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REGULATORY ASSISTANCE PROJECT IN LITHUANIA

PN-ACD-076

98506

Use, Impact of Power Mixing Methodologies

FINAL REPORT

Prepared
Under Contract to

U.S. Agency for International Development

Regulatory Reform and Energy Sector Restructuring in Central and Eastern Europe and the Baltics

Contract No DHR-0030-C-00-5016-00

Bechtel International, Inc.

October 1996

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Development of Energy Pricing Methodologies

1. Introduction

This report describes energy pricing (tariff) methodologies – developed by Bechtel and its Lithuanian partners – for Lithuania's electricity, heat, and natural gas sectors Undertaken as part of the United States Agency for International Development's (USAID's) Regulatory Assistance Project, the work was performed for the State Control Commission of Prices for Energy Resources and of Energy Activities (SCC) in Lithuania and was done in cooperation with the Lithuanian Energy Institute (LEI) acting under the contract with Ministry of Energy - Energy Agency (MEEA)

Section 2 of this report contains background information Section 3 describes how the tariff methodologies were developed Section 4 presents institutional recommendations Section 5 discusses how the tariffs are to be implemented Section 6 presents a project chronology, and, finally, Section 7 provides a list of project participants

Appendices A through C set forth the methodologies as they were discussed with LEI experts After the discussions, final versions were developed by LEI and submitted to SCC for approval All methodologies use a cost-based approach, referred to as revenue requirements Appendix D presents the terminology used in the revenue requirements, a brief introduction to the methodology, and financial statements required to apply the methodology, and is intended to help address initial implementation issues Appendix E comprises the commission's restructuring proposal presented to the government In preparing this proposal, the commission's working group made use of Bechtel suggestions and comments and National Economic Research Associates (NERA)-submitted materials describing regulatory experiences in selected European countries

2. Project Background

Energy supply in Lithuania is the responsibility of state enterprises which are currently structured as vertically integrated state-owned monopolies Most of these enterprises have recently been transferred into state-owned joint-stock companies AB Lietuvos Energija and the Ignalina Nuclear Power Plant generate the country's electricity and heat, AB Lietuvos Energija transmits and exports this electricity, and seven regional utilities of AB Lietuvos Energija distribute the electricity within the country

As part of the Energy Law of the Republic of Lithuania, SCC was defined as the regulatory body for the energy sector and was established as a regulatory body by the President's decree of July 7, 1995 SCC, which has nine members who serve a 5-year term and who are approved by the Government of Lithuania (GoL), (1) establishes the principles of energy pricing, (2) determines the rules for calculating prices and tariffs, (3) verifies and approves price and tariff calculations

for electric and thermal energy and natural gas for confirmation by the GoL, (4) controls the quality of energy and its conformity to standards, and (5) inspects the trade in energy raw materials and energy products

In order to meet the these objectives, USAID offered to provide immediate assistance to the GoL in the areas of energy tariff/price setting analysis and methodology, and associated regulatory issues USAID's prime contractor, Bechtel International, Inc , led the team of experts that were to perform the work

3. Tariff Methodology Development

3.1 Introduction and Definitions

The tariff development work was done in close collaboration with the experts from LEI in Kaunas, which worked under subcontract from the regulatory commission to develop electricity, heat and gas tariff methodologies LEI experts did the initial drafting of the methodologies, Bechtel consultants then reviewed these methodologies and submitted their comments On the basis of these comments and follow-up discussions, LEI experts modified the methodologies and presented their results to the regulatory commission Bechtel experts took part and expressed their views in most of the regulatory hearings The text of the final, adopted version of the tariff methodologies was subject to the approval of the Lithuanian regulatory commission The text of the methodologies presented in the appendices of this report is the last version of the methodologies discussed prior to the commission hearings

Observations and comments regarding electricity pricing and tariffs are presented below Comments are included as they were presented during the tariff methodology development phase Comments on general tariff development apply to all tariff methodologies The final version of the tariff methodology submitted to SCC includes most of the comments and observations Some of these comments are relevant only to future methodology development and to the implementation phase

The financial analysis is key in determining revenue requirements, which in turn enable one to determine the average unit price for electricity, heat, and natural gas Financial statements include income statements, balance sheets, and sources and applications of funds Appendix D explains how these statements are used to estimate revenue requirements For electricity, heat, and gas, separate financial statements are needed in order to measure the financial viability of each enterprise, thereby preventing cross-subsidies involving joint facilities (e g , combined heat and power plants) The revenue requirements approach is based on the assumption that assets are valued close to their replacement value Periods of high inflation in Lithuania call for a revaluation of assets, and future indexation of their value, for proper application of methodologies based on revenue requirements

Ideally, the tariff structure for each of the areas (electricity, heat, and gas) will be made up of the three components customer charge, energy or commodity charge, and demand charge

Customer charge is intended to cover those costs associated with customers (e g , connection fees, meter reading, billing)

Energy or commodity charge is intended to cover those costs associated with the volume of usage (e g , fuel) and can vary with time of day and season

Demand charge is intended to cover those costs associated with the maximum rate of usage (e g , fixed costs in generation, transmission, and distribution networks) As is the case with the energy or commodity charge, demand charge can vary with time of day and with season Demand charge includes an allowance for return on investment (often referred to as operating income) This usually amounts to between 5 and 10 percent of the real value of net fixed assets plus general inflation

In the case of electricity, the cost of demand metering makes this structure practical only for the largest customers The result is a three-component tariff for major customers and a two-component tariff for others Since demand metering of heat is less practical than of electricity, it may be advisable for demand charges to be included in the energy charge for heat Likewise, in the case of gas, a two-component tariff is recommended with demand charges included in the commodity charge

It is important that the transition to cost-reflective tariffs for different fuels be coordinated and that the competition between fuels be considered For example, liberalization of district heating sector tariffs and continued subsidies or cross-subsidies to household electricity and gas sectors could encourage fuel switching by households supplied by district heating Such a switch is likely to be uneconomic, resulting in unneeded capital investment, and have a negative financial effect on the district heating sector On the other hand, continued subsidies to the district heating sector could result in its expansion to areas more efficiently served by gas

3.2 Electric Tariff Review

The principal characteristics of the Lithuanian power sector are overcapacity of generating resources, dependency on fuel imports from Russia, decreased local electricity consumption, and the export of a significant share of power to neighboring countries

The main factors affecting Lithuanian generation costs are

- Ignalina Nuclear Power Plant (INNP) cost structure
- Pumped-storage power plant operation

- INPP maintenance and forced outage level

The INPP meets a large portion of the total electricity demand, exceeding baseload capacity requirements, and is driving the operation of the electric and district heating sectors Thus, its cost structure strongly impacts the generation costs of the country as a whole

The pumped-storage plants are used for balancing the daily variation in electricity demand At night, when electricity demand is low, they operate in the pumping mode During the day, they generate electricity when demand exceeds the INPP's capacity If only the losses of energy in one pumping and generating cycle are considered, a surcharge of at least 30 percent should be superimposed on the energy charge during the peak period The pumped-storage fixed cost should be recovered through the demand charge Consequently, this additional capacity should be spread over all customers and allocated on the basis of responsibility for the peak load

When the INPP is experiencing an outage or undergoing maintenance, and hence is not on line, other generation capacity has to be available to meet the demand for electricity Since the capacity of the INPP units is so great, a number of smaller, more expensive generating options have to be brought on line The result is an increase in the cost of electricity

The future of two INPP units is uncertain at this time Their replacement would require substantial capital investment As a means of reducing capital requirements, demand side management (DSM) measures could become extremely important It is also important that SCC strongly encourage the Lithuania Power Company (LPC) to achieve certain measurable goals in DSM programs, including energy conservation

