

Biomass Resources and Consumption in Cambodia

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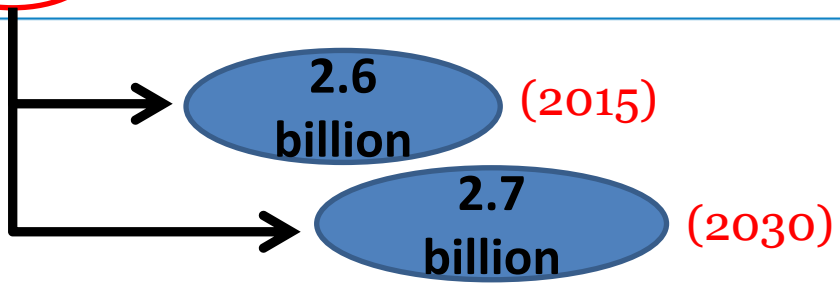
Outline

- Introduction
- Wood/Biomass energy value chain in Cambodia
- Biomass Resource Potential in Cambodia

Introduction

People Relying on Biomass Resources as their Primary Fuel for Cooking in developing countries, 2004

	Total population		Rural		Urban	
	%	million	%	million	%	million
Sub-Saharan Africa	76	575	93	413	58	162
North Africa	3	4	6	4	0.2	0.2
India	69	740	87	663	25	77
China	37	480	55	428	10	52
Indonesia	72	156	95	110	45	46
Rest of Asia	65	489	93	455	35	92
Brazil	13	23	53	16	5	8
Rest of Latin America	23	60	62	59	9	25
Total	**52**	**2 528**	**83**	**2 147**	**23**	**461**

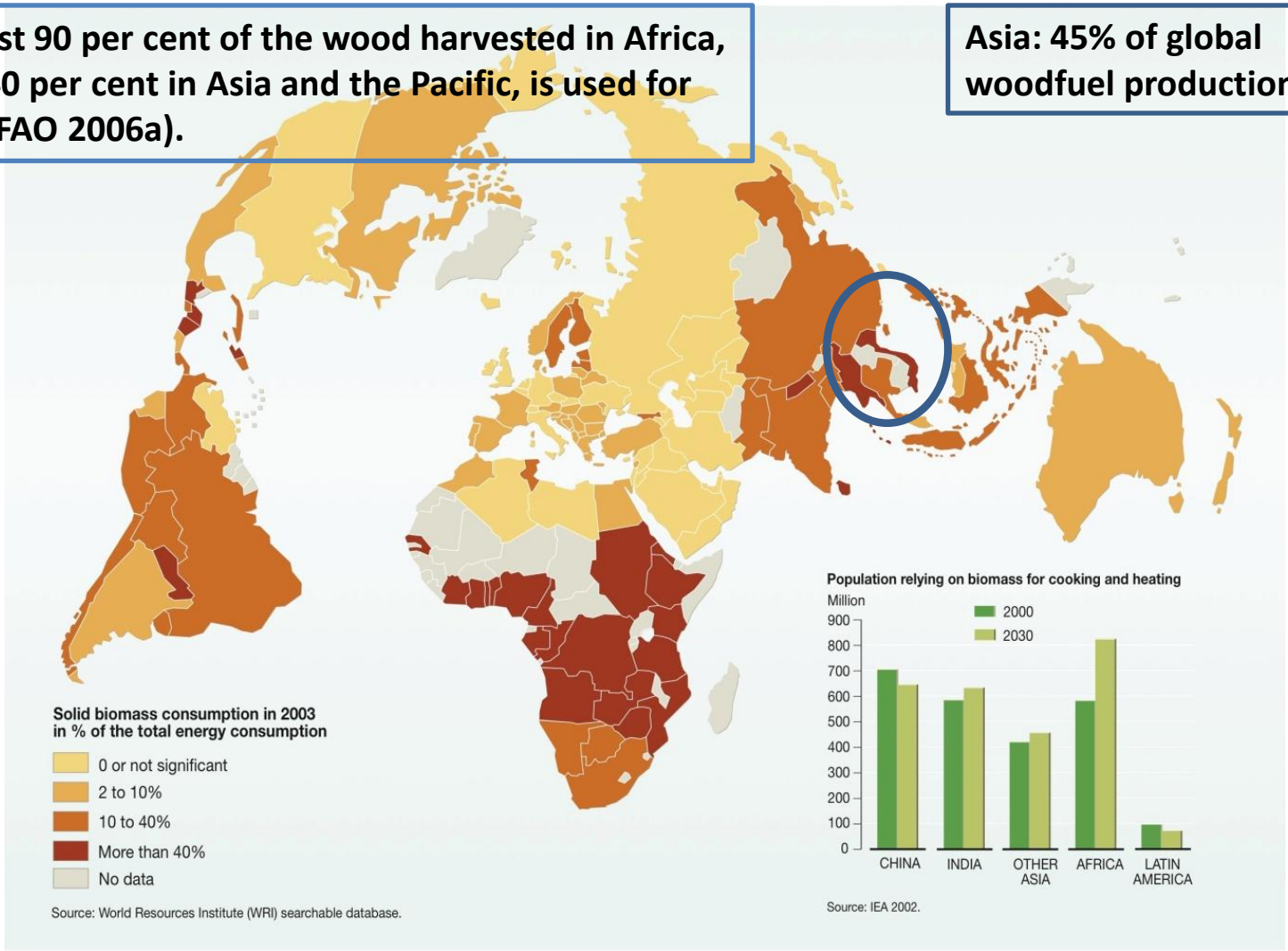


(IEA, 2006)

