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# Energy conversion in Bamako (Mali): the request of flexibility

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L. Gazull, CIRAD

Campus international de Baillarguet, TA10/D, 34398 Montpellier Cedex 5, France.

Tel : 33 4 67 59 37 25, Fax 33 4 67 59 37 33.

email : laurent.gazull@cirad.fr

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## Summary

Since the mid -1970s, Sahelian countries are involved in energy policies which aim to substitute traditional energies (wood and charcoal) to modern fuels derived from petroleum.

In Bamako (Mali), as in Ouagadougou (Burkina Faso) or N'Djamena (Chad), in spite of political incentives by governments in favour of fossil fuels, urban dwellers progress very slowly on the "energy ladder". Woodfuels are still the most preferred energy sources. This paper analyses the reasons of this conversion failure in the Malian capital, focusing on the preferences of the Bamakois, the incentives from the Malian government, and finally the resistance of the woodfuel market.

Experience with Household Energy Policies in Mali shows that economic realism and government incentives will not persuade people to accept new fuels or new stoves. It shows also that woodfuel supply chains are alive and can react very quickly to any attempt of changes, to remain in force, and to offer urban dwellers a good energy service in terms of access and prices. Finally the analysis of Bamako's case shows that the choice of an energy portfolio is more important than a single efficient, modern and cheap source. In spite of the equivalent cost for using gas and charcoal, the more well-off people in Bamako continue to prefer woody fuels. This consumption pattern gives the people of Bamako an energy independence, which allows them not to be subjected too severely neither to marked rises in petroleum prices, nor to supply interruption.

The freedom of choice is an amplified demand in urban area where the diversity in the rhythms of life and the large range of buyable foods involve the diversity of cooking habits. The request of flexibility is certainly one the reason of the failure of most conversion programmes.

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## Key-Words

Africa, Mali, woodfuels, energy ladder, energy conversion, consumer choice

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## Introduction

Since the mid-1970s, Domestic Energy Projects (DEP)<sup>1</sup> have been major components of the national energy policies of West African countries. These programs initiated by UNDP and the World Bank aimed at reducing woodfuels consumption and at substituting more efficient fossil fuels (LPG, kerosene). These modern sources of energy were supposed to improve the quality of life of urban dwellers, to alleviate their energy expenditures and to alleviate the pressure on natural forest resources (ESMAP, 2001). At the opposite, the use of woodfuels was considered as negative by most international development organizations. For the International Energy Agency (IEA), such wood energy is not only a demonstration of poverty, but is also considered as an obstacle to economic and social development, causing ecological degradation, as well as being a source of respiratory diseases (IEA, 2002; DFID, 2002).

In the 1980s, considering in one hand, the rapid growth of rural and urban populations, and in the other hand, the low capacity of forest regeneration, many studies announced that sahelian big towns would have to face, in the early 2000s, deep woodfuel shortages (Barnes, 1990; Eckholm, 1975).

This is not to deny that there are growing shortages problems in some parts of sub-Saharan Africa, but in 2009, while the urban demand grows with the development of West African cities, no crisis has been observed yet which is likely to change the practices of consumption of urban dwellers. In Bamako (Mali), as in Ouagadougou (Burkina Faso), Niamey (Niger) or N'Djamena (Chad), in spite of political incentives by governments in favor of fossil fuels, urban dwellers progress very slowly on the "energy ladder". Woodfuels are still the most preferred energy sources.

This paper analyses the reasons of this conversion failure in the Malian capital, focusing on the domestic energy policy of the Malian government, the preferences of the Bamakois, and finally the economic weight of woodfuel trade. The conversion process is analyzed as the result of three driving forces:

- The energy policies and incentives: to change energy patterns, most of domestic energy policies aim at increasing the relative price of woodfuels (via taxation and/or subsidies for other fuels). We will analyze the effects of such policies.
- The choice of urban consumers: the consumer preference is commonly presented as the main driving force of the conversion process. Choosing an energy source is a multidimensional choice. It not only depends on cost considerations, but also on

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<sup>1</sup> Household Energy Project, in Mali (1991 - 2001); Domestic Energy Project in Niger (1991 - 1999); ....

physical access to sending points, food tastes, cooking method, safety reasons, etc.... The paper analyses all these dimensions and compares the woodfuel offer to other fuel offers.

- The resistance of the urban merchants. If the consumer choice is often highlighted as the main point in the conversion process (Leach, 1987), we can't neglect that wood energy, the "tangible sign of poverty", represents an economic sector of primary importance for most of the Sahelian countries. In fact, the general contribution of the wood energy sector to the economy of these countries is at least equal to that of the electricity sector (Amous, 1999; Castillo, 1994). In 2001, in Mali the commerce linked to woody fuels was employing about 450 000 people and represented a turnover of 21 billion CFA francs<sup>2</sup> (Konate, 2001). The woodfuel market with its dynamism and its diversity represents a huge force of resistance to conversion mechanisms.

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## **The domestic energy consumption pattern of Bamako**

For their domestic needs (cooking, water heating), the consumers in Bamako have had for more than 20 years a choice between five types of fuels:

- Firewood in the form of bundles;
- Charcoal sold by the kg, in small bags or sacks;
- Butane gas (LPG), mostly sold in 3 kg or 6 kg containers;
- Kerosene sold by the liter;
- Electricity.

