

Title page

Title: Household energy transition in Sahelian cities: an analysis of the failure of 30 years of energy policies in Bamako, Mali.

Running title: Household energy transition in Bamako.

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Abstract

In West Africa, household energy transition has so far mainly been synonymous with the conversion from woodfuel to LPG. This paper analyses the failure of 30 years of household energy transition policies in Mali by combining two major frameworks: Multi-Level Perspective (MLP) and Social Practice Theory (SPT). Based on empirical field studies undertaken in Bamako since 1985 and on literature review, two historical narratives are presented, one focusing on the dynamics of the dominant woodfuel regime and the other on changes in cooking practices. The MLP analysis showed that all elements seemed aligned for destabilization of the dominant regime, yet the woodfuel regime has resisted and is maintained. The SPT analysis showed that the stability of cooking, eating and fuel purchasing practices did not converge towards and even opposed the transition to LPG. This paper shows that the MLP and SPT frameworks offer complementary perspectives for understanding transitions in developing countries. It concludes that the definition and implementation of energy policies need to integrate an analysis of daily practices and should consider that energy transition is not synonymous with the replacement of one fuel by another, but with new opportunities to diversify ways of cooking.

Keywords

Household energy transition; Woodfuel; Mali; Multi-Level Perspective; Social Practice Theory.

1. Introduction

In West Africa, energy transition has so far mainly been synonymous with the conversion from traditional biomass fuels to so-called modern alternative energies (butane gas/LPG, kerosene or electricity) in the household sector (IEA, 2015; Leach, 1992).

Since the 1980s, particularly in the West African Sahel, most governments have developed policies to try reducing this reliance on woodfuels (FAO, 2012) and preserve woodlands in a context of high climatic, environmental, and demographic pressures. For this objective, ambitious energy transition programmes were designed and implemented in the 1990s, aimed at encouraging people to switch to LPG (or kerosene) and reduce woodfuel consumption. With the assistance of the World Bank, the first programme started in Niger in 1990, followed by Mali, Burkina Faso, Guinea, Chad, Mauritania and Senegal (The World Bank, 1996).

However, 30 years later woodfuels are still the most widely used energy sources for urban and rural people living in Sahelian countries. In 2015, the share of biomass in final energy demand had not much changed since 1980 and it has even increased in some countries (IEA, 2015). Today, while some studies have been undertaken to describe this lack of energy transition, (Arnold et al., 2006; Foley et al., 2002), very few studies have been carried out to analyse why energy systems have barely changed, if at all. This paper aims to fill this gap and to explain the reasons for this lack of transition in a large Sahelian city: Bamako, the capital of Mali.

Since the 1980s, many theoretical frameworks in different literatures have emerged over time for the analysis of changes in energy systems (Li et al., 2015). Among the most widely used in the energy sector, we can cite the Actor Network Theory (Akrich, 1993; Akrich et al., 1988), the Social Practice Theory (SPT) (Crosbie and Guy, 2008; Gram-Hanssen, 2010; Shove, 2003a), Technological Innovation Systems (TIS) (Bergek, 2002; Jacobsson and

Johnson, 2000) and finally the Multi Level Perspective (MLP) (Geels, 2012, 2010, 2002; Geels and Schot, 2007). Over the last decade, MLP has been widely used to describe and analyse energy transition in the industrialized world. More recently, this framework has been used in some emerging economies in Asia, but very little in developing countries in Africa (Nygaard and Bolwig, 2018; Wieczorek, 2018).

In this specific context, recent work has highlighted the difficulties of this framework (Hansen et al., 2018). The reservations expressed by scholars regarding the application of MLP in developing countries are of several kinds, but we will discuss just two of them here: the first concerns the training of niches in sectors highly assisted by major international donors and where the novelty is often imported from developed countries (improved stoves, solar kits) and comes rarely from within; the second, and probably the most important, concerns the notion of a socio-technical regime that is challenged in a context of generalized informality. As Ramos et al. pointed out (Ramos-Mejía et al., 2018), informal regimes are very complex and are deeply rooted in high-level social relationships and practices. Thus, not only are these regimes very resilient, but they are also difficult to understand and describe.

This last remark echoes a major criticism made by a number of sociologists against MLP in the field of energy transitions. For Shatzki, Shove and Walker (Schatzki, 2010; Shove and Walker, 2014), energy is inseparable from the practices it allows and those practices affect many intertwined regimes: transport, food, housing, etc. Shove acknowledges that MLP is extremely valuable in helping to understand novelty but it overlooks the wider forces that hold things in place and maintain normality (Shove, 2003a). From these sociologists perspective, domestic practices, including cooking, are for the most part habits, i.e. common and recurrent practices that structure a "normal" life (Shove, 2012). The strength of habits depends on many factors, including the number and extent of carriers that are committed, the

size of reproduction circuits, but also the strength of beliefs and consistency with other practices in other areas of everyday life.

For this kind of practices, Shove and many authors have proposed to enrich the MLP framework considered as a vertical perspective (referring to the ‘vertical’ levels of MLP) with a horizontal theoretical approach, the Social Practice Theory (SPT), which focuses on routinized practices, their elements, their reproduction and their integration and linkage with other practices in other regimes (Hargreaves et al., 2013).

Recent literature and, in particular, the review by A. Wieczorek (2018), clearly shows that frameworks for studying energy transitions tend to open up and hybridize, particularly in developing countries. Considering the informal nature of the woodfuel sector in Mali (Gazull and Gautier, 2014), the weakness of formal institutions and above all the routine nature of the use of domestic energy, we propose here to conduct a cross-analysis of Bamako's energy transition over the last thirty years combining, on the one hand MLP, which provides a structuring framework to describe energy developments at several levels and, on the other hand SPT, which makes it possible to follow developments in the main domestic energy practices: cooking and domestic water heating.

2. The analysis framework

2.1. Combining MLP and SPT

In MLP, changes in the energy system come about through the interaction of three levels: 1) Landscape, which refers to the exogenous environment defined by macro-economic, political scenarios and deep cultural patterns that influence niches and regime dynamics; 2) Regime, which includes all elements that shape patterns in socio-technical systems, such as

infrastructure, regulation and standards, cognitive routines, lifestyles; 3) Niche, which refers to protective spaces where novelties emerge (Geels and Schot, 2007).

According to Geels and Schot (2007), “transitions come about through interactions between processes at these three levels (a) niche innovations build up internal momentum, (b) changes at landscape level create pressure on the regime and (c) destabilization of the regime creates windows of opportunity for niche innovations. The alignment of these processes enables the breakthrough of novelties in main stream markets where they compete with the existing regime”.

