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DOES INFRASTRUCTURE REFORM WORK FOR THE POOR? A CASE STUDY FROM GUATEMALA[1]

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Executive Summary

Following the 1996 Peace Accords, Guatemala embarked on a major program of infrastructure reform involving the restructuring and privatization of the electricity and telecommunication sectors. At the same time, the volume of social fund resources channeled towards rural infrastructure programs increased from US$17 million in 1993/6 to US$152 million in 1997/01. Moreover, a further US$120 million of privatization proceeds were earmarked for rural electrification and telephony.

As a result, the pace of new connections to water, electricity and sanitation services increased significantly from 80,000 new connections per year for *each* service in the period 1993/6 to 115,000 new connections per year in the period 1997/01. Moreover, households in traditionally excluded sectors—the poor, rural, and indigenous populations—were twice as likely to be the beneficiaries of a new infrastructure connection than they had been prior to the Peace Accords. Connections to modern utilities are shown to bring significant time savings to rural households, and have a substantial impact on the profitability of home-based microenterprises.

The most dramatic change came in the telecommunications sector where the teledensity index increased by a factor of five from 4.2 in 1997 to 19.7 in 2001. Much of this growth has come from cellular telephony which now accounts for 57% of all telephone subscriptions in Guatemala. Although about half of these cellular telephones represent second lines for the highest income groups, the remainder provide substitutes for fixed line telephones particularly in rural areas where they are often operated as informal public telephones. Furthermore, the number of official public telephones in rural areas has increased by 80% since the Peace Accords, so that 80% of rural households now live within six kilometers of a public telephone.

Notwithstanding the significant progress made, the achievement of universal access to modern utility services is likely to take Guatemala a further 10 years and cost the country an estimated total of US$1 billion. However, it is important to note that about a third of those households that do not have piped water and electricity, live next door to households that do have these services. This suggests that the achievement of universal access will need to address demand-side barriers in addition to financing the expansion of infrastructure networks.

Although real electricity tariffs increased by between 60% to 80% following the reform, residential consumers have been shielded as a result of a 'social tariff' policy that has kept charges at pre-reform levels of US$0.08 per kilowatt-hour for up to 300 kilowatt-hours per month. In practice, this policy—which costs US$50 million per year—does little to benefit poor households. The reason is that 60% of them are not connected to the electricity network at all, and those that are consume only small amounts of electricity and hence capture only 10% of the total value of the subsidy. By contrast, poor households without access to electricity pay the equivalent of about US$11 per kilowatt-hour (or 80 times the electricity tariff) to light their homes with candles and wick lamps. Seen from this perspective, the US$50 million per year used to finance the 'social tariff' would be better employed in financing new connections for these households.

In the water sector, where there have been no reforms, tariffs are kept well below costs at US$0.10 per cubic meter. As a result, most households pay monthly bills of between US$1 to US$2, which absorbs barely 0.5% of the household budget and is well below the 3%-5% affordability guideline used by the World Health Organization. Even then, only 70% of households report paying their water bills. Moreover consumers have little confidence in water quality, with three quarters of them either buying bottled water or undertaking some form of self-treatment. Indeed, the practice of boiling drinking water is equally prevalent among those that have and do not have piped water.

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1. Introduction

> *'Para [el desarrollo] es imprescindible la infraestructura básica, de comunicación, electrificación y la productiva. La inversión pública se deberá orientar prioritariamente con ese propósito y se establecerá un marco de incentivos a la inversión para el desarrollo rural en las áreas consideradas.'* Acuerdos de Paz, 1996.

The 1996 Peace Accords acknowledged the pivotal importance of modern utility services[4] in the Guatemalan development process, and made a commitment to expanding coverage to disadvantaged groups in order to make-up for historic neglect. This commitment has given rise to substantial changes in the utilities sectors in Guatemala. On the one hand, the electricity and telecommunications sectors have undergone profound structural transformation, through an ambitious program of privatization and market liberalization. At the same time, the volume of resources channeled towards rural service expansion has been tripled through a variety of new and existing institutional mechanisms.

Poor households typically have much lower rates of access to modern utility services than the rest of society. As a result, they often rely primarily on traditional substitutes, consuming water from local rivers, meeting their sanitation needs in the open air, lighting their homes with candles, cooking with fuel wood collected from local forests, and traveling personally over long distances to pass on messages to distant relatives or business associates.

There a number of barriers that explain why many low income households remain uncovered by modern utility networks. They include inadequate development of physical infrastructure, prohibitively high capital costs of access, or in some cases lack of cultural familiarity or information about the services in question and their advantages.

As a result of this exclusion, poor households suffer a number of handicaps. First, the unit cost of some traditional substitutes is often considerably higher than the corresponding modern alternatives. For example, lighting with candles is very much more expensive per kilowatt-hour than lighting with electricity. Similarly traveling to a distant town to relay a message is often much more expensive than making a telephone call. Again, time spent collecting and storing water may be costly in relation to the price of a piped service. Where costs are high, households may consume too little of the service to satisfy subsistence requirements. For example, households may not be able to afford enough water to meet basic hygiene needs.

Second, access to modern services can substantially enhance the productivity of households and household-based micro-enterprises. Many of the traditional substitutes for modern services are time intensive to use (for example, collecting water and fuel-wood, or relaying messages). Time liberated from these tasks can potentially be reallocated to income generating activities, or in the case of children to education. Furthermore, electricity makes possible the use of appliances that substantially increase productivity and hence income generating potential of micro-enterprises (pumps, sewing machines, power tools), while information and communication technologies enhance the availability of market information and the possibility of social and political participation.

[4] For the purposes of this discussion, modern utility services are defined to include water, sanitation, energy, and telecommunications. Water is defined as having piped water in the dwelling or yard. Sanitation is defined to include latrines, septic tanks and sewerage.

Third, some traditional substitutes for modern utility service are associated with adverse health impacts and may contribute to infant mortality. Inadequate water and sanitation may give rise to waterborne diseases, while cooking with biomass fuels has often been linked to respiratory ailments. In this sense, infrastructure could be regarded as an input into the health production function that complements hygiene practices and health care interventions.

This paper explores how the important policy changes experienced in the utilities sector in Guatemala since the Peace Accords have affected the lives of poor households. First, Section 2 examines to what extent service expansion programs have succeeded in reversing the inequities that have traditionally existed in access to modern utility services, and the barriers that remain in achieving universal coverage. Second, Section 3 looks at how tariff reforms and related subsidy policies have affected the affordability of modern utility services for the poor. Finally, Section 4 attempts to quantify the broader benefits that such services bring to poor households, in terms of improved health and productivity. A Data Annex provides a set of standard cross-tabulations of all of the basic variables of interest by geographical, ethnic and economic categories. It also gives the descriptive statistics for each of the regressions reported in the paper, as well as tabulations of the numbers underlying each of the graphics.

The analysis draws primarily on household level data collected during the ENCOVI 2000 Survey; the first survey ever to be conducted in Guatemala in accordance with the Living Standards Measurement Survey methodology. The ENCOVI covered 7,276 households, drawn from 745 census clusters of UPM (Unidad Primaria de Muestreo), and is designed to be statistically representative at the national level, and of a number of strata including urban and rural areas, the country's eight geographical regions, and the main ethnic groups established in the 1994 census[5]. In some areas, it is possible to match-up the results of the quantitative analysis against subjective perceptions of poverty recorded in a parallel Qualitative Poverty and Exclusion Study (QPES), which conducted in-depth focus group interviews in nine communities selected to represent a broad ethnic cross-section of Guatemalan society. The survey data is complemented by sectoral statistics collected directly from the key policy-making and regulatory bodies, as well as a number of donor agencies active in the country[6].

2. Recent Developments in the Utilities Sector

This section provides a brief overview of the policy context each in the three utilities sectors: telecommunications, energy, and water and sanitation services. Two important developments are documented. First, the sector reform movement that has led to a complete transformation of the telecommunications and electricity sectors, but has yet to make any impact on the water and sanitation sector. Second, the various policies that were established to promote expansion of service coverage in rural areas.

2.1 Sector Reform

Electricity

Prior to reform, electricity was provided by two state-owned companies: EEGSA, which was responsible for electricity distribution in the metropolitan region; and INDE, which controlled the

[5] Kiche, K'aqchikel, Mam, Q'eqchi, 'other Maya' and 'other indigenous'.

[6] Throughout the study, quintiles are based on per capita household consumption..

remaining generation, transmission and distribution assets nationwide. The Electricity Law of 1996 (Decreto 93-96) sought to increase investment and improve efficiency in the sector by introducing competition in electricity generation, and privatizing the distribution networks. A regulatory agency, the Comisión Nacional de Energía Eléctrica (CNEE), was created to oversee the new system.

Table 2.1: Summary of structural changes in Guatemala telecommunications sector

	Pre Reform	Post Reform
Generation	INDE monopoly	50%INDE (hydroelectric) and 50% Independent Power Producers (thermal)
Transmission	INDE monopoly	INDE monopoly
Distribution	EEGSA, DEORSA, DEOCSA	Privatized EEGSA, DEORSA, DEOCSA

In 1998, an 80% stake in EEGSA was sold to Iberdrola of Spain. While the distribution assets of INDE were broken down into two regional distribution companies, DEORSA and DEOCSA (serving the east and west of the country respectively), which were also privatized in 1998. One investor purchased both companies: Unión Fenosa of Spain.

Notwithstanding the reforms, the state-owned enterprise INDE retains a dominant position in the system. It controls about half of the country's (mainly hydroelectric) generating plants, but competes with independent power producers that control the rest of the (primarily thermal) capacity. Furthermore, INDE continues to own and operate the national transmission grid.

An important benefit of the electricity sector reform has been the rapid increase in coverage, from 53% in 1996 to 70% in 1999[7]. However, prices have also risen substantially. Under the new regulatory framework, the privatized distribution companies are allowed to pass on to the customers the variations in the purchase cost of energy. Due to the fact that the current Power Purchase Agreements signed between generators and distributors are indexed to the US dollar and the price of oil, prices have risen substantially since 1998, between 60%-80% depending on the company.

Another issue that remains problematic in the electricity sector is that of illegal connections. As reported in the ENCOVI survey, while 73% of the households report to be connected to the electricity network (95% in the urban and 56% in the rural areas), only 62% have an electricity meter (78% in the urban and 50% in the rural areas). The lack of a meter suggests that these households are illegally connected, or at best, that the amounts they pay for the service are not proportional to their monthly consumption.

Telecommunications[8]

Until 1996, telecommunications services in Guatemala were the monopoly of GUATEL; a state-owned enterprise created in 1971. By the mid-1990s, there was growing dissatisfaction with the performance of GUATEL. Not only was the company comparatively inefficient (around 60 mainlines per 1,000 employees), but it was failing to satisfy mounting demand for telecommunications services. In 1996, Guatemala had one of the lowest teledensity ratios in Latin America with only 4.2 (fixed plus cellular) lines per 100 inhabitants. With only 350,000 fixed telephone lines in the country, unsatisfied demand was estimated at 1,000,000 lines.

[7] Official national coverage statistics provided by the regulatory agency, Comisión Nacional de Energía Eléctrica (CNEE). They are consistent with the coverage trends inferred from ENCOVI 2000 (see Section 3 below).

[8] The factual information reported in this section is either drawn from a number of World Bank Aide Memoires for the Guatemala Private Participation in Infrastructure Technical Assistance Project (Loan 4149-GU) or supplied directly by the Superintendencia de Telecomunicaciones.

The Telecommunications Law of 1996 (Decreto 94-96) paved the way for one of the most radical market liberalizations witnessed in the region (Table 2.1). All barriers to competition were removed with immediate effect, as were all regulatory restrictions on prices and quality of service. This stands in contrast to most other reforming countries in Latin America, which have tended to pass through a transitional exclusivity period—during which the historical incumbent retains much of its monopoly power—and which have tended to retain regulatory safeguards on price and quality of service even after the introduction of competition.

Table 2.2: Summary of structural changes in Guatemala telecommunications sector

	Pre Reform	Post Reform
Fixed telephony		
• Local calls	GUATEL monopoly	Privatized TELGUA plus 15 new entrants.
• Long distance calls	GUATEL monopoly	Privatized TELGUA plus 13 new entrants.
Cellular telephony	One private operator.	Three new entrants

The 1996 law also created a new regulatory agency, the Superintendencia de Telecomunicaciones (SIT). However, given the extent of deregulation in the sector, the functions of the SIT are limited to licensing and monitoring the use of the radio spectrum and resolving disputes involving telecommunications operators.

Although the privatization of GUATEL was an integral part of the reform strategy, this was delayed until 1998 owing to a variety of political and legal obstacles. In the end, due to legal obstacles, it proved necessary to transfer most of the assets of GUATEL (except for the network of rural public telephones) to a new company, TELGUA. The government then sold off a 95% stake in TELGUA via auction to the private sector; the successful (and in fact only interested) bidder being TELMEX.

An important consequence of liberalization has been the need to rebalance call charges, to remove the cross-subsidy that previously existed from long distance to local calls. As a result, local call charges increased tenfold from $0.51 per month (for the basic subscription including 200 free minutes; equivalent to $0.003 per minute), to $5.64 per month (equivalent to $0.028 per minute). However, even this falls below the estimated economic cost of around $0.030 to $0.033 per minute.

There are now more than 250 companies involved in providing the full range of telecommunications services in Guatemala. These include a number of major international investors such as Bell South, Telefónica, TELMEX, and Millicom International. Although the local telephony market continues to be dominated by TELGUA, with 95% of all fixed line subscribers, sixteen other companies have entered the market competing primarily in the most lucrative market niches, such as Guatemala City.

Competition for long distance services has been more vigorous, with fourteen players in all, and four major players. The combination of tariff-rebalancing and competition has led to dramatic reductions in long distance charges, from US$1.50 per minute to the United States in 1996, to around US$0.30 per

minute in 1998. More recently, charges have fallen to around US$0.15 per minute as a result of the introduction of the possibility of teleselection of the long distance operator[9].

In addition, four licenses have been issued for mobile telephony services. Calls are charged at around $0.14 per minute, with some calling plans costing less than $10 per month.

The reform has had a major impact on the performance of the telecommunications sector in Guatemala. The efficiency of the sector improved markedly, with the number of mainlines per 1,000 employees rising from 60 in 1996 to 130 in 1999. While, at the same time there have been massive gains in coverage.

According to SIT data, the total number of fixed plus cellular telephone lines rose almost fivefold from around 350,000 to over 1,600,000 between 1996-01, raising the teledensity index from 4.2 to 19.7. Much of this growth came from new cellular lines, which now represent more than half of the total (57%). The development of the cellular network has been less concentrated in the capital city. Whereas in 2001, 70% of the country's fixed lines were located in the Department of Guatemala, only 43% of the cells of the mobile telephony network were located in that Department.

Water and sanitation

Although sector reforms have been under discussion for some years in the water sector, it has not been possible to reach a political consensus on this issue.

At present, the provision of water and sanitation services in the metropolitan region remains the responsibility of the state-owned enterprise EMPAGUA. EMPAGUA serves about 70% of the market in the central city area (falling to 50% if the surrounding municipalities are taken into account). More than 200 private companies meet the shortfall in demand, of which the largest are Aguas de Mariscal and San Cristóbal, but the majority are small-scale operations serving a specific neighborhood or housing estate. A recent study (Solo, 1999) found that whereas charges by the main utility fell in the range $0.09-$0.42 per cubic meter depending on the consumption group, charges applied by alternative suppliers were substantially higher at between $0.25-$2.70 per cubic meter.

Table 2.3: Summary of the structure of the Guatemala water and sanitation sector

Metropolitan area	50% EMPAGUA, 50% small scale private operators
Non-metropolitan urban areas	Municipal utilities
Rural areas	Community Based Organization with support from central government UNEPAR

Outside of the metropolitan region, the country's 240 municipalities are responsible for providing water and sanitation services, at least in urban areas. However, they do not tend to reach isolated rural areas, where community-based organizations typically take charge of services, often with some financial support from central government via the Unidad Ejecutora del Programa de Acueducto Rural (UNEPAR) or from the various social investment funds.

[9] The lower cost of international calls is an important consideration for the approximately 10% of households in Guatemala who obtain about 10% of their income from international remittances.

A number of recent sector reviews[10] comment on the precarious financial position of many of the service providers, due to the relatively low level of water tariffs and the political unwillingness to raise them closer to cost recovery levels.

According to the ENCOVI survey, 69% of households have piped water and 87% of the households have some form of sanitation; although only 38% are connected to the sewerage network.

2.2 Peace Accords

The 1996 Peace Accords acknowledged the pivotal importance of modern utilities in the development process, and the historical neglect of the infrastructure needs of rural and disadvantaged urban communities. Although no quantitative targets were set, the Peace Accords made concrete commitments to expanding coverage of electricity, water and sanitation, as well as public telephones.

Following the Peace Accords, two main mechanisms were used to channel greater volumes of finance into (particularly rural) infrastructure.

First, both in the electricity and telecommunications sectors, some of the proceeds of privatization were earmarked to finance rural expansion programs.

In the electricity sector[11], the net sale revenues from the privatization of the two non-metropolitan distribution companies (DEORSA and DEOCSA), totaling US$110 million, were placed in a trust fund to be used to finance a five-year rural electrification program (PER). The fact that the government was willing to sacrifice such a significant sum of potential fiscal revenue to support rural service expansion is unusual within the Latin American experience of privatization, and indicates the degree of commitment that exists to rural electrification. The objective of the PER is to connect 2,633 communities to the national grid during the period 2000-05, at a total cost of US$333 million. The two distribution companies DEORSA and DEOCSA are contractually responsible for executing the investments. Since the program became active in 1999, almost US$55 million have been disbursed. As a result, about 23% of the coverage target has been met, with a further 5% in the pipeline. The projects executed to date suggest that the average cost of electrifying a rural household is of the order of US$1,000, which is not unusual by international standards.

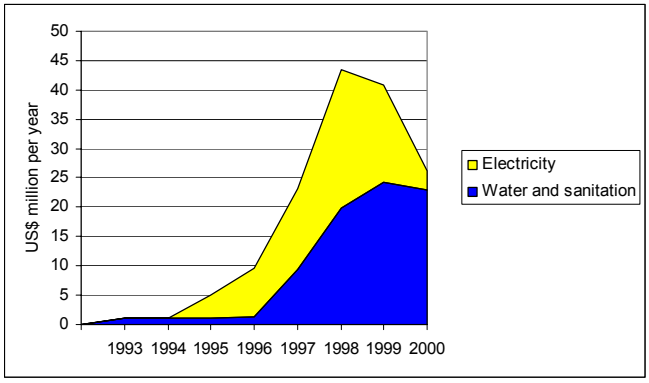
In the telecommunications sector[12], 70% of the proceeds of the spectrum auctions held for mobile telephony services (up to an annual ceiling of US$5 million) were allocated to a special fund (FONDETEL) designed to support the expansion of public telephones in rural areas. In line with best practice in a number of other Latin American countries (notably, Chile, Colombia and Peru), FONDETEL bid out the construction and operation of public telephones to the private operator requesting the minimum subsidy. Between 1998/99, FONDETEL disbursed US$7.5 million of subsidies for the installation of some 1,600 public telephones. Each US$1 of subsidy leveraged between US$2-4 of private investment, so that the total subsidy cost per town was US$4,400. However, unfortunately, the revenues from spectrum auctions have now been exhausted and no additional funding source has been identified for FONDETEL. While GUATEL - the state-owned company that continues to hold the rural

[10] See for example CEPIS, 2000 and IDB, 2001.
[11] Information provided directly by INDE.
[12] Information provided directly by FONDETEL.

telephone assets that were created prior to 1998 - has also lacked the financial resources to make any further investments.

Second, in addition to these privatization related initiatives, the existing social funds—principally FSDC, FIS and FONAPAZ—increased their investments efforts in the infrastructure sectors (Figure 2.1). Overall, the investments of these three funds in energy, water and sanitation services more than quadrupled between 1996 and 1998. However, this reflected an overall increase in social fund expenditure; rather than a shift in the portfolio of projects towards infrastructure sectors. Moreover, there is evidence that the water, sanitation and electricity investments of social funds have begun to tail-off since 1999.

Figure 2.1: Total social fund investments in rural infrastructure since 1993



Sources: FIS, FONAPAZ, FSDC

It is interesting to explore the relative importance of resources generated by the privatization process, those channeled via the social funds, and other sources of finance for rural expansion of utility services (Table 2.4). By far the largest volume of resources has gone to water and sanitation, US$153 million, versus US$99 million for electricity and US$7.5 million for public telephones.

In electricity, the volume of resources devoted to rural electrification tripled in the years before and after the Peace Accords. As well as this overall increase, the composition of financing has changed substantially. Up until 1996, about two thirds of the investment in rural electrification came from the state-owned operator INDE, whose program has since been dramatically reduced in scale. This reduction has been more than offset by a quadrupling of social fund investments, and by the beginning of the PER. The latter, which has only disbursed about 20% of its programmed expenditure to date, will become increasingly important over time as social fund investments appear to be tailing-off.

In telecommunications, the rural investment activities of GUATEL were substantial prior to the Peace Accords but came to a halt following the privatization and sector restructuring exercise that divested the state-owned company of all its assets except for the rural telephones, thereby curtailing its ability to finance further projects. While GUATEL continued to operate existing rural telephones, FONDETEL became responsible for constructing further rural telephones, which it did by contracting with private sector operators. The FONDETEL program rapidly succeeded in almost doubling the number of rural public telephones (from 2,000 to 3,600) in a very short period, with a fraction of the resources absorbed by GUATEL in the earlier period (US$7.5 million versus US$46.0 million), largely due to its ability to leverage private capital.

