The Restructuring and Privatisation of the Peruvian Electricity Distribution Companies: *A Social Cost-Benefit Analysis*

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Abstract

This paper attempts to assess the social welfare impact of the restructuring and privatisation of the electricity market in Peru. The target companies are Electrolima and Electro Sur Medio, which represents 64 per cent of the total distribution market and 100 per cent of the privatised distribution companies. Actual and counterfactual operating costs are examined. An individual analysis is performed per each company, due to the differences in terms of economies of scale and market structure. The benefits of being connected and additional costs were also computed based on counterfactual scenarios. Companies that were not privatised (benchmark companies) were used for making appropriate comparisons and for determining our preferred counterfactual cost decline. Benchmark companies were also important for analysing the trend in quality issues. The results show that privatisation was worthwhile and that the social welfare of being connected has an important participation on it. Government and producers benefited the most and consumers the least.

JEL Classification: H43, L94

Key words: cost benefit analysis, restructuring and privatisation, electricity market, peru

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1. Introduction

The restructuring and privatisation reform in Peru began in 1992 with the promulgation of the Electric Concession Law - LCE. The starting conditions, similar to other developing countries, were unfavourable. The poor performance of companies, cross subsidy policies, political intervention in price regulation, among others; were the main drivers. In addition adverse macroeconomics conditions and terrorist threats made the picture worse (World Bank, 1990). The LCE allowed the unbundling of the generation, transmission and distribution activities, being Electroperu and Electrolima the two state-owned companies that were subject to this de-merger. The application of this regulatory scheme has produced important achievements in the distribution electricity sector. The expansion of the electricity coverage, the reduction of distribution losses and improvements in quality issues such as the duration and number of interruptions, are among the main successful indicators. We expect that these improvements can be translated into benefits for the society.

This study will attempt to measure the social welfare for the restructuring and privatisation of the distribution market. Electrolima and Electro Sur Medio are the companies we focus on[2]. A cost benefit analysis will be performed, following the methodology discussed in Jones *et al.,* (1990). As a result, the gains (or losses) from restructuring and privatisation will be calculated. Based on the social welfare of being connected determined by the World Bank (per month and per household in four developing countries including Peru) it was possible to compute as well the gains due to the increase of electricity coverage. A counterfactual scenario was used for this calculation. Thus, the total gains for restructuring and privatisation includes the social welfare of being connected and these additional costs. Quality issues such as distribution

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[2] Electrolima and Electro Sur Medio were the first two distribution companies to be privatised in 1994 and 1997 respectively. In 2007 Electro Sur Medio and the three companies that were created due to the unbundling of Electrolima, accounted for 63.8 per cent of the total energy sold in the distribution electricity market with a total of 1.92 million customers. Electro Sur Medio and the unbundled companies from Electrolima (Edelnor, Luz del Sur and Ede Cañete) represent 100 per cent of the privatised distribution electricity market. In 1998 four additional distribution companies were sold but they returned to the Government three years later.

losses and number and duration of interruptions, will be also discussed with reference to both private and state-owned distribution companies.

This paper is organized in six sections. The next section describes the industry background. The third section sets out briefly the previous efforts for evaluating the impact of restructuring and privatisation and describes the cost benefit analysis methodology as well. The fourth section presents the data collection. The fifth section shows the analysis of results and includes the evaluation of additional benefits, which are aggregated in the final results. The last section contains the conclusions.

2. Background

Electrolima, the biggest distribution company was initially private. After several decades of private electricity ownership it was nationalized in 1972. In the same year, Electroperu, a state-owned company, was created and had exclusive rights on national generation expansion. The company was also responsible for managing the electricity sector nationwide, especially in areas not served by the main existing companies. Sectors that were also involved in the nationalisation programme were agricultural, mining, petrol and others[3].

In terms of prices, the Electric Tariff Commission (CTE) was the autonomous agency responsible for price regulation[4]. During the period 1985-1990, the tariff structure was based on accounting costs and marginal costs were greater than prices. In 1989 prices covered only 40 per cent of cost and the net operational losses represented 152 per cent of incomes by energy sold[5]. In addition, even though the autonomy for regulating the electricity tariffs was given to the CTE, the Ministry of Economy and Finance had a strong intervention in price regulation.

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[3] The nationalization programme continued until the 80s. The number of state-owned companies increased from 29 in 1968 to 177 in 1990. However, the bad performance of these companies produced an aggregated net loss of US\$ 531 million (World Bank, 1994)

[4] The CTE was created under the General Electricity Law (LGE) in 1982. The LGE also established an overall internal rate of return of 12 per cent from state-owned companies in relation to investments.

[5] CTE Annual Reports (1986-1990).

The sale and purchase of electricity among companies was not derived from a price mechanism either. Instead, a Generation Compensation Fund – Fondo de Compensación de Generación, was used. This fund was created to compensate the cost differences in generation and transmission activities among electricity companies, produced as a result of having different sources of energy production, production scales and market structures[6]. In 1988 CTE proposed a new tariff system based on marginal cost[7] and as a result tariffs increased. The new tariff system allowed the purchase of energy between electricity distribution companies and Electroperu.

Regarding the market structure, at the beginning of the 1990's Electroperu, the regional companies[8] and the isolated systems accounted for 70 per cent of the national electricity supply [9] (Bonifaz, 2001). Electrolima, the main electricity distribution company, was responsible for 57 per cent of the national electricity consumption and had its own generation installation for electricity production (Araoz, *et al.*, 2001). The nationwide transmission system was composed of three sub systems: (1) the Central Northern Grid - SICN[10], the South Western Grid – SISO and the South Eastern Grid – SISE and (2) the isolated systems. The main sector authorities were the Ministry of Energy and Mining (MINEM) through the General Bureau of Electricity (DGE) along with the Electric Tariff Commission.

Due to the lack of progress on the sector, the Government began the most important sector reform through the launch of the Electricity Concession Law (LCE) in November 1992[11]. The reforms involved: unbundling, privatisation and wholesale competition[12]. The LCE focused

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[6] One of the most affected companies was Electrolima, which transferred important sum of money to the less profitable distribution companies.
[7] The tariff system was developed by the CTE with the participation of Electroperu, Electrolima and regional electricity companies. It had the support of the Inter American Development Bank. The new system tariff was published in 1989 in the book "Nueva Tarifa de Energía Eléctrica". CTE Annual Reports (1992-1993)
[8] Among the regional companies were: Electrolima and those companies that were created under the General Electricity Law in 1982. The companies are: Electro Sur, Electro Sur Medio, Electro Sur Este, Electrocentro, Seal, Electro Norte, Electro Norte Medio, Electro Noroeste and Electro Oriente
[9] The remaining was produced by private auto generation companies for their own consumption.
[10] Electrolima was interconnected through this transmission line.
[11] This new Law repealed the previous one: The General Electricity Law from 1982.
[12] The United Nations recognises as a standard set of reforms these issues (United Nations, 2007).

on the following elements: (1) unbundling of state-owned companies, mainly Electroperu and Electrolima, in generation, transmission and distribution activities, (2) creation of a free market, which allowed customers with a capacity greater than 1 MW, to negotiate their supply contract freely, (3) the establishment of the Economic Operation Committee – COES, a private entity that coordinates the operation system at the lowest possible cost, composed of representatives (owners) of power plants, transmission lines, distribution networks and free customers, that are connected to the national grid and (4) the creation of the Energy Tariff Commission, which later on became the Tariff Regulator Office – GART[13]. In December 1996 the Supervising Agency for Investment in Energy (OSINERG)[14], an independent regulatory agency, was created.

The launch of the LCE along with the Law for the Promotion of Private Investment in State Enterprises, prepared the scenario for the privatisation process in the electricity market. Electrolima and Electroperu were unbundled into several new companies. In most of the cases, the strategy was to transfer 60 per cent of the state-owned shares through public auctions to companies that accomplish technical and financial requirements imposed by the different Commissions. The sale of state-owned shares to workers was also a practice and represented a maximum of 10 per cent[15]. The Government decided to retain the rest of shares for a subsequent sale through the scheme "Participacion Ciudadana" that involved selling shares in the stock market. This approach was used in the sale of generation and distribution companies. Other mechanisms were used as well such as the sale through capital investment and by Built Own Operate Transfer (BOOT), for generation and transmission companies, respectively. In addition regarding to the last ones, a concession of operation for 30 years was established.

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[13] The CTE and OSINERG, the energy regulator, merged in July 2000. GART is part of OSINERG.
[14] In January 2007 it became OSINERGMIN due to the extension of its duties in the mining regulatory arena.
[15] The regulatory framework established this limit.

As a result, a significant number of new companies were privatised during the period 1994-2004, including regional distribution companies [16]. At the end of 2007, generation, transmission and distribution markets were private[17] to the share of 66.62 per cent, 98.95 per cent and 64.23 per cent respectively[18]. The total amount raised by the sale of the companies was approximately US$ 3.3 billion from which generation, transmission and distribution accounted for 55.2 per cent, 17.4 per cent and 27.4 per cent, respectively. See Table 1.