Future development and implementation of the methodology should include

- Assure that the pricing methodology takes into account load research data (e g , peak load responsibility factors for allocating costs to customer classes)

- Update the depreciation and decommissioning accounts The amount of depreciation has to be adjusted to reflect inflation, and the regulators should verify that the depreciation reserve is adequate to replace facilities only and not used to fund operation and maintenance (O&M) costs The decommissioning fund should reflect an adequate amount to return the nuclear plant site to its original status when the plant is retired

- Modify the tariff structure to make social adjustments, such as lifeline tariffs or inverted tariffs, to reduce electricity charges for the disadvantaged (poor and elderly)

- Calculate total expenses, develop costs and pricing for the INPP in a similar fashion as for the rest of the system, adding expenses such as wages, benefits, materials for maintenance and

repairs, decommissioning, and depreciation To calculate depreciation accurately, reevaluate the fixed assets

- Develop time-differentiated electricity pricing using short and long run marginal cost (SRMC and LRMC) pricing principles, and document the method of determining the SRMC and LRMC An integrated resource planning (IRP) model is an important tool in determining SRMC and LRMC The utilities in Lithuania are beginning to use an IRP model Under a different USAID program, Bechtel International is helping LPC purchase and use an IRP model

- Develop a cost of service methodology for the financial statements, using formats familiar to the international banking community (This methodology will ensure that utility service is provided at the appropriate cost at each level of service and will facilitate obtaining future loans in the electric sector) See to it that the accounts are clear for the regulators and that the cost components are identified for inclusion/rejection of the revenue requirement in the calculations

- Develop the financial statements (including income statements, balance sheets, and sources and application of funds) and present them to the regulators Summarize the financial parameters for each utility to ensure the company's financial health

3.3 Heat Tariff Review

Regulating tariffs in the heating sector is important because of the large number of major cities served by the centralized district heating network Large portion of the district heating capacity is concentrated in the combined heat and power plants (CHP), so the pricing of heat is connected with the pricing of electricity The CHP plants and the heating network are presently owned and operated by the Lithuanian power utility A restructuring of the heating sector is currently underway

Some observations about the district heating system are noted below

- There are many problems in the district heating area regarding the operation of the system and its maintenance
- Some customers are served from combined heat and power plants (CHP), while others are served from boiler houses only
- The CHP plants are not producing projected electricity output since the electricity demand is met by nuclear power plant Ignalina and the pumped-storage facility
- The district heating network is not old, but has not been properly maintained Pipelines leak and are not adequately insulated which is resulting in poor quality of heating

The cost of producing and distributing hot water used for heating in various district heating systems varies Because of these variations, it was suggested that different tariffs be used in different regions

Some customers have meters, but these meters are not reliable Funds and effort will be required on the part of LPC to modernize the system

Heat tariffs should be differentiated according to the location of heat production, customer class, and heat production and supply conditions As is the case with electricity tariffs, district heating tariffs should track the cost of service and should have three components

Cost-based tariffs are difficult to implement since there are so many subsidies in the system Gradual implementation is a key issue A lifeline tariff or a voucher system could be used with a plan to phase out these subsidies gradually

District heating bills represent a large portion of low income customers' monthly budget during the winter An alternative to lessen this percentage is to make an average monthly payment plan an option for all customers The average payment is the estimated annual heating cost averaged over the 12 months of the year

LPC developed another version of heat tariff methodology Compared with the methodology developed by LEI, the LPC methodology is simpler, does not recognize the difference between main and branch pipelines (transmission and distribution networks), and transfers all heat losses to system customers In our opinion, heat customers should be responsible for their use plus a reasonable amount of losses (technical system losses) and the company providing heat should absorb the balance caused by inefficient operation as well as the cost of the system's idle capacity Customers should be charged only for a reasonable amount of reserve capacity

3.4 Gas Tariff Review

The existing gas pipeline system is well developed and serves major cities and industries The pipeline system is also used to transport gas for the Kaliningrad region The Lithuanian natural gas system depends almost entirely on gas imported from Russia The suplly of natural gas is carried through the government owned joint-stock company Lithuanian Gas

The tariff structure for natural gas could be in the form of a customer and commodity charge The commodity charge is similar to the energy charge proposed for district heating tariff structure Seasonal tariffs could be considered if Russia adopts seasonal tariffs for natural gas sales Latvian storage facilities should be considered in formulating seasonal gas tariffs

Connection fees, excess demand charges, seasonal demands, and interruptible supplies are all normally taken into account in determining natural gas tariffs Unfortunately, there appears to be

a lack of data on which to base the derivation of these elements The initial conclusion is that simple tariff formulas are the best that can be hoped for, both for the end-user price calculation and the third-party transportation tariffs

The third-party user charge is derived by dividing the total system costs (excluding the border gas purchase price) by the total gas carried (i e , third-party plus consumer gas) For the consumer tariff, the import gas price is added Although this should achieve the basic purpose of covering costs and allowing a return on capital, over the medium to long-term, it will in our judgment prove inflexible and probably inequitable between the various consumers/users Efforts therefore need to be dedicated to compile the necessary data that will allow demand and commodity charges for third-party users to be derived The basis for cost recovery should be costs associated with connections in and out of this system and seasonal gas demands This approach should be applied to discounts given to interruptible customers, and should be addressed in the methodology

We have proposed allocating total revenues between consumers on the basis of their consumption levels Even though there is a lack of data on actual segmented costs, this proposal is probably acceptable in the circumstances, as it is based broadly on allocation of the line lengths of the distribution and main systems actually used However, if it is not possible to differentiate between the locations and costs of supply to specific users, the need to consider competing fuel economics has to be addressed

4. Institutional Recommendations

Until now, SCC has functioned without permanent staff and offices Given the current responsibilities and the workload of the commission members, this situation is no longer sustainable As a result, the commission formed a working group to propose to the GoL a new organization and functional structure for the commission To help prepare this proposal, Bechtel drew up a list of recommendations on the organization of the commission and a list of duties the commission should perform As part of the USAID assistance, NERA prepared a report describing the regulatory structure and functions in selected European countries In the course of this project, some commission members traveled to Hungary to study the Hungarian regulatory model In July of this year, the commission working group finalized, and the full commission approved, the restructuring proposal to the GoL The proposal is found in Appendix E of this report

The immediate requirement for the normal functioning of the commission is to have minimal permanent staff, budget, and offices The for review and approve the following tasks

- Request that the utilities produce 1-year and 5-year load forecasts
- Request that all utilities develop and provide a capital plan for new facilities or for rehabilitation and replacements The capital plan should be based on the load forecast approved by the commission
- Set standards for the utilities to report their expenses using unified accounting standards (chart of accounts) This task could be coordinated with other Baltic and neighboring countries
- Review cost-of-service studies, and have the responsibility of reviewing all cost/expense components and allow/disallow their inclusion in the tariff base
- Have the responsibility and authority to license all facilities at different phases in the lifetimes of these facilities (e g , planning, construction, commissioning, operation, and decommissioning)
- For each licensing step, define reporting requirements from the utility and specify fees The collected fees should support the commission in hiring a technical staff and space to operate independently of the political parties
- Set standards for service in each energy sector (e g , in the electric sector, define standards frequency, voltage regulation, reliability, quality of electricity, and responsiveness to customer complaints)