Table 2.4: Summary of rural infrastructure initiatives since 1996

Sector	Initiative	Description	Funds Invested (US$ million) 1993-1996	Funds Invested (US$ million) 1997-2000
Electricity			**32.6**	**99.0**
	PER	• *Programa de Electrificación Rural*: A program incorporated into the concession contracts of the two non-metropolitan distribution companies (DEORSA and DEOCSA). The two companies are required to extend grid access to 280,000 households in 2,700 communities over the period 2000/05. The property of the assets financed by PER will revert to the state. INDE will be responsible for operating transmission assets, and DEORSA and DEOCSA for the distribution assets. About a quarter of the target communities are in the department of Quiche, and the average size of the communities is around 500 inhabitants. The total cost of US$333 million, will be financed in part by the net proceeds of privatizing DEORSA and DEOCSA (US$110 million).	0.0	36.1
	FSDC	• *Fondo de Solidaridad para el Desarrollo Comunitario*: The largest of the country's three main social funds, financed primarily financed by central government, and providing a range of services requested by communities including electrification. Covers mainly rural communities.	12.2	57.3
	INDE	• *Instituto Nacional de Electrificación.* The statutes of the company require that it devotes any operating surplus to rural electrification projects. These have tended to involve mini-grid projects and grid extensions for communities close to the Mexican border.	20.4	5.6
Telephony			**46.0**	**7.5**
	FONDETEL	• *Fondo de Telecomunicaciones*: A fund established from the proceeds of spectrum license auctions. Bids out minimum subsidy concessions for private operators to build and operate public telephones in rural communities.	0.0	7.5
	GUATEL	• *Guatemala Telecom*. The state-owned enterprise that owns and operates the state's network of rural public telephones. During the period 1993-96, the company invested $46 million with finance from IDB and EXIMBANK to provide services to 1,150 rural communities. Lack of investment finance has prevented further progress since privatization, although a new project for 1,324 rural communities is in process to be financed by FONAPAZ and BCIE.	46.0	0.0
Water and Sanitation			**NA.**	**153.1**
	FIS	• *Fondo de Inversión Social*: One of the country's largest three social funds, financed predominantly by international donors, providing a range of services requested by communities including water and sanitation. Covers primarily rural communities.	0.4	29.6
	FONAPAZ	• *Fondo Nacional para la Paz*: One of the country's largest three social funds, financed predominantly by international donors, providing a range of services requested by communities including water and sanitation. Focuses on areas that were most affected by the armed conflict.	4.1	7.8
	FSDC	• *Fondo de Solidaridad para el Desarrollo Comunitario*.	0.0	64.4
	UNEPAR	• *Unidad de Proyectos de Acueductos Rurales:* The public entity responsible for finance and TA to rural water projects. In 1997, was transfered from the Ministry of Health to the Instituto de Fomento Municipal (INFOM). Finance comes from IDB and KFW among others.	NA.	51.3

In water and sanitation, the investments made by the social funds since the Peace Accords represented about two thirds of the total, with the remainder being supplied by the central government's rural water program UNEPAR. The total value of UNEPAR's investments in the years prior to the Peace Accords is not known, however they are unlikely to have been as high as those currently allocated by the social funds, and hence overall it seems likely that the volume of resources devoted to rural water and sanitation project has increased substantially.

3. Impact on Service Coverage

3.1 The coverage situation[13]

The current coverage situation in Guatemala, as portrayed by the ENCOVI survey, is summarized in Table 3.1. Sanitation (broadly defined to include latrines, septic tanks and sewerage) is the service with the highest level of coverage, followed by electricity, water, sewerage and telephony. The gaps between urban and rural coverage are lowest for sanitation, and highest for sewerage and telephony. Water and sanitation are those with the most egalitarian distribution, while sewerage and telephony are the least egalitarian.

Table 3.1: Coverage of utilities (service by service)

(Proportion of households)

	National	By area		By quintile				
		Urban	Rural	1	2	3	4	5
Electricity	.73	.95	.56	.39	.64	.78	.90	.95
Water	.69	.88	.54	.50	.62	.63	.76	.92
Sanitation	.87	.97	.79	.73	.80	.88	.95	.98
Sewerage	.38	.76	.09	.06	.18	.32	.54	.81
Fixed telephone	.15	.31	.03	.003	.01	.03	.14	.58
Cellular telephone	.10	.18	.03	.001	.01	.03	.11	.34
Community public telephone	.64	.89	.44	.37	.53	.65	.79	.83

No service = lack of all network services and latrine.

Network services = electricity, piped water in dwelling or field, telephone (fixed or cellular), and toilet connected to sewerage.

Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística - Guatemala

While it is conventional to report separate statistics on the coverage of different services, in terms of understanding quality of life, it is informative to consider the combinations of utilities services that people have access to (Table 3.2). The results show that one in six Guatemalan households has no access to any modern network services (electricity, piped water, sewerage or telephony). In rural areas the proportion rises to almost one in three; while in the lowest consumption quintile it is as high as two in five. At the other end of the spectrum, one in six Guatemalan households has access to all four network services, with the ratio rising to one in three for urban areas.

It is interesting to question which is the first service to reach those Guatemalan households that only have access to one of the network services (Table 3.3). The statistics show that in about 60% of cases the only service available in the household is electricity, and in the other 40% of cases water. The greater prevalence of electricity services holds good for almost every sub-category of the population except for the poorest. Where only two services are available, they are invariably water and electricity, while households with only three services most typically have electricity, water and sewerage.

[13] See Annex D for definitions of coverage, takeup, and availability.

Table 3.2: Coverage of utilities (in combination)

(Proportion of households)

	National	By area		By quintile				
		Urban	Rural	1	2	3	4	5
No network service	.16	.02	.27	.39	.21	.15	.06	.02
One network service	.23	.09	.34	.33	.32	.29	.27	.04
Two network services	.28	.22	.32	.26	.37	.34	.32	.11
Three network services	.18	.34	.06	.02	.09	.20	.31	.27
Four network services	.15	.32	.01	.001	.01	.03	.14	.56

No service = lack of all network services and latrine.

Network services = electricity, piped water in dwelling or field, telephone (fixed or cellular), and toilet connected to sewerage.

Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística - Guatemala

Table 3.3: Specific combinations of utility services

(Proportion of households)

	National	By area		By quintil				
		Urban	Rural	1	2	3	4	5
One network service	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Electricity	.57	.79	.53	.34	.52	.75	.78	.69
Water	.42	.19	.47	.65	.47	.25	.22	.25
Phone	.004	.01	.003	0	.01	0	0	.06
Sewerage	.001	.01	0	.001	.002	.002	0	0
Two network services	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Electricity and water	.93	.88	.95	.99	.97	.97	.84	.72
Electricity and phone	.04	.07	.02	0	.002	.004	.10	.14
Electricity and sewerage	.02	.03	.01	0	.01	.01	.04	.04
Water and phone	.01	0	.01	0	.01	.001	.01	.07
Water and sewerage	.01	.02	.001	.01	.004	.01	.01	.03
Phone and sewerage	0	0	0	0	0	0	0	0
Three network services	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Electricity, water and phone	.19	.14	.44	.11	.06	.13	.16	.31
Electricity, water and sewerage	.80	.85	.53	.89	.94	.87	.81	.66
Electricity, phone and sewerage	.01	.01	.03	0	0	0	.02	.02
Water, phone and sewerage	.005	.004	.01	0	0	0	.004	.01

Network services are electricity, piped water in dwelling or field, telephone (fixed or cellular), and toilet connected to sewerage.

Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística - Guatemala

From the previous figures, it is not possible to say whether the higher prevalence of electricity rather than water in single-service households reflects a preference on the part of the household or simply greater success in rolling out electricity networks versus water networks. In order to shed some light on this question, attention is focused on that subset of the population that live in communities where both services are available (Table 3.4). The results show that such households are twice as likely to choose an electricity connection than a water connection, and that this relationship holds across almost all sub-categories, except the first quintile where households are a little more likely to choose the water service. A possible explanation for this is that electricity connections are free of charge, at least in urban areas, whereas water connections entail paying a significant connection fee (see Table 3.14 below).

Table 3.4: Choice between electricity and water

(Proportion of households, among with only one service and in census tract where both water and electricity are available)

	National	By area		By quintile				
		Urban	Rural	1	2	3	4	5
Electricity	.63	.69	.60	.44	.59	.76	.79	.63

Water	.31	.31	.40	.56	.41	.24	.21	.37

Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Another way of exploring the relative value that households place on different services is to consider how much extra they are willing to pay to rent a dwelling that—other things being equal—has access to utilities. This rental premium can be estimated using a hedonic function that models rental payments (or estimated rental payments in the case of owner-occupied housing) as a function of the availability of utilities and of a wide range of variables that affect the price of housing (geographical location, quality of construction, size and age of dwelling, facilities). For full details of the model see Table A5 of the Data Annex. The results show that utility services attract statistically significant rental premia, which represent a substantial percentage of the rent. Although the results vary by geographical zone, telephone services typically attract the highest rental premium, followed by electricity and water.

Table 3.5: Rental value of access to modern utility services

	Metropolitan (urban and rural)	Urban (non-Metropolitan)	Rural (non-Metropolitan)
Predicted rent in Quetzales	794	379	159
Value as a % of rent			
Water	48%***	0.3%	-1%
Drainage	2%	9%*	17%**
Electricity	9%	31%***	18%***
Telephone	56%***	22%***	32%***
Value in Quetzales			
Water	379***	1	-2
Drainage	16	32*	27**
Electricity	72	118***	29***
Telephone	447***	82***	51***

Notes: Values calculated from the regional-specific hedonic price function estimations.
Significance level of corresponding variables in the hedonic model: *** 99% level. ** 95% level,* 90% level.
Metropolitan includes urban and rural in this region, while urban and rural exclude the Metropolitan region.
Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

3.2 International context

To put these findings in an international context, comparable figures are presented for three neighboring Central American countries: El Salvador, Nicaragua and Panama (Table 3.6). Coverage levels in Guatemala lie towards the middle of the range for this peer group; in general, they are somewhat better than those in Nicaragua and El Salvador, but not as good as those in Panama. Finally, the pattern of access to modern utilities across consumption quintiles in Guatemala is very similar to that found in neighboring Central American countries (Figure 3.1). This illustrates that the degree of inequity in access to basic services found in Guatemala is typical of the Central American region.

Table 3.6: Central American comparisons of urban and rural coverage

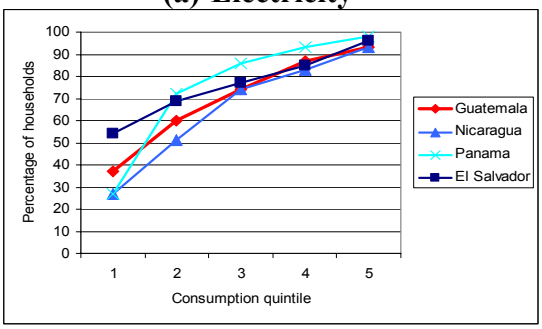
(Percentage of households)

	Electricity			Piped water♦			Basic sanitation♣			Telephone		
	Nat'l	Urban	Rural	Nat'l	Urban	Rural	Nat'l	Urban	Rural	Nat'l	Urban	Rural
Guatemala	70	92	54	69	88	54	87	97	79	20	40	5
El Salvador	80	95	55	52	69	25	81	85	74	20	32	1
Nicaragua	69	91	40	61	95	74	84	95	70	16	16	1
Panamá	79	98	52	86	95	74	93	99	86	41	62	11

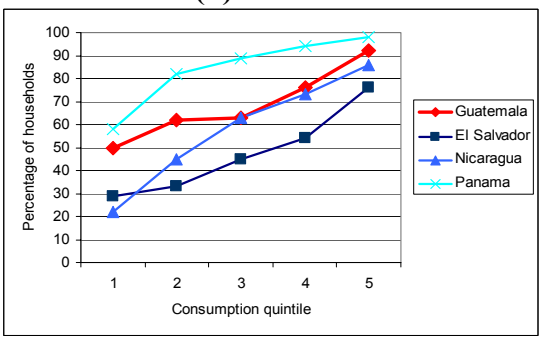
Notes: ♦Piped water in dwelling or yard. ♣ Includes toilets and latrines. El Salvador and Honduras quintiles based on income aggregate.
Sources: El Salvador (Encuesta de Hogares de Propósitos Múltiples 1997); Guatemala (ENCOVI 2000, Instituto Nacional de Estadística - Guatemala); Honduras (Encuesta Nacional de Ingresos y Gastos de los Hogares, 1999); Nicaragua (LSMS 1998-99); Panama (LSMS 1997).

Figure 3.1: Central American comparisons for equity of coverage

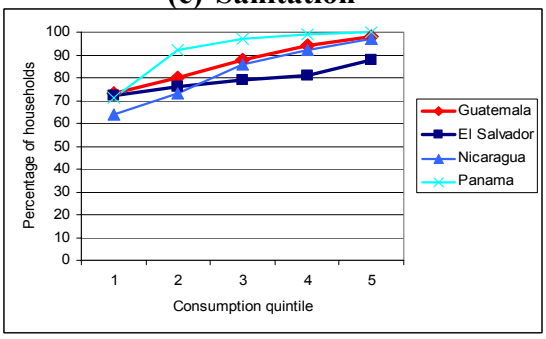
(a) Electricity



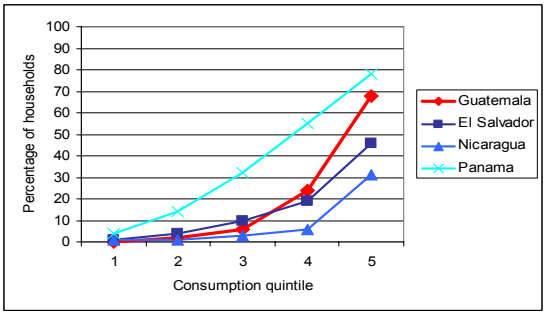
(b) Water



(c) Sanitation



(d) Telephone



Sources: El Salvador (Encuesta de Hogares de Propósitos Múltiples 1997);
Guatemala (ENCOVI 2000, Instituto Nacional de Estadística - Guatemala);
Honduras (Encuesta Nacional de Ingresos y Gastos de los Hogares, 1999);
Nicaragua (LSMS 1998-99);
Panama (LSMS 1997).

3.3 Historical context

It is important to understand how current levels of coverage have been reached, an in particular the extent to which the greater volume of resources devoted to service expansion following the Peace Accords is reflected as faster growth of coverage.

Expansion of electricity, water and sanitation

Historical trends show that the rate of increase of coverage accelerated after the major policy changes introduced in 1996[14] (Figure 3.2). For all three services (electricity, water and sanitation), coverage improved by close to 15 percentage points over the subsequent four years (1997-00) compared with just over 10 percentage points over the previous four years (1993-96)[15]. Clearly, it is difficult to attribute the causality for this acceleration to the Peace Accords and to the structural reforms introduced at that time. Other factors—notably economic growth and urbanization—could equally have been at work. Nonetheless, the fact that neither GDP per capita nor urbanization rates increased substantially over this period makes it more likely that the observed improvements were at least partially attributable to changes in the policy environment and increases in public investment[16].

However, coverage statistics can be misleading because they confound growing numbers of connections with growing population. To disentangle these effects, Table 3.7 reports the absolute number of new connections made in the period before and after the Peace Accords. The results confirm that the rate of service expansion was in general about 50% higher in the years following the Peace Accords, and that these differences are statistically significant (in most cases at the 99% level). Furthermore, the acceleration of coverage was quite generalized affecting both urban and rural areas, as well as poor and non-poor populations. Moreover, the changes in the number of new connections per year were largest (in percentage terms) and most significant in the case of poor and rural populations.

On reflection, it is not entirely surprising that new connections went disproportionately to traditionally disadvantaged groups, since most other groups in society were already being served. Therefore, in order to detect whether there has really been an improvement in targeting of services towards socially excluded groups, it is necessary to normalize the number of new connections they received against the size of the corresponding unserved population in each group. In other words, it is necessary to compare the probability that an unserved household in any particular category would become connected during the period immediate preceding and following the Peace Accords (Table 3.8).

[14] It is important to explain how this historical series was derived. Due to the paucity of earlier household surveys in Guatemala, the historical series is based on a question in the ENCOVI 2000 survey that asked households to recall the year in which they had first received these services. Hence, the accuracy of the historical trend is contingent on the accuracy of households' recollection. It has been noted in the literature that respondent recall in household surveys can sometimes be affected by a phenomenon known as 'telescoping' whereby events are recalled as being more recent than they actually were. Such a phenomenon, if present, would create the impression that coverage growth had been more rapid in recent years.

[15] Where possible coverage rates derived from the ENCOVI have been compared with official figures. In the case of electricity, the current estimated coverage of 70% coincides precisely with that reported by the Ministry of Energy. While rural water coverage of 54% is almost identical to that reported by UNEPAR.

[16] Average GDP per capita was US$1,449 for 1993/96 and US$1,532 for 1997/00. While urbanization stood at an average of 38.6% for 1993/96 and 39.4% for 1997/00.

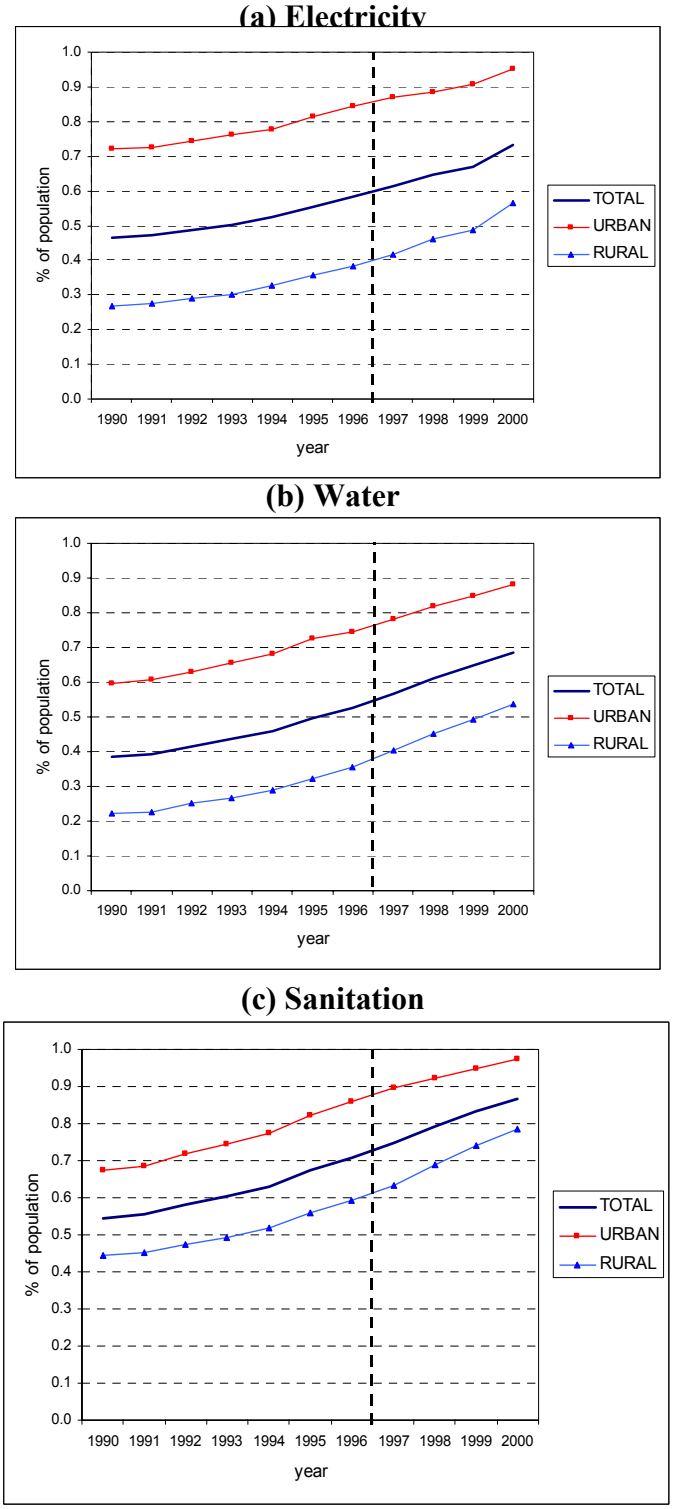
Table 3.7: New connections in a three year period before and after the Peace Accord

(Number of new connections)

	Electricity	Piped water♠	Sanitation♦
National			
1993-1996	208,518	240,069	281,106
1997-2000	329,734***	352,336***	350,418**
% change	58%	47%	25%
Urban			
1993-1996	92,823	109,453	134,692
1997-2000	105,009	128,593	109,792
% change	13%	17%	-18%
Rural			
1993-1996	115,695	130,616	146,414
1997-2000	224,725***	223,743***	240,626***
% change	94%	71%	64%
Extreme poor			
1993-1996	13,662	24,253	27,979
1997-2000	33,135***	43,091**	38,674*
% change	143%	78%	38%
All Poor			
1993-1996	95,296	108,754	132,815
1997-2000	180,842***	184,682***	176,028**
% change	90%	70%	33%
Non-poor			
1993-1996	113,222	131,315	148,255
1997-2000	148,892*	167,654*	174,390
% change	32%	28%	18%
Indigenous			
1993-1996	87,785	105,547	114,052
1997-2000	142,414***	153,789***	137,572
% change	62%	46%	21%
Non-indigenous			
1993-1996	117,976	133,965	166,007
1997-2000	186,392***	195,611***	209,926*
% change	58%	46%	26%

Notes: Based on household recall of the year in which they were first connected
The null hypothesis of equality of the number of users before and after
Peace Accord is rejected at: *** 99% level. ** 95% level,* 90% level.
♠ Piped water in dwelling or yard. ♦ Includes toilets and latrines.
Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística - Guatemala

Figure 3.2: Historical coverage trends



Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística - Guatemala

Table 3.8: Probability that an unserved household was connected

(Proportion of unserved households receiving a connection)

	Electricity	Piped water♣	Sanitary services♦
National			
1993-1996	.19***	.19***	.31***
1997-2000	.36	.34	.55
% change	89%	79%	77%
Urban			
1993-1996	.38***	.31***	.50***
1997-2000	.70	.53	.82
% change	84%	71%	64%
Rural			
1993-1996	.13***	.14***	.22***
1997-2000	.29	.28	.48
% change	123%	100%	118%
Extreme poor			
1993-1996	.06***	.13***	.21***
1997-2000	.17	.26	.37
% change	183%	100%	76%
All Poor			
1993-1996	.13***	.15***	.25***
1997-2000	.28	.29	.44
% change	115%	93%	76%
Non-poor			
1993-1996	.29***	.24***	.38***
1997-2000	.55	.41	.72
% change	90%	71%	89%
Indigenous			
1993-1996	.16***	.18***	.30***
1997-2000	.30	.32	.52
% change	88%	78%	73%
Non-indigenous			
1993-1996	.21***	.19***	.31***
1997-2000	.42	.35	.57
% change	100%	84%	84%

Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística - Guatemala

Notes: The null hypothesis of equality of the probability of coverage before and after Peace Accord is rejected at: *** 99% level. ** 95% level,* 90% level.