In summary, the restructuring and privatisation of the electricity market is considered successful, (COPRI, 2000; Torero, 2003; Alcazar *et al,* 2007). Among other Latin American countries with very successful results are Argentina, Brazil and Chile, (Mota, 2003; Pollitt, 2004a; Pollitt, 2004b). In Peru, the electricity coverage[19] increased significantly reaching 80 per cent in 2007 up from 53 per cent in 1990. Regarding total distribution losses, an important downturn was also observed, having moved from 22 per cent in 1993 to 8.2 per cent in 2007. The number of customers per employee[20] had also grown. It jumped from 415 to 1,210 in 2007 (CTE, 1986-1999; OSINERGMIN, 2000-2007)

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[16] In 1998 four additional distribution companies were sold, Electro Norte, Electro Norte Medio, Electrocentro and Electro Nor Oeste. The four companies were sold to Jose Rodriguez Banda - JORBSA – Holding Group-, which offered a total price of US$ 145 million. After nearly three years of operation, the four companies returned to the government because the buyer did not exercise its option to purchase the remaining 30 per cent of shares. These companies now operate under the name Distriluz and are outside of the common legal framework for public companies. Currently, the process for the sale of these companies has been suspended

[17] Composed of privatised companies and those that were private since the beginning.

[18] In terms of energy sale for generation and distribution companies and in terms of length of transmission line for transmission companies.

[19] Based on population coverage.

[20] Regarding the electricity distribution companies.

Privatisation of the Electricity Market

1. Generation Companies	Date	Buyers	Reservation price (US$ million)	Offer price (US$ million)	Initial company participation	Commitments: Investments (US$ million)	Installations (MW)	Sale of state-owned shares: Stock market (US$ million)	%	date	Workers (US$ million)	date	%	Total (US$ million)	Energy production (GWh) - 2007: Hydro	Thermal	Total	%	Energy sold - 2007 [16]: (US$ million)	%
Edegel [1]	Nov-95	Generandes	373	524.45	60%	42.00	100	139.22	30%	Apr-99 / Nov-99 / Jan-00	74.8	Jul-96	10%	780.47	4,443.42	3,344.44	7,787.86	28.38%	335.07	22.61%
Egecen - Energía del Sur [2]	Feb-04	Enersur	n.a.	62.05	100%	146.87	130	--	--	--	--	--	--	208.92	784.62	3,081.91	3,866.53	14.09%	259.25	17.49%
Egenor - Duke Energy	Aug-96	Inversiones Dominion	175	228.20	60%	42.00	100	60.00	30%	Oct-99	36.3	Nov-96	10%	366.50	2,060.51	125.20	2,185.71	7.97%	145.81	9.84%
Electroandes	Dec-01	Tractebel	n.a.	227.10	100%	17.50	n.a.	--	--	--	--	--	--	244.60	976.04	--	976.04	3.56%	55.41	3.74%
Eepsa [3]	Nov-96	Consorcio Cabo Blanco	n.a.	19.70	60%	40.00	80	--	--	--	--	--	--	59.70	--	601.00	601.00	2.19%	62.35	4.21%
Cahua [4]	May-95	Sipesa	21.12	41.81	60%	--	--	9.00	30%	Mar-00	6.67	Oct-96	10%	57.48	527.58	0.36	527.94	1.92%	25.75	1.74%
Etevensa [5]	Jan-96	Consorcio Generalima	65	120.10	60%	--	280	n.a.	n.a.	n.a.	3.44	Nov-96	1.78%	123.54	--	--	--	--	--	--

2. Transmission Companies	Date	Buyers	Reservation price (US$ million)	Offer price (US$ million)	Tx. Lines	Transmission Line (Km) - 2006: 220 KV	138KV	<75KV	Total	%	Income - 2007 [16]: (US$ million)	%
Red de Energía del Perú (ETECEN, ETESUR) [6]	Sep-02	Interconexión Eléctrica	250.00	261.99	63	3,073.67	1,237.51	30.40	4,341.58	64.03%	65.30	49.64%
Consorcio Transmantaro [7]	Feb-98	Hydro Quebec International	300.00	179.18	4	603.03			603.03	8.89%	28.86	21.93%
Red Eléctrica del Sur [7,8]	Mar-99	Red Eléctrica de España	92.50	74.48	4	427.75			427.75	6.31%	10.82	8.22%
Interconexión Eléctrica ISA Perú [9]	Apr-01	Interconexión Eléctrica	n.a.	65.40	5	261.72	130.52		392.24	5.78%	10.09	7.67%

3. Distribution Companies (includes those that returned to government)	Date	Buyers	Reservation price (US$ million)	Offer price (US$ million)	Initial company participation	Commitments: Investments (US$ million)	Installations (MW)	Sale of state-owned shares: Stock market (US$ million)	%	date	Workers (US$ million)	date	%	Total [15] (US$ million)	Present state ownership	Present owners	Number of customers 2007: No	%	Energy sold - 2007 [16]: (US$ million)	%
Luz del Sur [10]	Aug-94	Ontario - Quinta AVV	129.42	212.12	60%	--		172.56	30.0%	Dec-96/Feb-99	32.40	Jul-96	10.0%	417.08	0%	Endesa	777,289	17.8%	439.83	31.66%
Edelnor	Aug-94	Inversiones Distrilima	127.72	176.49	60%	--		94.24	36.3%	Mar-02	10.89	Jul-95	3.7%	281.62	0%	Ontario - Quinta AVV	986,365	22.6%	418.75	29.63%
Ede Chancay [11]	Dec-95	Inversiones Distrilima	10.35	10.36	60%	--		--	--	--	0.12	Apr-96	1.8%	10.48	0%	Endesa				
Electro Sur Medio [12]	Mar-97	Consorcio HICA	35.00	25.64	100%	25.64		--	--	--	--	--	--	51.28	0%		130,701	3.0%	43.33	3.19%
Ede Cañete [13]	Jul-96	Luz del Sur	8.20	8.62	100%	--		--	--	--	--	--	--	8.62	0%	late Ontario - Quinta AVV	27,210	0.6%	6.99	0.52%
Electro Norte Medio [14]	Dec-98	Jose Rodriguez Banda	36.08	67.88	30%	--		--	--	--	--	--	--	6.79	97.40%	Government	469,967	10.8%	103.43	7.04%
Electrocentro [14]	Dec-98	Jose Rodriguez Banda	26.28	32.69	30%	--		--	--	--	--	--	--	3.27	100%	Government	433,576	9.9%	67.52	4.27%
Electro Nor Oeste [14]	Dec-98	Jose Rodriguez Banda	12.96	22.89	30%	--		--	--	--	--	--	--	2.29	100%	Government	279,266	6.4%	60.12	4.27%
Electro Norte [14]	Dec-98	Jose Rodriguez Banda	11.35	22.12	30%	--		--	--	--	--	--	--	2.21	100%	Government	247,389	5.7%	48.55	3.33%

1/ US$ 273 million cash and US$ 100 millio. in debt title. The offer price includes both.

2/ Includes US$ 124.51 million (usufruct right) and US$ 22.36 million (social contribution)

3/ A capitalization investment modality and the transference of shares was used. The sell of 40% of state owned shares is still pending

4/ 20% cash and 80% in 8 years, interest rate= Libor (180 d) + 2%

5/ A capitalization investment modality was used. 60% of the state ownership's shares was sold for US$ 120 million (investment). It was absorved by EDEGEL in June 2006.

6/ Includes the base price for 30 years of concession (US$ 229.59 million) and spares stock, materials, assets (US$ 20.41 million).

7/ The company that proposed the lowest investment cost (based on a project implementation) was selected. Form of project financing: Build-Own-Operate-Transfer (BOOT)

8/ Transmission lines in concession: Socabaya-Moquegua, Moquegua - Puno, Moquegua-Tacna.

9/ Transmission lines in concession: Pachachaca-Oroya, La Oroya-Carhuamayo-Derivación Antamina, Aguaytía-Pucallpa

10/ The previous name was Edelsur

11/ Ede Chancay was sold to Edelnor at the end of 1996

12/ The government established the payment of 50% by cash and/or credit and the other 50% in investments. The company agreed: 20% cash and 80% in 8 years, interest rate= Libor (180 d) + 2%

13/ The first auction was declared void

14/ The government established the payment of 10% by cash and 90% by credit (12 years, including a 3 years pay off, interest rate=Libor (180d) + 2%). Due to the lack of payment the four companies returned to the government in 2001

15/ For the companies that were privatised temporarily only 10% of the offer price is considered as recaudation.

16/ Market share in terms of total market (privatised, private and public)

Source: CEPREL (1997), COPRI (2000),MEF (2000), MINEM (2006), MINEM (2007), OSINERGMIN (2006), OSINERGMIN(2007), Proinversión, Libro Blanco from Regional Electricity Companies

Table 1

3. Methodology

Many empirical studies attempt to measure the impact of restructuring and privatisation of public utilities using different methodologies. One of the most popular and pioneering is the analysis of financial and physical indicators of performance. Among the literature that supports this is Hutchinson (1991), Megginson *et al*., (1994), Bishop and Green (1995), Boubakri and Cosset (1998), La Porta *et al*., (1999), Estache. *et al*., (2001), Torero (2003). Selected indicators are compared pre and post privatisation in order to measure any improvement. The following category involves the use of labour and total factor productivity, Bishop and Thompson (1992), Parker and Martin (1995), O' Mahoney (1998). Other empirical studies are based on the use of frontier methodologies, such as Data Envelopment Analysis or Stochastic Frontier Analysis. Here productivity inefficiency is determined by the distance from the frontier. Examples of this grouping are Pollitt (1995), Bonifaz (2001), Kirkpatrick *et al*., (2004), Mota (2004), Giannakis *et al*., (2005). The last category, which is included in this empirical study, focuses on a social cost-benefit analysis. In comparison with the categories previously cited, this one also measures the broader welfare impact due to privatisation and also the individual effect among the different parties (customers, producers and government). It goes further than the comparison of performance indicators and the measurement of productivity. Among the empirical studies that support this approach are Galal *et al*., (1994), Newbery and Pollitt (1997), Pollitt and Smith (2001), Domah and Pollitt (2002), Mota, R. (2003), Boardman *et al*., (2007). All these studies are based on the methodology described in Jones *et al.,* (1990), which is also the one to be used in this study.