In SPT, the focus is on transitions in practices (Shove, 2012). The main assumption on which SPT is based is that the sources of changed behaviour lie in the development of practices themselves (Warde, 2005). Reckwitz (2002) defined a practice as: “ a routinized type of behaviour which consists of several elements, interconnected to one other: forms of bodily activities, forms of mental activities, ‘things’ and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge”. Practices are formed, changed and stabilized as the links between their elements are made, maintained, or broken (Shove and Pantzar, 2005). The practice concept inherently combines a capacity to account for both reproduction and innovation, but most of the work on SPT to date has focused on the reproduction of practices rather than on changes (Shove and Walker, 2010). Thus, the main purpose of SPT analysis is to describe the elements that constitute the practices, identify their reproduction circuits and understand how users integrate these practices into daily routines that form part of everyday life (Shove, 2003b).

Recently, Hargreaves (2013), based on Shove's work (2003a), proposed an analytical framework combining MLP and SPT that can be translated into the figure 1. The underlying assumption of this diagram is that transitions in regimes (the vertical circle) and transitions in

everyday practices (the horizontal circle) follow different dynamics that interplay (points of convergence or divergence) and then either reinforce or hinder each other.

In practice, the implementation of this framework consists of 3 types of analysis: (i) a classic MLP analysis of changes in the household energy regime on 3 levels: niche, regime, landscape; (ii) an SPT analysis of changes in daily cooking practices; and (iii) an analysis of how changes in the regime are reflected in daily practices and, conversely, how changes or stability in practices either contribute to or prevent transitions in the energy regime.

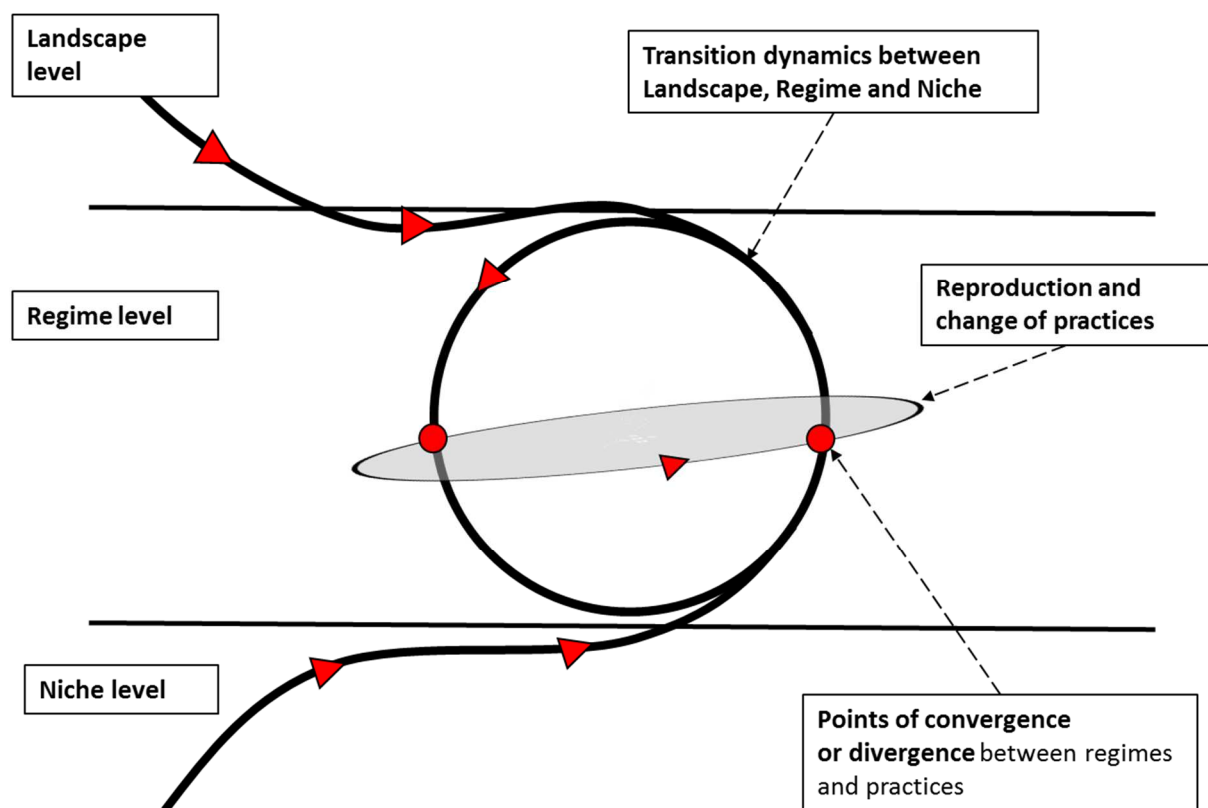


Figure 1: Combining MLP (multilevel perspective) and SPT (social practice theory) (adapted from Hargreave, 2013 and Shove, 2003a)

2.2. MLP application to household energy transition in Bamako

In this paper, the regime we focused on was the household energy system widely dominated by woodfuel production, distribution and consumption. The analysis of this dominant regime was carried out in three dimensions: i) material and technical artefacts; ii) networks of stakeholders; and iii) formal, normative and cognitive rules that guide the activities of stakeholders. The main stakeholders monitored are: households purchasing and using woodfuels for cooking and water heating, the various stakeholders of the woodfuel supply chains and, lastly, the agents of the governmental Forest Service, created under the 1935 colonial legislation to implement forest policy and regulate the sector. The formal rules we analysed were those laid down by the Malian Government to regulate the woodfuels market, promote alternative energies and reduce urban woodfuel consumption. The technical elements included fuel consumption and prices, and the distribution network.

The analysis of the socio-technical landscape not only focused on national energy policies, but also on the international narrative on the fuelwood crisis and on the political agenda of the donors who supported Malian domestic energy policies that have taken place in a long history of misguided environmental policies (Gautier et al., 2013). On this scale, the stakeholders we focused on were: international experts, international donors and the heads of the Ministry of the Environment and the Ministry of Energy, who all participated in conceptualizing and defining energy policies.

However, as Geels (2012) states, the socio-technical landscape is also a landscape in its literal sense. In our case, the urban landscape of Bamako was found to widely influence niche and regime dynamics. In this paper, we also considered demographic growth, urban structures and the housing environment where cooking occurred as landscape factors.

Lastly, the niche area we considered was the economic area promoted by the Malian Government to change the dominant regime and where resources were provided by public subsidies. It mainly concerned the protected sector of LPG, not only supported by the government but also by powerful international oil companies such as Shell, Total, or BP. According to Verbong and Geels (2007), the analysis of this niche will comprise narratives about two main processes: building of networks and articulation of expectations.