Introduction: Biomass Energy Consumption

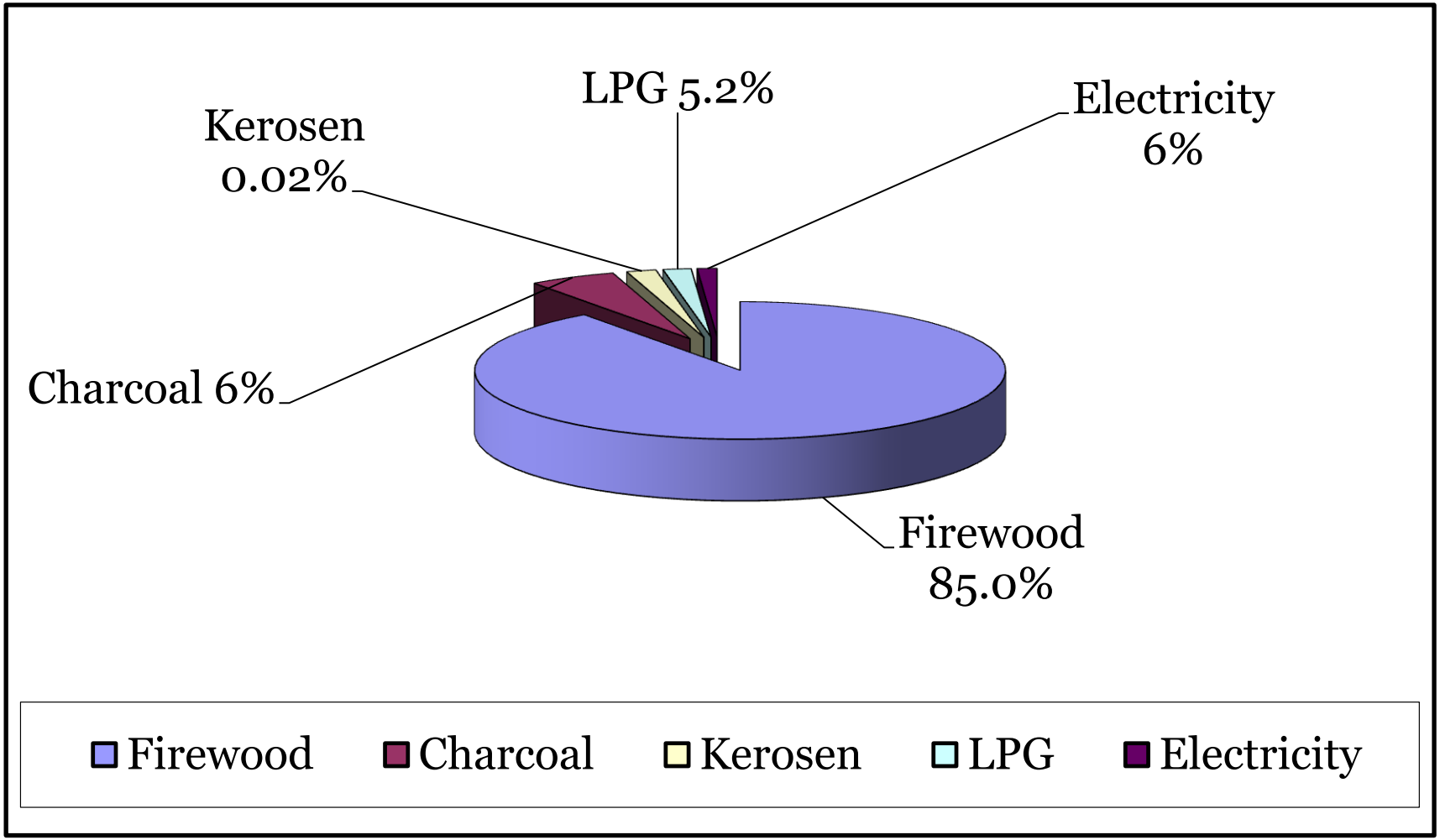
Almost 90 per cent of the wood harvested in Africa, and 40 per cent in Asia and the Pacific, is used for fuel (FAO 2006a).

Asia: 45% of global woodfuel production



Introduction:

Energy sources in Cambodia



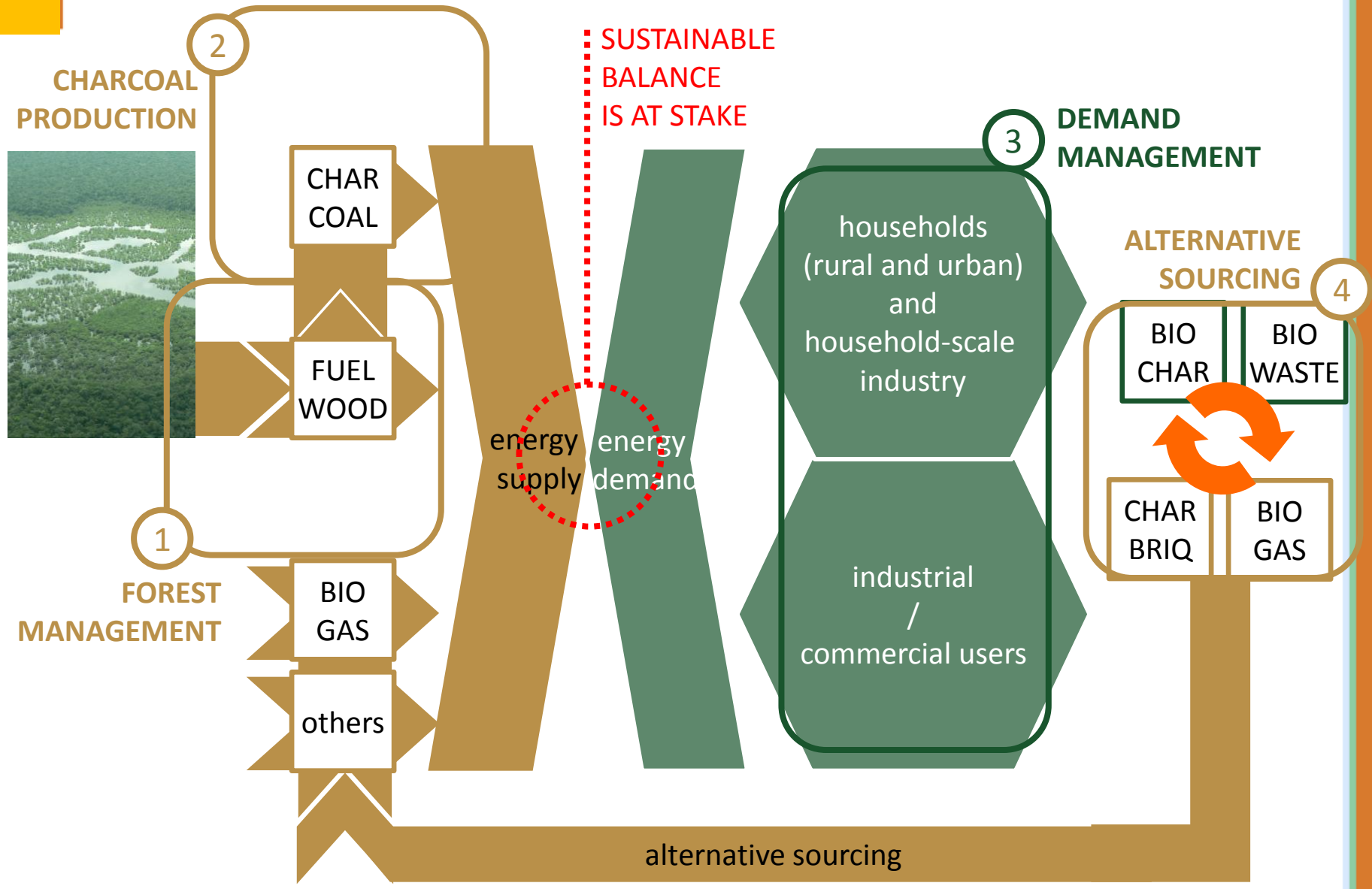
(Source : Kingdom of Cambodia Statistical Yearbook 2008)

Introduction:
Sources of Biomass Energy

- Woodfuel collection usually collected from natural forest.

2015

Wood/Biomass energy value chain in Cambodia



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Forest management in Cambodia: an overview

181,035 km² country area

100,940 km² covered by forest

23 protected areas

91%
of Cambodian households rely on woody biomass for cooking

only **20%**
of Cambodian households have access to electricity

90% of rural households have no access to electricity and rely entirely on biomass

5,500,000 tons
national yearly demand of fuelwood

- 60% of the national territory is covered by forests
- Woody biomass is still the main cooking fuel in Cambodia: it represents the main fuel in rural households (almost 100%) and the most popular one in urban households (almost 60%)
- Population growth and limited access to electricity put an extra burden on woody biomass
- Biomass is a renewable source only if the forest has time to regenerate (sustainable exploitation)
- High rate of deforestation may not only bring about a shortage of fuelwood but also soil degradation and impoverishment of agricultural land
- Overall balance between offer and demand is currently positive, there is however a discrepancy since wood energy situation varies between areas

