ARCAS – Asociación de Rescate y Conservación de Vida Silvestre
alterna – accionando ideas
EcoLogic
Soluciones Comunitarias
Fundación Progresar
UtzChe'
AMA – Asociación de Mujeres del Altiplano

Donors and Financial institutions

National

génesis empresarial – Cree en ti y en tus sueños
BANRURAL – El amigo que te ayuda a crecer
CONFECOOP – Unidos hacemos desarrollo

International

UNDP
USAID – From the American People
The World Bank
CARITAS
Organización de las Naciones Unidas para la Alimentación y la Agricultura
Trees, Water & People
Guatemala Stove Project – Building Masonry Stoves in Guatemala
STOVE TEAM INTERNATIONAL
PEACE CORPS
LEGACY FOUNDATION
Highland Support Project
Inter-American Development Bank
National Peace Corps Association
people unlimited – HIVOS

Advocacy organizations, Academia/Research organizations, Others

Galileo Universidad – La Revolución en la Educación
Universidad Rafael Landívar – Tradición Jesuita en Guatemala
ZAMORANO
1966 UVG – Universidad del Valle de Guatemala
University of California
POLITÉCNICA – "Ingeniamos el futuro"
Aprovecho Research Center
CDC
SICA – Sistema de la Integración Centroamericana
AGRAPTO – Asociación Gracia para Todos
olade – Organización Latinoamericana de Energía
Naciones Unidas CEPAL
BUN-CA
Fundación 13 aguas
Alianza de Derecho Ambiental y Agua – Abogando por el Derecho Humano al Agua
Riiatzu
esf
The Vetiver Network International – Proven & environmental solutions
WORLD LP GAS ASSOCIATION
Grupo Secacao
ALTERCO 21
HITECA

Map of actors

GUATEMALA COOKSTOVE SECTOR

REGIONAL INSTITUTIONS
- BUN-CA / HIVOS
- OLADE
- CEPAL
- SICA

ACADEMIA
- San Carlos de Guatemala
- Galileo
- del Valle de Guatemala
- Rafael Landívar - IARNA
- Berkeley University (USA)
- Zamorano University (Honduras)
- Aprovecho Center (USA)

MINISTRIES
- MAGA
- MARN
- MIDES
- MINEDUC
- MSPAS
- MEM

GOVERNMENT AGENCIES
- Secretaria de Planificacion y Programacion de la Presidencia
- Comisión de Energía del Congreso de la República
- Comisión Nacional de Energía Eléctrica
- Concejo Nacional de Ciencia y Tecnología
- Instituto Nacional de Bosques
- Procuraduría Derechos Humanos
- Secretaría Presidencial de la Mujer
- Instituto de Ciencia y Tecnología

LOCAL AUTHORITIES
- Municipalidades
- Instituto de Fomento Municipal

INTERNATIONAL FUNDERS
- USAID
- World Bank
- European Union
- IADB
- AECID
- AIN
- UNDP

LOCAL FINANCE
- Cooperativas
- BANRURAL
- Génesis Empresarial

INTERNATIONAL IMPLEMENTERS
- Guatemala Stove Project
- Highland Support Project
- Legacy Foundation
- StoveTeam
- Trees, Water and People
- Peace Corps
- Paradigm Project

LOCAL IMPLEMENTERS
- Alterna
- ARCAS
- Asociacion de Mujeres del Altiplano
- Asociación Socorro Maya
- Bienestar Progreso Desarrollo
- Centro de Estudios Para el Desarrollo y la Cooperacion
- Fundacion Progressar
- Fundacion Solar
- Iglesias – Caritas
- Ixchel
- Utz Che

PRODUCERS OF INDUSTRIAL STOVES
- HELPS International
- Ecocomal
- Ing. Manuel Tay
- Doña Dora
- Biotectura (gas)
- Industrias NIVI (gas)
- *Manufacturas Metálicas para la Construcción, S.A. de C.V (EcoStufa - Mexico)*
- *Tecnologías Ecológicas Centroamericanas (Turbococina – El Salvador)*
- *CEMEX (EcoStove - Mexico)*