♣Piped water in dwelling or yard. ♦Includes toilets and latrines.

At a national level, the probability of an unserved household receiving a connection increased by approximately 80% for electricity, piped water and basic sanitation. All types of households, irrespective of location, poverty or ethnicity experienced a statistically significant increase in the probability of being connected. Moreover, traditionally disadvantaged groups gained disproportionately, increasing their probability of being connected by well over 100% in most cases. For example, the probability of being connected increased by 183% for the extreme poor, 115% for the poor, and 90% for the non-poor.

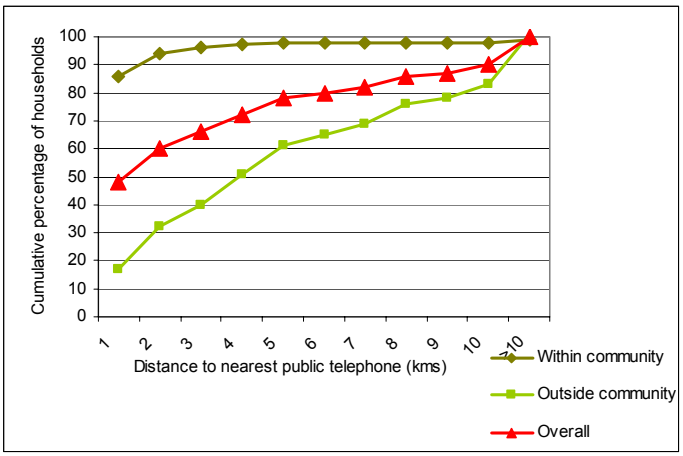
However, this disproportionate gain has not been enough to compensate for the lower initial probability of being connected for members of traditionally disadvantaged groups. Thus, notwithstanding the large percentage gains, in absolute terms the probability that a family in extreme poverty receives an electricity connection (at 0.17) is still lower than the probability for a family in poverty (at 0.28), and substantially lower than that for a non-poor household (0.55). Some indigenous groups also still have a relatively low probability of being connected, in particular the Q'eqchi (for electricity and water). However, other indigenous groups actually have a higher probability than average of receiving a connection, in particular the Ki'che and Kaqchikel (for electricity).

Expansion of telecommunications

The ENCOVI survey does not provide information on historical coverage trends for telecommunications at the household level. However, it is possible to trace the evolution of rural public telephones. As of 1996, GUATEL was operating some 2,000 rural public telephones, while FONDETEL added a further 1,600 between 1998/9.

Although, only about a third of the country's 19,000 rural *towns* have a public telephone service[17], the ENCOVI reveals that 50% of rural *households* have a public telephone in their community. This reflects the fact that the larger rural communities tend to be the first to receive a public telephone. For those living in unserved communities, the average distance to the nearest public telephone was 7.2 km (or about a 45 minute trip).

Figure 3.3: Distance to public telephone for rural households



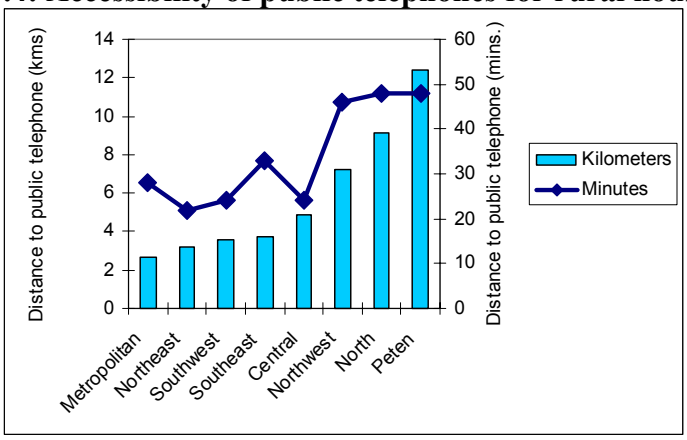
Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Overall, 80% of rural households in Guatemala live within 6 km of a telephone (Figure 3.3). However, the pattern differs significantly by region (Figure 3.4). The North and Northwest of the country, together with Petén, have the worst levels of access to public telephones with average distances of 6-12 km and average journey times of around 50 minutes. By contrast, in all other regions the average distance to a public telephone is less than 5 km representing typically a half hour trip. Fewer than 10% of rural households claimed to have spent money on making a public telephone call the day before the survey[18].

[17] Information supplied by FONDETEL.

[18] Unfortunately, the ENCOVI survey groups together expenditure on public telephone calls, faxes and postal services. The percentage reported relates to the number of people who registered non-zero expenditure in this category. Hence, it is very much an upper bound estimate for the proportion of rural households that are using public telephones. However, given the relatively scarce availability of facsimile and postal services in rural areas, it seems probable that quite a high proportion of these expenditures relate to public telephone calls.

Figure 3.4: Accessibility of public telephones for rural households by region



Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística - Guatemala

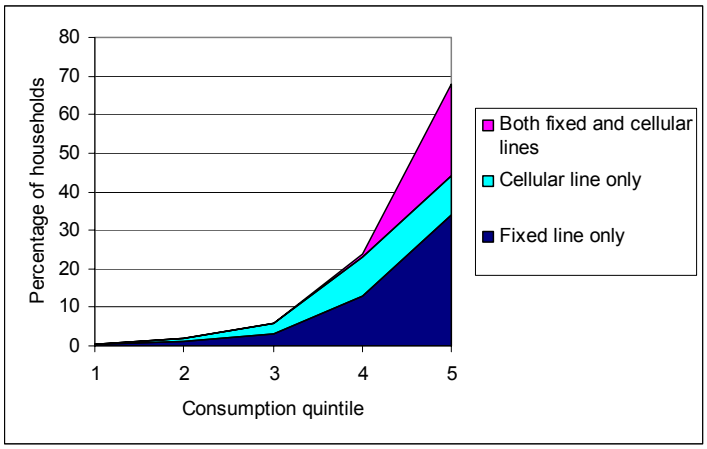
As of 2000, 20% of households in Guatemala claimed to have access to either a fixed line and/or a cellular telephone, although coverage rates differ substantially between urban areas (40%) and rural areas (5%). About 74% of Guatemala households continue to obtain their telephone service from TELGUA. With 16% of the household market, COMCEL is the most significant competitor to TELGUA; it has the second largest fixed lines business in the country, as well as a substantial presence in the cellular market. Moreover, it has developed a particular presence in the rural areas where it is the primary service provider for 29% of households.

There is a widespread anecdotal perception, not only in Guatemala, but throughout Latin America, that the advent of cellular telephony has helped to 'democratize' the telephone. However, to date, very few household surveys make it possible to distinguish between fixed and cellular telephone ownership. The ENCOVI is unusual in this respect, and hence it is interesting to examine ownership patterns across consumption quintiles (Figure 3.5). The results appear to indicate a high degree of concentration of cellular telephones in higher consumption quintiles, with more than 80% being held by the top two quintiles. Indeed, about half of all cellular telephones in Guatemala are second telephones belonging to households in the highest consumption quintiles.

However, on closer inspection, cellular telephones have become a very important phenomenon for certain other groups. For example, in the second and third quintiles, although cellular telephones are only held by a small minority, there are in fact equal numbers of households with fixed and cellular telephones. The same is true in rural areas, where there are equal numbers of fixed and cellular subscribers, and where two thirds of the households with cellular telephones have no other telephone service and are hence using the device as a substitute for a fixed line service. This is in contrast to urban areas where fixed telephones still outnumber cellular ones by 1.7 to 1.0.

Finally, this data may understate the full importance of cellular telephony in rural areas. On an anecdotal basis, the interview teams for the ENCOVI survey reported that cellular telephones are quite widely used to provide an informal public telephone service in rural areas, with the owner of the telephone allowing his neighbors to make calls on a charged out basis. However, unfortunately, it is not possible to corroborate this phenomenon with the ENCOVI data.

Figure 3.5: Access to fixed and cellular telephones



Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística - Guatemala

3.4 The remaining deficit

Notwithstanding this progress, a significant coverage gap remains (Table 3.9). Well over half a million households are still without electricity and piped water. Some 200,000 are without any form of sanitation, while about 1.3 million rely on latrines as opposed to conventional sewerage. The households that remain unserved are predominantly rural and predominantly poor.

Table 3.9: Coverage gap for modern utilities

(Number of unserved households)

	Electricity	Piped water♣	Basic sanitation♦	Improved sanitation	Total no. of households
National	585,933	686,893	288,807	1,353,895	2,191,451
By area					
Urban	45,189	113,235	24,156	224,291	951,654
Rural	540,744	573,658	264,651	1,129,604	1,239,797
By quintile					
1	266,931	220,182	116,340	411,318	438,437
2	155,116	163,797	84,249	349,173	427,908
3	98,428	164,199	52,064	304,708	446,068
4	44,513	104,894	25,003	203,850	442,583
5	20,945	33,821	10,161	84,846	436,455

Notes: ♣piped water in dwelling or yard; ♦includes toilets and latrines.

Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

From Table 3.7 it can be inferred that the typical annual rate of service expansion at present rates was around 115,000 new connections for electricity, water and sanitation. Given current levels of population growth of around 2.6% per annum, with this rate of expansion it will take more than eight years to reach universal coverage for all services except for basic sanitation (Table 3.10). Only a doubling of current rates of expansion, or a stabilization of population, would permit universal coverage to be reached in the medium term; that is between 3 to 12 years depending on the service.

Table 3.10: How far away is universal coverage?

(Anticipated date of universal coverage)

	Present effort levels sustained	Present effort levels doubled
Electricity	2006	2003
Water	2007	2004
Basic sanitation	2003	2002
Improved sanitation	2014	2007

Note: It is assumed that population growth remains at historically observed rates of 2.6% per annum and that household size remains constant.

Based on typical unit costs for service expansion, the total cost of meeting universal coverage across the electricity, water and sanitation services is estimated at US$1.5 billion (Table 3.11). The electricity service, owing to its relatively high unit cost of US$1,000 per household, accounts for over 40% of this total expenditure, compared with 25% for piped water. In the case of sanitation, two levels of universal service are defined. The first level is universal *basic* sanitation, which basically entails providing latrines to the 288,807 households that currently have no form of sanitation, and would cost less than US$15 million to achieve. The second level is universal *improved* sanitation. This entails providing sewerage to all households in conurbations with greater than 50,000 population (notably the Metropolitan area, Quetzaltenango, and Escuintla)[19], and upgrading all other households to a flush toilet with a septic tank. This is a very much more expensive proposition, accounting for almost a third of the overall expansion costs.

Table 3.11: Cost of reaching universal coverage

	Coverage gap (connections)	Unit cost♣ (US$ per connection)	Total cost (US$)	Share of total cost
Electricity	585,933	1,000	585,933,000	40.1%
Water	686,893	500	343,446,500	23.5%
Basic sanitation	288,807	100	28,880,700	2.0%
Improved sanitation	1,148,702	250	287,175,500	19.6%
• Large cities	205,193	750	153,894,750	10.5%
• Elsewhere	585,933	1,000	585,933,000	40.1%
Public telephones	12,730	5,000	63,650,000	4.4%
Total			1,462,980,450	100.0%

♣ Estimates provided by Kilian Reiche (electricity) and Franz Drees (water and sanitation) from the Finance, Private Sector and Infrastructure Division of the Latin America and Caribbean Region of the World Bank

In the case of water and sewerage services, international experience suggests that the costs of universalizing access could be reduced by as much as 40% if innovative 'condominial' designs are adopted and implemented through community participation (Foster, 2001). The 'condominial' approach to water and sewerage networks was pioneered in Brazil in the 1980s and has recently been applied with some success in Bolivia. The approach involves altering the engineering design of the water or sewerage network so that instead of providing a separate branch from the main network to each household, a single branch is provided to a whole block (or 'condominium') of households, who then make their connections along this common branch. This saves costs by reducing the length, diameter and depth of

[19] For the purposes of this analysis it was only possible to estimate the coverage deficit for the Metropolitan region.

the network needed to serve a given community, costs are further reduced by relying on community volunteer labor to construct the systems.

3.5 Obstacles to expanding coverage[20]

In order to develop a strategy for reaching unserved households, it is important to understand the reasons why these households remain unconnected at present. Broadly speaking, there are two possible explanations. The first explanation is that the service is simply not available in the communities where they live; this is essentially a supply-side problem that requires increased investment in infrastructure expansion. The second explanation is that the households fail to take-up the service even when it is available in the community; this is essentially a demand-side problem that may be less costly to overcome in investment terms, but is perhaps more complex to deal with requiring a careful diagnosis and considered policy response.

It is possible to capture this difference by comparing two indices (Table 3.12). The availability index gives the percentage of households that live in communities where the service is available, while the uptake index shows the percentage of households who live in communities where the service is available *who actually connect to the service*[21]. The results show that electricity has the highest uptake index of any of the services at 88%, followed by water, sewerage and fixed telephone. Not only are services more likely to be available in urban areas, but urban households are substantially more likely to take-up these services when they are available.

Table 3.12: Comparison of availability and uptake of services

(Percentage of households)

	Electricity			Piped water♦			Sewerage			Fixed telephone		
	Nat'l	Urban	Rural	Nat'l	Urban	Rural	Nat'l	Urban	Rural	Nat'l	Urban	Rural
Availability	83	100	70	81	95	70	51	91	20	36	68	11
Uptake	88	95	81	85	92	76	75	85	44	42	46	24
Coverage	73	95	56	69	88	54	38	76	09	15	31	03

Notes: ♦Piped water in dwelling or yard. See Annex D for definitions and calculations of Availability, Uptake, and Coverage.
Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Using these indices it is possible to calculate what proportion of the coverage deficit currently observed in Guatemala is attributable to supply-side or demand-side factors (Figure 3.7)[22]. The results indicate that, depending on the service, 20% to 40% of the coverage gap is related to purely demand-side factors and could be resolved without major investments in network expansion. Between 10% and 50% of the coverage gap, depending on service, would require both physical expansion and demand-side measures.

[20] See Annex D for an explanation of the definitions of coverage, take-up, and availability.

[21] It is important to clarify the definition of 'community'. The sampling frame of the ENCOVI 2000 was based on 'unidades primarias de muestro', which are blocks of 50 contiguous households from which 10-12 households were sampled by the survey.

[22] This breakdown is undertaken as follows. Households who live in communities where the service is available but who do not connect are counted as a demand-side only problem. For communities where the service is not currently available, the average take-up rate observed elsewhere in the country is applied to determine how many of these households could be expected to connect if the service were made available. These households are counted as a supply side only problem. All remaining households are counted as both a demand-side and a supply-side problem.

It is important to note that the cost estimates for universal coverage that were presented above were based on the assumption that new infrastructure investments would be needed to reach all households that are currently unserved. (Table 3.11). The analysis of the coverage deficit suggests that this is not in fact the case, and that a significant part of the coverage gap could be bridged by removing barriers that prevent households connecting to existing networks. Overall, it is estimated that this factor could reduce the cost of meeting universal access by as much as 30%, from US $1.4 billion to US$ 1.0 billion.

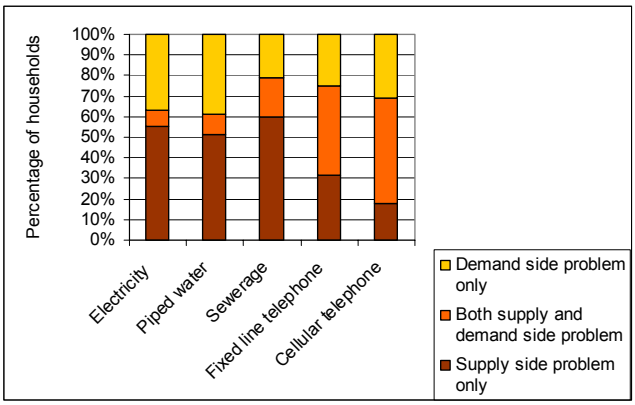


Figure 3.7: Decomposition of coverage deficit

Notes: ♦Piped water in dwelling or yard.
Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

In order to understand the correlations between specific household characteristics and the decision of whether to connect to a utility service that is already available in the community, a probit regression is used to control for other economic, cultural and geographic variables that may be related with the decision to connect to a service (Table 3.13).

Table 3.13: Take-up of modern utilities and household characteristics
(Marginal effects from probit regression are reported)

Variable	Electricity	Water	Sanitation	Sewerage	Fixed Phone	Cell Phone
Household head characteristics						
Male	-.021**	-.027**	-.003	-.081***	-.047	.047
Age	5x10-4*	.001***	7x10-4***	.001	.011***	-.002**
Years of school	.011***	.013***	.008***	.015***	.035***	.021***
Indigenous	-.016	-.004	.018**	-.067**	-.079*	-.046
Speaks Spanish	.026	.010	.016	.010	-.214*	.027
Household characteristics						
Business in dwelling	.035***	.004	.009	.009	.085**	.026
Income	.003	.007***	.007***	.013***	.025***	.007***
Urban area	.056***	.052***	.063***	.280***	-.015	-.071***
Regional dummies						
Metropolitan	.043*	.024	.007	.022	-.064	.042
North	-.041*	-.038	.031***	-.059	-.160***	-.039
Northeast	.031*	-.064	-.054**	-.106	-.034	-.010
Southeast	.021	-.024	-.059***	-.011	-.033	-.032
Central	.019	-.027	.008	.081***	-.080	-.020
Southwest	.023	.013	.002	.083**	-.035	-.016
Petén	-.070**	.020	-.080***	-.595***	-.065	.009
F (15,1043)	15.05	10.60	13.79	12.73	34.09	13.08
Observations	6,058	6,034	7,144	3,796	2,761	2,592
Population size	1,802,063	1,764,457	2,137,789	1,098,917	781,336	826,134

Results of probit regressions where the dependant variable is 1 if the household uses the service and 0 if it is does not even though available.

Significant at: * 90% level, ** 95% level, *** 99% level.
Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

The model suggests that households headed by men are significantly less likely to connect to electricity, water, and sewerage services. The propensity to connect to all services increases significantly with years of education of the head of household. Furthermore, households headed by an indigenous person are substantially less likely to be connected to sewerage and fixed telephony services. The presence of a business in the dwelling is significantly correlated to being connected to the electricity network, and particularly to having fixed line telephone service, where there is an impact of 8.5 percentage points.

Monthly household expenditure also is significantly correlated with the take-up of all modern utilities, with the exception of electricity. This finding suggests that connection charges for all services may represent a barrier for lower income households. Indeed, the charges levied for connection to all services, except for electricity in urban areas, represent a substantial proportion of the monthly poverty line (Table 3.14). Furthermore, it is important to note that the cost of connecting to utility services goes beyond the connection charge. There is often a substantial complementary investment that must be made in adapting the dwelling to the new service. For example, internal wiring for electricity can cost around US$100, while internal plumbing for water and sewerage can cost several hundred dollars.

Table 3.14: Affordability of connection charges

	Electricity	Piped water	Sewerage	Fixed telephone
Connection charge (US$)	Urban: None Rural: varies by project but can be substantial	EMPAGUA 250 Rural areas <100	Rural areas <25	TELGUA 350
Connection charge as a percentage of the budget of a 5 person household living exactly on the poverty line (%)	0	EMPAGUA 104 Rural areas <42	Rural areas <10	TELGUA 146

Source: CNE, TELGUA, IADB

Finally, people living in urban areas are significantly more likely to be connected to all, except fixed phone services. This difference is exceptionally high in the case of sewerage. There are two possible explanations for this. The first is that utilities may find it particularly easy to respond to connection requests in the urban areas, and specifically the capital city, than in remote areas. The second is that the greater prevalence of services in urban areas, and especially the metropolitan area, may create other types of neighborhood effects that will lead households to connect (e.g. social pressure, lower information costs, free riding from neighbors' lobbying efforts, etc.).

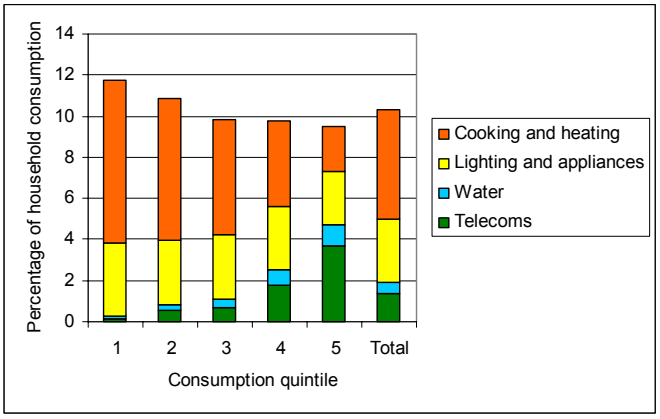
4. Affordability of Modern utilities

Evidently, there is little value in having access to a utility service if a household is unable to meet the corresponding bills. The Guatemalan government has been very conscious of the potential political and social ramifications of the tariff increases that typically result from private sector participation and sector reform. In the electricity sector, this has meant introducing socially motivated ceilings on residential tariffs. While, in the water sector, the unwillingness to raise tariffs to anything approaching cost recovery levels has been a significant barrier to reform. However well-intentioned these policies

may have been, there is significant evidence that they are not particularly successful in protecting poor households, and that they can have undesirable consequences.

To put these matters into context, households in Guatemala spend around 10% of their household budget on water, energy and telecommunications services. Over 50% of this expenditure goes on energy for cooking and heating, and over 25% goes on energy for lighting and powering appliances, while barely 0.5% of income is spent on water services. The overall budget share is relatively constant across consumption quintiles, although the composition of the budget shifts away from cooking fuels and towards telecommunications for richer households (Figure 4.1). Although only a tiny fraction of the poorest households have access to telephones, those that do so spend as much as 5% of their income on the service.