Source: National Census 2008, UNDP 2010, FAO 2011

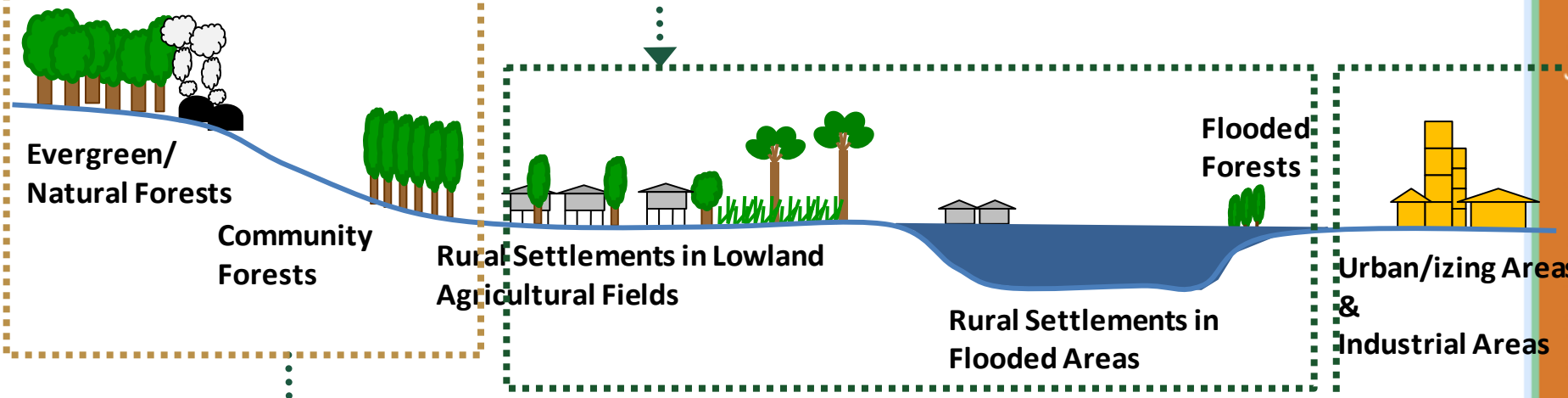
Forest management in Cambodia: wood energy situation varies between areas

BIOMASS ENERGY DEMAND IN RURAL AREAS

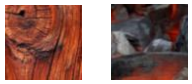
Fuelwood is collected for free from forest lands close to the villages

Charcoal is bought from illegal, inefficient kilns

WOOD SUPPLY BASSIN/ BIOMASS ENERGY SUPPLY



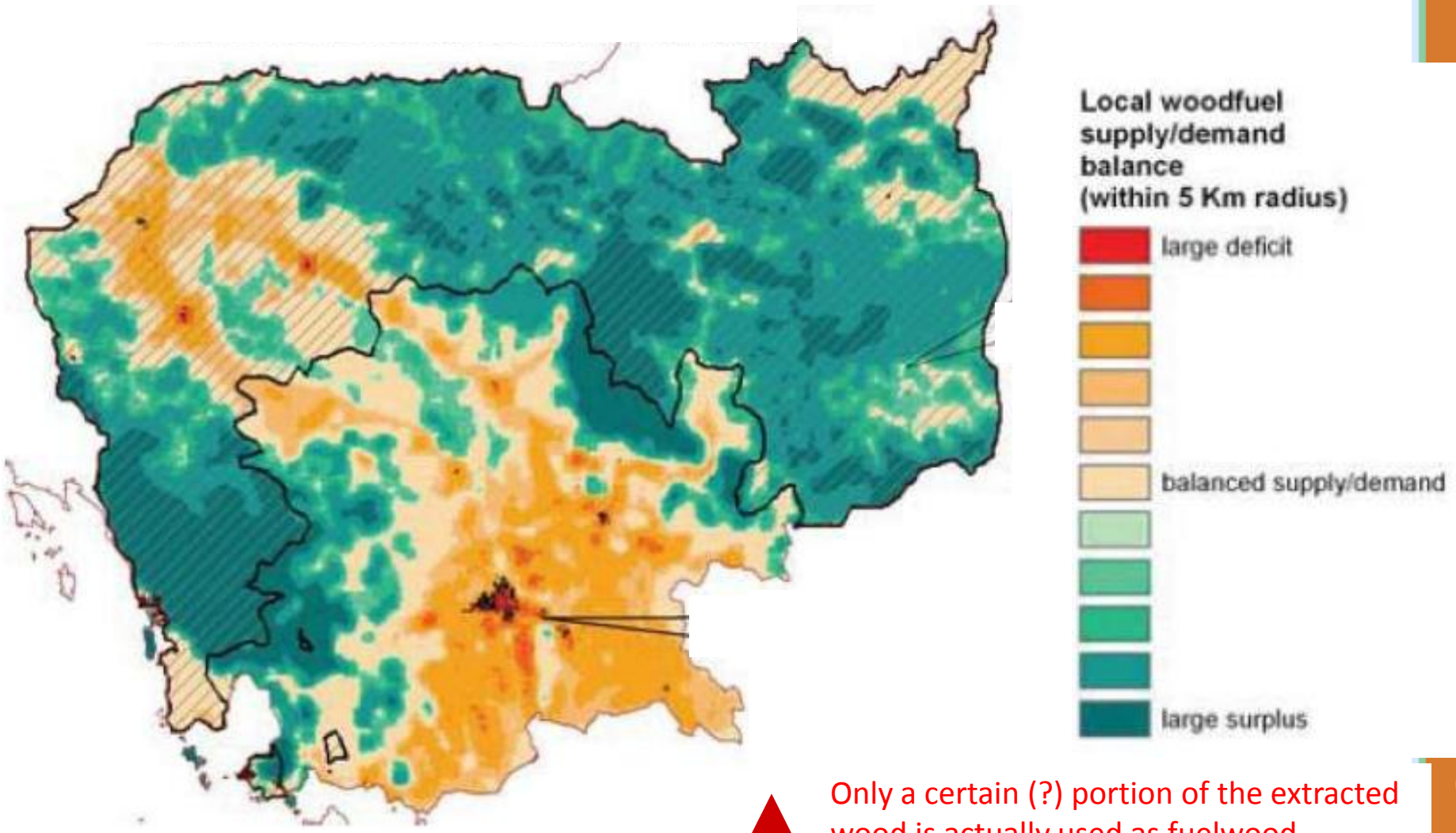
BIOMASS ENERGY DEMAND IN URBAN AREAS



Both firewood and charcoal are outsourced

Urban development exerts significant pressure on areas not positively affected by development