- Receive financial reports (e g , income statements, balance sheets, and sources and applications of funds) from each utility in all energy sectors
- Determine specific financial parameters for all utilities to calculate the rate of return in tariff settings
- Encourage the GoL in developing building standards, energy conservation guidelines, and laws, and participate in their development
- Encourage competition in all energy sectors
- Encourage independent power producers and, in particular, the ones using renewable resources of energy
- Establish processes and procedures for competitive bidding in executing projects
- Establish rules to reward/penalize utilities for efficient/nonefficient performance
- Establish rules for required/allowed amounts of reserve capacity If the utility exceeds the set limit, it would absorb the cost and customers would not pay for this expense
- Monitor losses of electricity, heat, and natural gas and determine reasonable standards for operation If a utility exceeds such target figures, it should not be allowed to pass excess cost on to customers
- Examine utility practices in borrowing funds and make sure that such practices are in customers' best interest
- Conduct public hearings to obtain feedback from all groups of customers
- Obtain the responsibility to request utilities to conduct load research to improve cost allocations to customer classes

It is critical that the commission be institutionalized and retain its independence in order to accomplish these objectives

5. Implementation of Tariffs

Once revenue requirement analyses are conducted and tariff design is developed, it is very likely that tariffs will have to be increased Our recommendation regarding the implementation phase are as follows

- The tariffs should be implemented gradually (over perhaps a 5-year period) Implementation of price increases to cover economic costs is essential for the financial stability of all energy sectors

- Social and political issues should be taken into consideration Rigorous analysis should be conducted to understand income distribution and to determine how tariff increases affect inflation, the standard of living, the ability to have adequate heating during the harsh winters, etc Commission/LEI research showing the relationship between salaries and monthly energy bills could be used for this analysis

- The SCC, along with its contracted staff (LEI), should establish certain tariff structures (e g , an inverted tariff structure) to provide some relief for low-income and low-consumption customers

- The SCC should encourage energy conservation and increase cooperation with neighboring countries The first initiative could be the implementation of pilot demand-side management programs This would be an important step in testing the cost-effectiveness of the proposed measures in the Lithuanian environment One example could be the development of new building standards

- Lithuania, along with other two Baltic countries, should implement full economic dispatching in the electric sector All parties would benefit economically from this mode of operation

6 Chronology of the Project

In September 1995, a definition meeting was held in Vilnius involving the Bechtel team, USAID, Mr Viktoras Valentukevicius, Secretary for the Lithuanian Energy Ministry, and Mr Marius Franckevicius, Head of the Integration and Foreign Relations Division, Energy Agency

Mr Sam Eskander from Bechtel, as a principal tariff consultant, made a number of trips to Lithuania during the December 1995 – June 1996 period His consulting work was performed mainly at the LEI in Kaunas, and he also participated at the SCC meetings Mr John McGhee of Gaffney, Cline & Associates (GCAs), as a subcontractor to Bechtel, helped develop a gas tariff methodology Mr Eskander was joined by Mr Miljenko Bradaric of Bechtel in March of 1996

In February 1996, a four-person delegation from SCC and LEI went to Hungary and visited representatives of the Hungarian Energy Office (HEO) During the 3-day visit, the delegation exchanged a great deal of information regarding electricity and district heating tariffs and related issues with Mr George Bekes, Mr Ferenc Csikos, Mr Tamas Szabo, and Dr Tibor Tersztyanszky of HEO The discussions also covered utility performance and service standards, cost-of-service studies, tariff changes, utility restructuring, privatization, and public hearings

As part of this program, one set of office equipment (personal computer and printer) was provided for the newly formed regulatory commission and one set for the LEI

7 List of Participants

Members of the SCC

Mr Viktoras Lukosevicius, Chairman of the SCC, Deputy Director of Lithuanian Competition and Consumer Protection

Dr Vidmantas Jankauskas, Project Manager, Lithuanian Energy Institute, Deputy Chairman of the SCC

Mr Saulius Kutas, Deputy Minister of the Ministry of Energy

Mr Viktoras Valentukevicius, Secretary of the Energy Ministry

Mr Marius Franckevicius, Head of Foreign Relations Department, Energy Agency

Mr Kestutis Dirgela, Committee of Economics, Seimas of the Republic of Lithuania

Dr Vita Safjan, Chief Social Indicators Division, Ministry of Social Security and Labor

Dr Anzelmas Bacauskas, Associate Professor, Department of Electric Power Systems

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Electricity Tariff Methodology

Mr Mindaugas Krakauskas, Research Associate

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Gas Tariff Methodology

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Appendix A

ELECTRICITY TARIFF METHODOLOGY

A.1 Introduction

The present tariff system in Lithuania's power energy sector is a complicated one, consisting of too many customer categories and too many tariff components The use of such methodology in practice is very complicated There is no clear and consistent methodology and there is no basis for current methodology Many customers have no understanding of the philosophy and the mechanics of cost of service and electricity pricing methodology

The purpose of this methodology is to simplify the existing tariff system, and to adhere to economic principles The objectives of the proposed tariff methodology are as follows

- Tariffs should be cost-based
- Tariffs should be just and fair to all customer classes
- Energy Law objectives should be met
- Tariffs should be easily understood by customers
- Tariffs should promote the financial stability of the Lithuanian Power Company (which should be able to expand/replace facilities)
- Tariffs should give proper economic signals to all customers

A.2 Main Principles of Pricing in the Power Energy Sector

To form more efficient relations of market economics in Lithuania, it is necessary to establish self-financing of the energy sector Therefore, electricity price levels should cover the cost of service and account for a reasonable profit (operating income) Pricing of electric power should be coordinated with district heating Required revenues are calculated by adding all expenses for operating and maintaining the utility business and operating income The operating income is defined here as the product of rate of return on net fixed assets and net fixed assets The rate of return is in the range of 2 5 to 10 percent The regulatory body in Lithuania (SCC) should control the rate return percentage to keep prices at level that is good for consumers and investors (LCP - for now) The operating income will help the utility to maintain and develop its operation This is one of the most important objectives in pricing

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Electricity prices should send proper economic signals to customers to help them make proper economic decisions Tariffs should be designed according to time-differentiated costing Proposed methodology follows this concept, and tariffs are structured in such fashion The time-differentiated costing for utility is developed using computer programs such as Integrated Resource Planning (IRP) models with proper information about generating facilities, their O&M expenses, load forecasts, generation expansion plans, and fuel data

Pricing principles should also ensure that all customer classes pay what is just and fair based on their cost of service We have to recognize that certain detail load information is needed to achieve this objective At present, there is a limitation on information relative to customer peak load responsibility, and therefore assumptions will have to be made This area will be studied in the future to improve the tariff setting process

Tariff structure should be transparent, available and acceptable for a customer and should correspond to the existing level of meters

A.3 Tariff Level

Tariff level is determined and should be based on required revenue The average tariff level is determined by dividing the required revenue from electricity sales by electricity sales Losses are to be factored in the price It is recommended that the LPC accounting system be modified to unbundle costs and expenses by voltage class so in future the cost of service study could be segregated by voltage level It is also important to separate electricity costs and expenses from the heat costs and expenses The method for pricing heat is developed in parallel to this methodology

A.4 Tariff Structure

Expenses related to production, transmission and distribution of electricity should be broken down into fixed and variable components Using accounting data from PES, the 1996 cost structure in million litas (LT) is projected as the following

Fixed cost for transmission and distribution[1]	340
Fixed cost for generation[2]	530
Variable cost for generation, transmission and distribution[3]	390
Total cost	1260

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1 This component includes depreciation based on fixed assets, wages and salaries and benefits

2 This component includes depreciation based on fixed assets, decommissioning and wages, salaries and benefits

3 This component is mainly fuel, parts, and all other variable costs directly proportional to electricity production

It should be noted that assets need to be reevaluated and therefore depreciation amounts will have to be adjusted Because of high inflation in the last few years and the unrealistic book value, it is believed that the net fixed assets are understated Furthermore depreciation reserve should be used for the allocated purpose and that is to replace facilities at the end of their useful economic life Depreciation reserve should not be used to cover operation and maintenance expenses