The reference study for the consumption of household fuels in Bamako dates from 1997. This revealed that even in the richer households (executives, businessmen), wood and charcoal were the most used fuels (CED, 1999). The investigations that we carried out in 2004 in a well-off neighborhood have confirmed these previous trends. Contrary to predictions announcing the demise of woodfuels (Matly, 2000), more than 80% of average and rich households continue to use wood and charcoal.

From different investigations concerning households in Bamako, it emerges that (cf. Table 1):

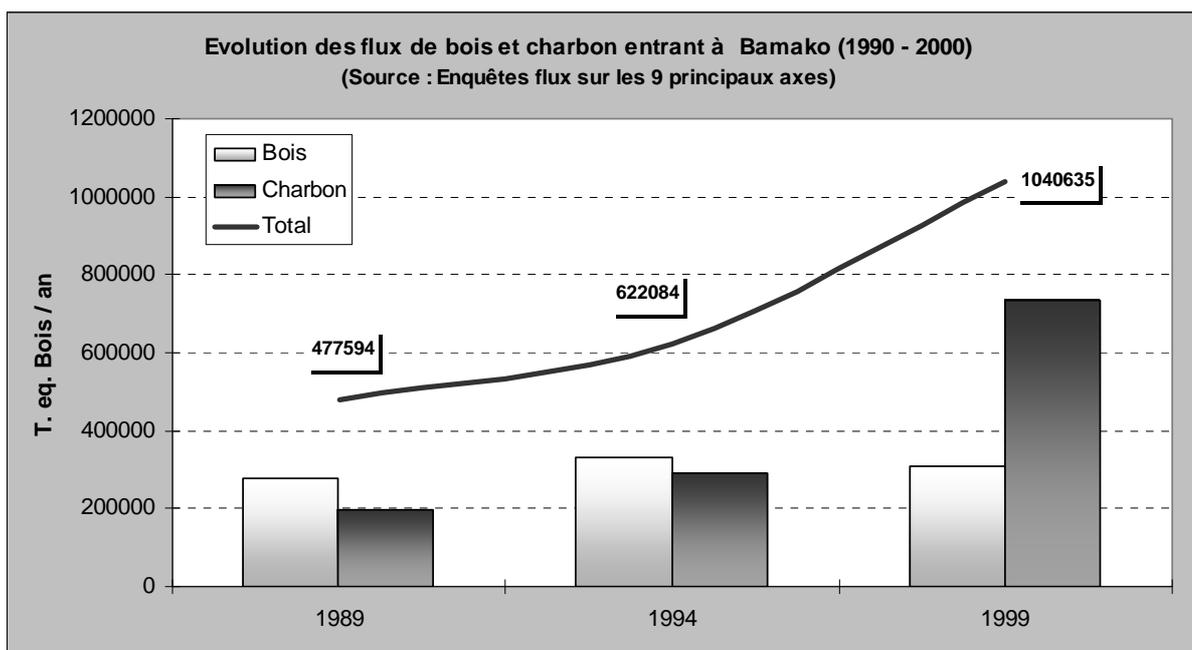
- Charcoal has only ousted wood within the last 10 years. It has become since 1997, the most used fuel for cooking in Bamako. Practically all the households in Bamako use charcoal as the major or secondary fuel.
- Wood has maintained its importance despite the predominance of charcoal and the slight rise of gas that can be linked to the weak economical power of people as well as to their cultural habits.

- Butane gas has shown a marked increase. More than a third of the households in Bamako possess a gas stove and use it regularly. Nevertheless, it remains an additional fuel. LPG serves essentially to prepare the breakfast, to boil water or to heat up a meal already cooked.
- Electricity rarely occurred in the city kitchens.
- Kerosene is almost abandoned for cooking, despite the special offer for kerosene stoves made by the energy state agency that is mainly supported by the World Bank.

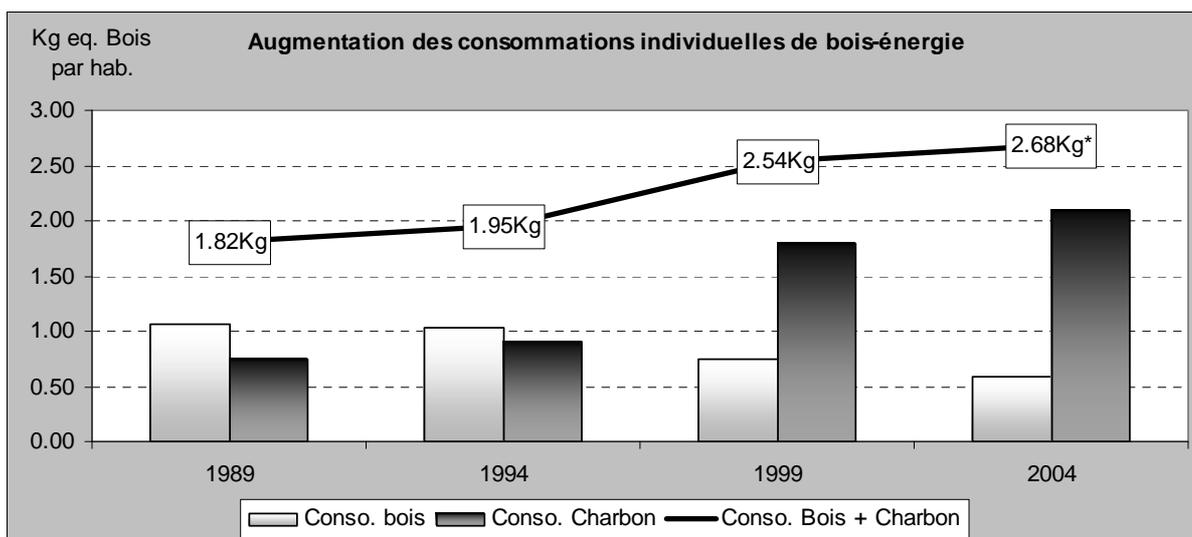
Fuel	1989	1994	1997	2004
Source	ESMAP	CCL/CED	CCL/CED	Authors
Sample size	90 households	168 households	1000 households	50 households
Firewood	89%	89%	54%	63%
Charcoal	67%	80%	73%	86%
Butane Gas	18%	21%	20%	37%
Kerosene	?	?	2%	0%
Electricity	?	?	0.5%	0%