Figure 4.1: Expenditure on modern utilities as a percentage of consumption



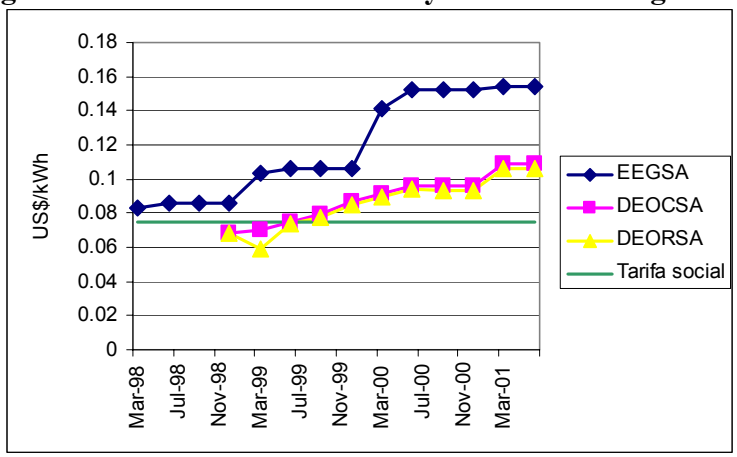
Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

4.1 Electricity

As a consequence of the electricity reforms, the newly privatized distribution companies were allowed to pass on to customers the changes in the cost of purchasing energy. Since Power Purchase Agreements signed between generators and distributors were indexed to the US$ and the price of oil, prices began to rise substantially from the end of 1998 (Figure 4.2). EEGSA experienced the steepest rises, with tariffs increasing 85% over the three year period 1998/01. While for DEORSA and DEOCSA the increases were somewhat lower at 55%-60%.

In order to protect domestic consumers from rising electricity prices, the government introduced a social tariff (‘tarifa social’), which held the price of electricity at around US$0.08 per kWh for all residential customers consuming up to 500 kWh. The cost of this subsidy, estimated at over US$57 million per year, was met by INDE on the basis of state transfers. It is noteworthy that even with the social tariff, about a quarter of all complaints received from consumers by the regulatory agency CNEE during 2000 are about tariffs being excessively high.

Figure 4.2: Evolution of electricity tariffs following reform



Source: CNE

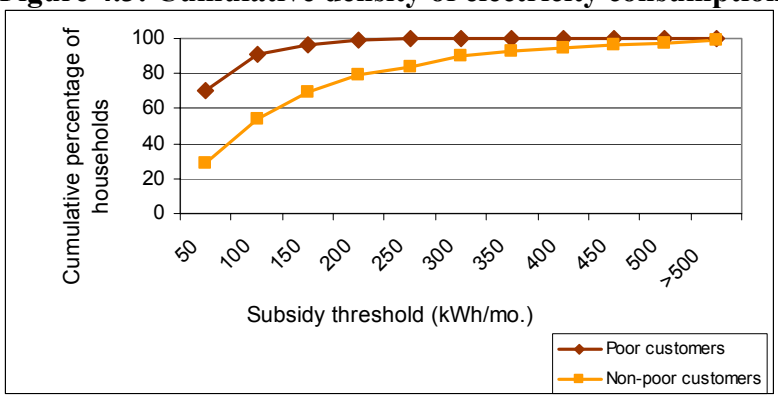
A new law passed in January 2001 made a number of changes to the social tariff, designed to reduce the associated fiscal burden and provide a more objective basis for determining and revising the level of the tariff. The new law reduced the threshold of eligibility from 500 kWh per month to 300 kWh per month, leading to an estimated cost saving of US$7.1 million annually. It also obliged distributors to tender out the purchase of power for the express purpose of meeting this 'social demand'. The idea is to allocate supply from the lowest marginal cost power plants (typically hydroelectric) to this category of domestic customers, while leaving more expensive power from mid-merit thermal plants to cover demand from largest domestic, as well as commercial and industrial, customers. Effectively, this approach has done away with the need for direct government finance of the subsidy, by creating a cross-subsidy between customer categories.

The thresholds that have been set for social tariffs are very high in relation to typical residential consumption (Figure 4.3). The average household consumes 102 kWh per month, with poor households consuming 48 kWh per month on average and non-poor households consuming 128 kWh per month. As a result, 99% of residential customers qualified for the social tariff under the original scheme. Following the recent reforms, this percentage fell only slightly to 94%, reflecting the fact that relatively few households consume in the bracket 300-500 kWh per month.

In terms of affordability, the effect of the current social tariff is to reduce the proportion of the household budget devoted to electricity from 3.7% to 2.7% for poor households, and from 4.1% to 2.6% for non-poor households[23].

[23] In practice, this is an over-estimate since it assumes zero price elasticity. If households, who currently benefit from the social tariff were faced with the true cost of electricity, they would presumably adjust by reducing their level of demand and hence the proportion of budget allocated to electricity would be somewhat lower than indicated.

Figure 4.3: Cumulative density of electricity consumption



Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Table 4.1: Comparison of electricity consumption

	Poor	Non-Poor
Connection rate	46	76
Average consumption (kWh/mo.)	48	128
Electricity expenditure ($/mo.)		
• With social tariff	5.1	14.4
• Without social tariff	7.2	21.9
Electricity expenditure as percentage of monthly budget		
• With social tariff	2.7	2.6
• Without social tariff	3.7	4.1

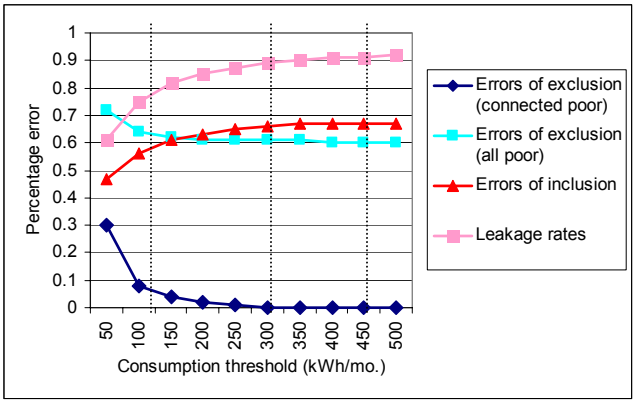
Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

It is important to question who benefits from the current social tariff policy, and in particular how effective is it at protecting the most vulnerable households. Owing to the high level of the consumption threshold, the social tariff evidently benefits a considerable number of households who live above the poverty line. Indeed, about 65% of the beneficiaries of both the old and the new schemes are not poor (errors of inclusion[24]), and given that their consumption is relatively high they absorb an even larger percentage of the resources devoted to the subsidy (leakage rate[25]), 90% in all (Figure 4.4). The subsidy reaches 100% of poor households with electricity connections (that is there are no errors of exclusion[26]), but only 40% of poor households enjoy these connections and hence benefit from the subsidy.

Given that poor households consume substantially less electricity than non-poor households, the cost-effectiveness of the social tariff could be significantly improved if the consumption threshold was reduced. In order to explore this possibility, a simulation exercise was performed to calculate the errors of inclusion and exclusion, as well as leakage rates, for a series of different consumption thresholds (Figure 4.4). There is an underlying assumption in this exercise that electricity consumption will remain constant despite the changes in the tariff structure by moving the consumption thresholds. The results show that the targeting performance of the subsidy could be significantly improved with an eligibility threshold of 100 kWh per month. Errors of inclusion would fall from 75% to 65%, and the leakage rate from 90% to 75%. At the same, time errors of exclusion would rise only 0% to 8%, while the overall cost of the subsidy would fall to almost a quarter of its current level, from $48.9 to $13.2 million per year.

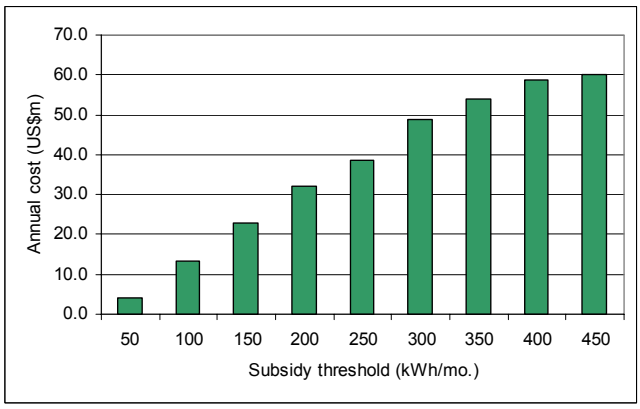
[24] Errors of inclusion are defined as the percentage of subsidy beneficiaries who are not poor.
[25] The leakage rate refers to the proportion of the total subsidy expenditure that flows to the non-poor.
[26] Errors of exclusion are defined as the percentage of the poor who are not subsidy beneficiaries.

Figure 4.4: Simulation of inclusion and exclusion errors



Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Figure 4.5: Simulation of subsidy cost



Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Notwithstanding the considerable policy attention that has gone into subsidies for electricity consumers, the empirical evidence suggests that households that lack access to electricity are in a much worse position in terms of their ability to afford basic energy requirements. The reason is that traditional substitutes for electricity, such as candles and kerosene lamps are extremely inefficient at delivering usable energy (Table 4.2). In particular, electric light bulbs give out 50 times more luminosity per kWh of raw energy used than do candles, and 100 times more than primitive kerosene wick lamps.

These differences in efficiency need to be taken into account when comparing the prices of these different sources of energy. In the table below, the gross price reports the standard unadjusted market price, while the net price corrects for differences between the efficiency of electricity and alternative energy sources. The results indicate that households without electricity pay 75 to 150 times more per kWh of light, and 5 to 30 times more per kWh to power home appliances using dry cell or car batteries.

Table 4.2: Relative efficiency and luminous efficacy factors used to adjust from gross to net energy consumption

Lighting		Appliances	
Fuel	Relative luminous efficacy	Fuel	Relative efficiency
Electricity	1.00	Electricity	1.00
Kerosene	0.01	Batteries	0.90
Candles	0.02	Car batteries	0.90

Source: Foster and Tre, 2000.

Table 4.3: Gross and net unit prices for different fuels (US$ per kWh)

	Lighting			Appliances	
	Gross	Net		Gross	Net
Electricity	0.08	0.08	Electricity	0.08	0.08
Kerosene	0.05	5.87	Batteries	0.59	0.53
Candles	0.26	13.00	Car batteries	2.57	2.31

Notes: The unit price is based on the assumption that the batteries are used to power a 16 watt radio.
The unit price is based on the assumption that the batteries are used to power a 16W black and white television set.
Source: Foster and Tre, 2000

The much higher implicit energy prices faced by households without electricity translate into very low levels of energy consumption. For example, households in the lowest consumption quintile without access to electricity consume only 1.4 net kilowatt-hours of energy per month on lighting and appliances compared with 40.0 kilowatt-hours per month consumed by households in the lowest consumption quintile who have electricity (Table 4.4). Interestingly, both of these groups of households spend a very similar monthly amount on energy for lighting and appliances; just over Qz.30 (US$4) per month.

Table 4.4: Energy consumption patterns of those with and without electricity

	National		By area				By quintile									
			Urban		Rural		1		2		3		4		5	
Electricity coverage rate (%)	73		94		57		40		64		77		89		95	
Connected to electricity	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
Energy expenditure(Q/mo.)	90***	33	119***	31	52***	34	37	31	41***	33	60***	38	82***	36	174***	40
Percentage of budget (%)	3	3	3	2	3	3	3	3	3	3	3*	3	3***	2	3***	2
Energy consumption																
• Gross kwh/mo.	101***	21	132***	58	11***	23	40***	22	46***	23	71***	23	100***	15	182***	15
• Net kwh cons	101***	2.1	132***	.81	11***	2.2	40***	1.4	46***	2.0	71***	2.6	100***	2.4	182***	7.6
Implicit energy price																
• Q/gross kwh/mo.	1.0***	5.5	.94***	9.1	1.1***	5.1	1.1***	4.5	1.1***	5.5	1.0***	6.1	.95***	7.9	.92***	8.9
• Q/net kwh cons	1.0***	85	.94***	233	1.1***	69	1.1***	69	1.1***	84	1.0***	89	.95***	153	.92***	121

Notes: For those with electricity, energy refers to electricity and for those without electricity, energy refers to electricity substitutes (i.e. candles, kerosene and batteries).
The averages for expenditure and prices excluded households that are connected to the electricity network but did not pay for the service.
If significantly different from those without electricity at: * 90%, ** 95%, *** 99%.
Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

To give a concrete idea of what such low levels of energy consumption mean in terms of quality of life, it is helpful to think of a subsistence package of energy requirements that can be used to define a 'fuel poverty' line. Based on consultation with local energy experts about the energy needs of low income households, this subsistence package provides enough energy to run two 60 watt light bulbs and one 16 watt radio for four hours each day, and incorporates a cooking requirement of ten kilograms of fuel wood each day. The survey indicates that 92% of households without access to electricity have energy consumption levels that fall below the 'fuel poverty' line, compared to only 35% of households with access to electricity (Table 4.5). It is estimated that if these households had access to electricity they would be able to substantially increase their energy consumption, so that the fuel poverty rate would fall from 92% to between 37% and 73%, depending on what assumption is made about the price elasticity of demand.

Table 4.5: Fuel poverty estimates with and without access to electricity

	Households with access to electricity	Households without access to electricity			
		Current situation	After gaining access, for different price elasticities of demand for energy		
			ε = -0.5	ε = -1	ε = -1.5
Price per effective kwh (Q)	1.7	39.3	1.8	1.8	1.8
Net consumption (kwh/month)	67.5	.98	16.2	21.6	32.4
Fuel poverty					
Headcount	.27	1.00	.68	.55	.33
Poverty gap	.12	.94	.34	.24	.14
Squared poverty gap	.08	.89	.21	.14	.08

Note: Refers only to energy used for lighting and appliances, based on a poverty line of 200 kwh/year
Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

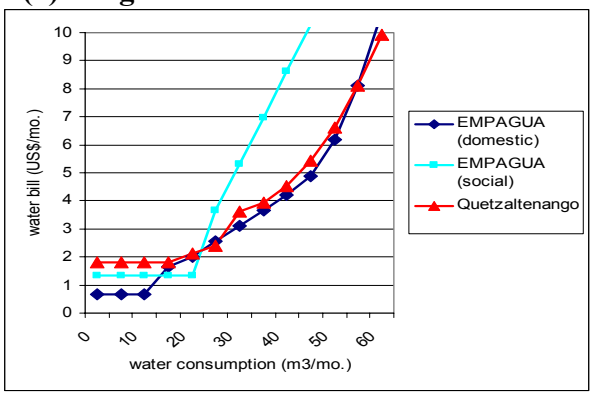
4.2 Water

The typical tariff structure for water in Guatemala comprises a flat payment up to a relatively high consumption threshold, and a linear unit charge for consumption above this level. This kind of tariff structure has the disadvantage that it does not provide any incentive for households to control consumption below this threshold level.

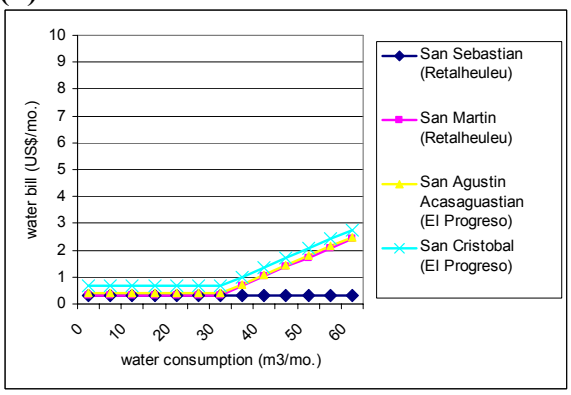
A recent survey of water tariffs found that in the larger cities—Guatemala and Quetzaltenango—the flat rate charge of $1 to $2 per month entitled households to consume between 15 and 25 cubic meters per month, while further consumption was charged at a rising rate of between $0.10 and $0.30 per cubic meter (Figure 4.6) (ESA Consultores, 2001). The same survey found that water charges in the smaller towns of the interior were substantially lower, with a flat charge of around $0.50 per month entitling the household to around 30 to 40 cubic meters per month, and subsequent consumption being charged at less than $0.10 per cubic meter (Figure 4.6). The implication is that for a typical monthly consumption of 20 cubic meters, households in the larger cities would be paying an implicit tariff of less than $0.10 per cubic meter, while households in the smaller cities would be paying less than $0.05 per cubic meter.

Figure 4.6: Typical structure of water bills

(a) Large cities



(b) Small towns



Source: IADB

Not only are water tariffs very low, but survey evidence suggests that revenue collection rates are also extremely low. On average, as many as 30% of those with piped water reported that they did not pay for the service during the last month, compared with only 8% for the electricity service in spite of the fact that average monthly electricity bills are almost 10 times as high as average water bills (US$12.97 versus US$1.48). Among the poorest, non-payment rate rises to 46%.

As a result, water utility revenues are extremely low, both with respect to the likely cost of providing water and sanitation services, and with respect to the likely willingness and ability to pay of the population.

Although there is no available information about the cost of potable water in Guatemala, international benchmarks would suggest a full cost of around $0.30 to $0.40 per cubic meter, exclusive of sewerage. This suggests that at current tariff levels, water utilities are unlikely to be covering their operating costs, let alone their capital costs.

Table 4.6: Comparison of expenditures on piped and bottled water

	National	By area		By consumption quintile				
		Urban	Rural	1	2	3	4	5
% of households that bought bottled water[1]	.17	.33	.04	.02	.03	.08	.23	.47
Among those who bought bottled water								
Quetzales spent on piped water	16	24	5	1	5	7	12	34
Quetzales spent on bottled water	47	50	30	10	30	30	39	56
Expenditure on piped water as % of consumption	.004	.005	.002	.001	.003	.003	.004	.006
Expenditure on bottled water as % of consumption	.01	.01	.01	.01	.01	.01	.01	.01

1: Refers to last two weeks before the survey.

Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística - Guatemala

In terms of willingness to pay, the WHO has traditionally recommended an affordability threshold of 5% of income for water and sanitation services, about 10 times as high as what households in Guatemala currently spend. Recent research in Central America—involving willingness to pay surveys in Nicaragua, Panama, and El Salvador—has provided empirical confirmation of the WHO threshold (Walker *et al*., 2000). Further confirmation of willingness to pay for water in Guatemala comes from expenditure on bottled water. The ENCOVI survey shows that 20% of households purchase bottled

water at a price of $0.50 per liter (equivalent to $500 per cubic meter). Moreover, households who use both piped and bottled water, spend three times more on bottled water than on piped water.

Table 4.7: Water treatment practices
(proportion of households)

	National	By area		By consumption quintile				
		Urban	Rural	1	2	3	4	5
Among those **with** water in dwelling or yard								
Buys bottled water only	.13	.22	.02	.002	.01	.04	.13	.35
Buys bottled water and also treats	.08	.13	.03	.02	.03	.05	.12	.15
Boils water	.38	.29	.50	.55	.51	.47	.32	.20
Filters water	.02	.02	.01	.001	.004	.003	.01	.04
Puts chlorine	.12	.12	.12	.07	.10	.16	.18	.09
Other strategy	.01	.01	.003	.001	.01	.003	.01	.01
No treatment	.26	.20	.32	.36	.34	.27	.24	.15
Among those **without** water in dwelling or yard								
Buys bottled water only	.03	.11	.01	0	.02	.02	.11	.07
Buys bottled water and also treats	.02	.05	.02	.005	.02	.03	.04	.09
Boils water	.42	.43	.41	.51	.39	.42	.32	.16
Filters water	.002	.001	.002	.0003	.0004	.005	.002	.003
Puts chlorine	.17	.15	.17	.09	.17	.23	.19	.37
Other strategy	.01	.0005	.01	.002	.0003	.001	.03	.05
No treatment	.35	.25	.37	.40	.40	.30	.31	.26

Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

The shortage of resources going into the sector probably goes some way towards explaining the relatively low quality of service provided. Households surveyed in the ENCOVI received water on average only 17 hours per day and faced 3.6 days each month without water. The fact that as many as 74% of households with piped water, either buy bottled water or perform some kind of self-treatment, suggests that they are not confident about the potability of public water supply (Table 4.7). Boiling is the most popular form of self-treatment, particularly among low-income households and in rural areas. While higher income urban households are more likely to rely on bottled water. It is very striking that the prevalence of water boiling is about the same for households who have piped water as for households without the service, around 40% in both cases.

5. Benefits of Access to Modern Utilities

It is often argued that access to modern utility services brings benefits to households in terms of improved productivity and health. While these arguments are intuitively persuasive, there is relatively limited rigorous empirical evidence to document the link and quantify the magnitude of the associated effects. Therefore, this section uses the ENCOVI survey data to try and shed some light on the nature of these relationships.

5.1 Productivity benefits

Use of household time endowment

It is anecdotally well-known that the collection of fuel wood and water for household use, particularly in rural areas, can be very time consuming and it is often suggested that these activities come at the cost of more productive pursuits, such as paid employment or education of children (Table 5.1).

Table 5.1: Anecdotal evidence on time use from qualitative poverty study

> *'A los niños los ponen a trabajar, a traer leña, a acarrear agua.'*
> School Teacher, Ladino Community, Qualitative Poverty Study.

In the ENCOVI, households who collect water on a regular basis report that on average they travel around nine minutes to reach their nearest water source (Table 5.2). The equivalent distance for fuel wood collection was a 50 minute walk in urban areas and a 70 minute in rural areas. The average number of persons per household involved in such a trip is around 1.50 in urban areas and 1.85 in rural areas. Moreover, the survey demonstrates clear gender specialization in collection activities, with men and boys accounting for 65% of the labor devoted to the collection of fuel wood, and women and girls accounting for 74% of the labor devoted to the collection of water (Figure 5.1).