It should be also noted that the tariff for serving an electric customer is broken down into three components customer charge, demand charge (reserve capacity charge), and energy charge

The *customer charge* includes all expenses directly related to customer service and they are depreciation of installed facilities (service entrance), metering and recording equipment, and expenses related to meter reading, meter calibration and repair, billing, accounting and other administrative expenses The average connection cost is used in this calculation If the customer has a special requirement such as a bigger wire or longer distance from the grid, then the customer is required to pay an additional connection fee, a single payment, at the time of connection

The *demand charge* or *capacity reserve charge* is made up of fixed costs which are related to fixed assets This charge is directly proportional to the peak demand applied by a customer to the system Since only the coincident peak demand for the system is known and the non-coincident peak demand for the customer is recorded, it is essential to establish a relationship between customer class non-coincident peak demand to the system peak, so costs could be assigned accurately to customer classes This is another area for LPC to develop/improve, so tariff methodology could be greatly improved

The *energy charge* is related to the variable component namely fuel cost and is directly proportional to the amount of electricity used (kWh)

The utility (LPC) is advised to communicate all this information to its consumers to increase their confidence level and increase their awareness

At present, the existing accounting system does not provide enough information to calculate the customer charge component It may be assumed here as an example to be about 5 percent of transmission and distribution cost, i e , 17 mill LT Power demand charge should include fixed

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power generation and transmission cost The tariff structure has three components as discussed above and is in the following form

$$M_3 = a + T_p * P + T_{v3} * E$$

here M_3 - customer's expenses for electricity according to triple tariff structure,
a - customer charge, paid each month depending on type and location of customer in a power network, but not related to energy consumption and power demand,
T_p - price of power demand,
P - amount of power demand in kW,
T_{v3} - energy prices in triple tariff structure,
E - consumed energy in kWh

Tariffs should be compatible to present energy metering equipment, which is given in Table 1

Table 1
The number of electricity meters of the customers in Lithuanian Republic

Metering type	Availability of Power demand Metering	Number of time zones in energy metering	Number of meters
1 Energy tariff with one time zone of this one phase three phases	no	1	1 308 600 1 099 200 209 400
2 Energy tariff with two time zones of this one phase three phases	no	2	45 500 26 200 19 300
3 Energy & Demand tariff with four time zones (ELGA-EMH),	exists	4	6500
			1 360 600

As shown, most metering systems have no power demand recording facilities To have power demand meters installed for the balance of customers, it would be very expensive and economically not justified Therefore simplification of tariffs is a necessary step and the two-component tariff is proposed for customers without power demand recording capabilities as follows

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$$M_2 = a + T_{2v} * E$$

This tariff is applicable to customers without peak demand meters It consists of two components customer charge and energy charge The energy charge covers variable and fixed costs only under the component tariff Therefore the fixed cost will be spread over the energy quantity

A.5 Time Differentiated Tariffs

Production cost depends upon the power plants loading level and the cost of producing electricity varies during peak, shoulder peak and off-peak load periods Usually peak load is met by peakers (fast starting or hydro units) and off peak load is met by base load generation (NPP Ignalina) In order for pricing to follow cost of service, the following time-differentiated tariff structure is proposed This tariff structure also has three components customer charge, energy charge and peak demand charge This tariff structure has three time zones and is formulated as follows

$$M_{3d} = a + T_p * P + T_{3m} * E_m + T_{3v} * E_v + T_{3d} * E_d ,$$

where

M_{3d} - electricity price based on time differentiated tariff (three time zones)
T_{3m} - energy tariff during off-peak load period in LT/kWh
T_{3v} - energy tariff during shoulder peak load in LT/kWh
T_{3d} - energy tariff during peak load period in LT/kWh
E_m, E_v, E_d - energy consumed during off-peak, shoulder peak and peak load periods respectively

The two-component tariff with three time zones has the following structure

$$M_{2d} = a + T_{2m} * E_m + T_{2v} * E_v + T_{2d} * E_d ,$$

where

M_{2d} - electricity price according to time differentiated tariff
T_{2m} - energy price during off-peak load period in LT/kWh
T_{2v} - energy price during shoulder peak load period in LT/kWh
T_{2d} - energy price during peak load period in LT/kWh

To implement such tariffs, meters which can record consumption in three time zones are necessary As it is seen in Table 1, more than six thousand customers have such meter But there are still 45 000 meters in Lithuania which can record only two time zones in energy consumption The three time zones are collapsed into two time zones and time differentiated tariff is used This is accomplished by combining peak and shoulder peak loads into one

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$$M'_{2d} = a + T_{2m}^{*} E_m + T'_{2d}^{*} E'_d ,$$

Other chapters will give background and calculate the values of above tariffs according to technical-economic indices of the power system

A.6 Tariffs for Customer Classes

At the present time, there are too many customer classes and tariffs require simplification Therefore customers are grouped into four classes where they share similar power use characteristics These customers are summarized as follows

1 Single family houses, apartments, hostels, summer-houses, collective gardens, garages for private cars, (low voltage customers with power demand up to 30 kW) This class of customers uses one and two time zones meters For one time zone customers, tariff M_2 is applied and for customers with two time zones tariff of type M'_{2d} is used

2 Agricultural, and commercial, (excluding residential) customers in the country side (low voltage- 380 volts) The same metering and tariff system is applied to them as it is for the first customer class The difference between this customer class and the previous one is the amount of customer charge

3 Customers connected to low voltage network (380 Volts) with power demand over 30 kW This customer class includes small industrial, commercial and service companies excluding residential and agricultural customers This class uses two and three time zone tariff tariffs and M'_{2d} & M_{2d} prices will be applied respectively

4 Customers connected to high voltage network (≥ 6 kV) This class includes large industrial customers and big commercial centers Peak demand is measured monthly and the three component tariff is used here The three components are customer charge, energy charge and demand charge Tariff formula M_{3d} is applied and it consists of three time zones

The distribution of customers for the various customer classes and their associated percentage of energy consumption could be projected as follows

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Table 2
Distribution of customers into classes in the PES of Lithuania

customer Class	number of customers	energy consumption %
I	1 2 mill	28
II	5000	12
III	15000	25
IV	1000	35
total	1 221 mill	100

A 7 Calculation of PES Required Revenue

Revenues from electricity sales should cover fixed and variable costs and include rate of return on fixed assets The required revenue should be collected through all three components of tariffs Based on cost of service calculation methodology and the data from LPC, the following revenue level is projected for 1996

$$RP = I_p + I_k + K * p_n = 870 + 390 + 1428 * 0\ 025 = 1295 \text{ million LT}$$

where

RP - Required Revenue for the functioning and development of PES,
I_p - fixed cost (LPC and Ignalina NPP),
I_k - variable cost (LPC and Ignalina NPP),
K - Net Fixed Assets of PES (LPC and Ignalina NPP),
p_n - example Rate of Return (assumed to be 2 5%)

Anticipated revenue from electricity exports

$$EP = EE * T_e = 4250 * 0\ 066 = 280 \text{ million LT}$$

where

EE -Anticipated amount of exported energy,
T_e- Anticipated exports tariff

Projected revenue from Lithuanian customers

$$PL = RP - EP = 1295 - 280 = 1015 \text{ million LT}$$

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where

PL - Anticipated revenue from Lithuanian customers

A.8 Customer Charge Calculation

This charge accounts for the depreciation of investment for service entrance, metering, billing, accounting and administrative expenses related directly to serving customers At the present time, there is no separate accounting of such type of cost, and it may be assumed that this charge amount to approximately 0 5 percent of T & D fixed cost