**Table 1.** Evolution of the fuels used by the households in Bamako: charcoal has surpassed wood since 1997.

The woodfuel consumption of Bamako reached in 2000, 1 million tons of wood. For at least 20 years, it has never stopped increasing at the annual rate of 5% (**Figure 1**). Meanwhile, the population has grown at the annual rate of 4%. Thus, in spite of the measures taken by government to encourage people to shift from woodfuel to kerosene or LPG, the individual woodfuel consumption of the Bamakois, has increased during the last 15 years (**Figure 2**).



**Figure 1 :** The consumption of Bamako between 1989 and 1999



**Figure 2 :** The individual consumption of a Bamakois between 1989 and 2004

## The Domestic Energy Policy

At the beginning of 1990s, The World Bank, through its ESMAP Energy Sector Management Assistance Program), helped the Malian government to define a new strategy of development and management of its energy sector. Considering the importance of the household energy sector and the dominance of fuelwood in the energy balance (Fuelwood represented 96% of final energy consumption, this assistance aimed mainly at proposing a coordinate framework of medium and long term policies for the households sector, with the

objective to manage more efficiently national and imported energy resources and to provide better energy service to the urban population (ESMAP 1992).

The proposed strategy addressed, and still addresses, two fundamental objectives for developing the household energy sector:

- (a) at the demand level, improve access to and utilization of energy, pedially “modern” fuels, and thereby improve the daily standard of living for the Malian people;*
- (b) at the supply level revise the means of supplying woodfuels so as to generate Economic development without substantial risk to the environment by establishing Practices for rationally managing forestry resources among the rural communities.*

Since 1994, in urban areas, to promote “modern” energy fuels and to reduce fuelwood consumption, the Malian government has initiated for types of actions :

- (a) Promotion of improved charcoal and firewood stoves
- (b) Subsidy for LPG (Butane Gas)
- (c) Subsidy for gas and kerosene stoves
- (d) Increase of taxes for wood and charcoal

### **Subsidies of petrol and gas importations**

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Since 1989, the Malian State directly grants the importation and the distribution of Butane gas. The amount of this grant, directly paid to private operators, has fluctuated over time. The subsidy stabilized the LPG price at the same level between 1994 and 2005 (320 Fcfa/kg). But with the increase of petrol prices, this amount represents a heavy expense for the Malian government. Since 2002, this amount is regularly paid to operators with more than one year of delay. Thus, this irregularity in the payment caused serious disruption in the supply, resulting sometimes in shortages. For private operators, these fluctuations and the lack of promotion campaigns are the main reasons why people don't substitute for this fuel.

Kerosene isn't directly subsidized but is taxed at a lower rate than the other oil products because it is consumed primarily by low-income groups.

### **Aids for improved stoves**

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At the same time, the Malian State tried to promote the importation and the local making of improved stoves. The means used for this promotion were diverse: direct subsidies, importations aid, direct importation of raw material, ... Fairly quickly, this program stopped because of the complexity of procedures and the small amount of each subsidy. Finally, the Malian government has estimated that savings in time and in wood consumption, supposedly made with improved stoves, should be the best selling points. Mali's distribution

rate for improved stoves is quite high relative to other Sahelian countries. But those stoves are generally not primary stoves used for daily meals. They are considered as auxiliary appliances.