Forest management in Cambodia: wood energy situation varies between areas



Source: FAO 2008

▲ Only a certain (?) portion of the extracted wood is actually used as fuelwood

Sustainable balance supply-demand of biomass: actions and constraints in forest management

RECOFTC

- CBSFLMP project (2006-2010)
- Goal: secure local forests
- Target group: 451 villages / 200,000 ha
- Some achievements: 65 field-level training sessions on community forestry; 33 nationals trained to become community forestry trainers

Other projects

FOREST MANAGE MENT

LEGAL AND SOCIAL CONSTRAINTS

- Limited environmental consciousness
- Weak law enforcement against illegal wood cutting
- No regulation of charcoal production
- Lack of data on wood use

FAUNA & FLORA INTERNATIONAL

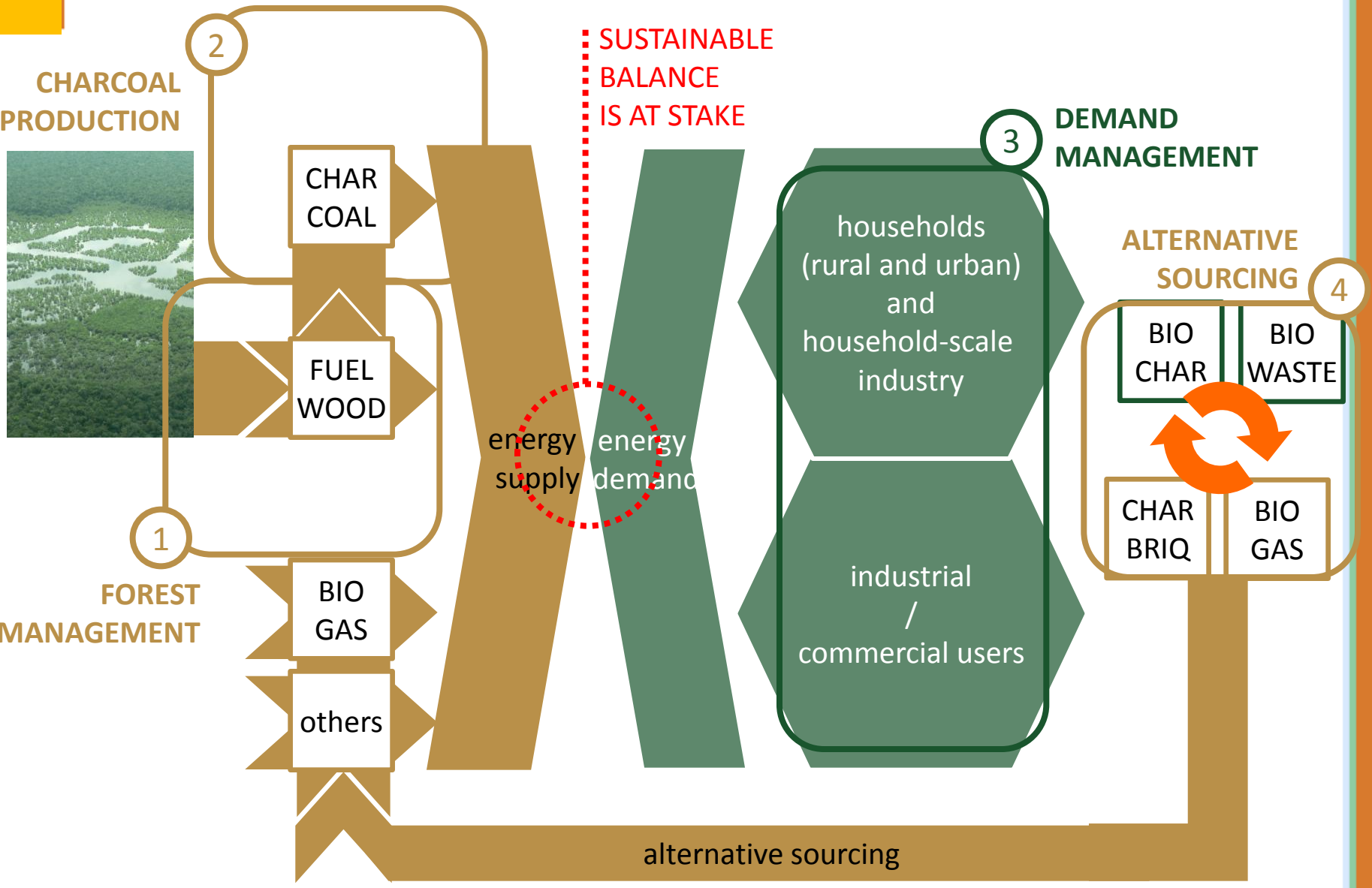
- University Capacity Building Project
- Goal: address the shortage of trained biologists and reliable biodiversity data
- Some achievements: first Cambodia's Master's Degree in Biodiversity conservation; over 100 biologists trained to date

Policies needed?