2.1. The Social Practices Theory (SPT) framework and its application to household energy transition in Bamako

Changing domestic energy has a direct impact on cooking and water heating practices: Cooking with LPG requires less time than cooking with wood, it can hardly be done outside, unlike cooking with wood and, moreover, gas stoves are generally smaller in size than traditional wood-burning stoves and cannot take the same large pots.

In addition, as Shove and Walker pointed out (2014), the practice of cooking is a complex practice that integrates many others, the main ones being fuel purchasing and eating practices.

To operationalize an analysis of practices, we followed here Shove and Pantzar's (2005) definition, which see practices as made up of 'images' (meanings, symbols), 'skills' (know-how), and 'materials' (artefacts) that are actively and recursively integrated through everyday performance. Thus, the analysis of developments in cooking practices will comprise narratives about these three main elements for the main three practices: cooking, fuel purchasing and eating.

3. Material

The MLP and SPT analyses were based on five main empirical field studies undertaken in Bamako over the 1984–2015 period. The data gathered and used were intended to assess and

analyse the energy consumption of Bamako households, their preferences and expectations, the functioning of the different energy supply chains, and the institutional context regulating this household energy sector. It benefited from the field work undertaken by the following projects (table 1), four out of five of which were coordinated by the authors' institution and two were implemented by the authors themselves.

Project	Lead	Years	Surveys	Report and data status	Authors' involvement
République du Mali. Planification de l'énergie : Etude du secteur des combustibles forestiers au Mali	Ministry of Energy / TransEnerg	1985 - 1989	Census of fuelwood and charcoal consumption Market surveys Woodfuel flow survey at the entrance to Bamako in 1985	Restricted access. The authors had access to the secondary data through their institution	Secondary data from the various surveys carried out in 1985
Republic of Mali. Household Energy Project (HEP).	Joint UNDP/World Bank Energy Management Assistance Program (ESMAP)	1989 - 1994	Household surveys (100 households) Market surveys Woodfuel flow survey in 1989	Restricted access. The authors had access to the primitive data through their institution	Primary data from the woodfuel flow survey carried out in 1989 , entered and processed by the authors
Republic of Mali. Household Energy Project (HEP)	Ministry of Environment, Ministry of Energy, funded by WB and Netherlands cooperation	1994 - 2000	Woodfuel flow survey in 1994 and 2000 Household panel surveys (1000 households) in 1994 , 1997 , 1998, 1999	Restricted access	Primary data from the woodfuel flow surveys carried out in 1994 and 2000 and from the household panel surveys in 1997 entered and processed by the authors
Design and use of information systems to facilitate common resource management	CIRAD	2003 - 2007	50 market surveys in 2005 232 urban merchant and rural woodfuel producer	Restricted access	Conception, implementation and processing of all the primary data collected by the authors

(SICOGER)			interviews in 2006		
Sustainable management of woodlands and of Sahelian cities supplied with woodfuel (FONABES)	CIRAD, co-funded by FFEM	2014 - 2019	Woodfuel flow survey in 2015 Household panel surveys (500 households) in 2015	Restricted access	Primary data from the woodfuel flow survey carried out in 2015 Secondary data from the household survey

Table 1 : Main empirical field studies used as primary and secondary data

An important and original part of this study was to critically evaluate and harmonize all data existing since 1985 on the woodfuel commodity chains of Bamako. The analyses conducted were based both on time series and on instantaneous data from in-depth surveys of the stakeholders involved in the energy sector. Data on woodfuel consumption were collected through supply flow measurement campaigns set up with the Malian Forest Administration in 1989, 1994, 2000 and 2015, with the authors' institution providing technical support for all the campaigns except the one in 1989.

Data on woodfuel supply chain functioning and on consumer practices, preferences, beliefs and expectations were collected through fairly roughly semi-structured interviews in 1997 and 2015 by two projects supervised by the authors' institution and in 2005 by a project implemented by the authors.

In addition, we collected statistical data from the National Directorate of Statistics and Informatics of Mali (DNSI) on LPG imports, energy prices, household revenue, household composition, etc. The main sources we used were: (INSTAT, 2003, 2014, 2016a, 2016b; ODHD/LCPM, 2006; OEF, 2004).

Lastly, the analysis benefited from the observations made *in situ* on the daily life of the people of Bamako by one of the authors who lived for 6 years in the Malian capital.

4. MLP analysis of the household energy sector (1985-2015)

This section illustrates the development of the household energy sector in Bamako from 1985 to 2015. This period can be broken down into three phases arising from the Malian political and economic agenda affecting the different household energy supply chains in Bamako.

The main findings are presented as an historical narrative highlighting changes on the three levels of MLP, and illustrated by two figures showing the evolution of consumption and prices of household energy (cf. figures 2 and 3).

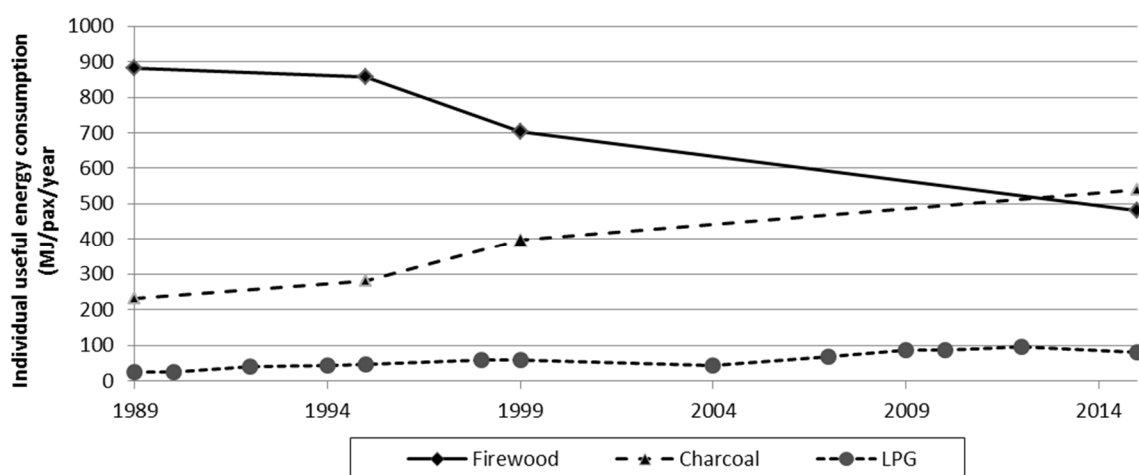


Figure 2: Final annual useful household energy consumption in Bamako (MJ/year/capita)