**Wood taxes’ regulation**

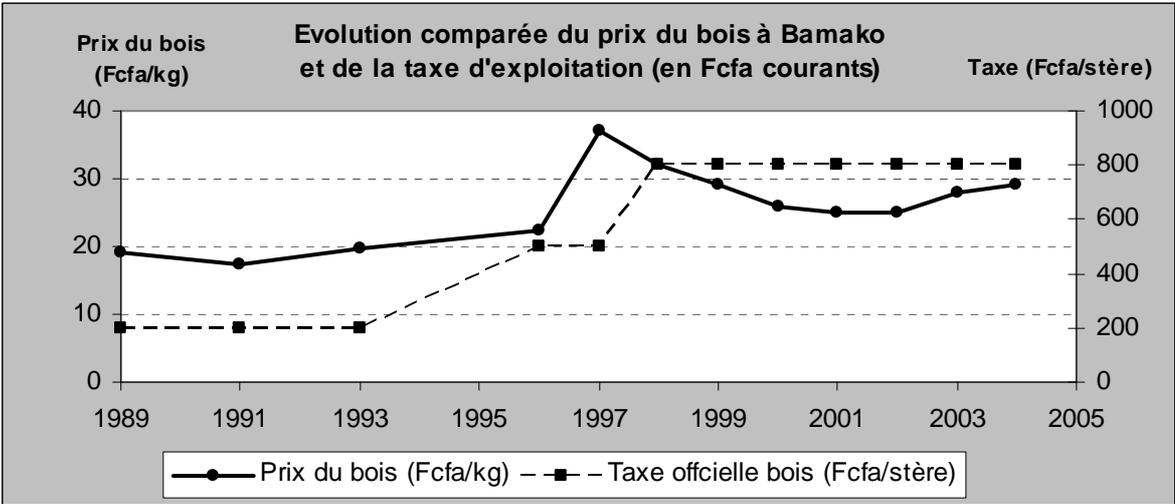
Since 1902, all the Malian regulation system of forestry resources’ management is based on a unique tax paid by producers before logging. One of the underlying principles of the Household Energy Strategy, was that wood retail prices didn’t reflect its real economic value. Thus the Strategy aimed at increasing the fuelwood prices by increasing taxes on wood exploitation. Application of tax for wood and improved monitoring of woodfuel fluxes were expected to cause an increase of 10% to 20% in the urban retail prices of wood and charcoal. We will see further that this effect never occurs.

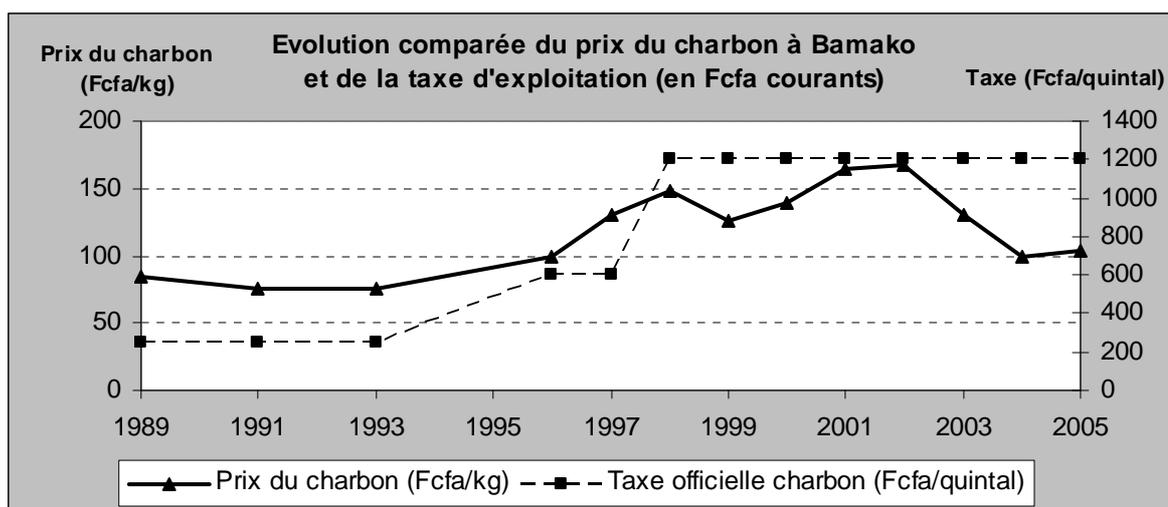
**Figure 3** shows that the increase of the tax wood between 1995 and 1998 caused, at the same time, the increase of retail prices of fuelwood. But after this instantaneous “booster effect”, retail prices slowly recovered their original levels.

Two main factors could explain this progression:

- The first explanation is that urban consumers can’t afford to pay expensive energy. The increase of taxes forced merchants to adopt new strategies to supply the market. As we will see further, the development of the distribution market led to shorter supply chains and to harder competition between traders. These two marked facts alleviated intermediary costs, reduced the merchant margins and finally cut the retail prices;

- The second is that the State has difficulties to monitor the fuelwood market and to collect taxes owed by producers. The official tax is rarely paid and, in practice, the real amount of the exploitation tax is equivalent to the 1995 official tax.





**Figure 3 (a and b):** Compared progression of taxes for fuelwood and fuelwood retail prices

Finally, it appears that all the governmental measures introduced to redirect the demand towards modern fuels and to reduce wood consumption, have difficulties getting success. As we saw above, wood consumption continued to increase and the market penetration of gas or kerosene is unsuccessful. The gas sector is totally supported by government aids, and this market is very fragile. The penetration rate of improved stoves is more or less satisfactory but the replacement of these equipments is very low. Without the aids of the government, the sectors of gas and of improved stoves would fall down.