3.1 Social Cost-Benefit Methodology

The social cost-benefit analysis proposed by Jones *et al*., (1990) allows us to evaluate the impact of privatisation in terms of (1) efficiency gains from restructuring and privatisation and (2) distributional impact. The first concept measures the overall gains and the second one

the gains (or losses) per actor (Government, Consumers and Producers). The methodology involves a counterfactual scenario and differs from others which are focused basically on financial and performance indicators, labour and total factor productivity and productivity. The counterfactual scenario, that simulates the continuation of government ownership, will be constructed in order to be compared with the scenario under privatisation.

$$\Delta W = Vsp - Vsg + \left(\lambda g - \lambda p \right) * Z \ldots\ldots\ldots\ldots..(1)$$

Where: Vsp : social value under private operation, Vsg : social value under government operation, λg : shadow multiplier on government revenue, λp : shadow multiplier on private funds, Z : actual price of the executed sale.

$$\Delta W = \lambda c * \Delta Con + \lambda g * \Delta Gov + \lambda p * \Delta Prod + \left(\lambda g - \lambda p \right) * Z \ldots\ldots\ldots\ldots(2)$$

Where: ΔCon : Surplus of the consumer, ΔGov : Surplus of government, ΔProd : Surplus of producers, λc: Shadow multiplier on consumer surplus.

Following Newbery and Pollitt (1997) and Mota (2003), from a policy maker position, government revenue would be more appropriate as a numeraire for the measure of welfare. Under this approach, the idea is to determine the shadow multipliers based on the shadow multiplier on government revenue. The shadow multipliers represent the weight that different parties have in the social welfare function.

Following Jones *et al*., (1990), expression (1) is referred to the fundamental formula of divestiture, while the difference between social value under private and government operation is called the Difference Principle. When the variation in welfare is greater than zero ($\Delta W > 0$) it may be stated that privatisation was socially worthwhile. The social value is represented by

the controllable operating cost (under private or public scenario) net of restructuring and privatisation costs[21].

Regarding expression (2), surplus of consumer is given by the difference between the private and counterfactual net average revenue[22]. The surplus of government is given by the difference between private and counterfactual taxes, which can be computed by projecting tax rates over operating profits. Tax rates are estimated using actual tax paid. The surplus of producers is obtained after subtracting the government and consumers' net gains from the total net benefits (ΔW).

In both scenarios, different values of shadow factors are assumed in order to analyse their impact in the social welfare. All values are aggregated on a present value basis.

3.2 The Counterfactual and Projected Scenarios

The two state-owned companies that are part of this study are Electrolima and Electro Sur Medio, which together represent 100 per cent of privatised distribution electricity companies. These companies were privatised in different years, 1994 and 1997. Both companies differed considerably in size[23], thus an individual counterfactual and projected scenario was performed. For the construction of counterfactual and projected figures some assumptions were made, see section 3.3 for details.

Regarding Electrolima, the unit operating cost was obtained calculating the average unit operating controllable cost for the years previous to privatisation, 1991-1993. In relation to

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[21] Net operating controllable costs = total operating costs – (generation costs + transmission costs + purchase of energy costs + depreciation + operating non-controllable costs)

[22] Counterfactual net average revenue = counterfactual operating profits + counterfactual operating controllable costs + operating non-controllable costs + depreciation. Counterfactual operating profit is computed using a rate of return on tangible fixed assets. Counterfactual operating controllable costs are calculated from unit counterfactual controllable costs taking into account a counterfactual cost decline.

[23] The average energy sold for the period 1986-1993 was 4.6TWh (Electrolima) and 0.21TWh (Electro Sur Medio).

Electro Sur Medio, a similar procedure was followed. The average of unit operating controllable cost was computed using the accountings for the period 1994-1996. As expected, the unit operating controllable cost calculated for Electrolima is around 18 per cent lower than that from Electro Sur Medio.

With the calculation of these unit operating costs the next step is to perform a sensitivity analysis using different annual cost fall rates, from 0 per cent to 4 per cent. That means for example that a 2 per cent p.a. fall in controllable cost under the counterfactual scenario implies that this cost will decrease 2 per cent p.a. In addition to the sensitivity analysis for the five cost fall rates, a central-case scenario related to the total efficiency gains and to the distributional gains is also discussed in this study. The unit operating cost is multiplied by the number of actual distributed units to obtain the total operating controllable cost for the period 1994-2007 (Electrolima) and period 1997-2007 (Electro Sur Medio). These costs are then compared with those from the actual scenario under private ownership. The efficiency cost savings are obtained from this difference, after aggregating on a present value basis with a specific discount rate.

In terms of projections (future), it was assumed that the efficiency gap under both approaches, public and private ownership will be closed in the medium term and that prices would be the same. Following Pollitt and Smith (2002), 15 years would be an appropriate time to make this possible[24].

Total efficiency cost savings are computed by the difference between (1) the counterfactual and the counterfactual projected costs and (2) the actual and projected costs; aggregated of a present value basis.

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[24] In summary, the cost benefit analysis will be performed from 1994 to 2022. Regarding the simulation of public ownership, figures from 1994 to 2007 refers to the counterfactual values and from 2008 to 2022 to the counterfactual projections. Regarding private ownership, figures from 1994 to 2007 are actual values and from 2008 to 2022 are projected values.

3.3 Assumptions

Some assumptions were made for the construction of the counterfactual scenario and projections for computing the efficiency gains:

1. The Wholesale Price Index (IPM[25]) is used for adjusting all the accountings. All figures are expressed in 2007 prices[26].

2. A total of 5 discount rates[27] were selected: 5 per cent, 6 per cent, 8 per cent, 10 per cent and 12 per cent. A discount rate of 7.3 per cent is used for the central-case which represents the annual average reference interest rate in the 1990's.

3. Projections of the demand growth rate are based on the Electricity Reference Plan (Plan Referencial de Electricidad) developed by the Ministry of Energy and Mining for 10-year period (MINEM, 2008).

4. Generation and transmission assets for the period 1986-1992 (Electrolima) and 1986-1994 and 1996 (Electro Sur Medio) remain the same in real values. Distribution assets are the same under public and private ownership. For projections, assets increase at the demand growth rate.

5. The counterfactual operating profits are based on the average rate of return of assets for the period 1991-1993 (Electrolima) and period 1994-1996 (Electro Sur Medio).

6. Depreciation and operating non-controllable costs are the same under public and private scenarios. For projections, the depreciation rate is equal to 3.3 per cent based on the lifetime of electricity connections[28]. Projected operating non-controllable costs per KWh, regarding Electro Sur Medio and the companies that were unbundled from Electrolima,

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[25] According to the National Accounting Regulatory Council, the IPM is the index used for the adjustment of companies' financial statements. Electricity companies submitted both, historical and adjusted financial statements to OSINERGMIN until 2004. After that the submission of the adjusted accountings was not compulsory due to the low inflation rate in the last years.

[26] All calculations are made in Nuevo Soles, the Peruvian currency, and were adjusted using national accounts data. Then we use the 2007 exchange rate (US$/Soles) for presenting the results.

[27] Based on the reference interest rate established by the Peruvian Central Bank – BCRP.

[28] OSINERGMIN estimates a 30-year lifetime for calculating the connection costs.

follow the same trend of their respective unit operating non-controllable cost after privatisation.

7. The efficiency gap under public and private ownership will be closed in the following 15 years. For counterfactual projections, operating controllable costs will decrease to reach the same level of costs under the projected values (private ownership). These projected values were computed per each company based on the trend of unit operating controllable costs after privatisation.

8. Prices under public and private ownership will be the same in the following 15 years. Projected prices (private ownership) will decline to reach the same level of prices under the counterfactual projections. Projected prices were calculated per each company based on the trend of net revenues per KWh after privatisation.

9. Tax rate is equal to the ratio of tax to operating profits[29]. A rate of 0 per cent for the first three years after privatisation (1995-1997 for Electrolima, and 1997-1999 for Electro Sur Medio) and a rate of 30 per cent after these periods is assumed[30].