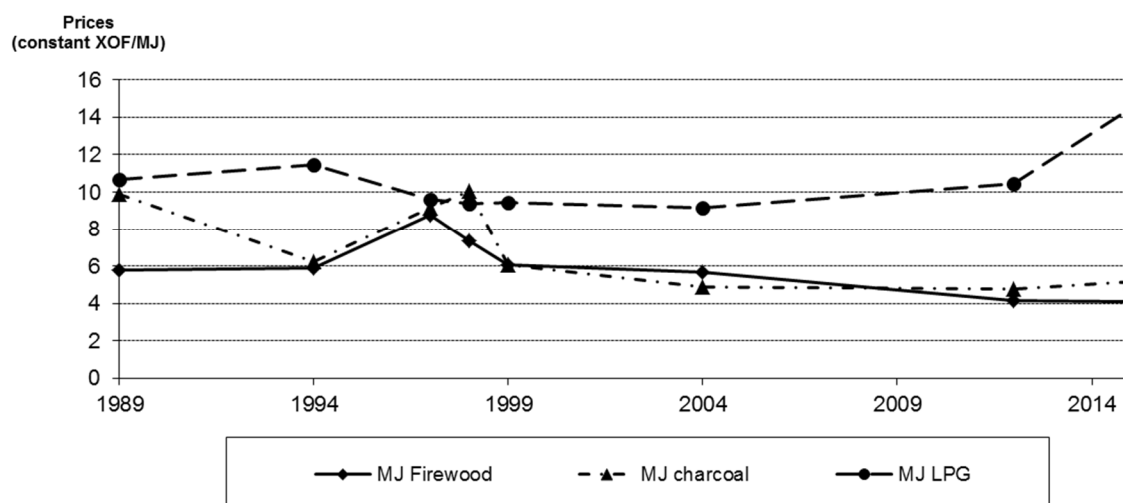


Figure 3 : Comparison of final useful energy prices in constant XOF/MJ.

4.1. The crisis phase (1985 – 1995)

4.1.1. The socio-technical landscape

The political landscape: an international consensus against fuelwood

In the 1970s and the 1980s, the dominant discourse about the domestic energy sector in Mali and throughout West Africa was that of a crisis (Cline-Cole et al., 1990; Eckholm, 1975; Ki-Zerbo, 1981; Mearns and Leach, 1989). The 1970s and 1980s brought major fears that the disappearance of the natural woodlands in the SSA drylands would bring severe wood energy shortages, as well as disastrous consequences for many rural households, for agriculture and for the natural environment (Barnes, 1990; Eckholm, 1975; FAO and Engeler, 1981).

As a direct consequence, most large international development organizations (IEA, The World Bank, etc.), negatively judged the use of these traditional energy sources. Moreover, for the institutions of the Bretton Woods system, the woodfuel sector was a sector under the control of coercive African forest administrations that needed to reform (Gautier et al., 2013).

Thus, throughout the Sahel region, this gave rise to international proposals and plans to encourage African governments to reform their domestic energy and forest sector in order to i) reduce woodfuel consumption by adopting improved stoves and by switching to LPG; ii) promote sustainable forest management; and iii) open up these sectors to private companies (Arnold et al., 2006; Kerkhof et al., 2002).

The urban landscape

In the 1970s, natural demographic growth combined with a rural exodus led to a huge increase in Bamako's population. It increased from 160,000 inhabitants in 1966 to 420,000 inhabitants in 1976, following annual average growth rates of over 20%. In the 1980s, population growth stabilized at about 5% per year and in 1995 Bamako reached about 1

million. The population was young with a low level of education and one of the poorest in the world: in 1995, the per capita GDP was only US\$ 280. The income poverty rate was 32% and the employment rate was around 50%. Trade was by far the main economic activity of the city and the informal sector provided more than two thirds of the jobs. Most jobs were precarious, working conditions were difficult and incomes were not guaranteed.

Over this period, the development of the city was primarily characterized by an uncontrolled expansion of the periphery without real urban planning operations. New so-called "spontaneous" neighbourhoods spread very far from the centre, joining the first ring of outlying villages and producing huge complexes with uncertain status (Bertrand, 2000). These new unplanned subdivisions were not serviced and had no water, sanitation, energy or road infrastructures. In 1988, only 20% of households had access to running water in their homes and 20% were connected to the electricity grid. In 1995, the rate of electricity-connected households was only 30%.

In the 1980s and 1990s, urban settlements in Bamako were mostly courtyard-type housing: a group of low-rise houses grouped around a common courtyard where residents cooked outdoors. Courtyard housing accounted for more than 90% of the housing stock.

4.1.2. The household energy regime

Technologies and fuels

During this first period, wood – in the form of bundles or charcoal - was the very dominant domestic fuel. It provided about 98% of households' final useful heat requirements (cf. Fig. 2). Firewood was the predominant form of energy and charcoal accounted for only 20% of useful energy needs. The use of gas was marginal (less than 2%).

During this period, wood was the cheapest fuel to buy and use. Calculation of the price of the final useful energy (taking into account the calorific power of each energy source and the

energy efficiency of the associated stoves) clearly showed that wood-energy was almost twice as cheap as LPG (cf. Fig. 3).

Rules

The woodfuel trading sector in Mali has always been classed as an informal economy widely controlled by the State. In Bamako, wood came from all the wooded areas located at an average distance of about 60 kilometres: savannas, fallows, trees outside forests in fields, and open forest. Until 1995, the commercial and legal system regulating the woodfuel trade granted authority to the forest administration to assign any specialized contractor, usually a city dweller, the right of access (and logging) to any wooded area considered to be State property, with no consideration for customary rights.

In town, the woodfuel market was free. Trade was only subject to the constraint of a declaration at the town hall, to be able to sell on the markets in Bamako.

Stakeholders and networks

Until 1995, the woodfuel sector was totally regulated by the National Forest Service. This service was in charge of managing forests and regulating fuelwood production and marketing. Historically, it also served to police and tax rural areas.

The fuelwood supply chain was in the hands of a small number of large wholesalers, who controlled the whole chain from production up to sales in the city. These large operators benefited from strong support within the forest administration, which issued logging and transportation permits.