POLICY FRAMEWORK

2015

Wood/Biomass energy value chain in Cambodia: charcoal production



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Charcoal Making in Cambodia

About 40% of Phnom Penh's population rely on charcoal for their energy needs.

With ever more stringent laws coming into place, much of Cambodia's charcoal production is considered as **illegal** because it is one of the main deforestation drivers.

Charcoal production: some basic figures

192,400 tons national demand of charcoal per year

6.5 kg/1 kg conversion ratio firewood/charcoal with traditional ground-pit kiln

1,251,000 tons of firewood needed yearly to cover national demand of charcoal

26.4 GJ/ton calorific value of charcoal produced with traditional ground-pit kiln

15.6 GJ/ton calorific value of fuelwood

40% of national demand for charcoal comes from Phnom Penh

Source: GERES Cambodia analysis

- Traditional charcoal producers operate with low-efficiency technologies (i.e. ground-pit kilns) with uncontrolled carbonization processes
- High conversion ratios and low calorific values bring about a greater demand for firewood
- Charcoal is produced in rural areas (mostly areas around Kirirom, southeast of Kampong Speu)
- Charcoal is mainly transported to and consumed in urban areas
- Charcoal transportation has both an economic and environmental impact
- Due to rarefaction of resources, price of charcoal increases steadily

Charcoal producing

Fuelwood consumption rate for charcoal producing (Mean±SE)

Production period	Number of month	Time of producing (month^{-1})	Fuelwood Consumption (tonne family^{-1} month^{-1})	Fuelwood Consumption (tonne family^{-1} year^{-1})
Peak	3 ± 0.17	2 ± 0.06	7.72 ± 1.12	13.81 ± 1.80
Medium	2 ± 0.19	2 ± 0.06	2.75 ± 0.31	7.72 ± 1.12
Low	2 ± 0.22	2 ± 0.07	1.38 ± 0.16	4.38 ± 0.67
Mean/Total	6 ± 0.27	2 ± 0.06	3.49 ± 0.34	20.90 ± 2.61

Sustainable balance supply–demand of biomass: actions and constraints in charcoal production

- Some achievements: 1 Yoshimura Kiln installed in the Sustainable Charcoal Pilot Center of GERES in Takeo and 2 in Pursat
- Conversion ratio of 4.5
- Calorific value of 29.3 MJ/kg (tested in IUT-LUACOB, France)
- Potential yearly savings of 470,600 tons of firewood
- Taken into account the higher calorific value, savings of 37% of woody biomass can be achieved
- Support by public authorities is becoming stronger

Other projects

CHARCOAL PRODUCTION

Policies needed?

LEGAL AND TECHNICAL CONSTRAINTS

- No regulation for charcoal production
- Limited basic knowledge of producers and no rigid compliance to standards and specifications
- Low affordability of producers
- Lack of financial incentives/institutional mechanisms to bridge the financial gap between low affordability of producers and high price of efficient kilns

POLICY FRAMEWORK

Wood/Biomass energy value chain in Cambodia: demand management

2
CHARCOAL PRODUCTION

1
FOREST MANAGEMENT

CHAR COAL
FUEL WOOD
BIO GAS
others

SUSTAINABLE BALANCE IS AT STAKE

energy supply
energy demand

3
DEMAND MANAGEMENT

households (rural and urban) and household-scale industry

industrial / commercial users

ALTERNATIVE SOURCING
4

BIO CHAR
BIO WASTE
CHAR BRIQ
BIO GAS

alternative sourcing

Demand management of biomass energy: households and household-scale industry

84% of Cambodian households use firewood for cooking purposes

an average rural household consumes every day

3.135 kg of firewood

7% prefer charcoal

1.543 kg of charcoal

an average urban household consumes daily

3.11 kg of charcoal

2.1 kg of firewood

a rice wine distillery

42.5 kg

a palm sugar industry consumes daily

104 kg of firewood

- Households and household-scale industries are the biggest consumers of firewood in Cambodia
- Biomass consumption for domestic cooking in rural and urban areas accounts for more than 50% of Cambodian energy consumption
- Household-scale industries have a limited thermal efficiency (18-24% according to the industry), which could be improved by utilizing efficient stoves and kilns
- Improved stoves and kilns are expensive and difficult to afford for households and household-scale industries

Source: GERES Cambodia analysis and monitoring tests, National Census 2008

Woodfuel consumption rate per capita

Household size	Annual woodfuel consumption rate per capita			
	Cooking (kg capita^{-1} year^{-1})	Boiling water (kg capita^{-1} year^{-1})	Preparing pig food (tonne head^{-1} year^{-1})	Cattle protection (tonne head^{-1} year^{-1})
Very small	663.62±40.67^{a}	373.83±39.58^{a}	0.69±0.10^{a}	0.36±0.03^{a}
Small	521.27±19.98^{ab}	267.00±13.88^{ab}	0.61±0.06^{a}	0.33±0.02^{a}
Medium	429.86±16.01^{bc}	252.69±20.41^{ab}	0.62±0.06^{a}	0.30±0.02^{a}
Large	334.71±18.07^{c}	174.17±17.45^{b}	0.74±0.10^{a}	0.26±0.14^{a}
Very large	354.26±38.95^{c}	188.83±31.52^{b}	0.78±0.13^{a}	0.23±0.11^{a}
Total/Mean	491.28±12.15	267.97±10.96	0.65±0.04	0.31±0.01

The letters a, b and c are used to show the significant difference (p = 0.05) between/among the values within a column according to the Contrast test in the one-way ANOVA. Values in the same column followed by the same letters are not significantly different.