4. Data Collection

The companies' financial statements for the target companies, Electrolima and Electro Sur Medio, were obtained from Annual Reports of the Electric Tariff Commission (period 1986 – 1999) and OSINERGMIN (2000 – 2007). Among the data required were: revenues, total operating costs, controllable operating costs, taxes, compensation funds and transferences, purchase of energy, fuel expenses, depreciation, labour expenses, purchase of energy, taxes and social contribution, among others. In addition, the collection of physical data such as number of employees, units distributed and distribution losses were also obtained from these

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[29] For the construction of the figures, taxes are composed of income tax and social contribution. Thus, tax rate refers to the combination of income taxes and social contribution over operating profits. In Peru the rate tax is equal to 30 per cent over operating profits.

[30] The tax trend payment in state-owned companies (Seal and Electro Norte Medio) was examined. These companies did not report tax payment after the first and four years of being established the payment of taxes (in the financial sheets the item of "tax" appears from year 1994, after the beginning of the sale of generation and distribution companies). Thus, we believe that the three-year interval is convenient.

reports. Regarding the generation and transmission costs[31] before privatisation, they were calculated using the Informational Memorandum and the Diagnostic Report both developed by the International Finance Corporation and Coppers & Lybrand respectively for CEPREL. These reports were found in the Libro Blanco[32] from CEPREL. These costs are important for analysing the cost trend before privatisation in order to approximate the unit controllable operating cost. The generation assets were obtained from Electrolima and Electro Sur Medio Libro Blanco as well. The transmission assets regarding Electrolima were obtained from the Ministerial Resolution No 164-93-EM-VEM[33].

The restructuring and privatisation costs were collected from the Libro Blanco and from the National Public Treasury Office (Ministry of Economy and Finance). The IPM index and its specific adjustment factors[34] were required for adjusting figures to 2007 prices, and for the calculation of generation and transmission costs before privatisation. This was obtained from the National Accounting Regulatory Council (Ministry of Economy and Finance). See Appendix 1 for details.

Figure 1 depicts the composition of revenue (actual values, 2007 prices) from the period 1986 – 2007, in terms of operating profits, net operating controllable costs, operating non-controllable costs, depreciation and restructuring and privatisation costs.

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[31] This study concentrates on the distribution business, other business such as generation and transmission were excluded.

[32] "Libro Blanco" is a large report that contains important documents before the privatisation of Electrolima.

[33] This resolution established the transmission assets that would be transferred from Electrolima to the company Empresa de Transmisión Eléctrica Centro Norte. This company was created to assume the transmission business of Electrolima and Electroperu.

[34] Due to the high inflation rate in the late 1980's, the adjustment factors were divided twofold: before 1990 (initial adjustment) and after 1990 (final adjustment). See Resolutions No. 02-90-EF/93.01 and No. 03-93-EF/93.01 from the National Accounting Authority (Consejo Normativo de Contabilidad) – Ministry of Economy and Finances.
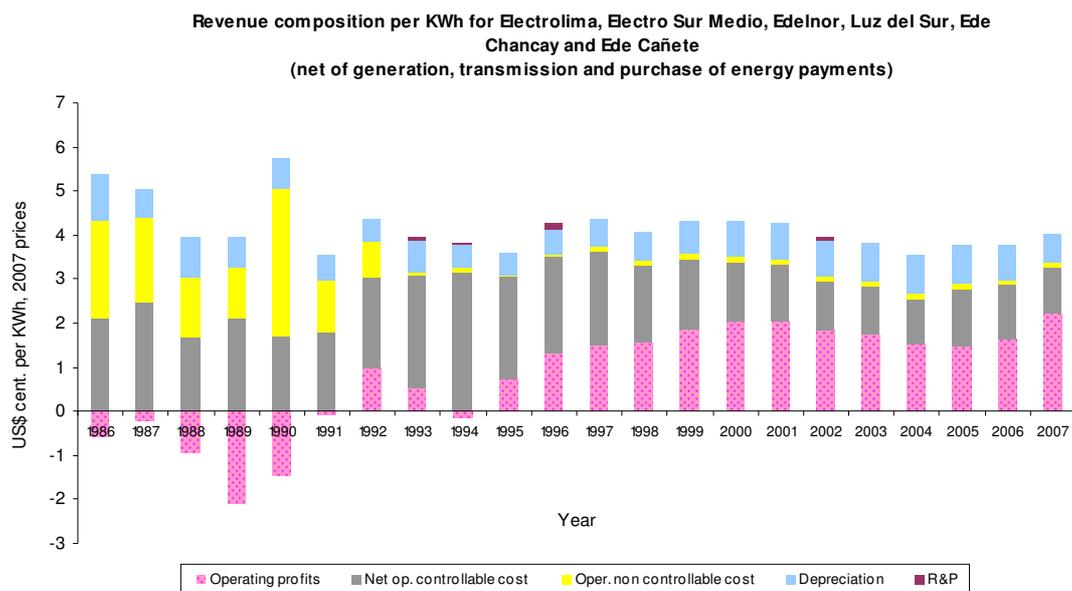
Revenue composition per KWh for Electrolima, Electro Sur Medio, Edelnor, Luz del Sur, Ede Chancay and Ede Cañete
(net of generation, transmission and purchase of energy payments)

Figure 1

5. Results

5.1 Efficiency Gains

In this section the savings due to restructuring and privatisation of Electrolima and Electro Sur Medio are calculated. Both savings are then added in order to obtain the total gains. The net efficiency gains are calculated by subtracting restructuring and privatisation costs (R&P) from the gains explained by the controllable costs reduction. Table 2 shows the gains and losses under different scenarios for the whole period (including the future). Five discount rates were selected from 5 per cent to 12 per cent, based on the assumptions given in section 3.3[35]. Net efficiency gains vary from US$ 4 million to US$ 705 million. If we believe that there would have been no cost variation (or a little variation) under state ownership the use of counterfactual cost fall of 0 per cent and 1 per cent would be more reasonable. For instance, with a counterfactual cost fall of 0 per cent, gains would be US$ 627 million net of

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[35] For Electrolima savings, we calculated the present value for the period 1995-2007. The year 1994 was excluded because the sale of companies (Edelnor and Luz del Sur) was completed in August 1994. In the case of Electro Sur Medio, the computed period for the present value is 1997-2007. We include the year 1997 because this sale was at the beginning of that year.

restructuring and privatisation costs at a discount rate of 6 per cent. On the other side, if we think that public sector would have been able to reduce costs significantly the use of a counterfactual cost fall of 3 per cent and 4 per cent would be more appropriate. With a counterfactual cost decline of 4 per cent, public sector ownership would be the best option at a discount rate of 12 per cent, with US$ 4 million in losses net of restructuring and privatising costs. The use of a counterfactual cost decline of 2 per cent is a more impartial position in comparison with the four previous counterfactual cost falls. Gains vary from US$ 153 million to US$ 349 million net of restructuring and privatisation costs. The next section explains in detail the selection of the counterfactual cost decline for the central-case scenario (up date and the future) and section 5.3 discusses the distributional gains at different social weights.

Efficiency Gains

Counterfactual cost fall 2007 prices (US$ million)	Discount rate				
	5%	6%	8%	10%	12%
Electrolima					
0%	687.3	611.8	489.0	395.1	322.3
1%	511.1	454.2	361.6	290.7	235.7
2%	349.8	309.8	244.7	194.8	156.0
3%	201.9	177.4	137.4	106.6	82.6
4%	66.4	56.0	38.9	25.5	15.0
Electro Sur Medio					
0%	33.4	30.0	24.5	20.2	17.0
1%	23.7	21.3	17.5	14.5	12.2
2%	14.7	13.3	10.9	9.2	7.8
3%	6.2	5.7	4.8	4.1	3.6
4%	-1.7	-1.4	-0.9	-0.6	-0.3
Efficiency gains					
0%	720.7	641.8	513.5	415.3	339.3
1%	534.9	475.6	379.1	305.2	248.0
2%	364.5	323.1	255.6	203.9	163.8
3%	208.1	183.1	142.2	110.7	86.2
4%	64.7	54.7	38.0	24.9	14.7
Efficiency gains (% cost)					
0%	25.4%	27.2%	29.0%	29.3%	28.7%
1%	18.9%	20.1%	21.4%	21.5%	21.0%
2%	12.9%	13.7%	14.4%	14.4%	13.9%
3%	7.3%	7.7%	8.0%	7.8%	7.3%
4%	2.3%	2.3%	2.1%	1.8%	1.2%
R&P	15.3	14.6	13.3	12.1	11.2

Table 2

5.2 Gains based on the central-case scenario

In order to select the counterfactual cost fall for the central-case scenario the trend of public companies was analysed. The target companies were those that operate in areas with high population density[36]. The companies selected were Electro Norte Medio (a company that was sold but then returned to public ownership) and Seal (a company that was always under public ownership) [37]. The results show that the annual average cost fall is approximately 2.4 per cent for Seal and 4.3 per cent for Electro Norte Medio[38]. Thus, a counterfactual cost fall of 2.4 per cent was taken for the central-case[39]. The counterfactual cost fall of 4.3 per cent was not taken into account because this rate may be capturing the effect of having been privatised for some years.

Table 3 shows the benefits regarding the central-case scenario at different discount rates for the period today (from privatisation to 2007) and the future (from privatisation to 2022). A 7.3 per cent discount rate is selected for the analysis. The selection of the period for computing this rate (1990's) is in line with our base year.