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## The energy choices of the Bamakois

As described in literature and from our field observations, the factors influencing the choice of an energy source are (Leach, 1987):

- The price of the fuel and more precisely the economic weight energy represents for households. In urban areas, fuels (including woodfuels) are purchased products and utilization costs are major expenses for households. It is particularly significant for the poor where household budget shares for energy can reach 20% of the total amount (Leach, 1987). The cost of energy impact directly the *monetary ease* of households. Energy expenditures impact the number of meals and the quality of food that are consumed by poor households. Meikle and al report that to face the increase of energy costs in Ghana households have reduced the number of meals cooked per day. Poor households have also switched to cheaper, usually less nutritious, food and in extreme cases reduced the amount of food consumed (Meikle and Bannister, 2003).

- The flexibility the pair fuel/stove offers to the cook and its adequacy to cooking habits. Experience with previous stove projects shows that economic realism alone will not persuade people to accept a new stove. People's cooking patterns often lie deep in tradition, and behaviour cannot meet priorities like time saving and energy efficiency. Technology change requires that the stove and its immediate surroundings, as well as the user must be included. The time and energy saving argument has not been strong enough to persuade families to use better stoves;
- The danger or the apprehension of danger. Some energy sources are considered as dangerous by users. These dangers can be due directly to corrupted fuel packaging (old gaz tanks, nude electric wires) or indirectly to poor understanding by the user of the way to use it (risk of open wires or contact with water). But more than the real danger, that's the apprehension of danger which matters. The safety of a fuel is a subjective feeling. When a fuel or a stove isn't well adapted to the traditional culinary activity chain (bad working positions, control of heat, etc..), it is often considered as unreliable and unsafe;
- The air pollution: where traditional fuels are used, which is the case for over the half of the population of the world, kitchen users are exposed to indoor air pollution, with the risk of acute or chronic respiratory diseases, cancers, or carbon monoxide poisoning.

To these established factors, we will also add :

- The physical accessibility to points of sale: to choose among different forms of fuel, consumer must access the different points of sale. Distribution networks are different for each energy source and time dedicated to purchase is also a factor affecting the choice of the fuel (Martins, 2005).
- The easy terms of payment, quantity and packaging: buying and using the right quantity adapted to needs and is a strong demand;
- The reliability of supply: eating is a basic need. Supply shortages can have impacts on health and can generate civil unrests as it occurred in Cotonou or Dakar, in 2006 when Gas shortages happened.

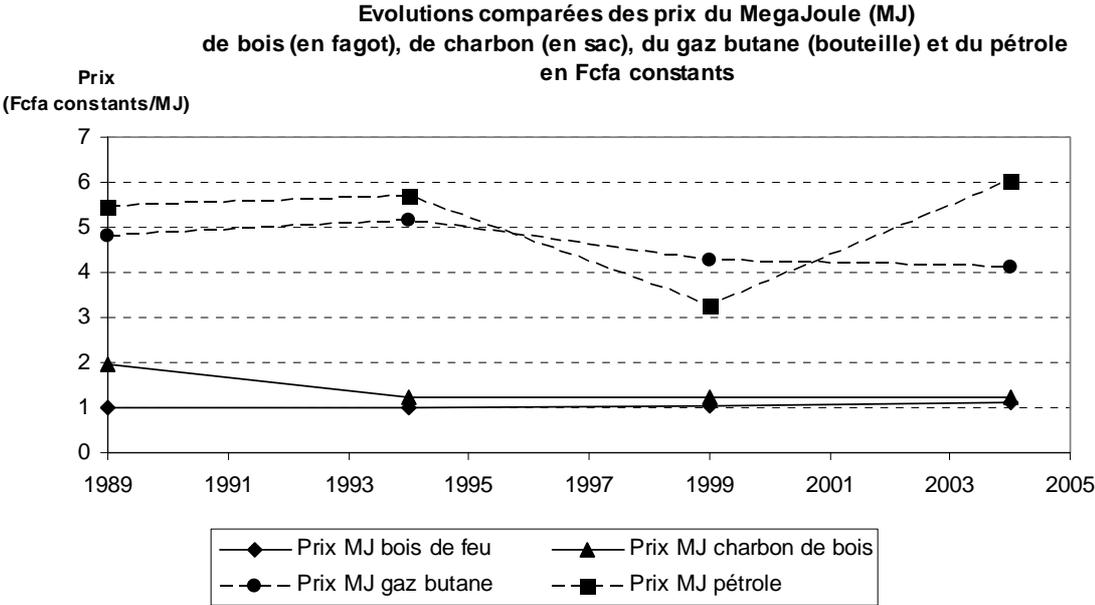
## **Energy prices and expenditures**

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**Figure 4** shows the evolution of the useful energy prices of the different fuels between 1989 and 2004. It shows clearly that for the last 15 years wood has been the least expensive fuel. Until 1999, prices charcoal, LPG and kerosene were equivalent. But since 2000, the

price of kerosene has doubled while charcoal and LPG prices remained stable. Electricity has ever been three times more expensive than the other fuels.

For the last 15 years, the retail prices of firewood or charcoal have followed the cost of living, whereas the kerosene prices have soared. Subsidies for LPG prevented its price to follow the same trajectory of kerosene's one. Between 2005 and 2005, the price of non subsidized LPG has increased by 47%.



**Figure 4 :** the evolution of the useful energy prices in Bamako.

But beyond the price in itself, the main factor of choice is the budget share devoted to energy and its proportion of the global household expenses.