OTHER
- Gentegas
- Impact Carbon
- Aprovecho Center (USA)
- Tomza
- Dagas
- Zetagas

Gas distributors

Legend: Internanational Non-profit | National Non-profit | International Private | National Private | Government | International Academia | National Academia

Overview of activities related to ICS in Guatemala

By the Government

- Implementation of plancha-type stoves in rural areas (**Fondo de Inversión Social, FIS**) ~approximately 160000 stoves from 1996 to 2008.
- Implementation of plancha-type stoves in Baja Verapaz under health and nutrition programs (**Tezulutla´n project**) ~more than 4000 ICS from 1998 to 2001.
- Other **government** programs, such as Fondo Nacional para la Paz (FONAPAZ), Fondo para el Desarrollo Indígena de Guatemala (FODIGUA), Programa Nacional de Desarrollo Rural (ProRural), Desarrollo Integral de Comunidades Rurales (DICOR), Secretaria Presidencial de la Mujer (SEPREM). About 20000 stoves. No integration of results, only partial documentation.

By the Private sector

- **Noya** (Ing. Tay) ~ 6500 stoves since 1998.
- **Ecocomal** ~ 10,500 stoves since 2008.
- **Doña Dora** ~ 225 stoves since 2011.
- **Lola** (Arquitecto Luis Alberto Sarti) ~ unkown quantity .

By NGOs

- **HELPS International**- Production and distribution of ONIL/NIXTAMAL stoves ~111000 stoves since 2002.
- **INTERVIDA** - Dissemination of cookstoves to improve lives of women and children ~9000 stoves.
- **Guatemala Stove Project** - Implementation of plancha-type stoves in the Western Highlands (Centro de Estudios Para el Desarrollo y la Cooperacion).
- **Highland Support Project** (Asociacion de Mujeres del Altiplano) ~ 2000 in-situ cookstoves in 20 years.
- **Fundacion Solar -** Pilot-project on willingness-to-pay with the ONIL model. 430 stoves sold at market price. Financing provided by CNEE and PURE projects. Study of the willingness-to-pay with the Ecocina in Alta Verapaz and Baja Verapaz.
- **Many other projects** (Utz Che and with Trees, Water & People, Bienestar Progreso Desarrollo, Peace Corps, ACMA with Municipalites in the Lago de Amatitlan watershed, Municipalidad de San Lucas, etc., multiple small projects all over the country. Unknown number of stoves.
- *Under development*: **Paradigm Project** (Socorro Maya Foundation, with international partners, including private partners)) ~100000 Eko-stoves by 2021Some biogas projects, still scarce, such as projects by **Biotectura Agropecuaria** in rural areas ~ 50 biogas systems implemented since 2008.

By Academia/Research organizations

- **RESPIRE**: Randomized Exposure Study of Pollution Indoors and Respiratory Effects in the Western Highlands of Guatemala (University Del Valle, University of Guatemala, University of California, Berkeley, USA, United States Centers for Disease Control and Prevention, University of Bergen, Norway, World Health Organization).
- **CRECER**: Chronic Respiratory Effects of Early Childhood Exposure to Respirable Particulate Matter (University of California, Berkeley, USA).

Many efforts by various actors with many different scopes and procedures, but no systematization of the action, and lack of information on the number of cookstoves in-place.

Sources: CEPAL (2011), Wang et al. (2013), Interviews.

Case studies: Suppliers

HELPS International : A mix of donations and sales to the users in integrated programs

Initial motivation: Dr. O'Neil visited Guatemala in medical missions and was so impressed by the number of children with severe burns, that he designed the ONIL stove, with a cement cover to prevent burns.

Dates and location: Helps has been working in Guatemala since 2002, and the Onil stove has been installed in most parts of the country.

Type: HELPS manufactures three types: the Onils, the nixtamalera (used to cook corn for making tortilla sough), and an institutional cookstove used in schools, hospitals etc. Since 2002, more than 90000 Onil stoves have been installed, more than 21600 nixtamaleras.

Donations and sales: 85% of Onil stoves have been donated by HELPS International, integrating their effort to help achieve higher standards of living amongst the poor. Efforts integrate water, relieve of HAP, improvement of agricultural crops and in many cases, medical attention.
15% of their production is sold at market price, to other donors for their projects, or as stoves for people that can pay the price.