Net Efficiency gains for central-case scenario

Central case scenario (2.4%) 2007 prices (US$ million)	Discount rate											
	Up to 2007						Up to 2022					
	5%	6%	7.3%	8%	10%	12%	5%	6%	7.3%	8%	10%	12%
Electrolima	183.5	166.1	146.0	136.2	111.7	91.4	289.1	255.5	218.2	200.7	158.6	125.9
Electro Sur Medio	6.3	5.9	5.5	5.3	4.7	4.3	11.2	10.2	9.0	8.4	7.1	6.1
Efficiency gains	189.7	172.0	151.5	141.5	116.4	95.7	300.3	265.6	227.2	209.1	165.7	132.0
Efficiency gains (% cost)	6.7%	7.3%	7.8%	8.0%	8.2%	8.1%	10.6%	11.2%	11.7%	11.8%	11.7%	11.2%
Net efficiency gains	174.5	157.5	137.8	128.2	104.3	84.6	285.0	251.1	213.5	195.8	153.6	120.8

Table 3

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[36] Electrolima operated in Lima, where the population density is high. Electro Norte Medio and Seal operate in Trujillo and Arequipa respectively, two of the most important cities in Peru with high population density as well.
[37] An additional characteristic is that generation electricity is almost negligible in both cases (similar to Electro Sur Medio). This fact facilitated the calculation of the unit controllable operating costs
[38] The analysis was made for the period 1994-2007.
[39] This result is also in line with the counterfactual cost decline selected in different studies that involved developed and developing countries. Domah and Pollitt (2001), Mota (2003) selected a 2 per cent counterfactual cost decline for the central-case scenario. Thus, we believe that a selection of a counterfactual cost fall of 2.4 per cent is quite acceptable.

From Table 3 we observe that total net efficiency gains (including future gains) are equal to US$ 213.5 million in real terms and that gains amounts to US$ 137.8 if the period of analysis is limited to 2007. In both cases, the gains explained by the controllable costs reduction relative to Electrolima are much higher than those from Electro Sur Medio. Electrolima accounts for 96 per cent of the net gains (including future gains) and Electro Sur Medio for the remaining 4 per cent. These results are very dependant on the selected discount rate due to the skewness of the distribution cost and benefits. A 5 per cent discount rate produces an increase of 34 per cent in the net efficiency gains while a 12 per cent discount rate produces a decrease of 43 per cent.

It is important to remark that gains are also sensitive to the size of the market. Results from Domah and Pollitt (2001) for the UK electricity market and Mota (2003) for the Brazilian electricity market, show much higher efficiency gains than our results, under similar conditions[40]. Total delivered units previous to privatisation were about 250 TWh and 135 TWh respectively, in comparison with 5.3 TWh regarding the Peruvian market.

5.3 The distribution of gains based on the central-case scenario

A distributional analysis will tell us about the winners and losers due to restructuring and privatisation. In this section and the next one the analysis will include future gains. Table 4 shows the net distributional gains for the central-case scenario when $\lambda g = \lambda c = \lambda p = 1$.Government and producers benefit at the six discount rates of our analysis. Consumers suffer at any discount rates. This fact can be explained by the increase in tariffs after the following years of privatisation. In addition, it is perceived that the distributional gains between the two companies are different. For the central-case scenario at 7.3 per cent discount rate regarding Electrolima, producers have the highest gains equal to US$ 329.3 million. In the case of Electro Sur, government accounts for the highest benefits equal to US$ 8.7 million.

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[40] In terms of discount rates and counterfactual cost falls.

Distribution of the net efficiency gains from restructuring and privatisation
Central-case scenario

Central-case scenario (2.4% cost fall) 2007 prices (US$ million)	Discount rate					
Net Distributional Gains	5%	6%	7.3%	8%	10%	12%
1. Electrolima						
ΔGov	320.9	291.9	259.7	244.5	207.9	179.1
ΔCon	-482.6	-435.4	-384.3	-360.6	-304.9	-262.6
ΔProd	435.6	384.6	329.3	303.7	243.6	198.3
ΔW	274.0	241.1	204.7	187.6	146.6	114.9
2. Electro Sur Medio						
ΔGov	10.7	9.8	8.7	8.2	6.9	5.9
ΔCon	-8.1	-6.7	-5.3	-4.6	-3.0	-1.8
ΔProd	8.4	7.0	5.4	4.7	3.1	1.9
ΔW	11.0	10.0	8.8	8.3	7.0	6.0
Total net distributional gains						
ΔGov	331.7	301.7	268.3	252.6	214.8	185.0
ΔCon	-490.7	-442.2	-389.5	-365.2	-307.9	-264.4
ΔProd	444.0	391.6	334.7	308.4	246.7	200.2
ΔW	285.0	251.1	213.5	195.8	153.6	120.8

Table 4

Figure 2 depicts the annual trend of the distribution net efficiency gains regarding both companies after privatisation and for the central-case scenario. Government benefits from the beginning, fact that is explained by the collection of taxes. The fall observed between 1997 and 1998 is explained by the assumption that state-owned companies start to pay taxes since 1998. Producers benefit continuously since 1997. Based on the assumptions made (efficiency gap will be closed and prices will be the same under private and public ownership in 15 years time), for the period 2008-2022 government and producers' gains decrease continuously and customers' gains increases. Consumers are the most affected by assumption. The fall in the distribution of benefits to consumers is in agreement with the increase in price after privatisation[41].

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[41] Based on the estimations made for the period 1994-2022, prices under private ownership would be in average 8.6 per cent higher than those under public ownership. Prices were obtained dividing net revenues by the total distributed units. Then, the price difference between the actual and counterfactual scenario per year was calculated. The difference was expressed in percentage. Finally, the average of this difference was computed for the period 1994-2022. This value is the average variation in prices equal to 8.6 per cent

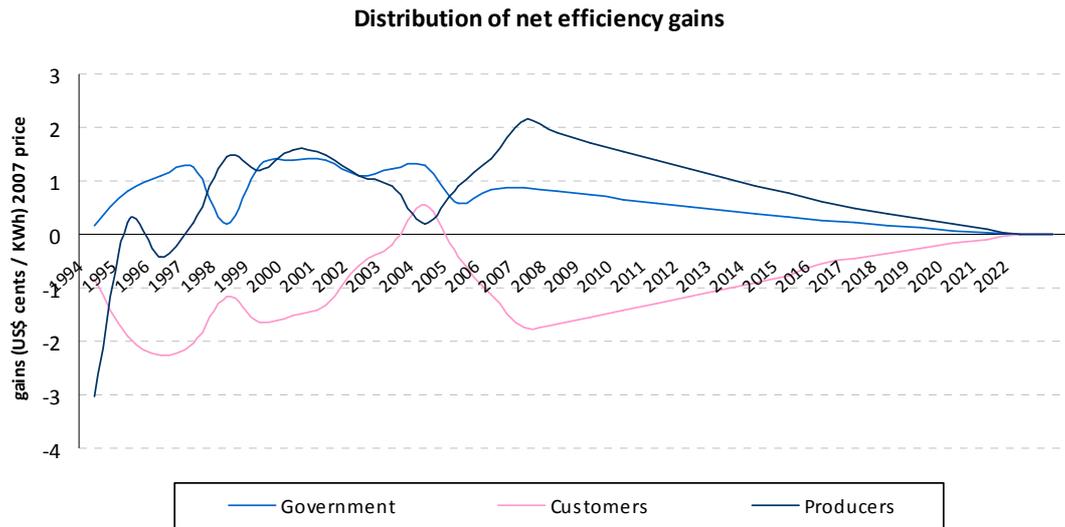**Distribution of net efficiency gains**

Figure 2

The use of different social weights increases significantly these gains. There is not a definitive agreement about the most appropriate value for λg, λp and λc. Galal et al (1994) state that different weights may be required when an economy is highly distorted. Domah and Pollitt (2001) agree with that statement and assume $\lambda g = \lambda p = 1$ in the case of a developed economy. Jones et al. (1990) find prudent to assume that $\lambda g > \lambda p$ *from* the taxation perspective, otherwise it would imply that government would minimize the sale price. In addition, they agree that $\lambda g > \lambda c$ in the case of developing economies. Mota (2003) assumes $\lambda g > \lambda p$, and sets two different values to λp and λc (0.8, 0.5) for analysing the social benefits in restructuring and privatising the Brasilian electricity distribution companies. Thus, the selection of the most appropriate value for each social weight involves a specific country analysis which is beyond the extent of this empirical study. Therefore, taking into consideration that Brazil and Peru are both developing economies, it is considered properly to assume that $\lambda g = 1$, $\lambda p = 0.5$ and that λc can take two values, 0.8 or 0.5. The results of introducing different social weights are discussed in the next section.