4.1.3. The emerging niche of the LPG market

From 1980 to 1995, the gas sector was totally controlled by the Malian State. As a landlocked and non-oil producing country, Mali's consumption of hydrocarbons was entirely dependent

on imports from neighbouring countries. In Bamako, LPG mainly came by truck from the harbour of Abidjan (Ivory Coast). It was bottled in Mali and distributed by companies authorized by the Malian government. Between 1985 and 1995, the LPG market was in the hands of three international companies: Total, Shell and Mobil Oil. In 1989, the Malian State decided to promote the use of LPG in the domestic sector and decided to i) waive import duties and taxes on LPG and on equipment and accessories; and ii) directly grant the importing and distribution of LPG and cooking appliances. The amount of this grant, directly paid to private operators, stabilized the LPG price at the same level between 1989 and 1995 . However, despite these subsidies, the price remained more expensive than that of wood and charcoal (cf. Fig. 3).

In this phase, the objective of the Malian government was to increase LPG consumption from 1 kg/person/year in 1989 to 2 kg/person/year in 1992 – which was very little in absolute terms. However, in 1995 these goals had yet to be achieved. Even though the share of LPG in the annual energy consumption of Bamako households had increased from 2% to 4%, it remained marginal compared to wood consumption (cf. Fig. 2).

4.2. The Household Energy Strategy phase (1995 – 2005)

4.2.1. The socio-technical landscape

The political landscape

At the beginning of the 1990s, the World Bank, helped the Malian government to define a new strategy for the development and management of its energy sector. This assistance aimed mainly at proposing a coordinating framework of policies for the household sector, with the objective of managing national and imported energy resources more efficiently, and providing the urban population with a better energy service (ESMAP, 1992).

In 1995, the Household Energy Project (HEP) was drawn up in Bamako. Its main objectives were to promote “*popular participation in household energy activities, rational use of household energy resources, and improved end use of household fuels*”. The HEP programme was officially scheduled to last from 1995 to 2002. In fact, this project led by both the Ministry of the Environment and the Ministry of Energy developed actions aimed at reviewing the prices of fuels (wood and LPG), reforming the forest taxation and forest management system, and finally developing a new private sector for LPG and kerosene.

Application of new taxes for woodfuels and improved monitoring of fluxes were expected to cause an increase of 20% in the urban retail prices of wood and charcoal and to make alternative sources of "modern" energy more competitive. Meanwhile, the privatization of the energy sector and transfer of forest management to local communities were expected to lead to better management of natural resources and a better distribution of added-value throughout the supply chains.

The urban landscape

From 1995 to 2005, the population of Bamako increased from 1 million to 1.6 million. In 2005, 42% of the population was under 15 years. GDP per capita remained stable from 1995 to 2002 (around US\$ 300) and began to rise to US\$ 440 in 2005. In Bamako, the income poverty rate declined from 32% to 11%. However, even with this decline the population remained one of the poorest in the world. In the capital, the employment rate was 60%, a slight improvement over the previous period. Nevertheless, the job structure had not changed. Employees accounted for only 40%, self-employed 51% and caregivers 9%. Trade in the informal sector remained the major activity (82%) and household incomes were still low and very unstable.

In 1995, the government also set up a National Housing Strategy and in 1997 it launched the third “Bamako Urban Project”. These initiatives were intended to improve the provision of basic urban services and promote land development for housing in Bamako. Between 1995 and 2005, the rate of electricity-connected households rose from 30% to 45%.

The surplus population was partly absorbed by the division of existing parcels, and above all by the construction of new subdivisions of individual villas and courtyard housing in the southern part of the city. Thus, over those 10 years, the habitat changed little in nature and the population density in the urban area even tended to decrease, still offering opportunities for outdoor cooking and storage possibilities for woodfuels in the courtyards.

4.2.2. The household energy regime

The new rules defined by the HEP

Since 1995, the HEP has resulted in concrete actions in terms of both urban demand and energy supply.

On the supply side, the reforms carried out involved the taxation of wood and the reform of the forest sector. Between 1994 and 1998, the government decided to multiply the tax on firewood by 4 and that on charcoal by 5. However, the major change took place in forestry legislation. The new 1995 forest code (Act No. 95-003) considerably relaxed woodcutting conditions and made the woodfuel sector accessible to rural people (Hautdidier and Gautier, 2005).

On the demand side, in Bamako, to promote “modern” energy fuels and to reduce fuelwood consumption, the Malian government initiated three types of action: promotion of improved stoves, subsidies for LPG, subsidies for gas and kerosene stoves. However, fairly soon after 1997, the programme of improved stoves ended because of the complexity of the procedures and the small amount of each subsidy.

Technologies and fuels

From 1995 to 2005, despite all the governmental initiatives and incentives, wood remained the dominant cooking fuel. However, the use of charcoal increased considerably. On the other hand, despite continued subsidies for butane, the latter remained at around 4% of Bamako's needs (Fig. 2).

Wood and charcoal prices also remained remarkably stable. In 1998, when the Malian government decided to increase taxes, woodfuel prices almost doubled immediately to reach that of butane gas. However, after this instantaneous “booster effect”, retail prices slowly recovered their original levels (Fig 3). Three main factors explained this progression. First, in 1998 woodfuel sellers went on strike and negotiated a decrease with the State (Forest Service agents had no interest in hindering the woodfuel trade too much because a large part of their incomes came from taxes); second, merchants were forced to adopt new strategies to supply the market and to reduce their margins; third, the Forest Service had difficulties in controlling the fuelwood market and collecting taxes.

Stakeholders and networks

Since the 1991 revolution, the agents of the Forest Service have been driven out of the rural areas because of the negative role they played in the past. State budgets devoted to forest administration started to steadily decline in 1995 and recruitment halved between 1995 and 2005. In the field, due to understaffing, controls on woodcutting, flows, and fees were naturally reduced.

Meanwhile, with the new energy policy, the supply chain experienced a massive arrival of new traders who supplanted the historical operators. The wholesalers, who dominated the market over the 1980-1995 period, obviously did not know how to keep their oligopoly. As a

result, the supply chain lost its concentration, with a growing number of small merchants and commercial middlemen.

The redefinition of stakeholders' roles was also accompanied by a shift in the balance of power between urban traders, rural producers and the forestry administration. The forest administration was confined to a controlling role in a small number of locations. Rural woodcutters became more numerous and gained bargaining power against urban traders. One of the major consequences of this reorganization of the sector was better vertical distribution of added-value and an increase in competition at all levels, which played an important role in maintaining low prices.

4.2.3. Promising development of the LPG niche

Over the period, the objectives of the State were to continue to subsidize LPG and, above all, to develop the distribution network and the private sector for bottling.