Main insights

- Quality, manufacturers support and guarantee offered by the manufacturer make a difference.
- HELPS International spirit is to improve the quality of life of beneficiaries.
- HELPS International has introduced to the ICS world many of todays stakeholders in Guatemala, and has been the inspiration for a generation of cement top stoves (Ecocina II and III, Socorro Maya-CEMEX stove, and others).

Ing. Tay : 100% sales to intermediates

Initial motivation: after designing the Lorena stove, Ing. Tay continued working and researching stoves, incorporating feedback from thousands of women (amongst others, the fire chamber is slightly larger, so that the fire can be seen - important by some users). He kept his two main components in mind: mud and sand. He decided to change the concept of the built-in stove to a mobile stove, making it more modern.

Dates and location Ing. Tay started working with stoves in 1976, with the Lorena. He moved on to simplify and build a stove that women would love and use. Efficiency was slightly less, but the stove is used! His stoves are installed mostly in the Altiplano.

Type : Works with the Noya, and has installed around 6,200.
larger plancha to accommodate most of cooking pots for the day.

Donations and sales: Ing. Tay sells all his stoves at market price to intermediates, such as cooperatives in Huehuetenango.

Main insights

- Constant innovations and development to make sure that the stove is used. Long-term and solid experience with women has been incorporated in the development of the Noya stove to make it fully relevant to users.
- On-going innovations and developments (oven placed over the plancha, water heater with the exhaust gases, which also contributes to fix particulates)
- Simple stove, that can be easily and was copied (seen in Chimaltenango and over the country).

Sources: Interviews.

Case studies: Willingness-to-pay with or without credit support

Banrural: Micro-credit for the purchase of the ONIL stove

Initial motivation: To facilitate the purchase of the ONIL stoves.

Partners:
- *Banrural* is a private bank, working with most social sectors. More than 1000 agencies and 1300 rural boxes, where clients can pay, and receive information.
- *HELPS International*

Micro-finance approach: The stove is proposed as part of a wider portfolio of products for rural areas. The stove is sold at full price, financed up to one year. Non conventional guarantee is proposed (any good that the family may have). Of 10 requests, an average of 4 are accepted. Interested people need to have their identification card (DPI), the NIT (fiscal identity number) and open an account with Q100. (USD13).

Genesis Empresarial: Micro-credit for the purchase of the DOÑA DORA stove

Initial motivation: To facilitate the purchase of the Doña Dora stove.

Partners:
- *Genesis Empresarial* is the largest micro-finance institution in Guatemala, created in 1988 with the support of USAID. Non-lucrative Guatemalan foundation, its objective is to support entrepreneurships and activities of micro and small businesses, with a special focus on women in rural areas.
- *Doña Dora entreprise*.

Micro-finance approach: Within is financing activities in home improvement, Genesis has supported over 100 stoves in Quetzaltenango. The interested parties have to qualify with guarantees (any good in the possession of the family) and a secure form of income. The NIT (fiscal identity number) is not required. Savings are estimated around Q6/day in firewood.

Fundacion Solar: Willingness to pay and successful ICS sales in a pilot-project for CNEE

Initial motivation: To assess the implementation potential of ICS within the framework of the energy efficiency plan (PIEE-Plan Integral de Eficiencia Energética) in Guatemala.

Partners:
- *CNEE (National Commission on Electricity)*
- *IBD (Banco Interamericano de Desarrollo)*
- *Fundacion Solar*
- *HELPS International*

Market approach: Fundacion Solar decided to sell the stoves through a revolving line of credit in a location (Seja in Izabal, northeastern region of Guatemala) where people purchase most to their firewood. The complete funds were returned to CNEE for future projects. The ONIL stove was chosen given the guarantee associated to the stove.

Woodfuel savings, demonstration and technical support were identified as the secret for sale success: region where firewood is purchased by the households, at least 2 visits after installation (review conditions of use, solve problems and doubts, check maintenance issues), written quality guarantee and follow-up provided by Onil helped to gain peoples trust. In the very first demonstration, 39 stoves were sold cash! In total, 85% of the stove were purchased cash, the rest with a 3 month credit by the revolving line provided by CNEE out of the PIEE funds.