In Bamako, the average expenditure per capita (PCE) is estimated at 260 000 CFA francs (DNSI, 2003). In the poorest households (the two first deciles), the expenditure per capita is under 130 000 CFA francs, while in the richest (two last deciles) it's over 310 000 CFA francs. On average, 11% of household expenditures are allocated for energy: 7% for domestic services (cooking, lighting, warming) and 4% for other services (transportation). Thus, on average, households of Bamako are playing with the standard fuel poverty line. For the poorest the share of the cooking energy expenditure can reach 9% while for the richest people it can decrease to 4%.

The poor allocate their energy expenses mainly to woodfuels for cooking and kerosene for lighting. They devote a very small budget to transport and electricity. The rich own a car or a motorcycle and can have access to electricity. As income increases, budget devoted to

transport and electricity increases too. Finally, the global energy budget share is similar for the poor and the rich.

To assess the impact of the use of the available cooking fuels on the monetary poverty of households in Bamako we simulated their expenses for cooking the three daily meals. In *Table 2*, the theoretical daily expenditure in domestic energy is compared with the global daily expense. Simulations shows that to stay below the fuel poverty line (10% of the daily expenses devoted to energy), the poorest households have no choice but cooking with firewood. As for the median household, it has the choice between firewood, charcoal and butane gas.

	Wood	Charcoal	LPG	Kerosen	Electricity
Unit purchasing price (CFA francs/kg) except for electricity FCFA/Kwh)	26	85	320	430	99
Calorific power (MJ/kg ou MJ/Kwh for electricity)**	14	29	45.7	43.5	3.6
Daily individual consumption( MJ/jour/ind.)*	2.5	2.5	2.5	2.5	2.5
Daily individual fuel expenditure (FCA francs/day)	27.3	38.6	38.9	61.8	105.8
Daily wear on cooking equipment** (CFA francs/day)	0.0	1.4	7.8	11.0	39.1
<b>Poor household (14 pax)</b>					
Daily expenses (CFA francs/day)***	5 050	5 050	5 050	5 050	5 050
Theoretical daily fuel expenditure (CFA francs/day) and proportion of the daily expenses (%)	382	541	552	876	1520
	7.6%	10.7%	10.9%	17.3%	30.1%
<b>Median household (10 pax)</b>					
Daily expenses (CFA francs/day)***	5 600	5 600	5 600	5 600	5 600
Theoretical daily fuel expenditure (CFA francs/day) and proportion of the daily expenses (%)	273	387	397	629	1097
	4.8%	6.9%	7.1%	11.2%	19.5%

\* sources: *Essais in situ* by the Malian Ministry of Energy (CED) in 1998 on an household of 6 persons. (Madon, 1998)

\*\* sources: Technological data of ENDA/ RPTES – WorldBank

\*\*\* sources: Mali, Household Survey 2001 (DNSI, 2003)

**Table 2** : The theoretical fuel expenditures of a poor and a median household in Bamako.

## **The weight of cooking habits**

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For the majority of households, the menu is almost always the same. It is composed as follows: for breakfast, cereal mush; for lunch and dinner, cereals (rice or millet) and accompanying sauce (called the "Tò" in Bambara language) (Dumestre, 1996).

The meal is generally easy to cook, but the quantities are large and cooking times are long. For this reason, wood is preferred to other fuels. It can be used with a three stones stove well adapted to large recipients. It can quickly start the fire and be stabilized for a long time. Another reason of that choice is the possibility to see the flames on the pot and to regulate them by moving bunches. This important cultural fact echoes another one: the possibility, while cooking, to deal with other domestic activities.

Charcoal is preferred by small households where quantities are smaller. It is also preferred to cook modern meals as Pastas which can be cooked in a brief time (a spaghetti meal needs twice less energy than a Tò meal) or tea (the national brewage).

Gas cooking is well appreciated by Malian housewives. Like wood, it can be easily controlled and gives the opportunity to focus on other domestic activities.

Kerosene stoves are considered as difficult to control.

## **Risks and inconveniences**

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Even if the risks of acute or chronic respiratory diseases are not conscious factors of energy choice, the smoke is less and less accepted by urban housewives. In their terms, smokes make the kitchen dirty, ruin clothes and irritate the eyes. This inconvenience is one of the reasons why charcoal is preferred to firewood. However, this argument should be moderated in the Malian context. In Bamako, households live in houses (private or common) organized around a central courtyard where is located the watering-place (Bertrand, 2000). Thus, cooking is an outdoor activity which offers a wide variety of cooking modes and reduces the risk to inspire smokes. Even new villas always have a courtyard. As M. Nyström recalled (2006), in Africa respiratory diseases are above all the effects of confined and unhealthy kitchen areas.

LPG is a clean energy. However it is also considered as dangerous by the population and many stories of accidents circulate in town. This apprehension about appliance safety is judged as a major obstacle to the development of this fuel by the sellers.

Kerosene smells bad.

## **The terms of packaging and payment**

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In Bamako, 80% of the workers have intermittent employment: by the day, by the task required or of a seasonal nature. The incomes of the poorest households are therefore not only very low, but also not regular. The economic resources of these households are gained from day to day without the possibility of making savings, even for a month in advance. The possibility of only buying each day the quantity of woodfuels required is therefore an essential element influencing the accessibility of fuels.