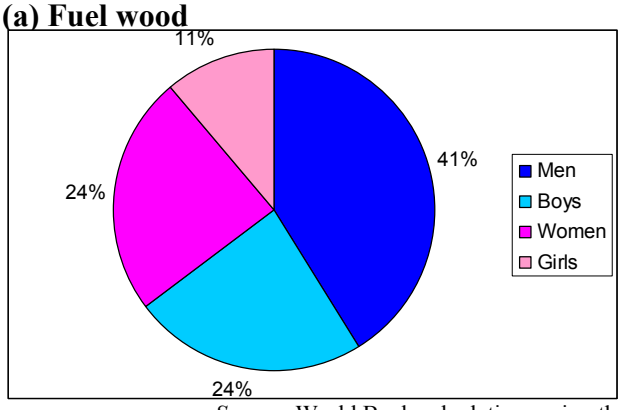
Table 5.2: Distance to source of wood and water
(Among those who collect water and buy or collect wood)

	National	By area		By consumption quintile				
		Urban	Rural	1	2	3	4	5
Water collection								
Minutes	12.5	13.2	12.3	14.5	12.8	10.6	12.6	7.0
Meters	242	111	267	351	216	222	136	72
Wood collection or purchase								
Minutes	63.4	51.0	67.2	66.9	67.2	63.3	54.8	47.9
Meters	1,336	1,032	1,448	1,611	1,511	1,236	961	917

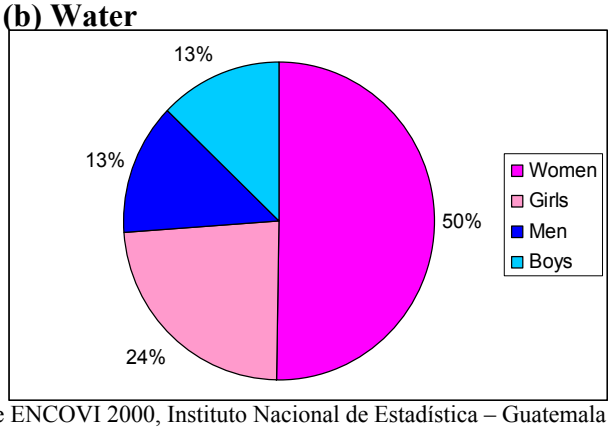
Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Figure 5.1: Intra-Household Allocation of Fuel Wood and Water Collection Tasks
(individuals who collected wood and water on the day before the survey)

(a) Fuel wood



(b) Water



Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Table 5.3: Time devoted to collection of fuel wood and water according to whether or not the household has access to modern water and energy services

	National		By area			
			Urban		Rural	
Access to modern services	Y	N	Y	N	Y	N
Proportion of households who collected yesterday						
• Fuel wood	.04	.18	.01	.11	.08	.19
• Water	.03	.33	.02	.22	.05	.35
No. of minutes spent collecting yesterday						
• Fuel wood	102	162***	77	173***	121	161***
• Water	63	96***	62	75***	64	99***
Expected no. of minutes per week spent collecting						
• Fuel wood	29	204***	5	133***	68	214***
• Water	13	221***	9	116***	22	243***

	By quintile									
	1		2		3		4		5	
Access to modern services	Y	N	Y	N	Y	N	Y	N	Y	N
Proportion of households who collected yesterday										
• Fuel wood	.16	.19	.06	.18	.09	.18	.04	.14	.01	.10
• Water	.03	.35	.04	.37	.06	.35	.02	.31	.01	.24
No. of minutes spent collecting yesterday										
• Fuel wood	na	202	154	165	94	99	72	107	na	86
• Water	82	127**	65	93**	70	76	50	57	21	84
Expected no. of minutes per week spent collecting										
• Fuel wood	na	268	208	65***	59	124***	20	105***	na	62
• Water	17	311***	18	242***	29	185***	7	124***	1	141***

na: Less than 30 observations were available.

Notes: A modern water service is defined as having piped water in the dwelling or yard.
A modern energy service is defined as having access to propane.
Percentage of households with and without service are significantly different at: *** 99%, ** 95% and * 90%.
Expected minutes = 7 * proportion who collected yesterday * minutes spent collecting.

Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Clearly, one of the potential benefits of providing households with access to piped water and modern energy sources, such as propane, is that they can save the time that would otherwise be devoted to collection activities. Using the ENCOVI data, it is possible to estimate the number of minutes per week that households spend on average collecting fuel wood and water, and to compare this between households that have access to modern alternatives and those that do not (Table 5.9). In urban areas, households without access to modern utilities spend on average two man-hours per week on each of the two collection activities, while those who have access spend less than ten minutes per week on each. In rural areas, households with access spend closer to four man-hours per week on each activity. However, even those with services spend a significant amount of time collecting fuel wood and water. This may be a reflection of the lower reliability of these services in rural areas. Consequently, the time saving for rural households who gain access to modern services is 2.5 hours per week for fuel wood and 3.5 hours per week for water.

Although it is difficult to place an economic value on these time savings, an approximate indication can be obtained from the average hourly earnings of rural workers in the agricultural sector, which are of the order of Q.3-4 (US$0.50) (Vakis, 2001). This would suggest that the value of weekly time savings associated with piped water could be around Q.12 (US$1.75), compared with a typical weekly piped water bill of Q.3 nationwide, or less than Q.1 in rural areas. The implication is that households who are not cash constrained would find it attractive to switch to a piped service. Although, the benefits are

exaggerated due to artificially depressed current water tariffs, the difference is significantly large that piped water would continue to remain attractive, even if water tariffs increased substantially. In the case of propane, the comparison is not so favorable, with a weekly value of time savings of around Q.9 (US$1.25), compared with a typical weekly energy bill of around Q.18.

Table 5.4 Time allocation and wood collection

(Number of minutes spent yesterday in each activity among those who spent time on them)

	Urban				Rural			
	Female		Male		Female		Male	
	7-15	>15	7-15	>15	7-15	>15	7-15	>15
Paid work								
Did not collect	33	167	34	360	19	85	55	342
Collected	0	82	50	275	9	47	34	263
Difference	***	***		***	*	***	**	***
Unpaid work								
Did not collect	39	57	49	81	75	74	172	159
Collected	48	43	103	164	75	82	165	216
Difference			*	**				***
Study								
Did not collect	312	314	296	299	302	282	311	296
Collected	382	368	302	178	285	313	299	243
Difference	**			**				
Housework								
Did not collect	136	373	44	58	194	448	34	33
Collected	263	416	48	73	251	466	62	43
Difference	***				***		***	***
Errands/shopping								
Did not collect	10	23	9	12	7	15	6	10
Collected	34	29	6	14	10	20	9	11
Difference	**							
Leisure and other								
Did not collect	913	750	951	778	916	763	945	799
Collected	781	658	940	777	846	709	903	776
Difference	***	***			***	***	**	**

Notes: Means of those who collected and did not collect wood are significantly different at: *** 99%, ** 95% and * 90%.
Minutes spent collecting wood among those who did it. The symbols describe cells that are significantly different from the one to the right at: ^^^ 99%, ^^ 95%, ^90%.

Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Those devoting such significant amounts of time to wood and water collection activities must presumably do so at the expense of other activities. It is therefore interesting to explore which types of activities households who engage in wood and water collection (Tables 5.4 and 5.5) curtail. Paid work and leisure (including sleep) seem to be the activities that are cut back the most in order to accommodate wood and water collection. Interestingly, the amount of time devoted to study by children who do and do not engage in these activities is not significantly different in most cases.

Table 5.5 Time allocation and water collection

(Number of minutes spent yesterday in each activity among those who spent time on them)

	Urban				Rural			
	Female		Male		Female		Male	
	7-15	>15	7-15	>15	7-15	>15	7-15	>15
Paid work								
Did not collect	34	168	36	355	20	94	55	330
Collected	13	104	16	368	14	42	16	254
Difference		***				***	***	***
Unpaid work								
Did not collect	38	57	53	85	76	79	179	172
Collected	59	44	39	79	71	61	112	165
Difference						**	***	
Study								
Did not collect	315	317	296	300	305	308	309	288
Collected	278	236	320	202	286	168	306	300
Difference				**		***		
Housework								
Did not collect	127	368	50	60	174	417	54	49
Collected	252	468	124	95	262	526	97	110
Difference	***	***	**	***	***	***	***	***
Errands/shopping								
Did not collect	11	23	9	12	8	17	7	10
Collected	5	26	6	12	7	15	6	12
Difference	**							
Leisure and other								
Did not collect	909	751	953	781	929	769	938	796
Collected	903	678	892	686	843	720	920	769
Difference		***	*	***	***	***		*

Notes: Means of those who collected and did not collect water are significantly different at: *** 99%, ** 95% and *90%.
Minutes spent collecting water among those who did it.

Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Micro-enterprise productivity

Modern utilities, in particular electricity and telecommunications, have the potential to improve the productivity of household based micro-enterprises. The electrification of household enterprises lengthens the potential working day, and permits the substitution of manual labor with more efficient power-assisted tools. Telecommunications improve links between enterprises and downstream buyers, as well as upstream suppliers, thereby helping entrepreneurs to expand sales and reduce supply costs.

While these arguments are convincing at an anecdotal level, there is limited rigorous empirical evidence to back them up. Using the data provided by the ENCOVI, this section explores firstly, whether households in areas where modern utilities are available are more likely to have household enterprises, and secondly, whether household enterprises that have access to modern utilities are significantly more profitable than those enterprises that do not. An important caveat is that all of the analysis in this section refers *exclusively* to households that own a micro-enterprise that operates in the dwelling.

As a preliminary step, the proportion of households with micro-enterprises is tabulated against the various indices of access to modern utilities developed above (Table 5.6). The results show that the probability of having a micro-enterprise is significantly higher among households with *coverage* of

modern utilities. However, within communities that have access to modern utilities, households that *take-up* a connection are no more likely to be entrepreneurs than those that do not (except in the case of fixed telephones).

Table 5.6: Cross-tabulation of household enterprise against access to modern utilities

(Proportion of households)

	Has an enterprise		Wald
	Yes	No	Test[2]
Availability			
Electricity	.85	.82	
Piped water	.85	.80	**
Fixed phone	.42	.34	***
Cellular phone	.42	.37	**
Takeup			
Electricity	.98	.98	
Piped water	.95	.95	
Fixed phone	.57	.46	***
Cellular phone	.33	.29	
Coverage			
Electricity	.81	.72	***
Piped water	.76	.67	***
Fixed phone	.22	.14	***
Cellular phone	.12	.09	**
Public phone	18	23	***
Population size	459,347	1,731,720	

Notes: Refers only to enterprises that operate in dwelling.
Null hypothesis (equality of enterprise owners and non-owners) is rejected at: *** 99%, ** 95%, * 90%.
Pubic phone variable refers to minutes to closest public phone in census tract.
Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

However, it is not possible to draw any inferences from cross-tabulations of this kind, because they do not control for many other factors that influence the disposition to form a business. In order to address this issue, a probit model is estimated that looks at the correlation between a variety of factors including characteristics of the households and the head of household, availability of modern utilities and geographical variables. Separate models are estimated for urban and rural enterprises (Table 5.7).

An important methodological issue that arises is the potential endogeneity of access to modern utilities. The model is estimated on the statistical assumption that access to modern utilities affects the probability of forming a micro-enterprise, *but not vice versa*. However, it could equally be argued that the presence of a micro-enterprise influences the choice of whether or not to connect to modern utilities. In order to avoid the resulting bias in the statistical estimates, it is necessary to find an instrumental variable that is related to the variable of interest but which has a greater claim of exogeneity. In this case, the community availability of the basic service is used as an instrument; that is to say, that instead of looking at whether or not the *household* has access to the service, the model looks at whether or not the household lives in a *neighborhood*[27] that has access to the service. It can be argued that local availability is somehow more likely to be exogenous to enterprise formation than household connection.

[27] As explained earlier, we use the word *community* in this context to describe clusters of contiguous households on which the survey design was based.

Table 5.7: Results of probit model for probability of having a micro-enterprise

(Coefficients are marginal effects)

	Everyone ∂F/∂x	Urban ∂F/∂x	Rural ∂F/∂x
Household head characteristics			
Male	-.009	.038	-.073**
Age	.002***	.002**	.001*
Years of school	.003	.003	.005
Speaks Spanish	.039	.135***	.024
Indigenous	.077***	.059	.077**
Household characteristics			
Number of adults	.021***	.017**	.022***
Urban area	.008		
Population in locality	-.0001	-.0002	.002
Availability of utilities			
Electricity	.008	.028	-.011
Water	.028	.067	-.003
Fixed phone	.036	.035	.031
Cellular phone	.001	-.017	.011
Minutes to public phone	-.0003	-.0009**	-.0001
Population size	1,553,028	735,373	817,655
F	(19,869)	(18, 870)	(18, 870)
	4.76	4.38	3.92

Notes: Region-level fixed effects were included.
Significant at: *** 90%, ** 95%, * 90%.
Refers only to enterprises that operate in dwelling.

The results report the marginal effects from the probit model, that is to say how much a 1% change on each continuous variable would affect the probability that a household enterprise is formed (for binary variables, we observe the effect of the change from 0 to 1). Enterprises are significantly more likely to be formed in larger households, with older heads of household. There is evidence of a small but significant effect from being located relatively close to a public telephone, but only in urban areas.

In the discussion that follows, attention is limited to those households that have a micro-enterprise, and turns to the question of how their profitability is affected by access to utilities. While the estimations so far have included expansion factors to have a sample that is representative at the national level, in the exercise that follows, attention is limited to the sample of households that have a micro-enterprise that operates in the dwelling and uses no expansion factors.

The cross-tabulation of net income per worker-hour indicates that households *covered* by modern utilities have significantly more profitable enterprises. The differences in profitability are very substantial: almost double for water, more than double for electricity, more than three times as high for fixed telephones and almost four times as high for cellular telephones. Moreover, within communities that have access to services, enterprises that take-up connections to electricity and telecommunications services are significantly and substantially more profitable than those that do not.

Table 5.8: Cross-tabulation of enterprise profitability against access to modern utilities

(Net income of owner in Quetzales per worker-hour)

	Basic service		Wald
	Yes	No	Test
Coverage			
Electricity	8.0	3.4	***
Piped water	7.9	4.7	**
Fixed phone	15.9	4.6	***
Cellular phone	20.2	5.2	***
Public phone	7.5	7.0	
Takeup			
Electricity	7.8	3.2	***
Piped water	7.9	4.2	
Fixed phone	15.9	6.2	***
Cellular phone	20.2	6.8	***
Availability			
Electricity	7.7	3.5	***
Piped water	7.4	5.0	***
Fixed phone	11.2	4.0	***
Cellular phone	10.6	4.4	***
Population size	459,347		

Notes: Refers only to enterprises that operate in dwelling.
Null hypothesis (equality of profits between enterprises covered and not) is rejected at: *** 90%, ** 95%, * 90%.
Public phone variable refers to availability of public phone in census tract.
Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

However, as before, it is necessary to control for other factors affecting enterprise profitability before reaching conclusions about the role of basic infrastructure services. In addition to the variables used above, a set of variables describing the characteristics of the business is introduced. These include measures of capital and labor input, sector of activity, source of finance, and type of premises.

Once again, there are potential endogeneity problems with access variables, since it seems likely that not only does access improve profitability, but also profitability may increase the likelihood of access. This problem is addressed by instrumenting each of the utility access variables, in a series of first-stage regressions using the community availability of the service as an instrument. As noted above, it can be argued that local availability is more likely to be exogenous than household availability. It could however be argued that local availability is correlated with unobserved characteristics of the local market. In order to control for this potential effect, a series of municipality specific dummies (or fixed effects) were included in the regressions.

As might be expected, the results indicate that enterprise profitability is significantly related to the magnitude of labor and capital inputs and the type of financing facilities that are available. Utility coverage variables do not prove to be statistically significant in urban areas, perhaps because coverage of services is close to universal, and hence there is little variation from which to estimate the coefficient. In rural areas—on the other hand—coverage of electricity, water and cellular telephones are all statistically significant with sizable coefficients. Moreover, the overall explanatory power of this model is much higher than the urban one, with an R-squared coefficient of 55% versus 15%.

Table 5.9: Results for regression model of profitability of the household micro-enterprise

	Urban	Rural
Household head characteristics		
Male	.437*	.026
Age	-.011	-.011**
Years of school	-.035	.018
Speaks Spanish	.634	.037
Indigenous	-.139	.247
Household characteristics		
Number of adults	-.101	.063
Population in locality	-.003	.0001*
Coverage of utilities		
Electricity	-2.14	.503**
Water	.931	1.0***
Fixed phone	1.73	-1.04
Cellular phone	2.36	2.7**
Minutes to closest public phone	.0008	-.001
Business characteristics		
Capital (Q)	$6x10^{-8}$	$1x10^{-5}$*
Labor (man-hours)	.001***	.001***
Age of business (years)	-.001	-.004
Months worked last year (#)	.092***	.105***
Economic activity		
Manufacture	.283	-.144
Services	-.124	.281
Provider		
Large firm	.254	.080
Small firm	.030	.013
Source of finance		
Bank / cooperative / NGO	.898*	.460
Family / friends	.720*	.836**
Providers	-.113	1.45**
Savings / assets / inheritance	1.02**	.660*
Type of dwelling		
House	.507	-.458*
Constant	3.66	5.13***
Observations	634	478
Pseudo R-squared	.1537	.5553
Chi 2	332.59	671.08

Notes: Results reported are those of second-stage regression. Coverage of basic services for electricity, water, fixed and cellular phone were instrumented using availability of these services in census tract as instrument. Estimations include a municipality-level fixed effect.
Significant at: *** 90%, ** 95%, * 90%.
Refers only to enterprises that operate in dwelling.

Table 5.10: Estimated change in profits due to connection to modern utilities

	Urban	Rural
In Quetzales per month		
Electricity	-1,445	399**
Water[2]	2,518	1,062***
Fixed phone	7,585	-395
Cellular phone	15,644	8,663**
As proportion of profits		
Electricity	-.88	.65**
Water	1.5	1.7***
Fixed phone	4.6	-.65
Cellular phone	9.6	14.2**
Observations	634	478

Notes: Refers only to enterprises that operate in dwelling.

From the regression model coefficients, it is possible to estimate the average impact that each of the utility services has on the profitability of the micro-enterprise (Table 5.10). Perhaps of greatest interest are the figures which express the additional profit attributable to utility services as a percentage of the average profit of micro-enterprises that do not enjoy access to the corresponding services. These show that the value of these services to micro-enterprises is very large indeed. For example, micro-enterprises without electricity in the rural areas have profits that are 65% higher on average than micro-enterprises with electricity. The corresponding figure for water is 170%. By far the largest effect is that of the cellular telephone, which raises profitability by 1420%. This effect appears implausibly large, and it is possible that the cellular telephone is picking-up some other unobserved variable that is important for profitability and which may not be captured either by the locality population or by the municipality fixed-effect; for example, proximity to a markets.

5.2 Health benefits

It is widely believed that modern infrastructure services have an important link with household health. Safe water and basic sanitation reduce exposure to waterborne diseases such as diarrhea and cholera. Garbage collection improves hygiene and reduces the presence of parasites. Use of modern cooking fuels, such as propane gas, reduces exposure to indoor air pollution.

Women participating in the qualitative poverty study, seemed to be particularly aware of the health benefits that had come about as a result of receiving access to water and sanitation services (Table 5.11).

Table 5.11: Impressions of water and sanitation health linkages from qualitative poverty study

'Nosotros…antes íbamos a traer agua en los pozos que hay en los barrancos. El agua era sucia y estaba lejos, nos costaba mucho, sufrimos con el acarreo del agua... Ahora el agua llega a la casa y es limpia, eso nos ha ayudado en la salud de la familia... Ahora hay muy pocas enfermedades pero es por descuido de la gente... también hay letrinas, todo eso nos ha ayudado en nuestra salud.' K'iche Woman, Qualitative Poverty Study.

'[Tener agua] ha mejorado la salud de la familia porque no hay muchas enfermedades del estómago (diarrea)... ahora las mujeres ya no sufren... ya no van al barranco a traer agua.' K'iche Woman, Qualitative Poverty Study

'El río queda lejos y se seca durante el verano… cuando no había agua se iban las mujeres por día a acarrear agua de los ríos… Antes, cuando no teníamos agua, era un sacrificio, peligroso y debajo de la lluvia. Ahora estamos mejor, antes nos bañábamos a veces hasta cada tres días y esto produce enfermedad, había mucho olor feo... Las mujeres lavan los trastos porque si no se hace esto trae enfermedad, sirve para la higiene.' Q'eqchi Woman, Qualitative Poverty Study.

'[Con el agua entubada] ha mejorado el problema de tomar agua del río crudo y hay menos niños que se enferman... en la casa cloran el agua de tomar.' Ladina Woman, Qualitative Poverty Study.

To gain an initial impression of the extent of the correlation between health and access to modern utilities, a series of cross-tabulations are performed. The cross-tabulations distinguish between children and infants as well as between urban and rural areas.

The first of these relates to the relationship between access to piped water and sanitation and the incidence of diarrhea among children (Table 5.12). In urban areas, no significant correlation was found

between access to water and sanitation and incidence to diarrhea. In rural areas, however, two variables are found to be statistically significant both for children and infants, namely possession of a toilet collected to drainage and purchase of bottled water. Interesting, self-treatment of piped water supply does not show a significant correlation with the incidence of diarrhea. The presence of piped water in the community (though not in the dwelling) is also correlated with the incidence of diarrhea in the case of children but not of infants. However this is expected in that infants tend to be breastfed and are hence less exposed to impurities in water.

Table 5.12: Cross-tabulation of incidence of diarrhea and access to water and sanitation

(Proportion of children who had diarrhea)

	Urban			Rural		
	Service		Pearson	Service		Pearson
	Yes	No	Test	Yes	No	Test
Infants: 0-12 months old						
Piped water in dwelling or yard	.26	.50		.33	.30	
Community covered by piped water	.50	.50		.27	.31	
Dwelling connected to sewerage	.25	.40		.33	.32	
Toilet connected to drainage	.24	.40		.17	.31	*
Latrine	.32	.40		.33	.31	
Excusado lavable	.43	.40		.31	.31	
Only treats water	.33	.32		.33	.31	
Only buys bottled water	.23	.32		.05	.31	**
Treats and buys bottled water	.29	.32		.33	.31	
Children: 13-59 months old						
Piped water in dwelling or yard	.27	.29		.37	.20	
Community covered by piped water	.35	.21		.32	.44	**
Dwelling connected to sewerage	.25	.31		.30	.39	
Toilet connected to drainage	.24	.33		.16	.35	**
Latrine	.32	.33		.40	.35	
Excusado lavable	.29	.33		.40	.35	
Only treats water	.27	.26		.39	.37	
Only buys bottled water	.22	.26		.14	.37	***
Treats and buys bottled water	.36	.26		.43	.37	

Notes: Refers to illness during the month previous to the survey.
Null hypothesis (homogeneity of users and non-users) is rejected at: ***99%,** 95%,*90%.
Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

The same exercise is performed for the incidence of respiratory illnesses, cross-tabulated against use of fuel wood for cooking (Table 5.13). Those households that do use fuel wood are further sub-divided according to whether or not they have some kind of chimney for ventilation of the kitchen. It is important to note that the definition of 'respiratory illnesses' used in the ENCOVI questionnaire is rather vague, identifying whether or not children had suffered from a very broad range of complaints—including cold, cough, bronchitis, chokes or respiratory infections—during the previous month. The results show that (in most cases) the use of fuel wood in the home is not significantly correlated with the incidence of respiratory disease. However, what does seem to matter quite significantly is whether households burning fuel wood have a smoke escape in the kitchen.