Micro-financing facilitates the removal of the up-front cost barrier of ICS, when conditions are well adapted to poor households (type of guarantee, fiscal data requirement, etc.). However, the willingness-to-pay by households with stable revenues and who buy firewood is clearly demonstrated as soon as wood savings are proved and guarantee and technical support is provided (trust builders). Information campaigns about the benefits of clean cooking and the ways to acquire cookstoves are key to the development of the market.

Sources: Interviews.

Case studies: Donations in integrated programs

Cookstoves part of "clean house – healthy house"
Asociación Mujeres Ixchel and Centro de Estudios Para el Desarrollo y la Cooperación

Summary: An Association formed by 100% indigenous women, 4 professionals. The process is to identify women leaders (including illiterate women) and community needs. Women have to participate for one year making a nursery and planting trees, vaccination for their children, working under a health program. After one year of participation in environmental and health activities, they are eligible for a donated stove. They bring sand and labour. Work with the concept of clean house – healthy house.

Partners: Centro de Estudios Para el Desarrollo y la Cooperación (CEDEC) and Asociación Mujeres Ixchel (AMI), two Quiché-Maya health-based organizations, Guatemala Stove Project, Ministry of Health, UN small donations (funding).

Dates and location : Region of Quetzaltenango, Altiplano.

Type and number of stoves: 4000 in-situ stoves in 16 years.

Main insights

Well integrated and respected local indigenous professionals with excellent communication and leadership skills are key to the success of the program.

Such an integrated approach is crucial to reach people living in extreme poverty. Integration of stoves in health, education, environment activities facilitates understanding and commitments by the families in the cookstove use, and places the cookstove in the process of improving conditions of live and protecting the environment.

Access to grants from the Government on health extension makes integrated approaches more attractive.

Physical limitation to satisfy to the interested communities in the area.

A recent project with Utz Che

Summary: Utz Che is an association integrating 32 other associations. Supported by a donation from Tree Water and People (NGO based in USA) , Uzt Che works in two communities, where they adapted the rocket elbow principle to local cooking needs and use: due to warm weather, women chose not to have a plancha, just the fire chamber, the elbow and a burner (metal support for pots and pans, like in a LPG stove). Stoves are donated, families provide labor, pay the mason and provide ash to fill the stove (around Q100, USD13). Cookstove activity is integrated in wider agriculture activities to create revenues.

Partners : Utz Che (local implementer), Tree Water and People (funding).

Dates and location: started in 2011 in south part of the country, Pacific region of Guatemala).

Type and number of stoves: Utz stove, around 25 units.

Main insights

The principle of adapting the stove to the existing conditions of the house (many have an elevated platform for cooking) with a rocket elbow and an efficient stem, and at a very low cost, could be the solution for extreme poverty situations at a lower price.

Integration of the cookstoves in agriculture activities contribute to the sustainability of the project.

Sources: Interviews.

Typical business models

Centralized mass-production facilities and retailers

Allows manufacturers to quickly ramp up stove production in order to lower stove costs and to assure standard product quality

- Preferred by private investors.
- Stoves usually sold at market price.
- Promotional campaigns, microfinance, carbon financing in order to attract the consumer.
- Funding obtained from international organizations, religious groups, and other in-country associations or governments.
- Considerable upfront investments needed are the main barrier, as well as an established market.
- Examples in Guatemala: HELPS International, Noya, Ecocomal, Dona Dora.

Decentralized mass-production

- Manufacturing through a network of regional stove production centers, run by local artisans or local associations formally trained in the manufacture of a particular set of stoves adapted to local conditions.
- Stoves sold in regular markets.
- Usually applied in countries with existing market of traditional stoves => frequent in Asia, Africa.
- Not yet explored in Central America given the lack of a traditional stove market, and the type of cookstoves (more expensive).