However, between 1995 and 2005, only three local companies emerged in Bamako: Sodigaz, Sigaz and Faso Gaz. They all imported gas from Abidjan and had extreme difficulties in regularly supplying Bamako. Since 2002, the marked rise in petroleum prices has caused a notable increase in the cost of hydrocarbon products. Between 2002 and 2005, the cost of non-subsidized butane gas rose 47%, while subsidies maintained domestic LPG at a fixed price (Fig. 3). The amount of the subsidies was a heavy expense for the Malian government. The subsidies were regularly paid to operators more than a year late. These irregularities in the payment of subsidies held back the development of this sector and caused serious disruption to supplies, resulting sometimes in shortages.

4.3. The current phase (2005 – present)

4.3.1. The socio-technical landscape: changes in continuity

The political landscape

At the beginning of the 2000s, the focus on abandoning woodfuel reflected increased international concern with the need to reduce damage to health from noxious fumes associated with the burning of wood and charcoal (World Health Organization, 2002). This new argument resulted in continued efforts to encourage LPG use.

However, since 2010, positions are changing. The sharp rise in the cost of fossil fuels in 2007-2008, as well as global concerns about climate change and GHG reductions, have done little to encourage new projects advocating the substitution of wood-energy by fossil fuels in Africa. Today, the global energy and economic context seems to be more favourable to woodfuel. However, at international level, the message is still unclear and, so far, most of the transition policies implemented in the 1990s are still ongoing in the same direction.

In 2003, a new 10 years project funded by the World Bank, called the Household Energy and Universal Access Project (HEURA) was launched by the Malian government. Its core objectives remained the same as the HEP. Implementation of the project was entrusted to a para-governmental agency, the Malian Agency for the Development of Domestic Energy and Rural Electrification (AMADER), under the virtually exclusive control of the Ministry of Energy.

The urban landscape

From 2005 to 2015, the population of Bamako increased from 1.6 million to 2.4 million. In 2015, 40% of the population was under 15 years old and the median age was still 17 years old. From 2005 to 2011, national poverty declined significantly: the national income poverty rate fell from 56% to 35% and in Bamako from 11% to 9%. However, since 2012, Mali has had to cope with a deep political, institutional and security crisis. This crisis led to a

worsening of poverty between 2011 and 2015. Over this last period, the rate of monetary poverty increased from 9% to 11% in Bamako, returning to its 2005 level.

4.3.2. The household energy regime

Stakeholders and networks

In 2003, the role of controlling and managing the household energy sector became the responsibility of AMADER. This new agency was not only responsible for implementing the new domestic energy programme, but also for LPG subsidies. This change in the leadership of woodfuel policy implementation from the Ministry of the Environment to this new Energy Agency was perceived as a real insult to the Forest Service. Over this period, the AMADER, as the leader of the new Malian energy policy and therefore of parts of the forest policy, tried to limit the role of the forest administration to forest control and to award more initiatives to private consultants in forest management. These tensions between the Environment and Energy ministries led to a dysfunction in the actions of AMADER.

Lastly, in 2010, the forest administration regained power, the National Forest Service was recreated as it was before 1995. It has taken over the forest management aspects, with funding from AMADER.

Rules

In 2010 a new forestry law was enacted. This one, still ongoing, excludes private companies from forest management and raises the level of taxes on firewood and charcoal by 30% in unmanaged areas and by 60% in managed areas, even against the logic of the former HEP. But finally, the rules of the energy sector have hardly changed. The HEURA was a follow-on from the HEP and its actions are still the same.

Technologies and fuels

In 2015, the preferred fuel for households in Bamako was charcoal: it provided about 49% of household final useful heat requirements, firewood 44% and LPG 7% (cf. Fig. 2). In 10 years, the share of LPG in energy consumption increased from 4% to 7% but this fuel remained marginal and this share has tended to decrease since 2012.

Despite the official rise in forest taxes in 2010, retail prices for firewood remained very stable, while charcoal prices slightly increased. However, when the government stopped subsidizing LPG in 2012 prices immediately jumped by 50%, which resulted in LPG unit prices that were three times higher than those of wood (Fig. 3).

4.3.3. The socio-technical niches: the LPG market

Expectations

In 2008, as part of the HEURA project, a new LPG plan was developed to reaffirm the conversion intentions. The objective was to i) expand and organize the LPG distribution network by developing outlets, increasing the number of bottles in circulation and the number of operators; ii) strengthen the import, filling and distribution capacities of private operators.

The objectives of the new HEURA project were to increase the share of LPG in the domestic energy balance to 40% in 2015. But in 2012, the major event was the cessation of LPG subsidies because of recurring funding difficulties. In 2015, the objectives were far from being achieved and the current trend is rather a decrease in gas consumption.

Stakeholders and networks

In 2015, ten private gas operators shared the market, including Total (accounting for 20% of the market) and nine local distributors. The two major international companies, Shell and Mobil, have abandoned this market. Half of the local companies have less than 5 years of existence. These private operators purchase gas individually, often at high prices, because

they cannot negotiate with tankers, they have low financial purchasing capacity and, lastly, they have very limited capacity for storage and bottling.

In 2014, the leader Total considered withdrawing from the Malian LPG market, denouncing non-compliance with the legal texts that governed the production, filling and distribution of butane gas in Mali.

In 2015, the situation was calmed, but Bamako still lacked bottles to ensure a sufficient turnover of refills. Many bottles are old and are not recycled as they should be. Leaks are numerous, which leads to accidents.

5. SPT analysis of household energy consumption (1985-2015)

5.1. Social practices of purchasing, cooking, eating

5.1.1. Purchasing practices

For 30 years, as for more than 80% of their purchases, Bamako dwellers have been buying their wood and charcoal on the city's markets. Markets do not only have a commercial function, they are important places in social life. Each market has several points of sale for fuelwood, generally grouped slightly on the periphery of the market because firewood stalls require large storage areas and charcoal makes undesirable dust.

The number of markets has been stable for 30 years. Bamako hosts 50 official markets distributed in the 6 municipalities of the city. This fuelwood sales network is complemented by countless small street vendors, small stores and even door-to-door sales. This dense network allows Bamako residents to buy their energy on foot or by public transport.

The woodfuel distribution network covers the whole urban area and, for 30 years, no inhabitant in Bamako, even in the peripheral areas, has lived more than 15 min on foot from a point of sale.

Conversely, for the past 30 years, LPG tanks have only been sold in a limited number of sales outlets. In the 1980s and 1990s, only service stations associated with international distributors (Total, Shell, etc.) and a few downtown stores could sell them. This LPG distribution network covered only the wealthiest areas of the Malian capital. From 1995 to date, due to all the difficulties encountered in the LPG sector, the distribution network has not developed. Points of sale have remained concentrated in the city centre and in the wealthiest districts. In 2005, there were only 150 points of sale and more than 30% of the city's area was still more than 1 km away from one of these outlets. In 2015, we estimated that only 200 points were selling LPG regularly in Bamako. At the same time, the number of fuelwood retailers rocketed and we recorded more than 5000 points of sale.