The customer charge depends on customer class (number and location) Using former assumption that the total customer charges should provide about 17 million LT , the customer charge per charge is calculated as follows

$$a = P_a/N = 17\ 000\ 000/1221\ 000 = 14 \text{ LT /year}$$

It should be noted that once the net fixed assets is revised, customer charge will be higher since it has been assumed to a percentage of T&D fixed assets

a - customer's charge,
$\mathbf{P_a}$ - revenue derived from customer charge,
N - number of customers

Revenue $\mathbf{P_a}$ must be collected from customers divided into four above mentioned classes It is our opinion that this charge should be differentiated for separate customers classes It is evident that service is more simple for residential rather than for industrial or commercial customers Once the accounting system separate costs, a more accurate estimation for customer charge is derived If we assume that

$$a_2 = X_1 * a_1$$
$$a_3 = X_2 * a_1$$
$$a_4 = X_3 * a_1$$

where a_1, a_2, a_3, a_4 - correspond customer charges for customer classes 1,2,3 and 4
X_1, X_2, X_3 are to be investigated by LPC and verified by the Commission

In this case it is possible to write balance equation for the revenue derived from customer charge

$$a_1 * N_1 + a_2 * N_2 + a_3 * N_3 + a_4 * N_4 = P_a$$

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where

N - number of customers in the corresponding class, presented in Table 2

From the above-mentioned ratios and the balance equation, the customer charge for inhabitants a_1 is calculated as follows

$$a_1 = P_a /(N_1 + X_1 * N_2 + X_2 * N_3 + X_3 * N_4)$$

Using the value a_1, the values of a_2, a_3, a_4 are calculated and they represent the customer charges in LT /year for corresponding customer classes

A.9 Power Demand Charge

Power demand charge should reflect the fixed power system costs These costs should include depreciation of generating, transmission, and distribution facilities Based on LPC data these costs are calculated by adding all fixed cost in power system except those which are assigned to the customer charge Export revenues are estimated from selling power to neighboring countries These revenues should exceed the variable cost (fuel cost), therefore these revenues are subtracted from required revenue derived from power demand charge Evaluating the above-mentioned, then the required revenue from power demand charge should be calculated according to this formula

$$P_{pp} = I_p - P_a - (T_e - I_{k\,AE}) * EE$$

where

P_{pp} -planned income from power demand charge
P_m - peak load demand of the customers

$I_{k\,AE}$ - variable cost for one kWh at Ignalina NPP

This required revenue from power demand charge should be divided by peak load demand of customers The peak load demand of all customers for year 1996 is forecasted to be about 1800 MW Therefore, the power demand charge should be calculated as follows

$$T_p = P_{pp} / P_m \qquad (LT/kW)$$

where

P_{pp} - Planned revenue from power demand charge

P_m - Coincident peak load demand of the customers at system level

Using peak load responsibility factors, power demand revenue for each customer class is calculated Using the sum of non-coincident demands of customers in a class (billing demands) then the non-coincident peak demand charge is calculated by dividing required revenue for each class by the sum of billing demands

If we sum up the recorded peak loads of individual customers, this sum will always exceed the actual generation of power system at the peak time Therefore the revenue from customers' power demand charge will be overstated In order to prevent it, the power demand charge should be recalculated by introducing coincidence factor or by the application of customers loads which were recorded (metered) at the power system peak time This task needs to be followed up by LPC

Fixed cost should be calculated by voltage level This would be an effort to calculate tariffs in a just and fair way to all customers In other words, generation, transmission and distribution fixed costs would assigned to low voltage customers On the other hand if a customer class is served off the transmission network, the fixed cost should be for generation and transmission systems only

A.10 Average Energy Charge

Export power is sold at a price higher than nuclear fuel cost That difference in the price is subtracted from required revenue for total power demand charge to calculate required revenues for power demand charge for internal customers

Electrical energy is sold to customer classes served off high and low voltage grids Power delivered to low voltage customers goes through more facilities, transformers, lines and cables and therefore will experience higher losses than the power delivered to high voltage customers Factoring technical energy losses in the energy cost is essential Energy loss factors will be calculated and energy charges at the different voltage levels are computed to establish energy tariffs Required revenue from the energy portion should cover variable cost and allowed operating income For the customers that do not have power demand meters, their power demand charges are spread over energy sales

To design a tariff system that could be quickly implemented, the average prices for energy during the two and three time zones are estimated

In case of the three time zone tariff

$$T_{3v} = (PL - P_a - P_{pp}) / EL = (1015\text{-}85\text{-}530) / 6746 = 6 \text{ CT/kWh}$$

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In case of two time zone tariff

$$T_{2v} = (PL - P_a) / EL = (1015\text{-}85) / 6746 = 14 \ \ CT/kWh$$

where

T_v - average energy tariff,
EL - electricity amount for sale to Lithuanian customers

A.11 Long Run Marginal Cost (LRMC) Tariffs

However, in pricing energy to the various customer classes, long run marginal cost concept should eventually be developed The LRMC should be used in sending economic signals to customers so they can make proper economic decisions If absolute LRMC figures are used in determining prices, required revenues for Lithuania will be much higher than what has been calculated by embedded cost of service (accounting or historical cost) Therefore LRMC will serve in determining the relative energy pricing structure for the various customer classes

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Appendix B

HEAT TARIFF METHODOLOGY

B.1 General Part

1 1 Heat tariffs are to be differentiated according to the location of heat production, customer class and heat production and supply conditions

1 2 Different tariffs are calculated for various heat generating sources and heat transmission The tariffs are also developed for the customer classes connected to the heating system at different points

1 3 Tariffs are based on financial and accounting data for heat producing and transmitting companies

1 4 Heat tariffs are divided into two parts fixed and variable part The connection fee is introduced for new consumers

1 5 Tariffs should be cost based Social and political factors are to be considered in the tariff structure and in the implementation phase

1 6 According to this methodology, tariffs are calculated by heat producer and transmitter Conflicts are resolved by SCC (Regulatory Body of Lithuania)

1 7 Utility assets need to be reassessed based on replaced cost concept

B.2 Tariff Objectives

2 1 Tariffs are based on cost of service

2 2 Fairness and equity to all customer classes

2 3 Financial viability of utilities

2 4 Least cost tariffs for customers

B.3 Heat Production/Transmission Tariff

3 1 Heat tariff consists of two parts
- Demand charge, LT / (Kcal/hr),
- Energy charge, LT / Kcal

3 2 Demand charge (TP) is calculated as follows

$$TP = \frac{PI + PEL}{PVG} \quad [LT / (Kcal/hr)], \qquad (3\ 1)$$

where PI - fixed production and transmission cost according to costs structure in Table 4 1

PEL - return on net fixed assets, This amount would be regulated by the SCC to ensure the financial viability of the utility The methodology for determining the rate of return is presented below

PVG - announced capacity (demand at the customer point) of all customers in the district heating system

3 3 Energy Charge (TK) is calculated as follows

$$TK = \frac{KI}{PQ} \quad [LT / KCal], \qquad (3\ 2)$$

where PQ - the amount of heat sold in KCal, calculated for a calendar year according to meters, which correspond to demands
During this transition period, not all customers have functioning meters and until meters are installed, the amount of purchased or sold heat would be calculated according to the amount of produced heat (consumed fuel)

KI - variable heat production costs, including fuel (using an average fuel cost), power and technological water costs

3 4 Item 3 3 calculates average energy charge, and since the fuel cost could change on monthly basis it is recommended to make a monthly fuel adjustment charge which is an additive component to the previously calculated TK

3 5 For CHP plants, annual fixed and variable costs are calculated according to methodology given below