5.4 Additional Benefits and the impact of different social weights

As it has been mentioned before, benefits from being connected were also computed and added to the total gains. A counterfactual scenario was also built to calculate benefits of being connected for the period 1995-2022. This scenario was built in two stages: one for the period 1995-2001 and the other one for the period 2002-2022. For the first stage it was assumed that the annual growth rate is similar to that from Seal (5.4 per cent); the state-owned distribution company whose trend in annual average cost fall was taking into consideration for the construction of the central-case scenario in section 5.2. For the second period, it was assumed that the gap in household connections under the public and private ownership will be closed in 2022. In terms of actual household connections it was assumed that these grow at 3.12 per cent p.a. for the period 2008-2022, which is the average annual growth rate of households in the companies' concession areas for the period 1995-2007. Figure 3 illustrates the actual and counterfactual household connections. During the following 5 years after privatisation the actual household connections increased notably at 6 per cent p.a. (this explains the significant gap observed between 1995 and 2000). This value is twice the annual growth rate of households placed in the companies' concession areas.
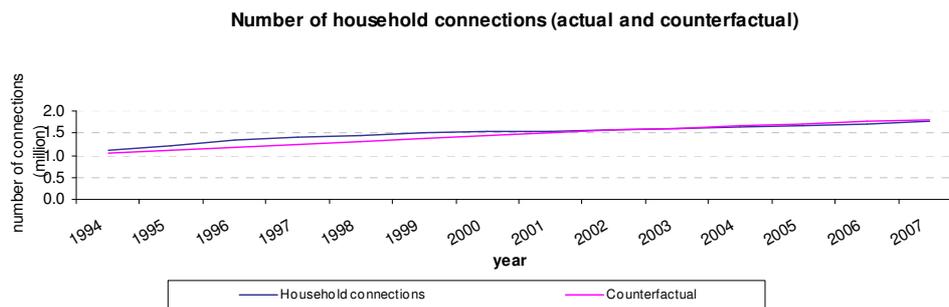

Figure 3

The World Bank (2008) calculated that rural electrification benefits are approximately US$ 30.5 per household per month in Peru[42].This value is taken as reference bearing in mind that an important number of customers are part of the poorest population into the companies' concession areas[43]. The GDP index was used for adjusting this value[44] and it was assumed that benefits are constant in real values for the whole period of the analysis. The difference between the actual and the counterfactual household connections is multiplied by the net benefit[45] of being connected per household. This product represents the total benefits per year. Then, all the values are aggregated on a present value basis using the same set of discount rates assumed in section 3.3.

Table 5 summarizes the total social welfare for restructuring and privatisation Electrolima and Electro Sur Medio under three scenarios (1) *λg=λc=λp*, (2) *λg>λc=λp and (3) λg>λc>λp.* Taking into account that it is the poor who are being connected, this assumption makes sense. Customer social welfare weight should be at least equal or greater than the producer one. Benefits to consumers of being connected have also been included in table 5.

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[42] From which U$ 16.16 accounts for benefits in lighting, US$ 8.5 for benefits in TV, US$ 5.5 for time saved for household chores/increasing leisure, US$ 0.02 for improving health, US$ 0.08 for reducing fertility and US$ 0.24 for reducing pollution. The Bank has estimated the valuation of the benefits of lighting and TV based on Willingness to Pay (WTP), which was calculated taking in consideration the cost of the existing source (kerosene lamp). Customer Price Index and GDP index were used for adjusting this value.
[43] 83 per cent of Edelnor' customers belong to the poorer segments of Lima population. Thus, access to electricity for the lowest social economic segments in Lima could be attributed to Edelnor. Electro Sur Medio and Ede Cañete area among the private companies that have also contributed to the expansion of electricity in remote areas (Alcazar *et al,* 2007)
[44] Actual GDP per capita was obtained from World Bank database. Projected GDP per capita was obtained from International Monetary Fund database.
[45]Net benefits are equal to benefits net of connection cost. Following Horn (2007), the average cost of a new connection in rural areas amounts to US$ 1,200[45] and it is assumed that it remains constant for the whole period. To compute the annual cost, this value was divided by the connection lifetime, equal to 30 years. The IPM was used for adjusting this value.

Social welfare from restructuring and privatisation under different values of social weights
Consolidation of results

Central-case scenario (2.4% cost fall) 2007 prices (US$ million)	Discount rate					
	5%	6%	7.3%	8%	10%	12%
Base Scenario ($\lambda g = \lambda c = \lambda p = 1$)						
ΔGov	331.7	301.7	268.3	252.6	214.8	185.0
ΔCon	-490.7	-442.2	-389.5	-365.2	-307.9	-264.4
$\Delta Prod$	444.0	391.6	334.7	308.4	246.7	200.2
Social welfare	285.0	251.1	213.5	195.8	153.6	120.8
Including additional benefits						
ΔCon	-156.0	-109.7	-61.3	-39.8	8.1	40.7
Social welfare	**619.6**	**583.5**	**541.7**	**521.3**	**469.5**	**426.0**
Scenario 1 ($\lambda g = 1$, $\lambda c = \lambda p = 0.5$)						
ΔGov	331.7	301.7	268.3	252.6	214.8	185.0
ΔCon	-245.3	-221.1	-194.8	-182.6	-153.9	-132.2
$\Delta Prod$	222.0	195.8	167.3	154.2	123.3	100.1
Social welfare	820.6	788.6	753.1	736.5	696.4	665.2
Including additional benefits						
ΔCon	89.3	111.4	133.5	142.8	162.0	172.9
Social welfare	**1,155.2**	**1,121.1**	**1,081.4**	**1,061.9**	**1,012.3**	**970.3**
Scenario 2 ($\lambda g = 1$, $\lambda c = 0.8$, $\lambda p = 0.5$)						
ΔGov	331.7	301.7	268.3	252.6	214.8	185.0
ΔCon	-392.5	-353.7	-311.6	-292.1	-246.3	-211.5
$\Delta Prod$	222.0	195.8	167.3	154.2	123.3	100.1
Social welfare	673.4	655.9	636.3	626.9	604.0	585.8
Including additional benefits						
ΔCon	-57.9	-21.3	16.6	33.3	69.6	93.6
Social welfare	**1,008.0**	**988.4**	**964.5**	**952.3**	**920.0**	**891.0**
Social benefits from being connected	334.6	332.5	328.2	325.4	315.9	305.1

Social welfare includes the sales component (scenario 1 and 2)

Table 5

The large size of the price of the executed sale[46] in comparison with the non weighed efficiency gains, explains the increase in efficiency gains when using different social shadow multipliers. At a discount rate of 7.3 per cent, benefits accounted for the sale prices represent 68 per cent and 81 per cent of social welfare[47], when $\lambda c = 0.5$ and $\lambda c = 0.8$, respectively. When $\lambda c = 0.8$ social welfare increases by 198 per cent in comparison with the non weighted gains. The rise is more impressive when $\lambda c = 0.5$, social welfare jumps from US$ 213.5 to US$ 753.1 million. The individual analysis (per company) shows a similar trend in gains variation for both companies.

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[46] Sales amount to US$ 1.02 billion in 2007 prices.
[47] Without including benefits of being connected.

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For the central-case and base scenario the social welfare moves from US$ 213.5 to US$ 541.7 million when the additional benefits are included. The application of different social weights increases the social welfare, in which the value of the sales still has an important participation. Social welfare ranges between US$ 541.7 and US$ 1,081.4 million when additional benefits are included. The distributional gains are affected as well; due to the new distributional gains for customers (government and producers' gains remain the same). Even though the inclusion of additional benefits for customers, they still suffer. Under scenario 1 and 2, consumers' gains improves and amounts to US$ 133.5 million and US$ 16.5 million respectively; however this quantity only represents 12 per cent and 2 per cent of the total social welfare under scenario 1 and 2.

5.5 Quality Issues

It is expected that quality and performance improve after privatisation. In order to compute an integrated social benefit analysis, the inclusion of quality parameters would make the task more difficult due to the need to (1) measure and value quality and (2) identify a counterfactual that simulates the quality dimension. In this sense, the discussion is limited to analyse briefly the evolution of quality indicators such as number and duration of interruptions per customer (SAIFI and SAIDI respectively) and distribution losses. For a better understanding of the evolution of these indicators, the trend of benchmark companies was examined[48].

SAIFI and SAIDI indicators dropped markedly during the first years after privatisation. A nationwide decrease of 64.4 per cent and 58.2 percent in SAIDI and SAIFI indicators respectively is observed for the period 1995-2001. The improvements are more noticeable in

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[48] The companies were grouped as follows: (1) privatised companies – type 1, (2) companies that were privatised but returned to public hands – type 2, (3) companies that were included in the privatisation process but were not sold – type 3, and (4) companies that were not included in the privatisation process and are still under public ownership– type 4. An additional kind of companies is composed of private companies and those companies that are managed by local governments, however due to the relative small size in comparison with the privatised companies; these were excluded from the analysis.

the biggest companies that operate in areas with high density, mainly in sector 1 and 2[49]. For instance, SAIFI and SAIDI indicators from Edelnor have significantly decreased by 75.1 per cent and 77.2 per cent respectively for the period 1995-2001. However after several years of privatisation, period 2002-2007, there is no notable trend due to a possible stabilisation of the indicators in special for the biggest companies such as Luz del Sur and Edelnor. Smaller companies, such as Electro Sur Medio and Ede Cañete, do not show a downward tendency even after seven years of being privatised. Customers from these companies that live in lower sectors are the most affected in terms of quality issues and seems to be that privatisation did not produce any important change for them. For instance, in the second semester of 2007 the average number of interruptions per customer/semester[50] for sector 1 and sector 5 was 2.82 and 20.53 in the same order and the average duration of interruption per customer was 5.32 and 48.51 respectively. Thus, there is an important difference in quality indicators among sectors and these indicators depend strongly on the area in which companies operate.