Charcoal and wood can be bought in small quantities (bags of charcoal of 25/50/100 CFA francs or bundles of wood of 100 CFA francs), which makes it adapted to the daily rhythm of incomes and expenses of the poorest households. It is more difficult for poor households to purchase butane cylinders because LPG is generally sold in 6kg containers which cost 1 920 CFA francs.

In this context the initial investment needed for the grid connection (electricity), for the deposit (cylinders of LPG) and for the different cooking devices, represents a real obstacle.

- Wood and charcoal don't require any major initial investment for the stove. People usually cook on a three-stones stove, which is free, or on a metallic tripod (the price of the Malgache stove is about 500 CFA francs).
- Investment in a gas or a kerosene stove can reach two months of income for the poorest households. Moreover, people are not use to buy energy for a month, but day to day.
- The connection fees for electricity can reach up to one year of income for the poorest households.

## **The physical accessibility**

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Butane gas is only distributed by five companies agreed by the Malian government. The containers are sold in service stations and in few shops. About 100 retail outlets are located along the ten major paved streets and in the center of Bamako. 70% of the urban area is located in a distance lower than 1 km from a point of sales. However, many popular neighborhoods don't have any sales points. It is difficult for poor households to buy LPG because the gas delivery network is concentrated in the richest neighborhoods of Bamako. The weight of containers and the distance to points of sales require users to have a car or a motorcycle.

The electric grid was 1332 km long in 2004. It covered only 41% of the street network. It powered mainly the richest residential neighborhoods and the centre of the city. Between 2000 and 2005, EDM-SA concentrated its investment in the peripheral quarters of Bamako. But investments were (and are still) insufficient compared to the extension of the town.

The sale of wood or charcoal is a business activity that occurs close to its customers. Householders can supply themselves with woodfuel practically everyday from the points of sales near their homes. They have a choice between various types of purchasing places: urban markets places, road-side shop, selling at the road-side, or selling door to door.

**The present woodfuel distribution network covers the whole urban area. Presently, the distribution network of woodfuels is therefore the densest network developed and the most reliable in providing energy.** No inhabitant in Bamako is living further than 15mn by foot from a point of sale.

### **The supply reliability**

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Mali does not possess any exploited fossil fuels yet. As a landlocked country, its consumption of hydrocarbons is entirely dependent on imports from the Ivory Coast (67%), Senegal (18%), and Benin and Togo (15%) (Source: ONAP- Office National des produits Pétroliers du Mali). **Because of its dependence on neighboring countries, Bamako is also prone regularly to major fluctuations in the supply of hydrocarbons.** The closure of access to the port of Abidjan in 2002 caused serious disruption in the importation of petrol and gas, which resulted in complete ruptures of available stock. **Gas is considered as an unreliable source of energy.**

Most electric equipments are very old and some judged as dangerous. The famous fire of the central market in 1993 was caused by a damaged electric pole. The power-cuts are common enough to greatly limit the use of electricity for food purposes (refrigeration and cooking). In 2003, the total of power-cuts duration exceeded 1500 hours (63 days) in Bamako due to damages or planned maintenances (Source: EDM-SA).

**At the opposite, during the last 15 years, the only notable shortage in the supply of woodfuels in the city took place in 1999, when the wood sellers went on strike,** following a proposal by the government to increase the taxes on wood production (Maiga, 2001).

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## **The dynamics in the distribution sector of wood-energy**

The distribution of woodfuels comprises diverse activities, ranging from the collection by the producers, the transportation to the city, selling in small or bulk quantities, packaging of products (i.e. putting charcoal in bags or splitting the firewood), handling, and watching.

The distribution sector is currently dominated by the trading sub-sector (integrating the collection) and the transportation sub-sector. We are therefore going to analyse the evolution of the urban employment market in these two highly dynamic sub-sectors.

### **An exponential growth of urban sellers and small hauliers**

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The commerce of woodfuels is considered as a completely separate trade and not as an additional activity. 90% of the traders interviewed in 2004 had it as their main activity and 80% as their only activity. This activity is judged easy to get into because it does not require major capital investment at the beginning.

The profiles of the traders are very various: one meets in the profession a large number of young men who were starting out in business, as well as many old people who did not wish just to look after their children.

The three large surveys carried out in 1994, 1997 and 2005 with urban traders allowed us to analyse the general evolution of the sales sector (see Tables 3, 4)

- Within 10 years, the number of charcoal sellers multiplied by three, while the number of firewood sellers remained almost identical.
- The average and older ages of the sellers has considerably decreased. This decline is especially notable in the sector of charcoal sales. The urban conversion to charcoal has caused the massive arrival of young sellers whose professional experience is only six or seven years, compared to an average of 12 years in 1997, and certainly higher in 1994.
- Between 1997 and 2004, the work has become largely female dominated.

The increase in the urban demand cannot only account for the marked rise in charcoal sellers. The observed increase is about 167%, while during the same period the population of Bamako has only risen by 40%. This enormous increase can be explained for practical and economic reasons.

The transport sector for woodfuels is also characterized by the arrival of a large number of new hauliers, younger and less specialized, who have identified an opportunity for obtaining additional income. This development has occurred to the detriment of the “whosalers-hauliers” who have monopolised this activity between 1995-2000.

