

**Desk Study**  
**on**  
**National Woodfuels and Wood Energy Information Analysis**  
**CAMBODIA**

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## **I)- Introduction**

Cambodia is a country of 181,035 kilometre square populated by about 11 million people, and growing at annual rate of 2.4 %. The majority of the population 85 % is located in rural areas. Agriculture reportedly employs the largest proportion, followed by wholesale and especially retail trade, services, construction and manufacturing. The country is rich in natural resource, of which forest serves as one of the importance resources in supplying wood fuels, timber and other forest products.

The country faces growing need for energy service to support the economic growth and social development of the growing population. The per capita energy consumption is lower compared to developed countries, but high consumption of biomass.

Cambodia relies for its all energy needs on two primary sources; Biomass comprising wood 82 % Charcoal 1.2 %, other biomass 1.7 % and imported petroleum product. The most recent national energy supply balance indicates traditional fuels contribute 85 % of the national energy supply, of which 80 % is firewood and charcoal. Wood fuels remaining the dominant sources of energy for cooking within the domestic sector and are used extensively by industry and services, as well as the expanding informal sector.

Economic growth is expected to lead to an increasing demand for conventional fuels such as LPG and electricity. However, whilst a higher consumption of LPG has been used to complement wood fuels. Such energy transition is limited by financial and spatial constrains, leaving the majority of the country's population reliant on wood fuels. Combine with rapid population growth, demand for wood energy unlikely to decline in the foreseeable future.

The production of firewood and charcoal as sources of rural income in basically a reflection of the increasing trend towards the commercialisation of the products. This applies particularly in urban areas and areas where there is a high concentration of demand for those fuels by industry and small enterprises. It is known that, in some areas, processing, trade and distribution of firewood and charcoal contribute considerably to rural income of people who otherwise have few other alternatives for income generation.

## **II)- Energy Consumption**

There is no proper study or database about energy consumption for Cambodia. There were several studies about energy consumption and supply, but those studies are usually only area or sectoral base with less quality of the data and information.

The most comprehensive study by Energy Department, Ministry of Industry, Mines and Energy in 1994-95 show the following findings:

- The national energy balance show that 94 % of fuel wood is used directly as fuel and 6 % converted to charcoal.
- Almost all fuel wood supply is used by household.
- Almost 100 % of rural households rely on fuel wood for their cooking and agricultural processing needs.
- 84 % of Phnom Penh households use either firewood or charcoal for cooking.
- 90 % of total fuel wood supply are consume directly in rural areas by households, and 8 % in other urban households.

- Of the 6.2 % of wood converted to charcoal, 90 is used by households with Phnom Penh households consuming 65 % of the total supply.
- Industry (mostly small industries: brick factories) use less than 1 % of firewood and 0.1 % of charcoal supplies.
- Service sector consumes negligible amount of firewood and only 9.7 % of charcoal supply equivalent to 1.5 % of total wood energy supplies.
- 90 % of wood energy is consumed by households.
- Industry is only a very small consumer of wood fuel, less than 1 %.
- Service sector mainly consumes charcoal, but represents less than 1 % of fuel wood supply.

However, the above finding need to be qualified since it is based on 1994-1995 survey, but unlikely the rural situation will not change much. The Department of Energy also tried to estimate the energy demand for the period from 1994 to 2010 as shown in the table below.

Table 1: National Energy Demand 1994-2010 ( Terajoules)

	1994	1995	2000	2005	2010
Households	81530	81395	93819	108240	110608
Wood	77329	77329	88985	102546	104730
Charcoal	935	935	1050	1179	1135
Kerosene	1046	879	1263	1468	1512
LPG	35	57	222	416	546
Diesel	80	176	93	106	107
Electricity	352	378	607	967	1229
Other	1754	1642	1600	1559	1351
Service Sector	918	989	1420	2104	3189
Wood	23	23	10	5	3
Charcoal	149	149	1432	152	165
Kerosene	278	233	415	614	918
LPG	69	113	199	313	504
Diesel	33	80	50	75	114
Electricity	367	391	605	945	1486
Industry	405	405	681	1096	1764
Wood	370	370	622	1001	1611
Charcoal	13	13	22	36	58
Diesel	22	22	37	59	95
Fuel Oil	63	63	101	157	248
Electricity	58	57	96	154	247
Transport	11174	11674	17988	26712	36188
Gasoline	6002	6089	10765	15288	20284
Diesel	4445	5116	7341	10299	14468
Jet fuel	725	468	881	1125	14352
Fuel oil	2	1	1	1	1
Total	94148	94583	115104	138463	152244
Wood	77721	77721	89616	103552	106344
Charcoal	1097	1097	1213	1367	1357
Other biomass	1754	1642	1600	1559	1351
LPG	103	170	421	729	1050
Kerosene	1323	1112	1678	2081	2430
Jet fuel	725	468	881	1125	1435
Gasoline	6002	6089	10765	15288	20284
Diesel	4580	5393	7521	10539	14783
Fuel oil	65	64	102	158	249
Electricity	777	824	1308	2066	2962