Decentralized in situ construction

- Training of local groups and other organizations to construct stove models adapted to local circumstances.
- Rather than purchasing the stoves, users often participate by providing labor and local materials.
- Usually associated to empowering and capacity-building of local communities and organizations with external and government funding.
- Appropriate for rural areas, with people with very limited income.
- Difficulty in building a supply chain and difficulties in assuring quality control once the stoves are installed.
- Examples in Guatemala: FIS, FONAPAZ, Intervida, Guatemala Stove Project, Highland Support Project, Utz Che and with Trees, Water & People, Bienestar Progreso Desarrollo, Peace Corps, etc.).

Market-oriented centralized mass-production facilities already exist in Guatemala. But the conditions for the creation of a strong market for clean cookstoves need to be enhanced to stimulate the supply. Decentralized in-situ construction remains driven by donation programs and will deserve attention in order to avoid any overlap with market-based targets.

Sources: Wang et al. (2013), field experience of Funsolar and Energia sin Fronteras

Enterprise financing options

Commercial loans

Challenges
- Difficulty in proving the financial feasibility of the proposals.
- High guarantees required by the banks.
- High interest rates.
- Needs for an existing market.

Possibility of adapted commercial loans
- Third party credit guarantee.
- Subsidized loans (longer time horizon, lower interest rates).
- Revolving fund approach with distributors.
- Creation of a special fund with soft loans.

Examples
- Financing of private companies information not readily available.
- HELPS International provides stoves to distributors, and is paid only after sales of the stoves.

Social business investments

Challenges
- High investments are needed.
- Need for a shared vision and mission.
- Coordination amongst all stakeholders.

Examples
- Alterna, centre for innovation and entrepreneurship based in Quetzaltenango, and its Enterprise Development Incubator program, supported the launch of Dona Dora enterprise.
- StoveTeam, NGO based in the US, assists local entrepreneurs to start factories using local labor and materials, they supported the activities of Ecocomal.

Grants

Challenges
- Dependence on external funding.
- Needs for an existing market so that the commercial activity becomes viable without the grant.
- Must be well defined to avoid distortion of the market.

Examples
- HELPS International has achieved an integrated vision (clean water, efficient stoves and illumination) with donors working in this line of support.

A possible role for intermediates and distributors: to buy large quantities and sell at better price?

Challenges
- Several suppliers already work with intermediates, but usually oriented to donation programs.
- Need to ensure the availability of a market.

Examples
- None associated with sales.
- Possible interest of cooperatives.

Enterprise financing will be much easier as soon as the demand-side of the market develops.

Sources: Interviews

- Executive summary
- Project approach
- Sector mapping
  - Macro environment
  - Fuel usage and trends
  - Health, social and environmental impact
  - Cookstove industry
  - Consumer assessment
  - Cookstove policy environment
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- Appendix

Summary of cookstove and fuels market assessment in Guatemala

Macro-environment

- High level of inequality and poverty, especially in rural and indigenous areas.
- Violence, environmental and climate vulnerability, cultural diversity contribute to the social complexity of the country.
- Challenges include fostering inclusive growth, addressing social and gender inequalities, improving the levels of citizen security and ensuring revenues to finance public spending on education, health and infrastructure.
- Ease of Doing Business is low.
- Public policies and programs lack systematization or continuity of successful interventions and synergies between initiatives.
- Microfinance activities are increasing rapidly, but still face legislative barriers.
- Guatemala is estimated to have the high potential for accelerating economic growth.

Fuel usage and trends

- Woodfuel is more than 57% of total final energy use, its share continues increasing while LPG is marginal (3%) and its consumption varies with prices. The majority of households continue to use traditional cooking methods that involve open fires.
- The woodfuel deficit and illicit wood extraction reinforce the need for efficient use of woodfuel and the development of other energy sources and of sustainable plantations for energy use.
- LPG is a relevant complementary fuel for fast heating.
- Increasing prices of woodfuel may raise interest in efficient cookstoves by those who buy woodfuel.
- Total Woodfuel consumers: 2.13 million households Total Woodfuel buyers: 1.29 million households

Health, social, environmental impact

- Collection of fuelwood is carried out by both men and women.
- Indoor air pollution accounts for economic losses equivalent to around 1% of Guatemala's GDP. It is one of the most important health problems and must be a priority in health policies.
- The use of firewood also contributes to outdoor air pollution.
- Conditions of use and type of wood are crucial drivers of the benefits associated with cookstoves.