3 6 Newly connected heat consumers may have constant Connection Fee (CF)(discount), which is fixed according to conformed "Regulations for Determining Connection Fees for New Consumers"

3 7 Same regulations are to be applied to heat transmission

B.4 Financial/Accounting Data for Heat Producers/Transmitters

4 1 Different financial / accounting data and information are required for the following group of heat producers /transmitters

- individual,
- small, the announced capacity (demand), the amount that exceeds own demand is less than 2 MW (or equivalent in KCal/Hr),
- large (≥ 2 MW or equivalent in KCal/Hr),
- CHP plants (do not depend on the capacity)

4 2 Individual heat producers (a person or an entity) - is defined here as he produces heat for his own demand only This individual should administer his own financial / accounting according to his own internal regulations It is up to individual to adhere to such tariff methodology

4 3 Small heat producers/transmitters should fill out an adjusted Paid Services Report (form PS - 01) each month

4 4 Large heat producers (≥ 2 MW) should be required to fill out the following forms of financial /accounting reports each month

- report of main financial indexes of the company (form F- 01) with production costs structure as in Table 5 1
- production report of the company (form P - 01), in case of heat production is not the main sphere of activity,
- fuel and energy balance sheet (form KEB- 01) with additional documents, indicating value characteristics of consumed energy resources

4 5 Accounting audits are to be performed by local authorities (municipalities and district authorities with participation from household associations, and communities of apartments in multistory houses)

B.5 Standardization of Variable and Fixed Costs

5 1 Variable and fixed costs in financial/accounting documents are divided into structural units as shown in Table 5 1

Table 5 1
Operating costs structure in economical planning for energy companies

Costs	Definition of costs in financial accountancy	Character of costs
A Variable costs		
A 1 Fuel	Variable costs	Directly proportional to production amount
A 2 Technological water	—"—	—"—
A 3 Energy for technology demands	—"—	—"—
A 4 Raw materials and purchased energy	Relatively fixed costs	—"—
A 5 Labor power	—"—	Indirectly proportional to production amount
A 6 Other costs proportional to production amount	— '—	—"—
B Fixed (additional) costs		
B 1 Maintenance & spare parts	Relatively fixed costs	Directly proportional to capacity of plant, type and consumed fuel
B 2 Utility services	—"—	—"—
B 3 Management services	—"—	—"—
C Assets costs		
C 1 Depreciation	—"—	—"—

5 2 Working capital is to provide for the accumulation of fuel, raw materials for production and credits, given to consumers (Accounts Receivable), as well as credits received from suppliers of fuel, raw materials, spare parts and utilities (Accounts Payable), and is regulated by standards Without fixed standards it is recommended to maintain the indexes presented in Table 5 2

Table 5 2
Costs for accumulating of working capital and stock

no	Costs and income	Credit amount in months
1	Raw materials for production	3
2	Final production	1
3	Credit for purchasers of production	1-3
4	Credit from raw materials suppliers	1
5	Credit from imported fuel suppliers	1
6	Credit from local fuel suppliers	1
7	Credit from spare parts suppliers	1
8	Imported fuel storage	2
9	Local fuel storage	0 5

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5 4 The responsibility of keeping operating costs and working capital conforming to the standards lies with heat producers

B.6 Determination of Customer Demand

6 1 Industrial customers forecast their annual average and maximum demands (capacity) Large industrial customers may fix additional component of variable tariff for exceeding the announced hourly capacity

6 2 The average annual capacity (demand) is projected based on actual statistical information for the residential and commercial customers If no statistical information is available on capacity, estimates will be made based on billing records for heating and for hot water

6 3 Municipalities are responsible for the registration of actual information concerning the change of capacity demand and for delivering the above-mentioned data to heat producers

B.7 Evaluation of Heat Production Costs in CHP Plants

7 1 Until costs in CHP plants for heat and power production are separated, it is assumed that fixed and variable costs for heat production in CHP plant form θ =35% of total production costs

7 2 The current supply and demand situation in Lithuania is characterized by the capacity surplus Normal capacity surplus (reserve) is paid by all customers, since it is required to ensure service reliability Since the capacity reserve is well above the normal range, there are few alternative ways to deal with it state could absorb the additional cost, additional cost is shared by all electricity and heat customers, or the cost is allocated to electricity customers only It is our opinion that this additional cost should be shouldered by electricity customers The heat prices should not exceed prices of heat produced by a dedicated boiler, otherwise customers will decide to leave the heating system which would seriously damage the CHP scenario

7 3 For power plants, which have water heating and steam boilers besides equipment working in CHP cycle, heat and power production costs in the CHP cycle should be separated in financial/ accounting documents

7 4 Power system purchases power, produced in the CHP cycle, without paying full attention to economically dispatching the various units

B.8 Tariffs for Heat Customers

8 1 Different tariffs are determined for customers, connected to
- heat producer,
- main heating pipeline,
- distribution heating pipeline

8 2 For customers, connected to collectors of a heat producer, tariffs are presented in Section 3 of this methodology If a customer has and operates his own thermal network, applicable tariff is used

8 3 For customers connected to the main heat transmission network, the average demand heat tariff (TPM) consists of two components average demand tariff for heat production and average demand tariff for heat transmission and distribution In the future, accounting data should segregate transmission from distribution costs Since these costs are not segregated at the present time, they are calculated as follows

$$TPM = \sum_{i=1}^{N} \frac{TP_i * LG_i}{PVG} + \frac{PTI + PELT}{PVG} \quad LT/MW \qquad (8\ 1)$$

where TP_i - demand heat tariff of producer i to main pipeline, (LT/MW),
LG_i - limit for heat producer i to serve capacity demand of the customers according to licenses (MW),
PTI - demand heat transmission costs for operating of all district heating system, i e , all fixed costs are allocated to all consumers uniformly,
PELT - Return on net fixed assets of heat transmission network
$PVG = \sum_{i=1}^{N} LG_i$ - capacity demand of all customers in district heating system (MW)

8 4 Each heat production facility obtains an operating license to operate at a level not to exceed the demand level requested by customers

8 5 For customers, connected to main heating pipeline, the average thermal energy tariff (TKM) is calculated as mentioned below Customers pay for standard and commercial losses of main pipelines as described below These losses are proportional to their capacity demand

$$TKM = \frac{\sum_{i=1}^{N} (TK_i * PQ_i) + KTI + (NQM+KQM) * TK_{vid}}{\sum_{j=1}^{M} QV_j} \qquad (8\ 2)$$

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where N - number of producers
PQ_i - supplied heat amount from producer i, MW
TK_i - thermal energy cost of producer i (these are mainly power and water costs) to support circulating in network, LT/MW
KTI - thermal energy transmission cost (pumping)
NQM - standard heat losses in network (amount allowed by the commission)
QV_j - thermal energy amount supplied to distribution branch j off main pipeline, MWh,
M - total number of branches
KQM - commercial losses in main pipelines, because of metering and recording equipment error
TK_{vid} - average cost of purchased thermal energy and is calculated as follows

$$Tk_{vid} = \sum_{i=1}^{N} KI_i * PQ_i / \sum_{i=1}^{N} PQ_i \qquad (8\ 3)$$

8 6 Commercial losses paid by customers should not exceed 3 % of total thermal energy amount supplied to main pipeline, i e

$$KQM \leq 0\ 03 * PQS\ , \qquad (8\ 4)$$

where PQS is the total amount of thermal energy supplied to the network, MWh

8 7 Thermal energy amounts QV_j transmitted to distribution pipeline should be metered

Until thermal energy meters are installed on branches off main pipeline QV_j is calculated as follows

$$QV_j = PVG_j * HQ_j, \qquad (8\ 5)$$

where PVG_j - customers' demand, connected to j distribution pipeline, MW,
HQ_j - load factor for branch j