Source: Energy Department, Ministry of industry, Mines and Energy (MIME)

The above energy demand table indicates that demand for wood energy will continue to increase, although its proportion to the total use of energy is reduced.

Table 2: National Energy Supply (1995-1999)

Type	1995 (Tj)	1997 (ton)	1998 (ton)	1999 (ton)
Wood fuel	77721			
Other biomass	1624			
Dung	18			
Charcoal	197			
Electricity	827			
Jet	468	12,826	8,599	11,671
Gasoline	6089	147,970	133,587	149,990
DO	5401	293,245	384,378	355,635
KO	1112	41,060	29,916	37,116
FO	65	35,093	53,345	72,509
LO		8,364	4,374	8,879
LPG	170	2,301	8,655	10,415
<b>Total</b>	<b>94591</b>	<b>540,859</b>	<b>622,854</b>	<b>646,215</b>

Source: MIME, Energy Department & Cambodia National Petroleum Authority.

### III)-Wood Energy Consumption

Wood energy is used by households, industries, commercial enterprises and institutions, mostly in rural areas but also in urban areas. With increasing rural populations and the limited incidence of large net shifts to conventional fuels, such as kerosene and LPG, wood energy consumption will continue to increase in the foreseeable future. Generally, woodfuels are consumed by direct combustion in their primary form after drying and resizing, or in the form of charcoal. However, policies affecting wood energy are few, and its importance is barely recognised within national plans and policies and as a result there is a lack of data and information about wood energy.

Some efforts have been made in the past in the Ministry of Industry Mines and Energy in cooperation with other institutions concerned. The table below is an extraction from the energy balance showing wood energy demand for 1994 and based on that projected for the demand of the preceding years.

Table 3: Wood Energy Consumption by Sector (1994-2010 in PJ)

	1994	1995	2000	2005	2010
<b>Households</b>	<b>81.53</b>	<b>81.39</b>	<b>93.81</b>	<b>108.24</b>	<b>110.601</b>
Wood	77.33	77.33	88.98	102.55	104.73
Charcoal	0.94	0.93	1.05	1.179	1.135
<b>Service Sector</b>	<b>0.92</b>	<b>0.99</b>	<b>1.42</b>	<b>2.10</b>	<b>3.10</b>
Wood	0.23	0.23	0.10	0.05	0.03
Charcoal	0.15	0.15	1.43	152	0.165
<b>Industry</b>	<b>0.40</b>	<b>0.41</b>	<b>0.68</b>	<b>1.10</b>	<b>1.76</b>
Wood	0.37	0.37	0.62	1.00	1.61
Charcoal	0.01	0.01	0.22	0.36	0.58
<b>Total</b>	<b>94.19</b>	<b>94.58</b>	<b>115.10</b>	<b>138.46</b>	<b>152.24</b>
Wood	77.72	77.72	89.62	103.55	106.34
Charcoal	1.10	1.10	1.21	1.37	1.36
Other biomass	1.75	1.64	1.60	1.56	1.35

Source: MIME, Department of Energy Technique.

The above energy demand table indicates that demand for wood energy will continue to increase, although its proportion to the total use of energy is reduced.

Table 4: Wood Energy Consumption from FAOP sources (1994-1998), (PJ&CUM)

Year		1994	1995	1996	1997	1998
<b>Woodfuel</b>	PJ	64	65	67	68	70
	CUM	6,351	6,518	6,680	6,638	6,968
<b>Charcoal</b>	PJ	0.31	0.31	0.31	0.31	0.31

### **Households**

As already stated in section above, household sector is the main energy consumer and in Cambodia. It is also the largest consumer of wood energy. The share of woodfuels in total household energy is over 90%. When other biomass fuels are included the figures are considerably higher. The main end uses are cooking, water heating and space heating. The share of wood energy in total energy used for cooking is generally high, with percentages of over 90% (Strengthening Energy Planning in the Department of Energy, October, 1996).