Variables	1994	2004
Sample size	18 markets	18 markets
Number of charcoal sellers	132	353
Number of firewood sellers	125	132

**Table 3:** Evolution of the number of charcoal and firewood sellers in 18 markets in Bamako between 1994 and 2004.

Variables	1997	2005	Significance (Fisher Test or Chi-square Test)
<b>Charcoal sales</b>			
Sample size (no. of sellers)	61	159	
Average age of sellers (years)	42.7	36.8	**
Average experience time in the job (years)	12.3	6.7	**
% of women	41.0	53.5	NS
<b>Firewood sales</b>			
Sample size (no. of sellers)	77	53	
Average age of sellers (years)	42.6	37.8	**
Average experience time in the job (years)	10.4	7.8	**
% of women	46.8	64.2	*

*NS test not significant at the 10% level; \* test significant at the 10% level \*\*test significant at the 5% level*

**Table 4 :** Evolution of the socio-professional profile of the woodfuel sellers

### **Incomes from the firewood trade**

The average income of a small-scale distributor of charcoal is presently between 65 000-230 000 CFA francs/month, according to their supply methods. That of a wood seller is about 105 000 CFA francs/month. The incomes of the woodfuel trade remain above the average incomes of the informal sector. In 2004 in Bamako, half of those involved in the informal sector (which comprises service, artisanal and trading activities carried out in the streets and markets) were earning in 2004 less than 30 000 CFA francs/month (OEF, 2002; OEF, 2004).

In the hierarchy of traditional commerce, however, the trade in firewood remains low on the economic ladder. In fact, at the markets, in order of increasing income, the different commercial activities can be divided up as follows: greengrocers (spices, fruits, vegetables),

general food supplies (butchers, fishmongers...) and finally sellers of manufactured products (tools, textiles, clothing..) (Wilhelm, 1997).

According to the analyses made by the FAO on the fruit and vegetable commodity chain around Bamako, in terms of incomes, trading in woodfuels is therefore comparable to that of a greengrocer (Tallec and Bockel, 2005).

Overall, the commerce and the transportation of woodfuels provide an important reservoir for employment. It is open to the young and old alike, to women as well as men, and especially to the less well off. The woodfuel business and especially that of charcoal offers therefore real employment opportunities for the poor population of Bamako which does not have much capital. And in an employment market dominated by men (50% of the women in Bamako do not work versus 29% of the men) (OEF, 2004), the woodfuels commodity chain appears to be a privileged sector for women.

Taking account of the highly dispersed distribution of people involved throughout the city, it is difficult to be precise about their numbers. Considering the quantities consumed overall and the data collected relating to daily sales, a reasonable estimate of the number of urban sellers could be in the range of 6000 (in equivalent full-time employment). One can estimate that the employment of a seller creates also related functions in transport, handling, conditioning and caretaking. The total number of active urban dwellers therefore involved in the commodity chain rises to about 12 000, which represents 4% of the working population in Bamako - source (OEF, 2004).

During the last 15 years, the woodfuel supply chain has changed a lot. It has had to face the reorganization and the redefinition of forest services, the increase of taxes, the decentralization process, and the growing number of urban dwellers. **The retail price stability of woodfuels reveals an efficient supply system which is able to adapt to the growing demand and the increasing distance of the production zones, while maintaining a reasonable price to the consumer.** For more than 20 years, the supply of woody fuels in Bamako has not been prone to any shortages, which reinforces the stability of the pricing system; the same cannot be said concerning the supply or pricing of petroleum products.

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## Discussion

Conversion is a complex process. It concerns not only consumer, but also a long supply chain ranging from thousands of producers to thousands of resellers.

Experience with Household Energy Policies in Mali shows that economic realism and government incentives will not persuade people to accept new fuels or new stoves. People's

cooking and purchasing patterns often lie deep in tradition, and behaviour cannot meet priorities like time saving and energy efficiency. This experience shows also that woodfuel supply chains are alive and can react very quickly to any attempt of changes, to remain in force, and to offer urban dwellers a good energy service in terms of access and prices.

The analysis of Bamako's case shows that the spatial organisation of the town, as its social and economical pattern, make firewood and charcoal the only fuels available for the majority of the households. But it shows also, that the access to an energy portfolio is more important than a single efficient, modern and cheap source. In spite of the equivalent cost for using gas and charcoal, the more well-off people in Bamako continue to prefer woody fuels. This consumption pattern gives the people of Bamako an energy independence, which allows them not to be subjected too severely neither to marked rises in petroleum prices, nor to supply interruption. Many towns in West Africa are actually facing high prices of kerosene and other petroleum-based domestic fuels. In Dakar (Senegal) or in Kano (Nigeria), lower and middle-income households shift away from commercial petroleum-based energy sources (mainly gas) in favour of cheaper and more readily available biomass alternatives (Maconachie et al., 2008). In a rapidly changing world economy, the energy portfolio is a defence mechanism against shocks.

This freedom of choice also echoes an amplified demand in urban area where the diversity in the rhythms of life and the large range of buyable foods involve the diversity of cooking habits. In that framework, the shift to charcoal or to gas, doesn't appear as a transition step to another cleaner source of energy, but rather as a new opportunity to diversify ways of cooking, according to disposable time, types of meal and number of guests

The request of flexibility is certainly one the reason of the failure of most conversion programs.

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