However, purchasing practices are not just about where fuels are purchased. The easy terms of payment and the possibility of buying the right quantity adapted to needs are strong elements of buying practices. In 1995, 80% of workers had intermittent employment. The economic resources of the households were earned from day to day, without the possibility of making savings, even for a month in advance. Thus, day-to-day purchases accounted for the vast majority of purchases.

Over the past 30 years, the socio-economic conditions of Bamako households have hardly changed and neither have the types of employment. Day-to-day purchasing remains the rule, and wood and charcoal can be bought in small quantities (small bags of charcoal or bundles of wood), making them adapted to the daily rhythm of incomes and outgoings of the poorest households. Conversely, LPG was sold only in 6 kg or 12 kg cylinders and required the rental of the cylinder, which was expensive for many households. No payment facilities or "bespoke" packaging were set up for consumers.

5.1.2. Cooking and eating

In the 1980s, the majority of Bamako's housewives prepared 3 meals, and all meals were taken at home. For the majority of households, the menu was almost always the same. It was composed as follows: for breakfast, cereal mush; for lunch and dinner, cereals (rice or millet) and accompanying sauce (called the “Tò” in Bambara language). The main meal was generally a family one where family members, but also relatives and sometimes neighbours and friends, shared the same meal. In 1987 and 1998, the average size of a household was 6.3 and the number of people to be fed per cooking unit ranged from 7 to 14. The quantities to be cooked required large containers devoted to the main and, usually, the only course.

These habits have changed very little over time. In 2015, 99% of households had breakfast and lunch at home, and 90% had dinner at home. Meals were always served with family and friends. Families have remained large: from 1995 to 2015, the size of households changed from 6.3 to 6.2. However, the main fact is that Bamako continues to be home to large households: 25% of households have between 9 and 25 people. Bamako households continue to welcome many people from outside the strict family circle. The 2012 crisis strengthened this phenomenon and many families have welcomed refugees from the north of the country (at war). The quantities of food to be cooked at household level are therefore still very large.

Similarly, the diet has changed relatively little. In 2015, millet porridge remained the most consumed food for breakfast (68%), even though coffee has become very frequent (19%). At noon, rice has replaced all the other cereals, and in the evening the menu is diversified: millet couscous, or tô, or rice, or pasta. But overall, the types of meals remain the same: a main cereal and a side sauce.

For 30 years, meals have been prepared outdoors, either in the courtyards of traditional habitats or in the backyards of the few new villas built in the 2000s. Until the 1990s, meals were mainly cooked over a wood fire on traditional open fireplaces called three-stone

fireplaces. The preparation of the meal and its cooking were very often entrusted to a household helper, usually a young woman member of the family from the countryside and welcomed in town.

In 1989, 89% of Bamako households used wood, 87% of which was used as the main fuel. Nevertheless, charcoal was already used by 56% of households as secondary fuel. Wood was used to cook the main dishes. Charcoal was used for secondary quick-cooking side dishes (pastas) and mainly for tea preparation and domestic hot water heating. LPG was also present in 17% of households but was only used for domestic hot water heating.

In 2015, housewives mainly cooked with coal on so-called improved metal stoves that can also be used with wood, 96% of households used charcoal, 66% of them as their main fuel. However, wood was still present in 64% of households. The rate of LPG equipment in households has changed very little since the 1990s and 24% of households were equipped with a gas stove. However, only 1% of households used LPG as their main cooking energy.

According to surveys conducted in 1997, a major share of housewives found LPG to be beneficial for their health, for the cleanliness of the home, for the time saved, and for the environment. However, most of them were reluctant to give their household helpers a gas stove for fear of their ignorance and the risk of explosion. LPG was considered as dangerous and many stories of accidents circulated in town. In 2015, fears about LPG had not disappeared. The surveys carried out in 2015 showed that the three factors explaining this lack of LPG use had not changed since 1990: i) the fear related to the dangers of fire and explosion (42%); ii) the lack of knowledge of this product and its use (28%) despite more than 30 years of promotion; iii) the initial acquisition cost of appliances and cylinders. The cost of refilling and, lastly, the price of LPG did not appear to be decisive criteria for household choices.

6. Synthesis and discussion

The MLP analysis showed that all elements designed by the international experts (in particular from the World Bank) and the heads of the Malian government, at macro and meso levels, seemed aligned for destabilization of the dominant woodfuel regime and successful transition to LPG: renewal of stakeholders, new rules for fuelwood production, new tax and price system, subsidies for domestic LPG, LPG niche promotion campaigns. At niche level, the price of LPG had been lowered to equal that of charcoal in 2000, new powerful players were present (national and international oil companies), and LPG had national and international support.

However, the analysis showed, above all, that these destabilization elements were not enough to bring out the LPG niche. The Multi-Level Perspective offered us two main explanations for this lack of change. The first is that the formal institutions (government, local gas companies, AMADER) were too weak and unstable to maintain a favourable environment ensuring the development of the gas niche: subsidies were hazardous, investment capacities were too low, commercial rules were not respected, etc. The second is that the informal woodfuel regime was tremendously flexible and capable of adapting to any attempt at destabilization: woodfuel traders multiplied, they adapted their supply circuits and practices, they forged new links with the producers and the forest administration, they proposed a new product, charcoal, and ultimately they resisted the new tax pressure.

These observations are consistent with those made by Ramos et al (2018), but also by S. Jaglin and M.H. Zérah (2010) in the water sector, on the difficulty of formal regimes in destabilizing and changing informal institutions. They also agree with Hansen et al (2018) on the difficulty of understanding the notion of stability and defining its role in change processes in informal regimes.

However, the informal dimension of the regime and a simple vertical analysis do not explain everything, in particular why gas is appreciated by consumers, why its price has been almost as expensive as charcoal for a long time, why it is present in 25% of household kitchens, but also why it is not used for cooking. The SPT analysis provided additional explanations from the point of view of cooking, purchasing and eating practices. The routines of purchasing in market places, in small quantities, cooking outdoors, eating large meals with many guests do not converge towards the model of LPG cooking, as illustrated in figure 4.