The devices used by households, such as cookstoves and ovens, are generally simple. They are made from locally available materials, and are of poor quality (smoky and inconvenient). Efficiencies are low, because a lot of the heat is lost to the environment and due to incomplete combustion.

Although fuel substitution takes places at household level, total woodfuels consumption by households continues to increase, mainly due to population growth. This trend is likely to continue in the foreseeable future.

### **Industries and Services**

Fuelwood, charcoal and other biomass fuels are used by industries (e.g. brick making, lime production, food industries etc), and by the services sector (e.g. restaurants, hotels, hospitals, schools and roadside/ambulant food vendors). When compared with the domestic sector, woodfuels use by industries and services appears small but nonetheless significant about 1-2 %. Most of them operate informally, i.e. without registration and they mostly purchase their woodfuels.

Woodfuels-using industries contribute significantly to income generation and socio-economic development in rural areas. However, the processing technology and the energy conversion devices are generally poor and inefficient, which means that there is a large scope for energy conservation.

The use of woodfuels and other biomass fuels by industries and services depends on the price and supply reliability of these fuels relative to conventional fuels, as well as other considerations. Many industries and services will continue to use wood and biomass fuels as long as these fuels are competitive and their supply is secure.

### **IV)-Wood Energy Supply**

Wood fuels in Cambodia originate from a variety of sources, including natural forests, agricultural land, land conversion, land around houses, along canals, roads and railways, as wastes from the timber industry, and wood recycled from construction, packing etc. However, stock and yield tables for different land types are unavailable, and therefore

difficult to determine how much wood is available for energy from forest areas, and likewise from non-forest areas. The last forest inventory was conducted in 1969, at which time 73 % of the total land area was classified as forest.

More recent information from MRC/GTZ (1997) classifies 58.6 % of the total land area as forest, and is adopted by the Department of Forestry. There is a wide difference in forest cover between and within the provinces, leading to wood surplus in some areas, and deficit in others. The Department of Forestry calculated that (Hong, 1997) 6 million cubic metres per year are supplied to households to satisfy their cooking requirements, of which half comes from forest areas. The large forest coverage area of Cambodia suggesting very large amount of wood energy for energy sources.

Table 5: Land Areas by Type of Land Use in 1996-1997

<b>Wood Land Use</b>	Area (ha)
Evergreen dense	625177
Evergreen disturbed	3183395
Evergreen mosaic	178,147
Mixed dense	95560
Mixed disturbed	1284446
Mixed mosaic	125320
Deciduous	3931219
Deciduous mosaic	350178
Forest regrowth	374197
Inundated forest regrowth	20819
Inundated forest	219906
mangrove forest	72835
Forest plantation	82425
Inundated forest mosaic	94582
<b>Total</b>	<b>10638209</b>
<b>Non-wood land use</b>	
Wood / Shrub land evergreen	545101
Grass land	488643
Bamboo	33730
Wood / Shrub land dry	1165377
Wood / Shrub land inundated	348971
Mosaic of cropping (< 30 %)	285155
Mosaic of cropping (> 30 %)	143796
Agricultural land	3901869
Barren land	18136
Rocks	2149
Urban / Build-over areas	27615
Water	469138
Other	1756
Wet land	83340
Cloud	0
<b>Total</b>	<b>7514776</b>
<b>Grand Total</b>	<b>18152985</b>

Source: Forest management office/FCMP MRC/GTZ, Department of forestry.

The share of woodfuels coming from non-forest areas is substantial. The ratio between woodfuels originating from forests and non-forest lands is generally not known. Typically, non-commercial sources of woodfuels are located near the end-users, and commercial sources within located far from the market. Stock and yield table for different land types are unavailable, and it is therefore difficult to determine how much wood is available for energy from those resources.

Non-industrial tree plantations and private and community woodlots, including scattered or linear tree plantations on privately owned or community managed lands, have contributed significantly to the supply of wood in recent years. At present tree planting programs under social or community forestry development and non-industrial tree plantations of commercial importance have started to play a great role.