Table 5.13: Cross-tabulation of incidence of respiratory illness and access to basic services

(Proportion of children)

	Urban			Rural		
	Service		Pearson	Service		Pearson
	Yes	No	Test[2]	Yes	No	Test[2]
Infants: 0-12 months old						
Use of fuel wood at home	.53	.37	*	.46	.46	
Kitchen has a escape for smoke	.22	.57	**	.35	.48	**
Children: 13-59 months old						
Use of fuel wood at home	.41	.47		.53	.49	
Kitchen has a escape for smoke	.39	.39		.47	.55	**

Notes: Refers to illness during the month previous to the survey.

Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

It is interesting to compare these results with those from a second source of data on this issue: the National Maternal and Infant Health Survey 1998/9. This survey, which falls into the broad category of Demographic and Health Surveys, has a much tighter definition of what constitutes an *acute* respiratory illness. This is defined as a child manifesting at least two of the following three symptoms simultaneously: coughing, fever and breathing in quick short breaths. Given the more stringent definition, the proportion of children reporting respiratory illness in the DHS (at around 20%) is substantially lower than in the ENCOVI (at around 40%). Moreover, the equivalent cross-tabulation for the DHS data, shows a significant correlation between cooking with fuel wood and incidence of respiratory illness. The correlation is particularly strong in the case of infants, who (due to their lack of mobility) tend to spend more time close to the mother while she is cooking (Table 5.14). Unfortunately, the DHS does not include questions about kitchen ventilation and hence it is not possible to make that comparison with the ENCOVI data.

Table 5.14: Cross-tabulation of incidence of *acute* respiratory illness and access to modern fuels

(Proportion of children)

	Service		Pearson
	Yes	No	Test
Infants: 0-15 months old			
Use of fuel wood at home	.30	.21	***
Children: >15-60 months old			
Use of fuel wood at home	.22	.19	*

Notes: Refers to illness during the two weeks previous to the survey.

Null hypothesis (homogeneity of users and non-users) is rejected at: *** 99%, * 90%.

Source: Torres, (2001) based on Guatemala National Maternal and Infant Health Survey 1998/9.

As well as looking at links between specific types of services and specific types of illnesses, it is interesting to consider the overall impact of modern utilities on the production of health at the household level. In the health literature, stunting (or the ratio of height for age in children) is considered a good stock measure of the accumulated health experiences of the child throughout life. Simple cross-tabulations of stunting rate against a range of access variables show that children living in households with modern services are significantly less likely to experience stunting. The differences are up to a factor of two in the case of some services.

Table 5.16: Cross tabulation of stunting rate against access to modern utilities

(Proportion of children)

	Urban			Rural		
	Service		Pearson	Service		Pearson
	Yes	No	Test	Yes	No	Test
Infants: 0-12 months old						
Piped water in dwelling or yard	.16	.10		.24	.22	
Community covered by piped water	na	0na	**	.28	.20	
Dwelling connected to sewerage	.17	.11		.18	.24	
Toilet connected to drainage	.17	.03	**	.05	.25	**
Latrine	.17	.03	**	.24	.25	
Excusado lavable	.12	.03		.13	.25	
Only treats water	.15	.21		.22	.25	
Only buys bottled water	.08	.21	*	0	.25	
Treats and buys bottled water	.19	.21		.33	.25	
Children: 13-59 months old						
Piped water in dwelling or yard	.32	.59	***	.60	.60	
Community covered by piped water	.57	.62		.66	.57	*
Dwelling connected to sewerage	.30	.51	***	.36	.62	***
Toilet connected to drainage	.28	.61	***	.23	.65	
Latrine	.46	.61	**	.62	.65	
Excusado lavable	.43	.61	*	.30	.65	***
Only treats water	.44	.37		.62	.59	
Only buys bottled water	.19	.37	***	.30	.59	**
Treats and buys bottled water	.27	.37		.40	.59	*

Notes: Null hypothesis (homogeneity of users and non-users) is rejected at: ***99%,** 95%,*90%.
na: not enough observations were available in this subgroup.
Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

However, such cross-tabulations are at best inconclusive since they do not control for the impact of many other health-related variables that are likely to be correlated with access to utility services, such as household income, geographical location, educational attainment, and a variety of other socioeconomic and demographic factors. While in principle it would seem relatively straightforward to control for these in a multivariate regression framework, there are a number of more serious methodological problems that lend caution to modeling the impact of modern utility services on health outcomes.

First, in the case of parentally-reported incidence of disease (such as whether or not children had diarrhea or respiratory illnesses) there may be serious reporting bias, with health-conscious parents being more likely to detect and report the presence of these problems among their children. In this sense, the stunting variable, based on anthropometric measurements, provides a more objective indicator of health status.

Second, there is the serious issue of the potential endogeneity of access to modern utilities in the health production function. That is to say that not only do modern utilities contribute to health, but households with unobserved preferences for health are also more likely to connect to modern utilities. Failure to take this into account could be expected to lead to biased coefficient estimates. The analysis of micro-enterprise profitability already illustrated how it can be possible to overcome endogeneity problems by using two stage instrumental variables techniques, with the community availability variable acting as an instrument. However, in the case of health production functions, the endogeneity problem affects not only the modern utility coverage variables but also many of the other key explanatory variables, such as family demographics and hygiene behavior. The shear number of potentially endogenous variables complicates the search for instruments and can make the estimation process computationally intractable.

For both of these reasons, no further modeling is attempted here. However, the health chapter of the Guatemala Poverty Assessment incorporates a reduced form health production function estimation that incorporates coverage of modern utility services (with appropriate instrumentation). The reader is referred to the corresponding paper for more details (Marini and Gragnolati, 2001). In brief, the main finding of interest is that access to piped water and use to bottled water are both found to make a positive and significant contribution to the height of children in urban areas, but not rural areas. While use of propane gas in the household is found to have a positive and significant effect on height overall.

6. Conclusions and Recommendations

Evidence from the Guatemala LSMS 2000 shows that households that have access to modern utility services obtain important benefits.

- First, the cost of modern utility services is often considerably lower than the corresponding traditional alternative. The clearest example is that of households without electricity who pay implicit prices of more than US$11 per kilowatt-hour (more than 80 times the price of electricity) to illuminate with candles and wick lamps and power appliances with dry cell batteries.

- Second, access to modern services can substantially enhance the productivity of households and household-based micro-enterprise. Rural households with access to piped water and liquid propane gas for cooking, save around six man-hours per week compared with households who must go out to collect water and fuel wood. Furthermore, micro-enterprises with access to water and electricity are twice as profitable than comparable enterprises without access to these services, and the effect of a cellular telephone on micro-enterprise profitability is even larger.

- Third, some traditional substitutes for modern utility service are associated with adverse health impacts and may contribute to infant mortality. Although it is difficult to isolate the underlying causality, children from households with access to piped water and adequate sanitation are significantly less likely to suffer from diarrhea and overall physical stunting.

These benefits serve to highlight the importance of the commitments made by the Government of Guatemala at the time of the Peace Accords: to improve access of modern utilities services to traditionally disadvantaged groups. The events of recent years demonstrate that the commitments made in the Peace Accords have been honored. Since 1996, there have been major structural reforms in the electricity and telecommunications sectors designed to improve efficiency and promote investment. Furthermore, resources channeled towards rural expansion of electricity, water, and sanitation infrastructure have approximately tripled; both as a result of earmarking privatization revenues and due to an overall increase in the resources allocated to social funds.

Overall about 70% of Guatemalan households now have water and electricity. These services are close to universal in urban areas, but reach little more than half of rural households. Almost 90% of households have some kind of basic sanitation, though fewer than half of these have sewerage. About 20% of households subscribe to either a fixed line and/or a cellular telephone service. Around 17% of Guatemalan households do not have access to any kind of modern network utility service, leading a

completely traditional lifestyle. This proportion rises to 33% in rural areas, an 40% among households in the lowest consumption quintile. Middle-income households tend to have only water and electricity services, while only among households in the highest consumption quintile do a majority also have sewerage and telephone. Interestingly, households who only have one utility service (23% in all) are most likely to choose electricity, even when other services (such as piped water) are available in their communities.

As a result there has been an appreciable acceleration in the rate of expansion of service coverage. The coverage indices for electricity, water and sanitation increased by about 14 percentage points from 1997/00 versus about 11 percentage points for the period 1993/96. Given the effects of population growth, this represents a substantial increase in the rate of new connections from around 80,000 per year in the years prior to the Peace Accords to around 115,000 per year in the years following the Peace Accords. Moreover, the probability that a household without access received a water or electricity connection rose from 0.19 in the years 1993/96 to 0.35 in the years 1999/00.

These increases in service coverage have begun to reverse traditional inequities in access to services. It is noteworthy that poor, rural and indigenous households have all seen their probability of receiving service more than double following the Peace Accords, increasing more than for any other group in society. However, even this substantial improvement has not been enough to offset their traditional disadvantage, so that in absolute terms these groups still remain the least likely to receive services.

Aided by the rapid expansion of cellular telephony, the overall teledensity index for Guatemala has risen almost fivefold from 4.2 to 19.7 over the period 1997/01. Although about half of the new cellular subscriptions are second telephones for the richest 20% of the population, they are also playing an important role in rural areas where they have become as common as fixed line telephones and have begun to be used to provide informal public telephone services. The network of formal public telephones in rural areas has increased by 80% since the Peace Accords. As a result, 50% of rural households now have a public telephone in their community, and 80% of rural households live within 6 kilometers (or about half an hour) of a public telephone.

Notwithstanding these improvements, coverage rates in Guatemala are still only about average for the Central American region, and a significant coverage gap remains. Over half a million households lack access to electricity and piped water, some 200,000 households are without any form of sanitation, and another 200,000 households in the largest cities are still relying on *in situ* sanitation as opposed to sewerage. Even if current—historically high—levels of expenditure and effort are sustained, with population growth of 2.6% per annum it will still take around 10 years to reach universal coverage for electricity, water, and sewerage. The overall cost to the country is estimated at around US$1 billion.

However, achieving universal coverage is not merely about building infrastructure networks. The evidence shows that about a third of households without electricity and water live in neighborhoods where these services are available, but simply fail to make a connection. Reasons appear to include high connection charges, cultural priorities, and the responsiveness of utilities to customer requests. Complementary policy measures are therefore required to encourage these households to connect to existing networks.

There has been a conscious government policy decision to keep water and electricity tariffs artificially low. To some extent this is understandable given that providing access to utilities services is only ultimately meaningful if these are affordable for poor households to use. However, the evidence suggests that this has not always had the desired consequences, and that the disadvantages of this policy are quite substantial.

In the electricity sector, the 'tarifa social' introduced following privatization of the distribution companies largely fails to reach poor households. This policy keeps domestic tariffs for those consuming up to 300 kilowatt-hours per month capped at US$0.08 per kilowatt-hour. However, the evidence suggests that this measure has only a very modest impact on poor households. Owing to relatively low connection rates among poor households and to the relatively high consumption threshold for the 'tarifa social', about 65% of the beneficiaries are non-poor households who together capture 90% of the total value of the subsidy, while 60% of poor households receive no benefits from the scheme at all since they do not have an electricity connection. Lowering the threshold from 300 to 100 kilowatt-hours per month would improve matters somewhat by lowering the number of non-poor beneficiaries to 55% and the leakage rate to 75%, and reducing the annual costs of the policy by 80%. However, even this still leaves a great deal to be desired.

A much more pro-poor policy would be to channel these resources towards expanding coverage of electricity to unserved households. It is important to recall that the—largely poor—households without access to electricity pay an estimated US$11 per kWh, compared with full cost electricity tariffs of US$0.11 to US$0.15 per kWh. From this perspective, it would appear to make much more sense to channel the US$50 million annual cost of the 'tarifa social' towards increasing connections to unserved households. It is estimated that an additional 50,000 new connections each year could be financed in this way. Moreover, given that over 70% of households without electricity belong to the poorest segments of the population, such a policy would be very effective at reaching the poor.

In the water and sanitation sector, tariffs are well below true economic costs and international parameters of willingness to pay. Households pay bills of less than US$2 per month in Guatemala City, and less than US$1 per month in other urban areas. The underlying tariffs are barely US$0.10 per cubic meter compared with typical costs of around US$0.40 per cubic meter for the Latin American region. In spite of these low tariffs, as many as 30% of households with piped water reported that they did not pay for the service in the last month, compared with only 8% for electricity. As a result, households spend barely 0.5% of their budgets on water and sanitation services, which is a fraction of the 3%-5% World Health Organization guideline for what households are typically willing to pay. Moreover, many households spend three times as much on bottled water as on piped water.

While low water tariffs may seem attractive, there is substantial evidence that the precarious financial position of water utilities is contributing to a very poor quality of service. Three quarters of households with piped water feel it necessary to either buy bottled water or perform some kind of self-treatment. It is particularly striking that the practice regular boiling drinking water is equally prevalent among households with and without piped water (some 40% of both groups). Moreover, households report that on average they receive only 17 hours of water per day and face 3.6 days per month without water.

In conclusion, the key policy recommendations that emerge from the assessment are as follows.

- To maintain and, if possible, increase the current level of resources channeled towards the expansion of modern utility services so as to reach universal coverage within a 10 year horizon.
- To try and improve further the ability of service expansion programs to target traditionally disadvantaged groups, in particular, poor, rural and indigenous households.
- To develop a strategy for removing the barriers that prevent a significant proportion of excluded households from making connections to services even when these are available in their communities.
- To find new financial resources for the FONDETEL rural telephony program and to consider using these to subsidize the extension of cellular networks into commercially marginal areas.
- To reform the 'tarifa social' policy by at least reducing the eligibility threshold to 100 kilowatt-hours per month, and preferably replacing it with a program to fund 50,000 new connections per year.
- To allow water tariffs to rise to a level that allows water utilities to become financial sustainable and thereby improve the quality of service that they offer to the public.
- To complement expansion of water and sanitation programs with measures to improve household hygiene practices so as to reap the full health benefits of the service.
- To complement expansion of electricity and telecommunications coverage in rural areas with measures to promote the productive use of these services by micro-enterprises.

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Data Annex

A. Summary Statistics for Regressions

Table A1: Summary statistics for the regression of determinants of the price per efficient kilowatt-hour

	National	Urban	Rural	Difference
Quetzales per net kwh consumed	10.8	11.9	9.9	
Household head characteristics				
Sex (1 if male)	0.82	0.77	0.85	***
Age (years)	44.29	44.49	44.14	
Ethnicity (1 if indigenous)	0.39	0.26	0.49	***
Language (1 if speaks Spanish)	0.92	0.98	0.88	***
Education (# of years)	4.06	6.47	2.22	***
Household size (# of adults)	2.90	2.85	2.94	*
Expenditure (thousands of Quetzales)	7.72	12.13	4.35	***
Area (1 if urban)	0.43			
Micro enterprise (1 if operates in dwelling)	0.21	0.23	0.20	*
Use of electricity	0.73	0.95	0.56	***
Use of kerosene	0.25	0.04	0.40	***
Use of propane	0.46	0.78	0.20	***
Use of fuel wood	0.74	0.46	0.96	***
Population size	2,183,071	947,643	1,235,428	

Significantly different (urban from rural) at: * 90% level, ** 95% level, *** 99% level.

Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Table A2: Regression of determinants of the price per efficient kilowatt-hour

	National	Urban	Rural
Household head characteristics			
Sex (1 if male)	-0.015	-0.005	-0.046
Age (years)	0.0001	-0.001	0.001
Ethnicity (1 if indigenous)	-0.181***	-0.100**	-0.254**
Language (1 if speaks Spanish)	0.147	0.283	0.148
Education (# of years)	0.002	0.003	0.002
Household size (# of adults)	0.002	0.010	-0.004
Expenditure (thousands of Quetzales)	0.0004	0.002*	-0.004
Area (1 if urban)	0.078		
Micro enterprise (1 if operates in dwelling)	0.032	0.122***	-0.042
Use of electricity	-0.833***	-1.059***	-0.817***
Use of kerosene	-0.173*	0.014	-0.181
Use of propane	-0.285***	-0.248***	-0.295***
Use of fuel wood	-0.225***	-0.159***	-0.621***
Constant	0.773***	0.673**	1.282***
R^2	.0931	.1301	.0962
Population size	2,169,354	937,759	1,231,596

OLS estimation where dependent variable is log of price of net kilowatts-hour consumed.
Regional dummies were included in the estimation.
Significant at: * 90% level, ** 95% level, *** 99% level.

Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Table A3: Summary statistics for regression on take-up of modern utilities

Variable	Electricity		Water		Sanitation	
	N	Y	N	Y	N	Y
Household head						
% of male	.85**	.80	.85***	.80	.84*	.81
Age in years	44	44	43**	45	43	44
Years of school	1.6***	5.0	2.0***	5.0	1.6***	4.4
% of indigenous	.56***	.33	.51***	.35	.41	.38
% who speaks Spanish	.88***	.96	.89	.95	.89**	.93
Household characteristics						
% with business in dwelling	.11***	.18	.15	.18	.12***	.18
Per capita income[1]	3.9***	9.2	4.2***	9.3	3.6***	8.4
% in urban area	.20***	.56	.25***	.56	.09***	.49
Regional dummies						
% in Metropolitan	.09***	.33	.10***	.31	.06***	.28
% in North	.08***	.03	.10**	.05	.06	.08
% in Northeast	.05	.07	.14*	.08	.15*	.08
% in Southeast	.09	.08	.12	.08	.18***	.07
% in Central	.13	.13	.12	.11	.08**	.12
% in Southwest	.32	.26	.24	.24	.26	.25
% in Petén	.03**	.01	.01	.02	.06***	.02
Population size	210,677	1,593,209	272,554	1,494,239	249,168	1,890,371
Variable	Sewerage		Fixed Phone		Cell Phone	
	N	Y	N	Y	N	Y
Household head						
% of male	.85***	.76	.80	.77	.76***	.84
Age in years	44	45	42***	48	45***	42
Years of school	3.1***	6.8	5.1***	9.8	5.3***	10.4
% of indigenous	.42***	.23	.28***	.11	.25***	.11
% who speaks Spanish	.96***	.99	.985*	.994	.986**	.997
Household characteristics						
% with business in dwelling	.16	.19	.17**	.22	.19	.19
Per capita income[1]	5.6***	12.9	8.4***	21.0	10.2***	20.9
% in urban area	.48***	.87	.76***	.90	.70***	.83
Regional dummies						
% in Metropolitan	.23***	.46	.37***	.58	.49***	.67
% in North	.04	.02	.03**	.02	.02***	.01
% in Northeast	.12*	.06	.09	.07	.12***	.08
% in Southeast	.07	.05	.05	.04	.06***	.03
% in Central	.12	.14	.13***	.08	.09**	.06
% in Southwest	.28	.23	.26***	.18	.17***	.12
% in Petén	.02***	.001	.01	.01	.01	.01
Population size	271,823	828,331	454,470	328,104	617,354	209,711

1: Household consumption aggregate, in thousand of Quetzales per capita per year.
If significantly different from those who use service at: ***99%, ***95%, *90%.
Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística - Guatemala

Table A4: Summary statistics for hedonic rental model

Variable / Region	Metropolitan (urban and rural)	Urban (non-Metropolitan)	Rural (non-Metropolitan)
Monthly rent (quetzales)	888	431	190
Proportion in urban area	.86		
Proportion with walls made of			
Block	.60	.55	.29
Adobe	.10	.24	.37
Wood	.07	.10	.20
Proportion with roofs made of			
Concreto	.33	.15	.02
Metal	.62	.72	.77
Tile	.005	.09	.18
Straw or palm	0	.001	.01
Proportion with floors made of			
Cement or clay bricks	.27	.17	.05
Cement	.32	.45	.38
Ceramic or granite	.22	.15	.03
Soil or sand	.19	.22	.53
Connection to			
Water	.85	.89	.59
Drainage	.67	.74	.10
Electricity	.95	.91	.59
Telephone	.42	.27	.03
Number of rooms	3.0	2.5	1.7
Number of rooms for business	.13	.22	.10
Exclusive use of			
Kitchen	.96	.96	.97
Water	.68	.71	.48
Sanitary service	.83	.80	.70
Age of dwelling (years)	17.4	18.3	16.3
Really rented dwellings	.13	.15	.02

Metropolitan includes urban and rural in this region, while urban and rural exclude the Metropolitan region.
Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Table A5: Regression results for hedonic rental model

Variable / Region	Metropolitan (urban and rural)	Urban (non-Metropolitan)	Rural (non-Metropolitan)
Urban area	-.39*		
Walls made of			
Block	.13	.17**	.28***
Adobe	.004	.12*	.10
Wood	.09	-.10	.03
Roofs made of			
Concreto	.31**	.03	.03
Metal	.11	-.15**	-.10
Tile	-.07	-.26***	-.10
Straw or palm	-	-.20	-.15
Floors made of			
Cement/ clay bricks	.02	.10	-.16
Cement	-.13	-.04	-.17
Ceramic or granite	.08	.04	-.17
Soil or sand	-.38**	-.25**	-.36*
Connection to			
Water	.39***	.003	-.01
Drainage	.02	.08*	.16**
Electricity	.09	.27***	.17***
Telephone	.45***	.20***	.28***
# of rooms	.09***	.14***	.13***
# of rooms for business	-.10*	.06*	.02
Exclusive use of			
Kitchen	-.07	.02	.07
Water	-.04	-.01	.11**
Sanitary service	.27**	.15***	.07*
Age of dwelling	-.003	.0002	-.0001
Rented	-.19***	-.30***	-.38***
Constant	5.28***	4.36***	4.20***
R^2	.7694	.6527	.5375
Population size	446,882	429,432	1,029,361