8 8 Customers connected to distribution network, use thermal demand tariff TPM (equation 8 1) as an approximation at the present time Once distribution costs are segregated from transmission, an additional component is added to distribution tariff to reflect that Thermal energy tariff is calculated as follows

$$TKP_j = \frac{TKM * QV_j}{QV_j - NQP_j - KQP_j}, \qquad LT/MWh \qquad (8\ 6)$$

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where TKM - has been calculated in formula (8 2),
QV_j - thermal energy amount supplied to branch j, MWh,
NQP_j - standard heat losses in branch j of distribution network, MWh
KQP_j - commercial distribution losses in branch j (KQP_j=0 03*QV), MWh

Remark It is assumed that no local heat generating sources are connected to j branch

8 9 Standard heat losses for each month are calculated

$$NQ = (\pi d \ l) \ [(t_p + t_g)/2 - t_{gr}] \ k, \text{ MWh}, \qquad (8\ 7)$$

where d - average diameter of main and distribution pipelines, m,
l - length of main and distribution pipelines, m,
t_p - average monthly temperature of supplied water, °C,
t_g - average monthly temperature of return water, °C,
t_{gr} - average monthly temperature of ground water, °C,
k - average heat transmission coefficient of insulation of thermal culverts, MWh/m^2 °C, calculated based on appendix

If system losses exceed calculated standard thermal losses, the customers are not responsible for paying for such losses

8 10 The heat customer, connected to distribution network and having no meters, is given the option of paying the demand tariff TPM during the whole year or during the heating season That customer pays for the thermal energy tariff TKP_j for average statistical heat amount, used by similar customer

8 11 The Energy Agency is responsible for calculating statistical heat consumption standards

B.9 Profit for Heat Producers

9 1 The determination of the rate of return on net fixed assets, including restrictions for production costs and working capital are the responsibility of SCC A reasonable return on the net fixed assets ensures financial viability of heat production/transmission utilities The rate of return is calculated based on present actual heat production costs and cost projections, provided that the utility is doing its utmost to improve its production, transmission and distribution efficiencies In addition, all components of cost of service have to justified to SCC

9 2 Simplified method used by the World Bank (WB) is based on revaluation of fixed assets based on replacement cost Then the rate of return is determined based on assets The method ensures consistent transition of thermal sector of the economy to the state of full financial viability during certain period of time (about 5 to 10 years), taking into account necessary investment and other financing sources The summary of financial-economical indexes and target values is presented in Table 3

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9 3 The proper rate of return on net fixed assets of the company ensures a positive cash flow and achieves good financial parameters for the utility, as mentioned below

Table 3

Main financial-economical indexes for fixing of Rate of Return by simplified method of the WB

No	Properties of Index	Target value
1	Ratio of Operating Expenses to Total Revenues	< 1
2	Ratio of Current Assets and Current Liabilities	1 – 4
3	Ratio of Internal Cash Generation to Annual Cash Expenditures	> 0 6
4	Quotient of Net Revenues over Debt Service	> 1
5	Ratio of Long-term Debt to Equity	< 1 5
6	Debt percentage	< 60%
7	Equity Percentage	> 40%
8	Accounts Receivable Times 365 days over Total Revenues	30 – 45
9	Rate of Return of Net Assets	6-12%

9 5 Evaluation of projected heat production costs is reviewed and approved by the commission (SCC)

B.10 Tariff Structure and Implementation

10 1 Tariff structure could be designed to encourage energy conservation

10 2 Social and political factors should be factored in minimizing the impact on low income population

10 3 Monthly heating costs should be maintained during the transition period at a level not to exceed a certain percentage of income

10 4 Gradual tariff changes are encouraged by the Commission

10 5 Pressure is put on the utility to reduce O& M costs and become more efficient

10 6 Commission should not allow the inclusion of any unjustified or unreasonable costs in cost of service

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Appendix C

NATURAL GAS TARIFF METHODOLOGY

C.1 Tariff Objectives

1 1 Natural gas tariffs have to just and fair

1 2 Tariffs should be based on cost of service

1 3 Tariff should be easy to read and understand

1 4 Tariffs should convey proper economic signals to enable customers to make good economic decisions

1 5 To promote national energy objectives such as energy conservation

C.2 Pricing Principles and Tariff Structure

2 1 Natural gas pricing is based on cost approach Gas price is formed from different charges Charges are calculated increasingly starting from the gas border price adding all operation costs incurred in all the supply chain to the final consumer

2 2 Gas price set by the tariff should cover all costs, including the purchase of gas, losses in the network, transmission, storage, distribution and customer service costs

2 3 Pricing principles should guarantee viability of the gas supply utility, i e , gas prices to the final consumers should be at the level where revenues cover all costs plus an operating income which is based on net fixed assets The operating income is the product of rate of return and net fixed assets The rate of return is determined by the SCC

2 4 Current assets and return on net fixed assets should guarantee efficient and safe operation of the pipeworks, and accumulation of some necessary fund for reconstruction, renovation and development of the network

2 5 The average basic gas supply and sale price to the customers is set with the examination and the approval of cost of service components All these costs have to be just and reasonable

2 6 The basic gas price to different customer groups is differentiated according to the indicators reflecting operation of the gas supply system, namely, sale volumes (gas pressure) and length of pipes (main pipeline or a branch pipeline)

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2 7 In order to have an optimal development of the gas network customer charge is set for new customers

C.3 Costs

3 1 Costs are separated into fixed and variable Variable costs consist of the gas price at the state border and losses in the network However it should be kept in mind that a portion of the variable cost (fuel cost) could be assigned to the fixed component The SCC should make that determination

3 2 Gas import price is set by the intergovernmental negotiations with Russia, determined in the contract with a participation of a representative from the State Energy Pricing Commission

3 3 Natural gas tariffs are designed based on projected negotiated gas price, a component that should be included in the tariff as a fuel clause When the gas purchase price fluctuates the fuel clause could be a positive or a negative component that is added automatically to tariffs The procedure is usually fairly easy to adjust tariffs and of course is to acknowledged by the State Energy Pricing Commission (SCC)

3 4 Fixed cost of the gas supply consist of real material expenditures, labor cost including social insurance and social needs of the employees, and various taxes (land, VAT, etc) This share of the operation cost is determined by the direct calculation of real costs from the last quarter of the previous year costs evaluating the forecasted inflation

3 5 Costs for the maintenance of the system including pipelines, pumps and calibration of meters

3 6 Calculations of depreciation, since inflation has been relatively high in the last few years, assets should be reexamined and reevaluated based on their replacement cost Depreciation should be based on the new value of assets and should be indexed to reflect inflation Otherwise utilities will not be able to replace such facilities when it is time The SCC should commission a study to evaluate the existing assets

3 7 Operating income as stated above is based on net fixed assets and the rate of return on net fixed assets which is determined by the SCC The proper rate of return is determined by the SCC after examining financial ratios for utility which is addressed in attached appendix

B 4 Basic Gas Price

4 1 Considering specific features of the gas network operating costs are differentiated between

a) Operation cost in the main pipelines (E_m),

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b) Operation cost in the distribution pipelines (E_p),

4 2 Total amount of gas flowing in at the border is Q_s

$$Q_s = Q_v + Q_{tr} + L_t$$

where Q_v = total gas supplied to distribution network

$$Q_v = Q_{vm} + (Q_{vb} + L_{vb})$$

where Q_{vm} = gas consumption by main pipeline customers

Q_{vb} = gas consumption by branch pipeline customers

L_{vb} = losses in branch pipeline

Q_{tr} = amount of transit gas

L_t = total gas losses in the transmission network

where $L_t = L_{tr} + L_v$

L_{tr} = gas losses related to transient gas
L_v = gas losses in transmission piping related to total consumption in Lithuania