The impact of wood fuel collection on the local resources base relates to its richness, and the land ownership or land use rights of the communities. Where households own land around their homes, they have an incentive to cut firewood on sustainable basis, and to invest in multiple-use tree planting on their land. All forest-land is owned by the State, with no community participation in management, resulting in a lack of incentive for local communities to cut and use wood gathered in the forest in a sustainable manner. Land ownership or land use rights are reflected in the harvesting methods, for example, for local use it is likely that twigs, dead branches and prunings are collected from around the house, whilst to supply markets, often the whole tree is cut from the forest and sold as wood fuel. In the areas of high wood fuel production, the trees are cut during conversion from forest to agriculture or settlement land.

Secondary sources of woodfuels are residues from logging and wood processing industries, but also recycled wood from construction activities, packing crates, pallets, driftwood, discarded furniture etc. However, within Cambodia it is not known how much wastes from those activities is accessible for wood fuel. Estimates within the region indicate that 80 % of trees in the forest are wastes during the production of sawn wood (RWEDP 1997), and half of this amount is left in the forest as branches and stumps, with the remainder lost during processing. Within urban areas, old construction wood, pallets and packing crates, furniture, etc, are recycled for wood fuel.

In general, wood fuel can be collected in all provinces of Cambodia, although the richness of wood fuel are different. Among the high production provinces, Kampong Speu, Kratie, Kampong Chhnang, Kampong Thom, and Pursat are considered to be the main areas for supplying wood fuel, especially for Phnom Penh. Woodfuel Flow Study in 1998 estimated that 216,250 stere ( or 216,259 CUM of stacked wood) of firewood and 10,536 tons of charcoal are produced in these provinces. However, it is believed that this figure are likely to be lower than the actual amounts as it was calculated from the study areas only.



Table 6: Forest Areas by Province (1996/97)

Province	Forest		Non-Forest		Total (ha)
	(ha)	%	(ha)	%	
Battambang	581,349	46.71	663,272	53.29	1,244,621
Bantay MeanChay	175,122	26.08	496,354	73.92	671,476
Kandal	20,890	5.85	336,222	94.15	357,112
Kampong Cham	265,174	28.14	672,292	71.86	942,466
Kampong Chhnang	172,305	32.57	356,790	67.43	529,095
Kampong Speu	339,147	49.74	342,626	50.26	681,773
Kampong Thom	633,898	50.93	610,849	49.07	1,244,748
Kampot	233,292	49.74	1,1431	50.21	468,582
Krong Kep	3,273	22.26	190,079	77.74	14,704
Koh Kong	1,048,454	84.65	292,987	15.38	1,238,532
Kratie	904,291	75.53	826,444	24.47	1,197,278
Mondulhiri	2,934,496	78.03	36,195	21.97	3,760,940
Phnom Penh	1,118	3.00	473,946	97.00	37,313
Prey Veng	7,607	1.58	352,077	98.42	481,553
Pursat	807,597	69.64	159,452	30.06	1,159,674
Preah vihear	1,242,088	88.62	204,392	11.38	1,401,540
Ratanakiri	985,339	82.82	280,985	17.18	1,189,730
Svay Rieng	4,641	1.62	53,187	98.38	285,626
Sihanoukville	85,937	61.77	600,271	38.23	134,125
Siem reap	596,120	49.83	134,259	50.17	1,196,390
Stung Streng	1,055,410	88.71	134,259	11.29	1,189,669
Takeo	5,218	1.49	344,171	98.51	349,389
Oudor Meanchey	340,858	66.66	170,491	33.34	511,349
Beung Tonle sap	3,165	1.24	251,688	98.76	254,854
Total					

The Department of Forestry recognised the ongoing demand for wood energy. The areas devote to firewood coupes in some provinces between 1994 to 1997 is shown in table below.

The strengths of the firewood coupe system were best illustrated before 1970, when the Department of Forestry, in cooperation with enterprises, operated under formal agreements to provide a sustainable supply of wood energy to Phnom Penh. Today the coupe areas are illegally encroached upon by the local communities and armed forces, and non of the firewood coupes have been sold. anarchic cutting allows lower price in the markets and firewood coupes can not compete with the freely exploited wood energy. Today, the Department experiences great difficulties in regulating the forest areas due to illegal cutting.

Recently, due to high transportation cost and legal constraints, it restricts the access to the resources and thereby reduce the amount available for woodfuels supply, and as a result the price of wood fuel in consumption areas ,especially in Phnom Penh is now higher.