Sustainable balance supply–demand of biomass: households and household–scale industry

- New Lao Stove (NLS) and Neang Krongrey Stove (NKS): improved cookstoves for households
- Some achievements of NLS: over 1,800,000 stoves sold; 35,000 NLS produced/month in 42 production centers; avoided deforestation for 10,000 football pitches; savings of 9-25% of woody biomass (according to cooking habits)
- Some achievements of NKS: almost 360,000 stoves sold; 42 production centers in 9 provinces

Other projects

DEMAND MANAGE MENT

Policies needed?

POLICY FRAMEWORK

LEGAL, TECHNICAL AND SOCIO-ECONOMIC CONSTRAINTS

- Lack of technical knowledge
- Lack of technical specifications, no energy efficiency standards for stoves made in Cambodia and for products entering Cambodia
- Lack of precision of current data
- Lack of financial/tax incentives for improved stoves and kilns
- Limited access to credits for household-scale industries due to their informal character
- Difficulties in changing the consumption patterns and cooking habits of end-users
- Low level of awareness on the potential of energy efficiency

Demand management of biomass energy: the case study of garment and brick factories

1,600,000 m³ obtained annually from abandoned rubber plantations to supply brick, tile and garment industry

273,000 tons volume of fuelwood consumed per year by **69** garment factories in Cambodia, corresponding to **3,900 ha** per year

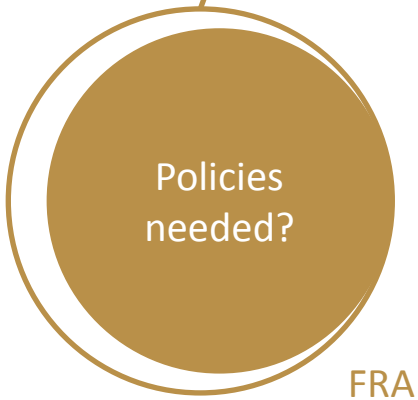
50,000 tons volume of fuelwood consumed per year by **40** brick factories in Cambodia, corresponding to **750 ha** per year

- Demand from small and medium-size industries in Cambodia is a threat to a sustainable forest management
- Supply from old rubber plantations is almost exhausted, industries are using other types of wood and biomass energy fuels (especially rice husks)
- Improved machinery (e.g. boilers for ironing in the garment industry) could be employed to increase the overall energy efficiency of the industrial processes and reduce the demand for fuelwood
- Other potential measures comprise the reutilization of industrial waste

Source: GERES Cambodia analysis, UNDP 2010, IFC study

2015

Sustainable balance supply–demand of biomass: the case study of garment and brick factories



POLICY FRAMEWORK

LEGAL, TECHNICAL AND SOCIO-ECONOMIC CONSTRAINTS

- Lack of technical knowledge
- Lack of technical specifications, no energy efficiency standards for stoves made in Cambodia and for products entering Cambodia
- Lack of precision of current data
- Lack of financial resources for small and medium local companies and absence of affordable borrowing schemes (rather high interest rates from local banks up to 9.5% per year)
- Lack of financial/tax incentives for improved machinery
- Low level of awareness on the potential of energy efficiency

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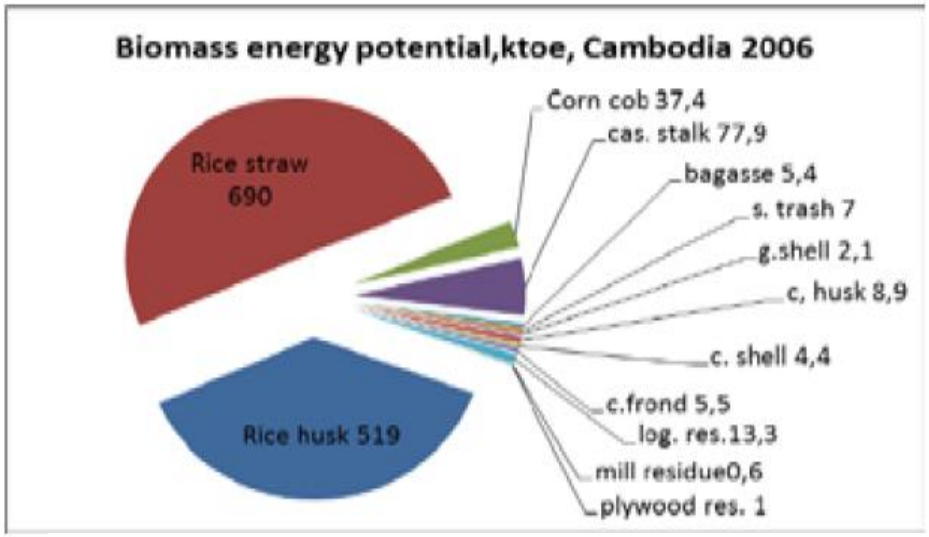
Wood/Biomass energy value chain in Cambodia: alternative sourcing