Results of OLS regressions where the dependant variable is the logarithm of the monthly rent for the dwelling.
Census-tract fixed-effects were included in each of the estimations.
Metropolitan includes urban and rural in this region, while urban and rural exclude the Metropolitan region.
Significant at: * 90% level, ** 95% level, *** 99% level.
Source: World Bank calculations using th e ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Table A6: Summary statistics for model of probability of having a micro-enterprise

	No enterprise	Enterprise	Wald test[3]
Household head characteristics			
Male	.77	.81	
Age	44	47	***
Years of school	6.5	6.6	*
Speaks Spanish	.98	.99	
Indigenous	.26	.29	
Household characteristics			
Number of adults	2.8	3.2	***
Urban area	.43	.48	**
Rural area	.57	.52	**
Modern utilities availability			
Electricity	1	1	
Water[2]	.94	.97	**
Fixed phone	.68	.73	***
Cellular phone	.66	.63	*
Modern utilities coverage			
Expenditure in electricity[4] (Q)	.43	27	***
Electricity	.95	.97	***
Water[2]	.87	.90	***
Fixed phone	.29	.39	***
Cellular phone	.19	.19	**
Minutes to closest public phone	11	8	***
Region			
Metropolitan	.50	.44	
North	.03	.03	**
Northeast	.06	.05	
Southeast	.05	.06	***
Central	.12	.14	
Southwest	.18	.19	
Northwest	.05	.06	
Petén	.02	.02	**
Population size	1,721,709	455,641	

1: Refers only to enterprises that operate in dwelling.
2: In dwelling or yard.
3: Null hypothesis (equality of enterprise owners and non-owners) is rejected at: *** 90%, ** 95%, * 90%.
4: For business purposes, only.
Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Table A7: Summary statistics for characteristics of households with micro-enterprises

	National	Rural	Urban
Household head characteristics			
Male	0.81	0.82	0.81
Age	46.90	46.10	47.54
Years of school	4.54	2.50	6.16
Speaks Spanish	0.93	0.87	0.98
Indigenous	0.40	0.52	0.31
Household characteristics			
Number of adults	3.19	3.15	3.22
Urban area	0.56	0.00	1.00
Modern utilities coverage			
Electricity	0.84	0.68	0.97
Water[2]	0.79	0.63	0.91
Fixed phone	0.24	0.06	0.39
Cellular phone	0.10	0.05	0.15
Minutes to closest public phone	16.10	27.64	7.00
Business characteristics			
Capital (Q)	1,0645	4,401	15,573
Labor (man-hours)	249	207	283
Age of business (years)	10.43	10.27	10.56
Months worked last year (#)	10.75	10.63	10.85
Economic activity			
Manufacture	0.33	0.35	0.31
Services	0.63	0.64	0.63
Provider			
Large firm	0.21	0.15	0.27
Small firm	0.32	0.34	0.31
Source of finance			
Bank / cooperative / NGO	0.05	0.03	0.07
Family / friends	0.10	0.09	0.12
Providers	0.01	0.01	0.02
Savings / assets / inheritance	0.85	0.89	0.82
Type of dwelling			
House	0.94	0.92	0.96
Modern utilities availability			
Fixed phone	0.46	0.16	0.71
Cellular phone	0.41	0.20	0.58
Water[2]	0.88	0.74	0.99
Electricity	0.89	0.75	1.00
Observations	1,299	726	573

1: Refers only to enterprises that operate in dwelling.
2: In dwelling or yard.

B. Summary Statistics Underlying Figures Presented in Text

Table B1: Total social fund investments in rural infrastructure since 1993

(US$ million per year)

	Electricity				Water and Sanitation			
	FIS	FONAPAZ	FSDC	Total	FIS	FONAPAZ	FSDC	Total
1993	0	0	0	0	0	1.0	0	1.1
1994	0	0	0	0	0	1.0	0	1.0
1995	0	0	4.0	4.0	0	1.0	0	5.0
1996	0	0	8.2	8.2	7.3	0.9	7.3	9.5
1997	0	0	13.9	13.9	15.9	1.9	15.9	23.2
1998	0	0	23.5	23.5	16.9	1.0	16.9	43.4
1999	0	0	16.6	16.6	7.9	3.9	7.9	40.8
2000	0	0	3.3	3.3	23.6	1.0	23.6	26.2
Total	0	0	69.5	69.5	31.1	12.8	71.7	114.5

Table B2: Central American comparison for equity of coverage

(percentage of households)

	Guatemala	Nicaragua	Panama	El Salvador
Electricity				
• 1st quintile	37	54	27	27
• 2nd quintile	60	69	51	72
• 3rd quintile	74	77	74	86
• 4th quintile	87	85	83	93
• 5th quintile	93	96	93	98
Water				
• 1st quintile	50	29	22	58
• 2nd quintile	62	33	45	82
• 3rd quintile	63	45	63	89
• 4th quintile	76	54	73	94
• 5th quintile	92	76	86	98
Sanitation				
• 1st quintile	73	72	64	71
• 2nd quintile	80	76	73	92
• 3rd quintile	88	79	86	97
• 4th quintile	94	81	92	99
• 5th quintile	98	88	97	100
Telephone				
• 1st quintile	0	1	1	4
• 2nd quintile	2	4	1	14
• 3rd quintile	6	10	3	32
• 4th quintile	24	19	6	55
• 5th quintile	68	46	31	78

Table B3: Historical coverage trends

(percentage of households)

	Electricity			Water			Sanitation		
	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
1990	46	72	27	38	60	22	55	68	45
1991	47	73	28	39	61	23	55	69	45
1992	49	74	29	42	63	25	58	72	47
1993	50	76	30	44	65	27	60	75	49
1994	52	78	33	46	68	29	63	78	52
1995	55	81	36	50	73	32	67	82	56
1996	58	84	38	53	75	36	71	86	59
1997	61	87	42	57	78	40	75	89	63
1998	65	89	46	61	82	45	79	92	69
1999	67	91	49	65	85	49	83	95	74
2000	73	95	56	69	88	54	87	97	79

Table B4: Distance to public telephone for rural households

(cumulative percentage of households who live with the distance indicated)

	Within community	Outside community	Overall
1km	86	17	48
2km	94	32	60
3km	96	40	66
4km	97	51	72
5km	98	61	78
6km	98	65	80
7km	98	69	82
8km	98	76	86
9km	98	78	87
10km	98	83	90
>10km	100	100	100

Table B5: Accessibility of public telephones for rural households by region

(average distance faced by households)

	Physical distance (kilometers)	Temporal distance (minutes)
Metropolitan	2.7	28
Northeast	3.2	22
Southwest	3.6	24
Southeast	3.7	33
Central	4.9	24
Northwest	7.2	46
North	9.1	48
Peten	12.4	48

Table B6: Access to fixed and cellular telephones

(percentage of households)

	Consumption quintile				
	1st	2nd	3rd	4th	5th
Fixed line only	.2	1	3	13	34
Cellular line only	.1	1	3	10	10
Both fixed and cellular lines	0	.1	0	1	24
Total	.3	2	6	24	68

Table B7: Decomposition of coverage deficit

(percentage of households who lack coverage)

	Demand side problem only	Both supply side and demand side problem	Supply side problem only	Total
Electricity	37	7	56	100
Water	39	10	52	100
Sewerage	21	19	60	100
Fixed telephone	25	44	32	100
Cellular telephone	31	51	18	100

Table B8: Expenditure on basic services

(percentage of consumption aggregate)

	Consumption Quintiles					
	1st	2nd	3rd	4th	5th	Total
Telecommunications	0.12	0.53	0.65	1.79	3.69	1.4
Cooking and heating	0.15	0.29	0.46	0.72	1.01	0.5
Lighting and appliances	3.58	3.15	3.1	3.08	2.58	3.1
Water and sanitation	7.87	6.86	5.62	4.19	2.21	5.3
Total	11.72	10.83	9.83	9.78	9.49	10.3

Table B9: Evolution of electricity tariffs following reform

(US$ per kWh)

		EEGSA	DEOCSA	DEORSA	Tarifa Social
1998	March	0.0835			0.0750
	July	0.0856			0.0750
	November	0.0856			0.0750
1999	March	0.0856	0.0685	0.0685	0.0750
	July	0.1033	0.0698	0.0595	0.0750
	November	0.1063	0.0750	0.0740	0.0750
2000	March	0.1063	0.0791	0.0772	0.0750
	July	0.1063	0.0870	0.0849	0.0750
	November	0.1415	0.0915	0.0892	0.0750
2001	March	0.1519	0.0962	0.0940	0.0750

Table B10: Cumulative density of electricity consumption

(cumulative percentage of households)

Electricity consumption (kWh per month)	Poor customers	Non-poor customers
50	70	29
100	91	54
150	96	69
200	99	79
250	100	84
300	100	90
350	100	93
400	100	95
450	100	96
500	100	97
<500	100	100

Table B11: Simulation of inclusion and exclusion errors and subsidy cost

(various performance variables)

Electricity consumption (kWh per month)	Targeting errors (percentage)				Subsidy Cost (US$m pa)
	Exclusion (connected poor)	Exclusion (all poor)	Inclusion (non-poor)	Leakage (subsidy cost)	
50	30	72	47	61	4.1
100	8	64	56	75	13.2
150	4	62	61	82	22.7
200	2	61	63	85	32.0
250	1	61	65	87	38.6
300	0	61	66	89	48.9
350	0	61	67	90	54.0
400	0	60	67	91	58.7
450	0	60	67	91	60.2
500	0	60	67	92	62.9
<500	30	72	47	61	4.1

Table B12: Typical structure of water bills

(US$ per month)

m^3 per month	EMPAGUA domestic	EMPAGUA social	Quetazal -tenango	San Sebastian	San Martin	San Agustin	San Cristobal
5	0.66	1.32	1.81	0.33	0.33	0.39	0.66
10	0.66	1.32	1.81	0.33	0.33	0.39	0.66
15	0.66	1.32	1.81	0.33	0.33	0.39	0.66
20	1.67	1.32	1.81	0.33	0.33	0.39	0.66
25	2.02	1.32	2.11	0.33	0.33	0.39	0.66
30	2.57	3.67	2.41	0.33	0.33	0.39	0.66
35	3.12	5.32	3.62	0.33	0.33	0.39	0.66
40	3.67	6.97	3.92	0.33	0.68	0.74	1.01
45	4.22	8.62	4.52	0.33	1.03	1.09	1.36
50	4.87	10.27	5.42	0.33	1.38	1.44	1.71
55	6.17	11.92	6.62	0.33	1.73	1.79	2.06
60	8.12	13.57	8.12	0.33	2.08	2.14	2.41
65	10.72	15.22	9.92	0.33	2.43	2.49	2.76
70	12.02	16.87	12.02	0.33	2.78	2.84	3.11
75	13.32	18.52	14.42	0.33	3.13	3.19	3.46
80	14.62	20.17	17.12	0.33	3.48	3.54	3.81
85	15.92	21.82	20.12	0.33	3.83	3.89	4.16
90	17.22	23.47	23.42	0.33	4.18	4.24	4.51
95	18.52	25.12	27.02	0.33	4.53	4.59	4.86
100	19.82	26.77	30.92	0.33	4.88	4.94	5.21

Table B13 : Intra-household allocation of water and fuel wood collection tasks

(percentage of man-hours devoted yesterday by different groups)

	Fuel wood	Water
Men	41	13
Boys	24	13
Women	24	50
Girls	11	24
Total	100	100

C. Standard Summary Tables

Table C1: Availability, Take-up and Coverage

	Piped water[1]			Electricity			Propane			Sewerage		
	Availability	Take-up	Coverage	Availability	Take-up	Coverage	Availability	Take-up	Coverage	Availability	Take-up	Coverage
National	0.81	0.85	0.69	0.83	0.88	0.73	0.74	0.61	0.45	0.44	0.68	0.30
Urban	0.95	0.92	0.87	1.00	0.95	0.95	0.98	0.79	0.77	0.85	0.74	0.63
Rural	0.70	0.76	0.53	0.70	0.81	0.57	0.55	0.37	0.20	0.13	0.39	0.05
Region												
Metropolitan	0.91	0.94	0.86	1.00	0.97	0.97	0.96	0.86	0.83	0.77	0.81	0.62
North	0.65	0.74	0.48	0.43	0.75	0.32	0.44	0.35	0.15	0.18	0.43	0.08
Northeast	0.85	0.77	0.65	0.65	0.91	0.59	0.86	0.53	0.46	0.29	0.61	0.18
Southeast	0.82	0.79	0.65	0.78	0.87	0.68	0.71	0.45	0.32	0.27	0.57	0.15
Central	0.82	0.83	0.68	0.95	0.88	0.84	0.87	0.57	0.50	0.49	0.60	0.29
Southwest	0.77	0.84	0.65	0.89	0.86	0.77	0.72	0.50	0.36	0.42	0.61	0.26
Northwest	0.85	0.78	0.66	0.74	0.76	0.56	0.30	0.46	0.14	0.23	0.58	0.13
Peten	0.46	0.89	0.41	0.46	0.78	0.36	0.60	0.38	0.23	0.04	0.19	0.01
Poverty												
Non-poor	0.87	0.91	0.79	0.94	0.95	0.89	0.91	0.79	0.72	0.64	0.77	0.49
All poor	0.74	0.75	0.56	0.70	0.77	0.54	0.53	0.25	0.13	0.21	0.36	0.08
Extreme poor	0.71	0.67	0.48	0.53	0.58	0.31	0.33	0.04	0.01	0.09	0.17	0.02
Quintile												
1 (poorest)	0.71	0.71	0.50	0.59	0.66	0.39	0.38	0.06	0.02	0.11	0.20	0.02
2.00	0.78	0.79	0.62	0.77	0.82	0.63	0.61	0.29	0.18	0.27	0.38	0.10
3.00	0.77	0.82	0.63	0.86	0.90	0.77	0.80	0.55	0.44	0.38	0.56	0.21
4.00	0.85	0.90	0.77	0.95	0.95	0.90	0.92	0.80	0.74	0.60	0.69	0.41
5 (richest)	0.96	0.97	0.93	0.97	0.98	0.95	0.98	0.90	0.88	0.84	0.90	0.76
Ethnicity												
Non-indigenous	0.83	0.88	0.73	0.88	0.92	0.81	0.85	0.69	0.59	0.54	0.74	0.40
Indigenous	0.78	0.79	0.62	0.75	0.81	0.61	0.56	0.42	0.24	0.28	0.51	0.14
Quiche	0.89	0.82	0.73	0.91	0.88	0.80	0.73	0.52	0.38	0.45	0.54	0.24
Q'eqchi	0.47	0.69	0.32	0.35	0.76	0.27	0.45	0.30	0.14	0.11	0.42	0.05
Kaqchiqel	0.81	0.82	0.66	0.98	0.87	0.85	0.80	0.46	0.37	0.38	0.50	0.19
Mam	0.84	0.80	0.67	0.72	0.70	0.50	0.32	0.28	0.09	0.17	0.45	0.08
Other ind	0.79	0.76	0.60	0.64	0.76	0.49	0.39	0.34	0.13	0.19	0.52	0.10

1: Piped water in dwelling or field.

Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística - Guatemala

Table C1: Availability, Take-up and Coverage (continued)

	Sanitation			Fixed phone			Cell phone		
	Availability	Take-up	Coverage	Availability	Take-up	Coverage	Availability	Take-up	Coverage
National	0.98	0.88	0.86	0.36	0.42	0.15	0.38	0.25	0.10
Urban	1.00	0.98	0.98	0.68	0.46	0.31	0.65	0.29	0.19
Rural	0.97	0.81	0.79	0.11	0.24	0.03	0.18	0.16	0.03
Region									
Metropolitan	1.00	0.97	0.97	0.66	0.53	0.35	0.81	0.32	0.26
North	1.00	0.91	0.91	0.13	0.26	0.03	0.09	0.14	0.01
Northeast	0.96	0.80	0.77	0.34	0.36	0.12	0.48	0.18	0.09
Southeast	0.96	0.75	0.72	0.19	0.34	0.06	0.23	0.15	0.03
Central	0.99	0.92	0.91	0.36	0.29	0.10	0.29	0.19	0.06
Southwest	0.99	0.88	0.87	0.32	0.33	0.11	0.24	0.19	0.05
Northwest	0.95	0.84	0.80	0.12	0.37	0.04	0.11	0.18	0.02
Peten	0.93	0.74	0.69	0.15	0.37	0.06	0.15	0.21	0.03
Poverty									
Non-poor	0.99	0.95	0.94	0.57	0.48	0.27	0.57	0.30	0.17
All poor	0.97	0.81	0.79	0.11	0.06	0.01	0.15	0.06	0.01
Extreme poor	0.95	0.75	0.71	0.03	0.14	0.00	0.07	0.00	0.00
Quintile									
1 (poorest)	0.96	0.77	0.74	0.04	0.06	0.00	0.08	0.01	0.00
2.00	0.98	0.82	0.80	0.14	0.05	0.01	0.18	0.06	0.01
3.00	0.99	0.90	0.89	0.27	0.11	0.03	0.34	0.08	0.03
4.00	1.00	0.95	0.95	0.50	0.28	0.14	0.50	0.21	0.11
5 (richest)	1.00	0.98	0.98	0.84	0.69	0.58	0.81	0.42	0.34
Ethnicity									
Non-indigenous	0.99	0.89	0.88	0.47	0.47	0.22	0.49	0.29	0.14
Indigenous	0.97	0.87	0.84	0.19	0.22	0.04	0.21	0.13	0.03
Quiche	0.98	0.85	0.83	0.36	0.18	0.06	0.31	0.11	0.03
Q'eqchi	1.00	0.88	0.88	0.10	0.14	0.01	0.19	0.08	0.02
Kaqchiqel	1.00	0.93	0.93	0.26	0.25	0.07	0.36	0.11	0.04
Mam	0.97	0.87	0.84	0.06	0.25	0.02	0.05	0.30	0.02
Other ind	0.91	0.83	0.76	0.10	0.30	0.03	0.09	0.34	0.03

Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística - Guatemala

Table C2: Coverage gap

	Number of households without access to							Proportion of total gap in each group						
	Piped water[1]	Electricity	Propane	Sewerage[2]	Sanitation[3]	Fixed Phone	Cellular phone	Piped water[1]	Electricity	Propane	Sewerage[2]	Sanitation[3]	Fixed Phone	Cellular phone
National	683,111	584,141	1,190,928	1,521,984	286,980	1,747,331	1,967,640							
Urban	111,843	44,468	206,408	346,951	23,478	574,821	767,760	0.16	0.08	0.17	0.23	0.08	0.33	0.39
Rural	571,268	539,673	984,520	1,175,033	263,502	1,172,510	1,199,879	0.84	0.92	0.83	0.77	0.92	0.67	0.61
Region														
Metropolitan	77,394	18,440	93,685	205,153	15,197	296,145	402,422	0.11	0.03	0.08	0.13	0.05	0.17	0.20
North	83,226	107,895	134,736	146,897	14,276	152,605	157,320	0.12	0.18	0.11	0.10	0.05	0.09	0.08
Northeast	66,432	79,395	104,240	158,207	45,275	156,070	176,092	0.10	0.14	0.09	0.10	0.16	0.09	0.09
Southeast	65,489	59,547	127,687	159,727	54,029	171,986	181,781	0.10	0.10	0.11	0.10	0.19	0.10	0.09
Central	75,934	39,508	122,526	171,028	20,684	208,283	228,082	0.11	0.07	0.10	0.11	0.07	0.12	0.12
Southwest	193,415	130,057	347,995	404,460	68,189	471,506	519,875	0.28	0.22	0.29	0.27	0.24	0.27	0.26
Northwest	82,838	107,566	209,848	212,135	49,090	230,098	239,224	0.12	0.18	0.18	0.14	0.17	0.13	0.12
Peten	38,383	41,734	50,211	64,377	20,241	60,640	62,844	0.06	0.07	0.04	0.04	0.07	0.03	0.03
Poverty														
Non-poor	240,705	124,009	324,404	598,060	68,169	762,763	976,921	0.35	0.21	0.27	0.39	0.24	0.44	0.50
All poor	442,406	460,132	866,525	923,924	218,810	984,568	990,719	0.65	0.79	0.73	0.61	0.76	0.56	0.50
Extreme poor	123,338	163,615	232,740	232,105	66,678	234,580	235,678	0.18	0.28	0.20	0.15	0.23	0.13	0.12
Quintile														
1 (poorest)	219,573	266,303	426,486	427,226	116,259	435,668	436,766	0.32	0.46	0.36	0.28	0.41	0.25	0.22
2	161,818	154,008	349,745	381,385	82,959	417,626	420,242	0.24	0.26	0.29	0.25	0.29	0.24	0.21
3	163,691	98,389	248,703	350,730	51,775	419,808	433,129	0.24	0.17	0.21	0.23	0.18	0.24	0.22
4	104,376	44,496	115,959	254,855	25,993	333,828	391,852	0.15	0.08	0.10	0.17	0.09	0.19	0.20
5 (richest)	33,653	20,945	50,035	107,789	9,993	140,401	285,650	0.05	0.04	0.04	0.07	0.03	0.08	0.15
Ethnicity														
Non-indigenous	359,148	255,024	543,016	794,063	158,100	952,527	1,143,277	0.53	0.44	0.46	0.52	0.55	0.55	0.58
Indigenous	323,963	329,117	647,913	727,921	128,879	794,804	824,363	0.47	0.56	0.54	0.48	0.45	0.45	0.42
Quiche	51,165	39,063	119,419	145,941	32,437	175,736	186,896	0.07	0.07	0.10	0.10	0.11	0.10	0.09
Q'eqchi	84,929	92,404	108,948	120,188	15,017	122,897	124,301	0.12	0.16	0.09	0.08	0.05	0.07	0.06
Kaqchiqel	65,097	29,162	120,929	154,483	13,444	173,358	183,755	0.10	0.05	0.10	0.10	0.05	0.10	0.09
Mam	52,676	78,102	144,693	147,139	25,416	154,325	156,707	0.08	0.13	0.12	0.10	0.09	0.09	0.08
Other ind	70,097	90,386	153,924	160,170	42,565	168,488	172,704	0.10	0.15	0.13	0.11	0.15	0.10	0.09