There are initiatives, recently by various institutions to establish community forestry as a means to manage the forest in a sustainable ways, and to meet the demand of wood fuel and local construction material.

Table 7: Firewood Coupes in Some Provinces (1994-1997)

Year	Province	Total Hectares	Total steres	Amount of Trees
1994	Kampong Thom			
	Pursat			
	Battambang			
	Kampong Speu			
	Kratie			
	Sihanoukville			
	Koh Kong			
1995		20590	158363	106500
	Kratie			
	Kampong Chhnang			
	Pursat			
	Battambang			
	Koh Kong			
1996		15498	151443	59800
	Kampogn chhnang			
	Pursat			
	Kratie			
	Koh Kong			
1997		14498	146443	93095
	Kampong Chhnang			
	Pursat			
	Kratie			
	Kph Kong			
		15498	152943	43000

Source: Department of Forestry

In the Global Forest Resources Assessment report FRA 2000 estimates that natural forest area of Cambodia is 9,245,000 ha, and forest plantation is 90,000 ha.

#### **V)- Wood Energy Transport, Trading and Marketing**

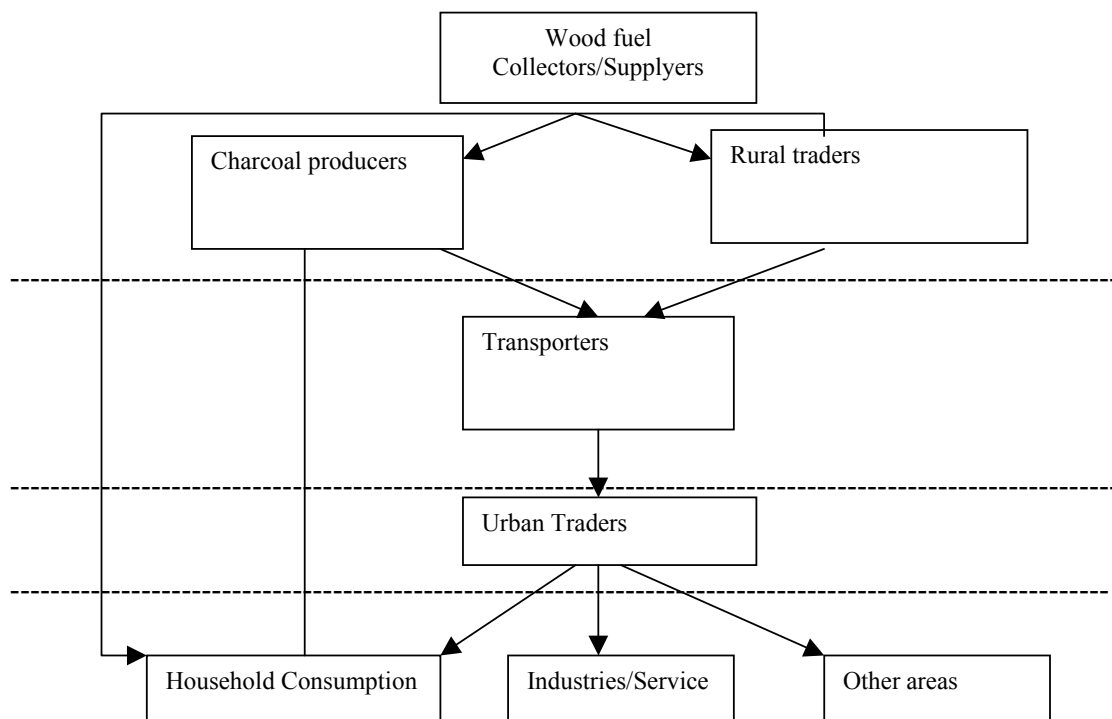
The marketing and distribution system for wood fuel is more applicable to urban than rural users. Generally within rural areas, firewood is collected freely by individual families, where within urban areas, especially Phnom Penh which is the major center of wood fuel trading in the country, they are obtained through commercial markets. The transport of wood fuels, like other forest products, is restricted by the limited markets and infrastructure.