The reduction of distribution losses[51] after privatisation is significant. Ruiz (2002) states that the increase in aerial installations instead of ground installations, contribute greatly to this reduction. For Type 1 companies, losses reduced in average from 17 per cent in 1994 to 7.5 per cent in 2007. The most important reduction was during the three years after the sale of the companies: Electrolima (1995 – 1998) and Electro Sur Medio (1998 – 2001); distribution losses decreased by 7.5 and 6.0 percentage points respectively. Type 2 companies followed the same direction with the difference that the decrease started two years before the sale of this group of companies and are on average higher by two percentage points than those from type 1 companies. One of the factors influencing this behaviour is the process of restructuring that companies experienced prior to their sale. The fact that these companies returned to the government at the end of 2001, did not affect negatively the trend in distribution losses which

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[49] In Peru one company can operate in more than one sector. There are a total of 5 sectors. Sector 1 is the area with high population density and sector 5 is the area with the lowest one.
[50] Includes all the public and private distribution electricity companies.
[51] The losses include technical and non-technical losses. A disaggregation was not possible due to the non-availability of this information.

was approximately 9.4 per cent at the end of 2007. For type 3 companies, the average distribution loss (10.3 per cent) did not differ significant from type 2 companies. The last category, type 4 companies has the highest distribution losses, 15.8 per cent at the end of 2007. One reason is that these companies are state-owned companies that never were included in the privatisation pack and therefore were never restructured for a future sale.

Unlike quality issues and electricity coverage, a reduction in distribution losses implies greater benefits for the electricity companies than for customers. The revenues would increase due to this reduction, however higher revenues do not always imply higher net operating profits. Revenues (net revenues[52]) for type 1 companies were analysed for the years following their privatisations and it was observed the average annual growth rate was higher for those years. Edelnor, Luz del Sur and Ede Cañete presented an average rate of 5.7 per cent for the period 1995-1998 and 3.2 per cent for the period 1999 – 2007. The average rate for Electro Sur Medio was approximately 13 per cent for the period 1998 - 2001 and 3 per cent for the period 2002-2007.

Even though there is empirical evidence that revenues increased during the years following their privatisations, reduction in losses could be just one of the factors that contributed to this phenomenon. Other factors may include tariff increase, electricity coverage expansion, tax benefits and improvements in the collection of commercial debts. Regarding to the first, the price control formula put in place at privatisation allowed price sincerity, as a consequence tariff increased notably; actual prices are in average 8.6 per cent higher than the counterfactual prices. In terms of electricity coverage, companies had enough incentives to expand their networks. A direct incentive could be the permission that electricity companies had to ask for a reimbursed funding to the population that would be served through the expansion of the electricity service. During the first years of privatisation 590 projects that

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[52] Net revenues exclude purchase of energy and generation and transmission costs.

amounted to US$ 105 million were implemented by this method[53]. In relation to the taxes, companies were subject to taxes benefits from 1994 to 1998[54]. Tax benefits allowed companies to revalue their fixed assets in favour of these. As a result, companies reported lower operating profits before taxes and by default net revenues increased. Regarding the last concept, the trend of the biggest and smallest companies was analysed. For this purpose, an indicator was constructed which allows us to measure the annual average commercial' debts in months[55]. An impressive improvement is observed during the first years after privatisation related to Edelnor and Luz del Sur. Customers debts decreased by 26.8 per cent, which means the annual average debts moved from 2.7 to 1.9 months for the period 1996-2000. After this period, the indicator does not report important changes. In terms of the smallest companies, Ede Cañete and Electro Sur Medio, an apposite trend is observed. During the first years of privatisation the variation is small and the annual average indicator is 2.8 months. From 2003 to 2007 an important decline is perceived; the indicator decreased at 3 per cent p.a. and was around 1.8 months in 2007, similar to the biggest ones. Thus, debt indicators have improved in the biggest and the smallest private companies. This improvement, specifically to the biggest companies, could contribute in some extent to the remarkable increase in revenues after the first years of privatisation.

From the perspective of distribution losses and irrespective of who were the main benefactors due to this reduction, it is clear that losses are lower under private ownership. Distribution losses in type 2 and type 3 companies differ in less than one percentage point, the difference can be explained by the fact that type 2 companies were under private ownership for three years and that type 3 companies operate in areas more dispersed. Type 4 companies are the least efficient in terms of distribution losses.

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[53] 2000 prices. Congreso (2002)
[54] Approved by Law No 26283, 10/01/1994 and its directive by Supreme Decree No 120-94-EF, 19/09/1994.
[55] The procedure is as follows: (1) the annual net commercial' debts are divided by the total energy billed, (2) this value is multiply by 12 in order to obtain the average consumer's debt. The net commercial' debts are found in the companies' balance sheet. Commercial debt refers to the customers' debts.

6. Conclusions

1. The partial privatisation and restructuring of the electricity distribution market was worthwhile and amounts to US$ 542 million in 2007 prices, relative to the central-case scenario at 7.3 per cent discount rate. The benefits of improving quality issues, namely the expansion of the electricity coverage contribute to these gains and represent around 61 per cent of the net gains.

2. The highest benefits of being connected are obtained during the first five years after privatisation. During the period 1995-1999 the number of household connections increased at 6 per cent p.a., which is twice the annual growth rate of households placed in the companies' concession areas. The incentives that companies received for expanding their networks in the lower-income population areas could explain the service expansion.

3. Results from the distributional gains with different social weights, show that government and producers benefit the most and consumers benefit the least. It is only with the introduction of the benefits of being connected that consumers start to gain.

4. An increase in prices (compared with the counterfactual scenario) was expected due to the application of the improved price calculation methodology which allowed "price sincerity". The actual average prices p.a. is higher than the preferred counterfactual in 8.6 per cent, for the period 1994-2022.

5. The increase of net revenues relate to the privatised companies during the first years after being privatised, is noticeable. The price increase, tax benefits, service expansion and the better collection of revenues (bills) are among the main issues that could contribute with this.

6. The improvements in quality indicators such as number and time of interruptions are more noticeable in the biggest companies that operate in areas with high density, mainly in sector 1 and 2. Smaller companies do not show a downward tendency even after seven years of being privatised. Thus the sectors in which the electricity companies operate

have a strong influence on these indicators, independently whether the companies are under private or public-ownership.

7. Restructuring and privatisation has contributed notably to the reduction of distribution losses. Edelnor and Luz del Sur have the lowest distribution losses and smaller privatised companies, such as Ede Cañete and Electro Sur Medio, show a less impressive but significant reduction of distribution losses after their sale. Important improvements were also observed in state-owned companies.

7. References

[1] Alcazar, L, Nakasone, E., Torero, M. (2007). Provision of Public Services and Welfare of the Poor: Learning from an Incomplete Electricity Privatisation Process in Rural Peru. Inter – American Development Bank. August 2007.

[2] Araoz, M., and Casas, C. (2001). Proyecto Andino de Competitividad: Atracción de la Inversión Extranjera Directa en el Perú. Centro de Investigación de la Universidad del Pacífico.

[3] Bishop, M. and Thompson, D. (1992). Regulation Reform and Productivity Growth. Applied Economics Vol 24, pp 24 – 36.

[4] Bishop, M. and Green, M. (1995) Privatisation and Recession: The miracle tested. Centre for the Study of Regulated Industries, CIPFA.

[5] Boardman, A., Laurin, C., Moore, M., and Vining, A. (2007). A Cost-Benefit Analysis of the Privatisation of Canadian National Railway. Working Paper 2007-03. Phelps Centre for the Study of Government and Business. Sauder School of Business, University of British Columbia. August 2007.

[6] Bonifaz, J. (2001). Distribución Eléctrica en el Perú: Regulación y Eficiencia. Consorcio de investigación económica y social. – Universidad del Pacifico.

[7] Boubakri, N. and Cosset, J.C. (1998). The financial and operating performance of newly privatized firms: Evidence from developing countries. Journal of Finance, No 53, pp. 1081-1110.

[8] CEPREL (1997). Libro Blanco. Informe Final del Proceso de Privatización. Comité Especial de Promoción de la Inversión Privada en.

[9] COPRI (2000). Evaluación del Proceso de Privatización. Grupo de Análisis de Post Privatización. Comisión de Promoción de la Inversión Privada. February 2000.

[10] CTE (1986 – 1999). Annual Reports. Comisión de Tarifas Eléctricas.

[11] CTE (1992-1993). Annual Reports. Comisión de Tarifas Eléctricas.

[12] Congreso (2002). Comisión investigadora sobre los delitos económicos financieros cometidos entre 1990 y 2001. Informe Final de Investigación. Congreso de la República. Junio 2002.

[13] Domah, P. and Pollitt, M.G. (2001). The Restructuring and Privatisation of Electricity Distribution and Supply Businesses in England and Wales: A Social Cost-Benefit Analysis. Fiscal Studies (2001) Vol. 22, No 1, pp. 107-146.

[14] Estache, A., Goldstein, A., and Pittman, R. (2001). Privatization and regulatory reform in Brazil: The Case of Freight Railways. Journal of Industry, Competition and Trade, Vol. 1. No. 1, 2001.

[15] Galal, A., Jones, L., Tandon, P., and Vogelsang, I. (1994). Welfare Consequences of Selling Public Enterprises: An Empirical Analysis. Oxford University Press for the World Bank. June 1994.