Consumer

- The existence of clean cookstoves and their benefits remain unknown by most of the households.
- Satisfaction of users is indispensable (size of the family, type of cooking, symbolism of fire).
- The extreme poverty segment of the population will deserve non-market based strategies, which must be well defined to avoid any distortion of the market based strategies
- Willingness-to-pay by households with stable revenues close or over the poverty line and who buy firewood is demonstrated as soon as wood savings are proved and guarantee and technical support is provided.
- The willingness-to-pay of the "non-extreme poverty" segment is more uncertain. From 0.7 to 1.4 million households could buy an efficient cookstove, under relevant conditions of payment.
- Rural or remote areas may present additional constraints (accessibility, insufficient volumes of sales)
- Consumer financing options are starting, but need much stronger support, supported by communication campaign on financing options
- LPG is used by households close to and over the poverty line, for specific uses (breakfast, re-heating food), combined with woodfuel. This niche is robust and could be reinforced.

Cookstove industry

- Many efforts by various actors but no systematization of the action, no follow-up, lack of information on number of cookstoves in-place
- A unique cookstove won't satisfy the needs and preferences of all households, nor a unique supplier. Hence the interest in a diversified supply.
- Manufacturers support and guarantee make a difference in the attractiveness of cookstoves.
- Market-oriented centralized mass-production exists, but demand for clean cookstoves must be enhanced to stimulate the supply.
- Decentralized in-situ construction remains driven by donation programs and will deserve attention in order to avoid any overlap with market-based targets.
- Enterprise financing will be much easier as soon as the demand-side of the market develops.
- Stove certification has to be mandatory, to secure quality, guarantees and availability of spare parts to the buyers. It will also support cookstove initiatives as a "trust building mechanism".

Cookstove policy

- Guatemala has unique experience in ICSs, but without systematization of information.
- The new National Energy Policy (2013-2027) opens the door for new initiatives and strategies to promote clean cooking
- Energy and commercial strategies must consider the regional level. A cookstove market at the regional level is of high interest.
- Experience in CDM projects and programs is available in Guatemala, including with cookstoves (under development). However, carbon markets remain complex and uncertain. Other climate finance opportunities such as the Nationally Appropriate Mitigation Actions (NAMAs) and forestry projects deserve more attention.

Implications for Intervention Options

The crucial needs identified to scale up and meet the magnitude of the problem in Guatemala are:

1. **Legal framework and policies**
   - Preparation of transversal policies.
   - Establishment of a focal point and multisector group.
   - To make standards and certification mandatory – Regional approach.

2. **Integrated projects and programs for the poorest**
   - Clear separation with market-based approach, to avoid any overlap.
   - Integration of clean cooking with health, education, environment activities – avoid full donations.
   - Cultural/language consideration.
   - Training of both users and masons, monitoring.

3. **Large national information campaign**
   - To inform about the existence of cookstoves and their benefits: fuelwood savings and health.
   - Well focused campaign: distinguish households buying firewood from those not, capacity to buy a stove or not, etc.
   - Demonstration activities.

4. **Diversified supply**
   - Different type of stoves.
   - Integrate LPG stove as a complement.
   - Guarantee and technical support required.
   - Training of users – crucial.
   - Geographic constraints, remote areas to consider.

5. **Financing options, regional and international frameworks**
   - Reinforce adapted consumer and supplier finance options.
   - Explore NAMAs opportunities.
   - Regional market and policies (Central America).