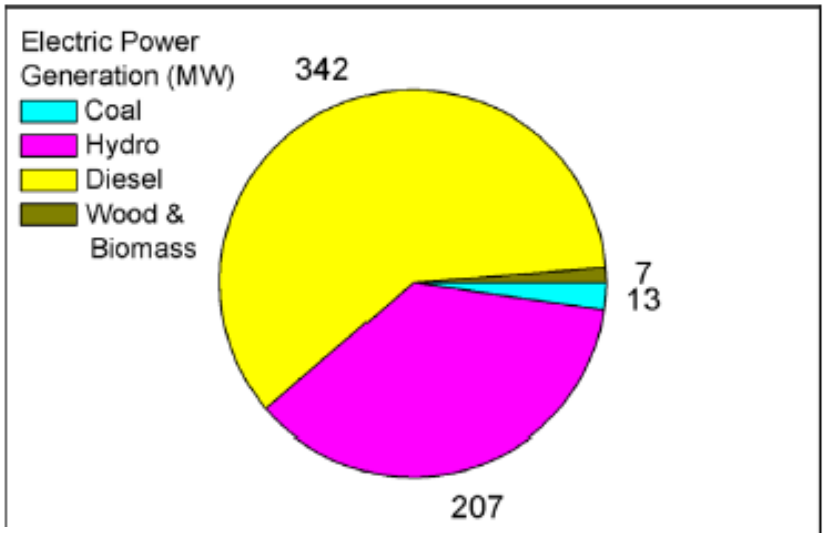
Alternative Resources: Biomass

Biomass Resources:

- **Rice husk**
- Cashew nuts shell
- Other agricultural residues
- Old rubber tree
- Woody biomass from forests
- Plantations
- Tree farming
- Community forestry

Biomass Potential: Rice straw and rice husk



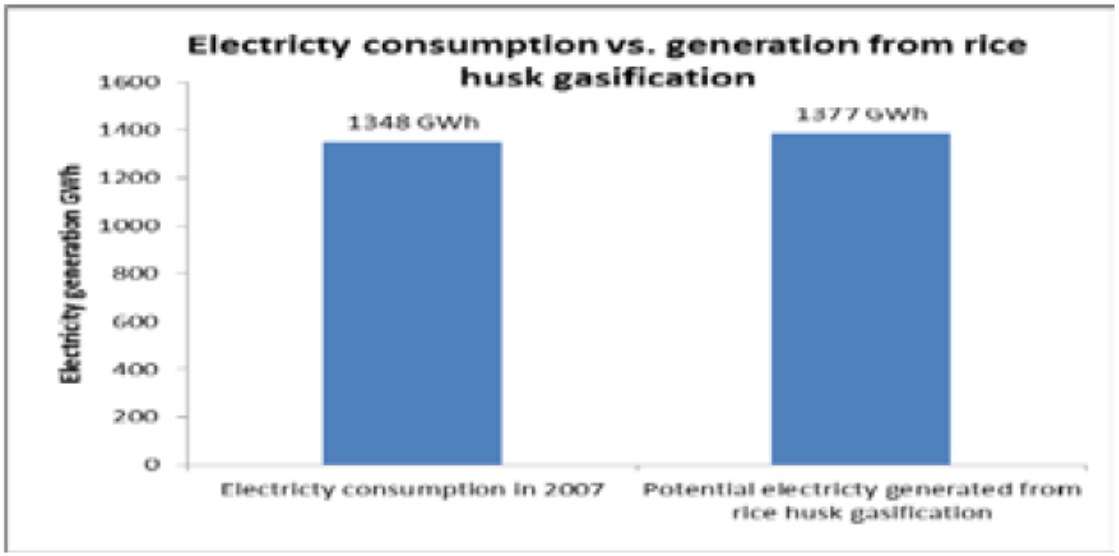


Energy sources	Technical potential	
	(GW h/year)	MW
Hydropower	37,668	300
Biomass	18,852	2000
Solar	65	
Wind	3,665	420
Other (Industrial energy and residential energy)	547+6591	
Total	67,388	2720

In 2012, only 17 MW are under current utility

Biomass potential: rice husk

	Rice (Mt)	Rice Residue	RPR	Residue (Mt)	LHV (MJ/kg)	Potential Energy (10^6GJ)
Cambodia	6.73	Husk	0.27	1.82	12.85	23.35



Rice Husk Biomass Power Plants in Cambodia

- Ankur gasifiers, Cambodia: Approximately 35 Ankur Scientific Ltd. (India) gasification units had been installed in rice mills and ice-making factories in Cambodia till 2010.
- SME RE gasifier
- Batt Daeng Electrification Company, Kampoung Speu province
- Golden Rice Company Limited, Cambodia
- Angkor Kasekam Roongroeung Company Limited, Kandal province
- BVB Investment Ltd., Phnom Penh
- Vinh Cheang Rice Company
- Biomass-generated electricity plant in Battambang
- 100 kW Rice husk-fired system in Thma Koul district, Battambang province
- 1 MW Rice husk-fired power generation plant in Battambang
- Charchouk Commune, Angkorchum district, Siem Reap province
- SOMA group

Thank You

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