[16] Giannakis, D. Jamasb, T., and Pollitt, M. (2005). Benchmarking and Incentive Regulation of Quality of Service: an Application to the UK Electricity Distribution Utilities. Energy Policy, Volume 33, Issue 17, pp. 2256-2271.

[17] Hutchinson, G. (1991). Efficiency gains through Privatisation of UK Industries, in K. Hartley and A.F. Ott (eds.) Privatisation and economic efficiency: A comparative analysis of developed and developing countries. Aldershot, UK: Edward Elgar Publishing, pp. 108-125.

[18] Horn (2007). Potencial de energía solar térmica y fotovoltaica en el Perú. Primer Congreso sobre Biocombustibles y Energías Renovables. May 2007.

[19] Jones, L., Tandon, P., and Vogelsang, I. (1990). Selling Public Enterprises: A Cost-Benefit Methodology. The MIT Press, Cambridge, Massachusetts.

[20] Kirkpatrick, C., Parker, D. and Zhang, Y. (2004). State versus private sector provision of water services in Africa: A Statistical, DEA and Stochastic cost frontier analysis. Working paper No 70. Centre of Regulation and Competition. University of Manchester.

[21] La Porta, R. and Lopez-de-Silanes, F. (1999). The Benefits of Privatisation: Evidence from Mexico. The Quarterly Journal of Economics, Vol. 114, No 4, November 1999, pp. 1193-1242.

[22] MEF (2000). Proceso de Promoción de la Inversión Privada. Ministerio de Economía y Finanzas.

[23] Megginson, W.L., Nash, R.C. and Van Randenborgh, M. (1994). The financial and operating performance of newly privatised firms: An International empirical analysis. Journal of Finance, vol. 49, No 2, pp. 403-452.

[24] MINEM (2006). Evolución de Indicadores del Mercado Eléctrico 1995 – 2006. Dirección General de Electricidad/Dirección de Promoción y Estudios. Ministerio de Energía y Minas.

[25] MINEM (2007). Anuario Estadístico Electricidad 2007. Ministerio de Energía y Minas.

[26] MINEM (2008b). Plan Referencial de Electricidad 2008-2017. Dirección General de Electricidad. Ministerio de Energía y Minas.

[27] Mota, R. (2003). The Restructuring and Privatisation of Electricity Distribution and Supply Businesses in Brazil: A Social Cost-Benefit Analysis. Working Paper EP16. Electricity Policy Research Group, University of Cambridge.

[28] Mota, R. (2004). Comparing Brazil and USA electricity performance: What was the impact of privatisation?. Working Paper EP39. Electricity Policy Research Group, University of Cambridge.

[29] Newbery, D. and Pollitt, M. (1997). The Restructuring and Privatisation of Britain's CEGB – Was it Worth it? The Journal of Industrial Economics. Volume XLV, pp. 269 – 303. September 1997.

[30] O' Mahoney, M. (1998). Britain's Competitive Performance: An Analysis of Productivity by Sector: 1950 – 1995. London, National Institute of Economics and Social Research.

[31] OSINERGMIN (2000-2007). Annual Reports. Gerencia Adjunta de Regulación Tarifaria – GART. Organismo Supervisor de la Inversión Privada en Energía y Minas.

[32] OSINERGMIN (2006). Compendio de Líneas de Transmisión. Gerencia de Fiscalización Eléctrica. Organismo Supervisor de la Inversión Privada en Energía y Minas.

[33] Parker, D. and Martin, S. (1995). The Impact of UK Privatisation on Labour and Total Factor Productivity. Scottish Journal of Political Economy, Vol. 42, No 2, May 1995, pp. 201-230.

[34] Pollitt, M. G. (1995). Ownership and Performance in Electric Utilities: The International Evidence on Privatisation and Efficiency. Oxford University Press for the Oxford Institute for Energy Studies.

[35] Pollitt, M. G., and Smith, A. (2002). The Restructuring and Privatisation of British Rail: Was it really that bad? Fiscal Studies,Vol. 23, No 4, pp. 463-502.

[36] Pollitt, M.G. (2004a). Electricity Reform in Chile Lessons for Developing Countries. Electricity Policy Research Group EP51. University of Cambridge.

[37] Pollitt, M.G. (2004b). Electricity Reform in Argentina Lessons for Developing Countries. Electricity Policy Research Group EP52. University of Cambridge.

[38] Ruiz, A. (2002). El Proceso de las Privatizaciones en el Perú durante el periodo 1991-2002. Instituto Latinoamericano y del Caribe de Planificación Económica y Social – ILPES. July, 2002.

[39] Torero, M. (2003). Peruvian Privatisation: Impacts of Firm Performance. Latin American Research Network. Research Network Working Paper R-481. Interamerican Development Bank.

[40] United Nations (2007). Competition in Energy Markets. Study by the UNCTAD Secretariat. United Nations Conference on Trade and Development. April 2007.

[41] World Bank (1990). Peru: Guideline Study for a Short-and Medium-Term Strategy for the Energy Sector. Energy Sector Management Assistance Programme. December 1990.

[42] World Bank (2005). Benchmarking data on the electricity distribution sector in the Latin American and the Caribbean Region 1995-2005. The World Bank.

[43] World Bank (2008). The Welfare Impact of Rural Electrification: A Reassessment of the Costs and Benefits. An IEG Impact Evaluation. The World Bank Group.

Appendix 1: Data construction and sources

Data	Sources and explanation
Operating revenue	Data obtained from the financial statements that companies reported to the authority (CTE and OSINERGMIN). The revenues are composed of: (1) sales to final customers, (2) others (incomes deduced from other activities related to distribution) and (3) compensations. The last category was excluded and was a component of the FCG and/or FOTAR.
Operating costs	Figures taken from the financial statements that companies reported to the authority. These are composed of: supplies, fuel, labour expenses, taxes, third-party services, management expenses, provisions and other operating costs. This item is net of purchase of electricity, generation and transmission payments.
Purchase of energy	This data was also obtained from the financial statements that companies sent to the regulatory authority. Before privatisation, the FCG (expenses) were allocated in this category. Two types of FCG were distinguished: type 1 (expenses incurred for the purchase of electricity), type 2 (composed of different kinds of compensations). This last was composed of compensation for: (1) source of energy, (2) economies scale and (3) market structure. Therefore for our calculations type 1 was taken as "purchase of energy" and type 2 was computed as non-controllable costs.
Generation & Transmission costs	For the years before 1994 they were calculated using two reports from CEPREL (Libro Blanco): (1) The International Finance Corporation and Interandean Bank Informational Memorandum, and (2) Coopers and Lybrand Diagnostic. For the period 1994-2007 this item was found in the annual reports from the regulatory authority.
Operating controllable costs	These are operating cost excluding depreciation and restructuring and privatisation costs.
Operating non-controllable costs	Before privatisation they are composed of: taxes (includes taxes on revenue), FCG, FOTAR and Fund for electric development. For 1994 they include only taxes.
Restructuring and privatisation costs	Those costs that Government incurred before and after the sale of Electrolima and Electro Sur Medio. These were obtained, from CEPREL (Libro Blanco), from the Ministry of Economy and Finance – MEF (National Public Treasury Office) and from the Agency for the Promotion of Private Investment – Proinversión (concluded process). These costs include: (1) expenses for national and international consultants, (2) travels, (3) administration, (4) third-party services, (5) equipments, (6) commissions for the sale of remaining shares in the stock market, (7) others.
Taxes and social contribution	This data is available since 1994 and was collected from the CTE and OSINERGMIN annual reports as well.
Assets	Assets were taken from CTE and OSINERGMIN annual reports for the period 1994-2007. For the previous period, generation assets were obtained from Electrolima and Electro Sur Medio's Libro Blanco respectively. In the case of Electrolima, transmission assets were obtained from the Ministerial Resolution No 164-93-EM-VME, 22/07/1993 in which the transmission assets that would be transferred to "Empresa de Transmisión Eléctrica Centro Norte" were defined.
Index and reference interest rate.	IPM was taken from the National Accounting Regulatory Council (Ministry of Economy and Finance) and the IPC from the Central Reserve Bank of Peru – BCRP. The reference interest rate was taken from the BCRP as well.
National accounts	GPD per capita for the period 1994-2007 was taken from the World Bank Database (World Development Indicators). For the period 2008-2015 we use the projections given by the International Monetary Fund (IMF World Economic Outlook)
Number of employees	Collected from the annual reports from CTE and OSINERGMIN. Data is available since 1990 (Electrolima) and since 1994 (Electro Sur Medio).
Units distributed	These are the net unit distributed to end customers. This data was taken from the authority's annual reports.
Electricity distribution companies' concession area	Obtained from the companies' website and also from the following Ministerial Resolutions: Luz del Sur (107-96-EM), Edelnor (011-95-EM, 080-96-EM, 040-2006-EM), Ede Cañete (095-95-EM) and Electro Sur Medio (066-94-EM, 091-96-EM, 032-2000-EM, 022-2002-EM)
Population, number of households and households with electricity	Data collected from the nationwide census of 1993 and 2005 provided by the National Institute of Statistics and Information (INEI). Data from these two years were used for approximating the annual population, number of households and households with electricity for the period 1994-2007.