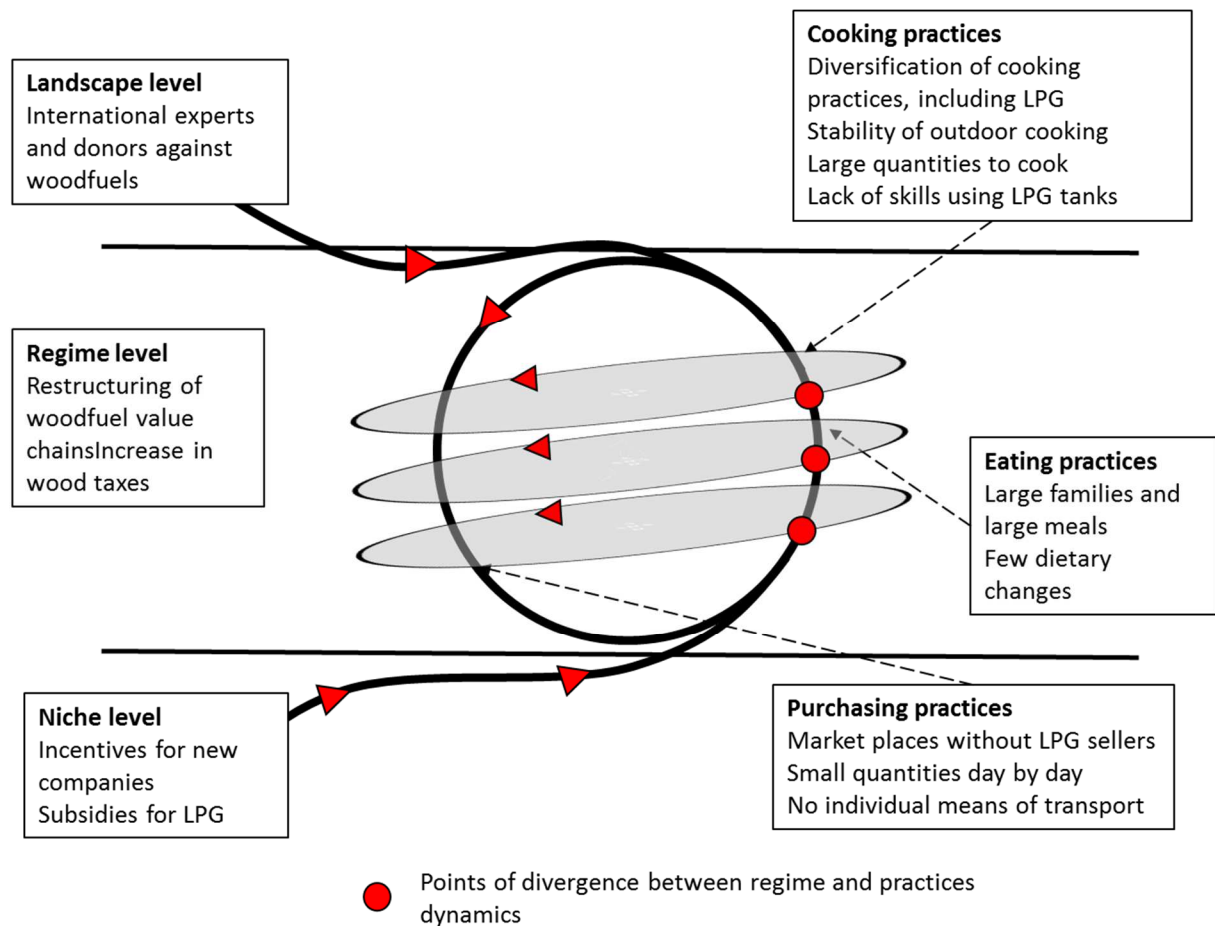


Figure 4: The points of divergence between cooking practices and the emergence of LPG in Bamako.

Firstly, it showed how the practice of cooking has evolved with the availability of new fuel sources, particularly charcoal and therefore, it showed that the shift from one source to another, such as to LPG, does not appear as a transition step to another cleaner source of energy, but rather as a new opportunity to diversify ways of cooking. This freedom of choice echoes an amplified demand in urban areas, where diversity in the rhythms of life and the large range of buyable foods affect the diversity of cooking habits. Secondly, purchasing practices have not changed. The purchase of commercial goods continues to take place on city markets and in small local shops. This lack of evolution can be explained by the cultural attachment to market buying, but also by the lack of available means of transport for Bamako dwellers. At the same time, the difficulties in the LPG sector have not allowed operators to develop their sales network and thus to get closer to consumers. And finally, the diets, the number of guests and the size of meals have changed little for many reasons. Economic crises have weakened the purchasing power of urban households and their ability to buy faster-cooking and often imported food products such as pasta or potatoes. Households have remained large and have continued to welcome family members from rural areas.

In the end, the stability of practices did not converge towards and even opposed the transition to LPG.

7. Conclusions

This article described the application of the MLP and SPT frameworks to analyse why the household energy transition in Mali has not been in favour of LPG. We showed that these two frameworks offer complementary and necessary perspectives for understanding this lack of transition in a developing country and in an informal energy regime context.

The MLP vertical approach showed how attempts to destabilize the dominant regime from above and below have been unsuccessful and how the informal regime has ultimately adapted to the new rules imposed, without moving towards a switch to LPG.

The SPT horizontal approach showed how cooking practices have remained very stable, embedded in the city's metabolism (housing, markets, lack of transport) and user habits, and ultimately were not compatible with a switch to LPG cooking.

Habits, including cooking practices, are based on regularity and reproduction. Changing or replacing these routines requires elements (materials, meaning, competence) that must be readily accessible and reliable (Shove, 2012). The study showed how the transition to LPG has failed to integrate these elements: LPG is neither physically nor financially accessible, its supply is still not regular and reliable and its use is still considered unreliable by many users.

This example shows how much a fuel change involves major changes in the habits of consumers and their relationship with their environment and cannot be summed up as a simple change in technology.

The lessons and recommendations that can be drawn from such an analysis of energy policy formulation are many. The first, also mentioned by Truffer and Coenen (2012), is that transitions cannot be understood independently of the geographical context in which they take place. The spatial characteristics of cities shape practices and are ultimately critical factors in transition processes. The second aspect is, before considering any transition, to examine energy practices: what are the materials, economics, know-how, beliefs, and elements that constitute them? The third aspect is to identify and measure the links that energy practices have with other practices in everyday life. The fourth, which follows on from the previous ones, is not only to consider the problem of domestic energy as an economic and environmental problem, as it is today, but as a problem of urban planning, mobility and social

family life, and thus to formulate policies in agreement with the stakeholders in all these fields. Lastly, it also means not considering energy sources in competition with each other, but in a complementarity of uses in response to an urban demand for flexibility.

8. Acknowledgements

We gratefully thank all the teams from the former Household Energy Project and the current FONABES project for all the field work, helpful feedback and sharing of data and knowledge.

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