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Acronyms *(1/3)*

ACOFOP	Asociación De Comunidades Forestales (Forest Community Association)
AECID	Agencia Española de Cooperación Internacional para el Desarrollo (Spanish Agency for International Development Cooperation)
AIN	*Asociación de la Iglesia Noruega*
AMI	Asociación Mujeres Ixchel (Women Ixchel Association)
ARCAS	Asociación de Rescate y Conservación de Vida Silvestre
AusAID	Australian Government Overseas Aid Program
AVAD/DALY	Años de vida ajustados por discapacidad (Disability-adjusted life years)
BOE/BEP	Barrels of oil equivalent (barriles equivalentes de petróleo)
BC/CN	Black Carbon (carbono negro)
BUN-CA	Biomass Users Network of Central America
CABI	Central American Business Intelligence
CCT	Controlling Boiling Test (Prueba de Ebullición Controlada)
CDM/MDL	Clean Development Mechanism (Mecanismo de Desarrollo Limpio)
CEDEC	Centro de Estudios Para el Desarrollo y la Cooperación (Centre for Development Studies and Cooperation)
CEPAL/ECLAC	Comisión Económica para América Latina y el Caribe (Economic Commission for Latin America and the Caribbean)
CEPALSTAT	Base de datos de estadísticas e indicadores sociales, económicos y medio ambientales
ESMAP	Energy Management Assistance Program
CIA	Central Intelligence Agency
CIFGUA	Cifras del Sistema Estadístico Forestal de Guatemala (proyecto)
CNEE	Comisión Nacional de la Energía Eléctrica (National Commission of Electric Energy)
CO	Carbon Monoxide (monoxido de carbono)
CO2	Carbon dioxide (dioxido de carbono)
CONFECOOP	Confederación de Cooperativas de Guatemala. (Guatemalan Cooperative Confederation)
CRECER	Chronic Respiratory Effects of Early Childhood Exposure to Respirable Particulate Matter
CSR/RSC	Corporate Social Responsibility (Responsabilidad Social Corporativa)
DICOR	Desarrollo Integral de Comunidades Rurales (Integrated Development of Rural Communities)
DPI	Documento Personal de Identidad (Personal Identity Document)
EC/CE	Elemental Carbon (Carbono elemental)
EDI/IDE	Energy Development Index (indice de desarrollo energetico)
ENCOVI	Encuesta Nacional de Condiciones de Vida (National Survey of Living Conditions)
ESMAP-WB	Energy Sector Management Assistance Program-World Bank (Programa de Asistencia a la Gestión del Sector de la Energía del Banco Mundial)
FE/EF	Factor de Emisión (Emission factor)
FIS	Fondo de Inversión Social (Social Investment Fund)
FONAPAZ	Fondo Nacional para la Paz (National Fund for Peace)
FODIGUA	Fondo para el Desarrollo Indígena de Guatemala (Fund for Indigenous Development in Guatemala)
FP/PF	Focal point (Punto focal)
GDP/PIB	Gross Domestic Product (Producto Interno Bruto)
GHG/GEI	Greenhouse gas (Gas de efecto invernadero)
LPG/ GLP	Liquefied Petrol Gas (Gas licuado de petróleo)
HAP/CAH	Household Air Pollution (Contaminación del Aire en los Hogares)
HIV/AIDS	Human immunodeficiency virus infection/acquired immunodeficiency syndrome
HIVOS	Human Institute for Cooperation (Dutch)
IADB/BID	Inter American Development Bank (Banco Interamericano de Desarrollo)