Woofuel flow study of Phnom Penh (1998) found the following situations:

- Annual supply of firewood to Phnom Penh is about 110,818 stere (or 110,818 CUM of stacked wood) and 16,938 tons of charcoal.
- Within the supply areas, firewood collectors cut wood from areas undergoing agricultural conversion, or from forest areas. Firewood is also supplied as off-cuts from sawmills. Some firewood collectors also make charcoal on small scale, whilst

other sell to larger scale charcoal producers, or enter firewood directly in to the distribution system. Charcoal is produce either close to the forest, or around the village in small earthen kilns, or large brick build kilns. Most firewood collectors and charcoal producers trade independently, selling to traders or transporters along the roadside or railway line. Some place river transport by boats also can transport large amounts of wood fuel to Phnom Penh, whose owners act as middle-men. The transportation of wood fuel act as the link between the suppliers and consumers. Generally, the transporters are from the supply areas, but some urban traders buy directly from the suppliers.

- Firewood is split and bundled within the urban areas to the request of the customers, and charcoal is usually sold the consumers in small quantities, or in bulk. Larger industrial users such as brick and tile kilns purchase their firewood as off-cut from sawmills, or directly from suppliers in the supply areas. It is difficult to differentiate between wholesalers and retailers as they have a lot of the same characteristics, but usually one who buy and sell in quantities of 5,000 to 50,000 bundles of firewood and 50 to 200 sacks of charcoal is called wholesaler, and one who buy or sell from 500-200 bundles of firewood and 1-10 sacks of charcoal is called retailer.
- Price of firewood and charcoal increase as they move through the distribution system, as it is added to cover expenditure at each level of trader. Price differ in the wet and dry season, with lower price in the dry season. Within the market system, price also very according to whether the trader is a transporters, wholesaler, or retailer, and therefore, reflects the number of traders the wood fuel has pass through. It is also very according to the distance of transportation, species of firewood, or quality of charcoal.



## **VI)- Impact of Woodfuels on Forestry**

Wood energy falls within the scope of the Department of Energy and Forestry, but also influences and is influenced by other sectors and sub-sectors. Therefore wood energy policies and plans require a multi-sectoral approach. It is a complex issue, dynamic and must therefore be an interactive and on-going process.

The Department of Forestry is striving to manage and develop the country's forest on a sustained-yield basis. Forest management is addressed through concession management, reforestation and firewood coupes. Forest law and policies are currently under review. The context to which wood energy is addressed within these documents is unknown at present.

Forestry reform is central to the future of the country in terms of international support, and the Department of Forestry embarked on a series of measures. Priority areas for reform are concession management and illegal logging, and include a cessation of investment in wood processing, review of forest concession contracts, and a review of forest management law. A forest crime monitoring and reporting project will assist in the implementation of the reforms. The measures have led to a crackdown on illegal cutting, and whilst not intended to effect the supply of wood fuels, it is indirect adversely impacting on aspects of wood fuel supply, trade and use.

The ongoing demand for wood fuel is recognized and firewood for rural use is planned to be met through community forestry/forestry extension programs, a small number of which have already been successfully established on a small-scale in some areas of the country. Whilst urban/commercial demand will be met through an improved firewood coupe system, which will require a thorough review. In the past the system has proven to be unfeasible, as the costs incurred by the operators mean that woodfuels from such areas are not competitive in markets supplied with freely exploited wood.

## **VII)-Impact of Wood Fuel on Energy**

Energy policy remains in its 1995 form. The principle objectives cover the provision of adequate supply of low cost energy for homes throughout Cambodia, and the supply of energy to all sectors of the Cambodian economy, whilst minimizing environment effects. Focus continues to be directed towards electricity development, reflecting the importance of economic growth within national policy. Electricity supplies are concentrated in urban areas, there are no proper rural electricity services at the moment, although plans are in place for rural electrification.

As all conventional energy is imported, energy policy of the government seems to encourage the development of renewable, indigenous energy supply systems. However, recent efforts of renewable energy development seem to have been focused mainly on hydro and solar energy, although wood energy is renewable, and provides the most important energy source for the majority of the population within Cambodia, and the largest share of the total consumed and supply mix of the national energy. The improvement of energy efficiency is an objective of the Department of Energy, although to date, this has focused on increasing the efficiency of the electric lighting in factories and hotels in Phnom Penh.

Some other efforts by other institutions and organizations have also been made to improve the efficiency of the stove for cooking by household, but those activities seem to be moving very slowly due to many reasons.