1: Piped water in dwelling or field.
2: Toilet connected to drainage.
3: Includes toilets and latrines.
Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Table C3: Quality of services

	Among those with electricity			Among those with piped water[1]			
	# of blackouts	days without Service[2]	hours/day with service[3]	days without Service[2]	hours/day with service[3]	proportion who treat water	proportion who buy bottled water
National	2.90	0.69	23.4	3.58	16.7	0.61	0.22
Urban	2.20	0.34	23.5	3.54	15.2	0.57	0.35
Rural	3.79	1.14	23.4	3.62	18.5	0.66	0.05
Region							
Metropolitan	0.75	0.22	23.8	3.76	13.1	0.47	0.43
North	3.36	0.56	23.4	3.98	20.1	0.64	0.07
Northeast	3.75	0.87	23.3	3.29	17.4	0.50	0.15
Southeast	4.25	1.30	22.5	4.66	17.8	0.49	0.06
Central	2.30	0.51	23.5	4.67	15.1	0.60	0.18
Southwest	3.65	0.90	23.4	2.76	19.1	0.83	0.12
Northwest	7.42	1.52	23.1	2.91	20.6	0.78	0.06
Peten	4.06	0.34	23.4	3.82	14.6	0.46	0.18
Poverty							
Non-poor	2.44	0.51	23.5	3.39	15.6	0.59	0.33
All poor	3.79	1.03	23.4	3.89	18.5	0.65	0.03
Extreme poor	4.89	1.30	23.3	*	*	0.64	0.03
Quintile							
1 (poorest)	4.56	1.19	23.3	3.79	19.8	0.64	0.02
2	3.64	1.06	23.3	3.91	17.8	0.66	0.03
3	2.87	0.74	23.5	4.33	16.2	0.69	0.10
4	2.52	0.59	23.4	3.76	15.7	0.64	0.24
5 (richest)	2.09	0.29	23.5	2.56	15.3	0.50	0.50
Ethnicity							
Non-indigenous	2.48	0.60	23.4	3.51	15.9	0.55	0.28
Indigenous	3.75	0.88	23.4	3.71	18.1	0.74	0.09
Quiche	3.38	0.60	23.4	3.06	19.2	0.78	0.13
Q'eqchi	2.44	1.00	23.3	5.41	18.7	0.76	0.06
Kaqchiqel	2.33	0.62	23.5	5.67	13.2	0.60	0.11
Mam	4.28	1.18	23.3	2.95	20.0	0.82	0.04
Other ind	7.03	1.50	23.4	2.37	20.1	0.75	0.06

*: No observations available. 1: Piped water in dwelling or field. 2: Consecutive days without service in previous month. 3: Consecutive hours-per-day with service in previous month.
Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Table C4: Consumption

	Energy for lighting and appliances					Energy for cooking					Energy for cooking, lighting and appliances				
	Gross kwh	Net kwh	Price of gkw	Price of nkw	Efficiency	Gross kwh	Net kwh	Price of gkw	Price of nkw	Efficiency	Gross kwh	Net kwh	Price of gkw	Price of nkw	Efficiency
National	69.1	61.6	3.15	33.5	9.9	1,268	236	0.21	0.51	4.51	1,341	298	8.0	1.69	5.67
Urban	108.5	105.0	2.30	27.0	4.0	759	194	0.34	0.59	2.88	870	300	4.4	1.50	3.02
Rural	39.1	28.6	3.79	38.4	14.3	1,656	268	0.10	0.45	5.89	1,699	297	10.7	1.84	7.70
Region															
Metropolitan	130.3	128.5	2.16	24.2	3.8	342	138	0.40	0.67	0.16	36	267	2.2	1.26	2.14
North	39.7	19.7	2.94	48.7	23.7	1,176	190	0.12	0.50	0.10	105	210	8.4	1.39	11.07
Northeast	50.5	42.1	4.50	43.3	13.0	1,500	268	0.19	0.49	0.28	224	312	9.8	1.96	5.65
Southeast	45.1	37.9	3.65	50.0	12.9	1,817	302	0.12	0.37	0.15	213	341	11.3	2.05	7.77
Central	68.3	60.4	2.82	27.5	6.2	1,264	238	0.19	0.50	0.15	95	301	8.0	1.75	5.10
Southwest	50.7	43.7	3.14	27.5	8.8	1,569	271	0.13	0.44	0.13	133	315	10.0	1.88	5.69
Northwest	31.9	22.8	4.35	39.3	12.6	1,812	286	0.10	0.47	0.09	177	308	10.2	1.71	7.80
Peten	51.2	31.2	3.25	46.4	20.3	2,408	380	0.11	0.36	0.15	292	411	14.3	2.36	9.93
Poverty															
Non-poor	99.1	94.5	2.60	22.7	4.7	973	220	0.30	0.56	3.29	1,076	315	5.4	1.56	3.49
All poor	33.7	22.8	3.80	46.1	15.9	1,616	255	0.09	0.44	6.10	1,653	278	11.0	1.85	8.24
Extreme poor	26.2	11.9	3.95	55.6	24.5	1,460	221	0.06	0.40	6.57	1,486	233	11.6	1.79	10.59
Quintile															
1 (poorest)	27.6	13.9	3.73	51.3	20.9	1,548	235	0.07	0.41	6.52	1,577	249	11.7	1.84	9.86
2	35.5	26.2	3.77	40.7	12.1	1,695	271	0.10	0.45	5.96	1,736	298	10.9	1.88	7.27
3	53.0	46.3	3.31	36.0	9.1	1,472	260	0.17	0.50	4.91	1,527	306	8.6	1.78	5.44
4	84.1	79.3	2.77	25.3	4.5	1,133	237	0.26	0.55	3.55	1,220	317	5.8	1.60	3.63
5 (richest)	145.5	142.4	2.16	13.8	2.5	493	176	0.42	0.63	2.05	641	320	2.8	1.36	2.17
Ethnicity															
Non-indigenous	86.0	80.3	3.17	31.2	7.4	1,040	216	0.27	0.54	3.73	1,130	298	6.5	1.62	4.59
Indigenous	42.6	32.2	3.13	37.1	13.8	1,626	266	0.12	0.47	5.75	1,671	298	10.3	1.81	7.37
Quiche	44.9	40.2	3.31	28.8	8.9	1,187	213	0.14	0.53	5.34	1,232	254	7.7	1.55	5.53
Q'eqchi	41.7	19.6	2.29	35.0	22.3	1,446	229	0.11	0.50	6.01	1,488	248	9.5	1.54	9.10
Kaqchiqel	59.6	55.3	2.39	41.9	7.5	1,724	295	0.15	0.49	5.27	1,792	352	10.0	1.94	5.53
Mam	29.6	16.9	2.66	27.3	17.2	1,878	290	0.07	0.38	6.35	1,907	307	13.7	2.19	7.83
Other ind	33.9	21.5	4.78	51.7	16.6	1,902	297	0.10	0.46	6.03	1,936	318	10.9	1.81	9.72

Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Table C5: Expenditure

	In Quetzales per month				As a percentage of consumption expenditure			
	Piped water[1]	Energy for cooking	Energy for lighting and applianes	Telecom.	Piped water[1]	Energy for cooking	Energy for lighting and applianes	Telecom.
National	11	74	96	69	0.33%	3.09%	5.35%	1.36%
Urban	20	109	98	130	0.52%	3.08%	3.81%	2.20%
Rural	3	48	94	22	0.18%	3.10%	6.53%	0.72%
Region								
Metropolitan	26	133	92	171	0.58%	3.13%	2.99%	2.48%
North	2	45	85	12	0.11%	3.50%	6.89%	0.29%
Northeast	6	57	88	48	0.26%	2.85%	4.92%	1.42%
Southeast	5	54	88	27	0.26%	3.22%	5.92%	0.90%
Central	12	70	98	36	0.48%	3.39%	5.43%	0.89%
Southwest	5	55	103	39	0.23%	2.91%	6.17%	1.06%
Northwest	2	43	105	34	0.09%	2.98%	7.66%	1.17%
Peten	6	56	91	34	0.25%	2.92%	5.17%	0.92%
Poverty								
Non-poor	17	102	101	120	0.44%	2.91%	3.75%	2.18%
All poor	3	42	90	8	0.20%	3.31%	7.24%	0.40%
Extreme poor	1	35	74	1	0.13%	3.87%	8.54%	0.07%
Quintile								
1 (poorest)	1	36	78	2	0.14%	3.57%	7.86%	0.12%
2	4	44	95	11	0.23%	3.16%	6.87%	0.58%
3	6	59	103	17	0.30%	3.08%	5.63%	0.64%
4	12	81	103	60	0.41%	3.08%	4.20%	1.79%
5 (richest)	31	151	99	256	0.56%	2.58%	2.22%	3.68%
Ethnicity								
Non-indigenous	15	90	93	99	0.40%	2.99%	4.13%	1.76%
Indigenous	4	49	101	21	0.21%	3.26%	7.27%	0.73%
Quiche	7	51	103	23	0.34%	2.87%	6.49%	0.72%
Q'eqchi	2	48	88	8	0.13%	3.81%	7.33%	0.26%
Kaqchiqel	6	64	115	19	0.29%	3.58%	7.35%	0.69%
Mam	2	36	92	19	0.15%	3.14%	8.09%	0.91%
Other ind	2	44	100	31	0.11%	3.04%	7.26%	0.98%

1: Piped water in dwelling or field.

Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Table C6: Cost recovery

	Piped water[1]			Electricity		
	Proportion of hh with service who do not pay	Monthly Quetzales paid		Proportion of hh with service who do not pay	Monthly Quetzales paid	
		Everyone	Only those who pay an amount >0		Everyone	Only those who pay an amount >0
National	0.30	11	22	0.08	60	89
Urban	0.22	20	29	0.07	103	118
Rural	0.40	3	11	0.09	26	51
Region						
Metropolitan	0.24	26	40	0.09	132	151
North	0.24	2	6	0.10	18	61
Northeast	0.28	6	12	0.12	39	76
Southeast	0.27	5	9	0.12	34	57
Central	0.28	12	24	0.07	55	71
Southwest	0.36	5	13	0.06	38	54
Northwest	0.49	2	5	0.07	21	41
Peten	0.14	6	17	0.06	30	91
Poverty						
Non-poor	0.25	17	29	0.07	93	112
All poor	0.39	3	8	0.10	21	42
Extreme poor	0.46	1	5	0.13	11	41
Quintile						
1 (poorest)	0.46	1	5	0.10	13	37
2	0.35	4	9	0.09	24	41
3	0.36	6	15	0.10	41	59
4	0.28	12	21	0.06	68	81
5 (richest)	0.17	31	40	0.06	152	173
Ethnicity						
Non-indigenous	0.26	15	28	0.09	79	107
Indigenous	0.38	4	11	0.07	29	52
Quiche	0.34	7	15	0.08	39	53
Q'eqchi	0.21	2	9	0.09	16	67
Kaqchiqel	0.30	6	12	0.04	50	62
Mam	0.56	2	8	0.04	16	32
Other ind	0.39	2	6	0.09	19	44

1: Piped water in dwelling or field.

Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Table C7: Social tariff

	Connection rate	Consumption[1]	Exp. in Quetzales		Exp. as prop. of consumption		Avg. subsidy	Number of hh	Total subsidy	Share of
	(proporiton of hh)	(kwh/month)	With tariff	No tariff	With tariff	No tariff	(Quetzales)	beneficiaries	(US$)	total subsidy
National	0.73	102	88	134	0.03	0.04	39	1,190,384	6,485,975	100%
Urban	0.95	135	119	183	0.03	0.04	57	652,726	5,280,061	81%
Rural	0.57	60	50	71	0.02	0.03	17	537,657	1,205,914	19%
Region										
Metropolitan	0.97	168	156	257	0.03	0.05	91	340,619	4,555,958	70%
North	0.32	80	61	81	0.03	0.04	13	38,831	68,183	1%
Northeast	0.59	96	74	95	0.03	0.03	15	86,141	180,050	3%
Southeast	0.68	71	54	72	0.03	0.03	12	100,019	162,700	3%
Central	0.84	88	73	112	0.03	0.05	35	153,292	732,674	11%
Southwest	0.77	67	54	71	0.02	0.03	13	334,862	599,038	9%
Northwest	0.56	46	39	51	0.02	0.03	9	117,064	142,250	2%
Peten	0.36	115	92	112	0.03	0.04	17	19,556	45,122	1%
Poverty										
Non-poor	0.89	128	112	171	0.03	0.04	52	794,359	5,807,678	90%
All poor	0.54	48	39	56	0.03	0.04	13	396,024	678,298	10%
Extreme poor	0.31	47	39	52	0.04	0.05	7	189	181	0%
Quintile										
1 (poorest)	0.39	42	35	48	0.03	0.04	8	127,889	142,763	2%
2	0.63	48	40	56	0.02	0.03	13	205,107	373,094	6%
3	0.77	63	51	76	0.03	0.04	21	242,727	698,583	11%
4	0.9	100	79	127	0.03	0.04	44	295,368	1,747,755	27%
5 (richest)	0.95	184	171	255	0.03	0.04	74	319,293	3,523,779	54%
Ethnicity										
Non-indigenous	0.81	123	107	164	0.03	0.04	50	791,990	5,534,813	85%
Indigenous	0.61	59	49	70	0.03	0.03	18	398,394	951,163	15%
Quiche	0.8	66	52	72	0.03	0.03	15	112,427	229,753	4%
Q'eqchi	0.27	69	52	74	0.03	0.04	15	21,797	44,463	1%
Kaqchiqel	0.85	72	61	91	0.03	0.04	28	116,886	440,690	7%
Mam	0.5	34	31	40	0.02	0.03	8	73,524	76,684	1%
Other ind	0.49	52	42	62	0.02	0.03	16	73,759	159,574	2%

1: From this column on (i.e. to the right), the analysis focuses only on households that have an electricity meter.
Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística – Guatemala

Table C8: Probability that an unserved household was connected

	Electricity			Piped water[§]			Sanitary services[¨]		
	1993-1996	1997-2000	% change	1993-1996	1997-2000	% change	1993-1996	1997-2000	% change
National	.18***	0.36	89%	.19***	0.34	79%	.31***	0.55	77%
Urban	.38***	0.7	84%	.31***	0.53	71%	.50***	0.82	64%
Rural	.13***	0.29	123%	.14***	0.28	100%	.22***	0.48	118%
Region									
Metropolitan	0.45***	0.73	63%	0.33***	0.46	41%	0.60***	0.73	22%
North	0.03***	0.15	335%	0.09***	0.23	149%	0.28***	0.5	78%
Northeast	0.06***	0.2	247%	0.07***	0.38	431%	0.16***	0.47	198%
Southeast	0.13***	0.34	167%	0.19***	0.38	103%	0.18***	0.39	118%
Central	0.23***	0.54	132%	0.15***	0.31	110%	0.30***	0.63	107%
Southwest	0.20***	0.46	127%	0.18***	0.33	79%	0.29***	0.64	122%
Northwest	0.20***	0.3	50%	0.24***	0.33	38%	0.30***	0.49	64%
Peten	0.05***	0.15	186%	0.08***	0.19	121%	0.15***	0.41	166%
Poverty									
Non-poor	.06***	0.17	183%	.13***	0.26	100%	.21***	0.37	76%
All poor	.13***	0.28	115%	.15***	0.29	93%	.25***	0.44	76%
Extreme poor	.29***	0.55	90%	.24***	0.41	71%	.38***	0.72	89%
Quintile									
1 (poorest)	0.08***	0.22	191%	0.13***	0.27	104%	0.22***	0.38	71%
2.00	0.20***	0.34	74%	0.18***	0.34	87%	0.26***	0.48	83%
3.00	0.21***	0.44	110%	0.18***	0.29	61%	0.33***	0.62	87%
4.00	0.33***	0.54	62%	0.22***	0.39	76%	0.41***	0.73	76%
5 (richest)	0.28***	0.68	140%	0.32***	0.61	93%	0.38***	0.82	113%
Ethnicity									
Non-indigenous	.21***	0.42	100%	.19***	0.35	84%	.31***	0.57	84%
Indigenous	.16***	0.3	88%	.18***	0.32	78%	.30***	0.52	73%
Quiche	0.22***	0.53	138%	0.23***	0.41	77%	0.30***	0.46	51%
Q'eqchi	0.02***	0.09	368%	0.07***	0.19	181%	0.20***	0.58	199%
Kaqchiqel	0.23***	0.56	144%	0.16***	0.32	100%	0.41***	0.64	53%
Mam	0.17***	0.25	51%	0.26***	0.39	49%	0.33***	0.59	81%
Other ind	0.16***	0.22	43%	0.18***	0.33	79%	0.24***	0.4	66%

Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística - Guatemala

Table C9: Number of new connections in a three year before and after the Peace Accord

	Electricity			Piped water[§]			Sanitary services[¨]		
	1993-1996	1997-2000	% change	1993-1996	1997-2000	% change	1993-1996	1997-2000	% change
National	208,518.00	329,734***	58%	240,069.00	352,336***	47%	281,106.00	350,418**	25%
Urban	92,823.00	105009	13%	109,453.00	128,593.00	17%	134,692.00	109,792.00	-18%
Rural	115,695.00	224,725***	94%	130,616.00	223,743***	71%	146,414.00	240,626***	64%
Region									
Metropolitan	54,521.00	49430	-9%	68,785.00	65,250**	-5%	86,176.00	41,926*	-51%
North	4,518.00	18,977***	320%	11,244.00	25,361**	126%	11,043.00	14,194.00	29%
Northeast	6,007.00	19,642**	227%	8,157.00	40,250.00	393%	15,711.00	39,447***	151%
Southeast	13,307.00	39,944**	200%	24,129.00	39,809***	65%	19,052.00	34,175***	79%
Central	25,794.00	46,023***	78%	19,129.00	34,249.00	79%	24,577.00	35,354*	44%
Southwest	61,419.00	111,103***	81%	65,222.00	95,398**	46%	76,948.00	121,819***	58%
Northwest	37,470.00	45246	21%	38,528.00	40,355.00	5%	40,353.00	46,521.00	15%
Peten	2,726.00	7,390**	171%	4,317.00	8,737**	102%	6,199.00	13,960***	125%
Poverty									
Non-poor	13,662.00	33,135***	143%	24,253.00	43,091**	78%	27,979.00	38,674*	38%
All poor	95,296.00	180,842***	90%	108,754.00	184,682***	70%	132,815.00	176,028**	33%
Extreme poor	113,222.00	148,892*	32%	131,315.00	167,654*	28%	148,255.00	174,390.00	18%
Quintile									
1 (poorest)	27,646.00	74,446***	169%	45,018.00	79,644***	77%	53,797.00	71,506**	33%
2	56,845.00	79,690*	40%	54,036.00	82,664**	53%	56,963.00	76,914*	35%
3	47,313.00	78,562***	66%	50,301.00	66,279*	32%	67,856.00	85,001.00	25%
4	48,566.00	52267	8%	49,883.00	67,898*	36%	67,271.00	69,273.00	3%
5 (richest)	25,391.00	43840	73%	20,273.00	52,924.00	161%	34,173.00	44,704.00	31%
Ethnicity									
Non-indigenous	117,976.00	186,392***	58%	133,965.00	195,611***	46%	166,007.00	209,926*	26%
Indigenous	87,785.00	142,414***	62%	105,547.00	153,789***	46%	114,052.00	137,572.00	21%
Quiche	24,287.00	44,912**	85%	25,581.00	34,880.00	36%	26,347.00	27,645.00	5%
Q'eqchi	1,945.00	8,928***	359%	7,760.00	20,327.00	162%	8,734.00	21,000*	140%
Kaqchiqel	19,417.00	36,647**	89%	18,406.00	30,914**	68%	26,123.00	23,484.00	-10%
Mam	20,817.00	26214	26%	30,730.00	33,853.00	10%	30,249.00	36,923.00	22%
Other ind	21,319.00	25713	21%	23,070.00	33,824.00	47%	22,599.00	28,519.00	26%

Source: World Bank calculations using the ENCOVI 2000, Instituto Nacional de Estadística - Guatemala

Annex D: Understanding whether coverage deficits are due to demand or supply side factors

Coverage is the traditional indicator of access to services. However, the drawback of this indicator is that it doesn't allow you to distinguish whether people don't use the service (a) because it is not available in their community, or (b) because they choose not to use it even if it is available. These two alternative supply-side and demand-side explanations have very different policy implications and hence it is useful to be able to distinguish between them.

As a first step it is helpful to calculate coverage, availability and take-up indicators as follows.

Coverage rate = No. of households using the service/Total no. of households
Availability rate = No. of households living in communities where the service is available/Total no.of households
Take-up rate = No. of households using the service/No. of households living in communities where the service is available

It is easy to show that:

Coverage rate= Take-up rate * Availability rate

Using these indicators, it is straightforward to decompose the coverage gap between demand-side and supply-side factors.

Unserved population = 100 - Coverage rate
Pure demand side gap = Availability rate - Coverage rate
Supply side gap = Unserved population - Pure demand side gap
Pure supply side gap = supply side gap * take-up rate
Mixed demand and supply side gap = supply side gap* (100-take-up rate)

These indicators can be normalized in the following way to show the actual proportion of any service deficit that is attributable to supply side factors, demand-side factors or both.

Proportion of deficit attributable to demand side factors only = Pure demand side gap / Unserved population
Proportion of deficit attributable to supply side factors only = Pure supply side gap / Unserved population
Proportion of deficit attributable to both demand and supply side factors only = Mixed demand and supply side gap / Unserved population

An example, may help to illustrate the methodology.

Availability rate = 80%
Take-up rate = 50%
Coverage rate = 80% * 50% = 40%

Unserved population = 100%-40%=60%
Pure demand-side gap = 80%-40% = 40%
Supply side gap = 60%-40% = 20%
Pure supply-side gap = 20% * 50% = 10%
Mixed demand and supply-side gap = 20% * (100%-50%) = 10%

Proportion of deficit attributable to demand side factors only = 40%/60% = 66%
Proportion of deficit attributable to supply side factors only = =10%/60% = 17%
Proportion of deficit attributable to both demand and supply side factors only = 10%/60% = 17%