Acronyms *(2/3)*

IARNA-URL	Instituto de Agricultura, Recursos Naturales y Ambiente – Universidad Rafael Landívar (Institute of Agriculture, Natural Resources and Environment - University Rafael Landivar)
ICS/EM	Improved CookStoves (Estufas Mejoradas)
INSIVUMEH	Instituto Nacional de Sismología, Vulcanología, Meteorología e Hidrología (National Institute of Seismology, Volcanology, Meteorology and Hydrology)
INAB	Instituto Nacional de Bosques (National Forestry Institute)
INTECAP	Instituto Técnico de Capacitación y Productividad (Technical Institute for Training and Productivity)
IUCN/UICN	International Union for Conservation of Nature (Unión Internacional para la Conservación de la Naturaleza)
kg	kilogram
KPT	Kitchen Performance Test
kt	kiloton (kilotonelada)
kt/yr	kiloton/year (kilotonelada per año)
Lbs.	Pounds (libras)
LIDER Party	Partido Libertad Democrática Renovada (Renovated Democratic Freedom Party)
MAGA	Ministerio de Agricultura y Ganadería (Ministry of Agriculture)
MARN	Ministerio de Ambiente y Recursos Naturales (Ministry of Environment)
MCC/CME	Multisector Cookstove Committee (Comité Multisectorial de Estufas)
MDG/MDM	Millennium Development Goals (Metas de Desarrollo del Milenio)
MEM	Ministerio de Energía y Minas (Ministry of Energy and Mines) (Ministry of Energy and Mines)
MFI/IMF	Micro Finance Institutions (Instituciones Micro Financieras)
MIDES	Ministerio de Desarrollo (Ministry of Development)
MINECO	Minsterio de Economía (Ministry of Economy)
MSPAS	Ministerio de Salud Pública y Asistencia Social (Ministry of Health)
MW	Megawatt
MWh	Megawatt-hour
NAMAs	Nationally Appropriate Mitigation Actions (Acciones Nacionales de Mitigación Apropiadas)
Nb/No	Number (numero)
NGO/ONG	Non-Governmental Organizations (Asocación no Gubernamental)
NIT	Número de Identificación Tributaria (Fiscal identity number)
NOx	Nitrogen Oxides (Óxidos de Nitrógeno)
OECD/OCDE	Organisation for Economic Co-operation and Development (Organización para la Cooperación y el Desarrollo Económicos)
OLADE	Organización Latinoamericana de Energía (Latin America Energy Organization)
OC/COr	Organic carbon (carbono orgánico)
OM/MO	Organic Mattet (materia organica)
PIEE	Plan Integral de Eficiencia Energética (Integral Energy Efficiency Plan)
PM	Particulate Matter (Partículas)
PM 2.5	Particulate Matter 2.5 (Partículas 2.5)
PM 10	Particulate Matter 10 (Partículas 10)
PoA	Programme of Activities
PPP/APP	Public Private Partnership (Alianza Publico-Privada)
PREPCA	Programa Regional de Energía y Pobreza en Centro América (Regional Energy Programme and Poverty in Central America)
ProRural	Programa Nacional de Desarrollo Rural (National Rural Development Programme)
Q.	Quetzal
REDD+	Reducing emissions from deforestation and forest degradation (Reducción de Emisiones de la deforestación y la degradación de bosques
RESPIRE	Randomized exposure study of pollution indoors and respiratory effects
SEDAC	SocioEconomic Data and Applications Center

Acronyms *(3/3)*

SEGEPLAN	Secretaría de Planificación y Programación de la Presidencia - Gobierno de Guatemala (Secretariat of Planning and Programming of the Presidency - Government of Guatemala)
SEPREM	Secretaría Presidencial de la Mujer (Presidential Secretariat for Women)
SICA	Sistema de la Integración Centroamericana (Central American Integration System)
SIECA	Secretaria de Integración Comercial de Centramérica (Central American Secretariat of Economic Integration)
SIFGUA	Sistema Estadístico Forestal Nacional de Guatemala (Statistical National Forest System Guatemala)
SO_2	Sulfur Dioxide (Dióxido de Azufre)
SREP	Scaling-Up Renewable Energy Program in Low Income Countries
tCO2e	Ton of CO_2 equivalent (tonelada de CO2 equivalente)
TSP	Total Suspended Particles (Partículas Totales en Suspensión)
ug / m3	microgram per cubic meter
UN/NNUU	United Nations (Naciones Unidas)
UNCTAD/CNUCD	United Nations Conference on Trade and Development (Conferencia de las Naciones Unidas sobre Comercio y Desarrollo)
UNDP/PNUD	United Nations Development Programme (Programa de las Naciones Unidas para el Desarrollo)
UNEP/PNUMA	United Nations Environment Programme (Programa de Naciones Unidas para el Medio Ambiente)
UNFCCC/CMNUCC	United Nations Framework Convention on Climate Change (Convención Marco de las Naciones Unidas sobre el Cambio Climático)
URL	Universidad Rafael Landivar
USAID	U.S. Agency for International Development
USD	US Dollar
VOCs/COV	Volatile Organic Compounds (Compuestos orgánicos volátiles)
WBT	Water Boiling Test (Prueba de Ebullición de Agua)
WHO/OMS	World Health Organization (Organización Mundial de la Salud)

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