### **VIII)-Socio-Economic Importance of Woodfuels production, Utilization and Trade**

As already stated in the introduction section above, the production of firewood and charcoal is also part of sources of income for some of the Cambodian people. This applies particularly in urban areas and areas where there is a high concentration of demand for those fuels by industry and small enterprises. The main users of woodfuels in enterprises and industry sectors are brick maker and food industries. It is also known that, in some areas, processing, trade and distribution of firewood and charcoal contribute considerably to rural income of people who otherwise have few other alternatives for income generation.

For many people involved in the collection, distribution and trade of wood fuels, this occupation represents the largest parts, if not all of their income, particularly for those in rural areas, where alternate income-generating opportunities are few, and the majority of the people have no other skills or experience. However, the number of people involved in the trade is unknown due to informality of the systems, although it is expected to be high.

Moreover, the production of wood fuels harvested from agro-forestry areas, trees in croplands and fruit orchards have also contributed considerably to total production from their agricultural activities, although there is no exact figure to show how much it can contribute. Furthermore, if woodfuels can substitute the use of imported petroleum fuels by main industries or enterprise, although the figure can not be estimated for the time being, but it is believed to be quite big amount foreign exchange that Cambodia can save (total imported petroleum fuels in 1999 is 646,215 tons).

### **IX)-Environmental and Health Impacts of Woodfuels Production**

National development is expected to impact on the environment, recognized by the Royal Government through its commitment to ensure that the pattern of development is sustainable socially, politically, fiscally and environmentally and to optimize the sustainable utilization of the natural resource based (RGC 1994). Therefore environmental sustainability is an overarching aspect in achieving policy objectives, and should be integrated into sectoral development plans. Environmental impact assessment is required for all development projects in Cambodia, but the Ministry of Environment is reliant on cooperation from other government departments and organizations to undertake this task. Environmental Units are established within some government ministries, which will develop cross-sectoral programmes for natural resource management.

There is no evidence of studies to the environment implications of energy systems having been conducted in Cambodia. However, the Ministry of Environment is currently preparing an inventory of greenhouse gas emission as part of its Climate Change Project, and in preparation for the country's first National Communication in response to the UNFCCC. Concerns related to the impacts of future conventional energy production focuses on hydropower, and its potential to disturb the country's unique hydrological system, which controls flooding and irrigation in the country, and is central to the agricultural sector within the national economy.

Asia Regional Cookstove Program (ARECOP, Vol.22-November 200) estimated that total GHG emissions from the biofuels and fossils in Cambodia are 1,322 GG Carbon or 55 % of total fuel emission from biofuels, and 1,068 GG carbons or 45 % of total fuel emission.

The benefits of wood fuel production systems include savings made in avoidance or recapture of carbon dioxide from the atmosphere, enhanced agricultural production through soil and watershed preservation, and reclamation of degraded or deforested land. The impacts of wood collection depends on the method of extraction. In the absence of information, it is thought that areas of adverse impact may include those supplying commercial markets, and those of high population density with limited local resources. These would be appropriate areas to commence studies to feed into the process of planning for future energy development.

## **X)-Conclusion and recommendation**

In Cambodia, the Department of Energy and Forestry, and the Ministry of Environment have been working in cooperation to promote the relevance of wood energy development and planning. However, outside this core team, misconception about wood energy abound within forestry and energy planning and management, particularly in relation to deforestation, energy transitions and the value of wood fuels. Such misconceptions emphasize the need for better understanding of wood energy production, trade and use, through training and research, in order to capitalize on the opportunities for development which wood energy presents.

Gaps in current data related to wood energy resources remain due to the lack of inventories. As it is difficult to estimate the amount of wood available for harvesting on sustainable basis, it is also hard to determine the potential amount of wood available for energy and its impacts on the environment. Whilst such information is essential for forest management, it is evident that a large amount of wood fuel is consumed on annual basis. However, wood fuels clearly originate from sources other than forests, and the importance of non-forest sources in supplying wood fuels must be recognised by policy makers and planners.

Agro-residues form an important source of energy in some area of the country. It is therefore, important for the Ministry of Agriculture to develop an overview of potential supply and the different demands on that supply in order to assess the availability of residues for energy.

It is important for Technical Energy Department of the Ministry of Industry, Mines and Energy, who responsible for the development of all kind of energy, and especially for the demand side of the wood energy to manage all related consumption data for better wood energy planning.

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**Note:** The Tables above also available in the Excel Worksheet.