4 2 The basic gas transmission & distribution tariffs T_m & T_d could be calculated by the following formulas respectively

$$T_m = E_m / (Q_{tr} + Q_v)$$

$$T_d = E_p / Q_{vb}$$

where Q_{tr} - volume of transit gas (delivered),
Q_v - volume of gas supplied to customers including branch losses
Q_{vb} - volume of gas sold to branch pipeline customers

4 3 Volume of gas supplied to customers is calculated as

$$Q_v = Q_{vm} + (Q_{vb} + L_{vb})$$

where Q_{vm} = gas consumed by customers connected to the main pipeline
Q_{vb} = gas consumed by customers connected to the branch pipeline

L_{vb} = losses in the branch pipelines (distribution network)

4 4 The main pipeline gas tariff T_1 , which is applicable to transit gas and main pipeline gas customers, could be calculated by the following formula

$$T_1 = (A_1 + E_m + Pn \times K_t) / (Q_{tr} + Q_v),$$

where A_1 - purchased gas (import) cost,
E_m - operating expenses in the main pipeline (transmission) network in Litas
Pn - rate of return on net fixed assets,
K - net fixed assets for the gas transmission network (main pipeline)

4 5 The branch pipeline gas tariff T_2, which is applicable to gas sold to branch pipeline customers, could be calculated by the following formula

$$T_2 = (T_1 \times (Q_{vb} + L_{vb}) + E_p + Pn \times K_d) / Q_{vb} ,$$

where $T_1 \times (Q_{vb} + L_{vb})$ = cost of gas delivered to branch pipeline network,
E_p - operating expenses in the branch pipeline (distribution) network in Litas
Pn - rate of return on net fixed assets,
K_d - net fixed assets for the gas distribution network (branch pipeline)

4 6 Losses in the network are calculated by the "Methodology of Calculating Gas Losses" approved by the Ministry of Energy

4 7 Basic, average or gas supply tariffs are further differentiated evaluating supply costs to the different consumer groups Calculations are presented in the following form

Consumer group	Gas Supply in Mm^3	Length of the distribution Pipelines Km	%	Operation Cost, MLT Main Pipe-lines	Distrib pipelines	Total	Gas network tariff T , LT/Km^3
xxxxx	xxxxx	xxxxx		xxxxx	xxxxx	xxxxx	xxxxx

Abbreviations k - kilo (thousand), M - Mega (million), LT - Litas

4 7 Natural gas tariff for the transit to the Kaliningrad region is set within the contract with the Russian company Gazprom, evaluating the gas network T_e in the main pipelines losses and operating income

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C.5 Differentiation of Consumers

5 1 Consumers are split into six groups

Consumers	Volume of gas consumed during one year, Q_1
1 Residential (cooking and hot water)	
2 Residential (cooking, hot water and space heating)	$Q_1 < 10\ Km^3$
3 Small residential, public and agricultural customers	$Q_1 < 100\ Km^3$
4 Industry and large public customers	$0\ 1 < Q_1 < 5\ Mm^3$
5 Large industrial customers	$5 < Q_1 < 15\ Mm^3$
6 Very large industrial customers (power plants)	$Q_1 > 15\ Mm^3$

5 2 Gas network operation tariff is recalculated every year according to the expected operation cost, inflation, indexation of assets, depreciation and return on net fixed assets

C.6 Connection Fees

6 1 A new customer connection fee is introduced It is differentiated according to the capacity of a new customer, length of new pipes and pipeline construction cost

6 2 Connection fee is differentiated as

a) residential and other small customers (less than 10 Km^3 / year - 3 kLT,

b) small public and agricultural customers (with capacity 12 - 25 m^3 / hr) - 4 5 - 14 kLT, depending on their capacity,

c) industrial and other large customers

Volume of gas consumption during a year, Q_1	Pipeline construction cost kLT/100 m	Gas Control and metering cost, kLT
0 1 $< Q_1 <$ 5 Mm^3	15 - 20	22 - 30
5 $< Q_1 <$ 15 Mm^3	20 - 30	34 - 40
$Q_1 >$ 15 Mm^3	50 - 60	120 - 180

prices are given in 1995 monetary values

6 3 Connection fee could be paid in several time intervals agreed upon in the contractual agreement

6 4 Connection fee is recalculated every year based on the construction cost index approved by the Department of Statistics

6 5 When the connection fee is applied the gas company, the company task is to plan an optimal development of the network (based on the requests of customers received), builds up pipelines to the building, installs meters and controls, using loans and repaying their interests from profit

6 6 Connection fee fund is a customer accumulated fund, therefore it is exempted from the profit tax

Appendix D

Revenue Requirements

Appendix D discusses basic steps in tariff implementation process The development of adopted energy tariffs is based on the revenue requirement approach, so Appendix D is provided to discuss revenue requirement method and its elements to provide the initial guidance in implementing tariff methodologies

D 1. Revenue Requirement Method

The objective of this section is to determine the revenue requirement necessary to operate and provide investment capital to all electric, heat and gas utilities In Lithuania utilities own and operate most of the generation capacity and transmission / distribution networks and SCC has a regulatory control over electricity, heat and gas sectors Electricity, heat and gas tariffs should be based on the analyses of revenue requirement that satisfy the projected financial requirements of each energy sector As discussed later, ultimately the pricing strategy should be based on long-run marginal cost (LRMC), meeting financial requirements as only one of several goals in the tariff setting process

D.2 Approach

The approach described in this section is applicable to the electricity, heat and gas sectors Consolidated financial data should be obtained for the most recent year The financial statements include revenues and expenses for electricity and heat generation and transmission/distribution A similar set of financial sets should be obtained for the gas sector

The steps are as follows

1 Select a reasonable load forecast to use for the financial analysis for the next period

2 Prepare an electric energy balance, a heat balance and gas balance for these utilities Energy balances should include sales to ultimate customers, internal use, losses and supply from external sources

3 Estimate fuel used to generate electricity and the fuel used to generate heat

4 Project operating expenses and revenues for electricity, heat and gas This step includes following analysis

- Project fuel and non-fuel operating expenses including purchased power and purchased gas, materials, other services, wages and salaries
- Include nuclear plant decommissioning cost

- Incorporate the generation investment plan
- Determine the necessary level of real rate of return on revalued assets to meet financial performance criteria
- Calculate revenue requirements based on projected expenses plus operating income based on fixed before-tax rate of return on net fixed assets
- Analyze sensitivity of the results to key assumptions including rate of return

5 Reevaluate fixed assets so the book value become more realistic With a reasonable rate of return, operating income is to be calculated Operating expenses and income are added to produce the required revenues for all energy sectors Cost-based tariffs for electricity, heat and gas are to be derived

This approach is based on the observation that depreciation is the primary cost category that appears most undervalued This approach leads to the cost-based tariffs

An alternative approach is to develop tariffs based on long-run marginal costs (LRMC) However, this approach may result in higher tariffs for Lithuania Ultimately, the LRMC price signals have to be analyzed and provided to the customers, but the calculated required revenue will stay at the same level Therefore, modification to tariffs for customer classes are usually required when LRMC price signals are applied

D 3 Revenue Requirement Elements

Revenue requirement elements include operating expenses and operating income Operating expenses include fuel expenses, purchased power, purchased gas, materials & other services, wages & salaries, depreciation and decommissioning Required revenues are calculated for electric and heat sectors combined as well as being separate Required revenue for natural gas sector is calculated separately

D.3.1 Operating Expenses

Operating expenses include fuel expenses which is usually the largest component of operating expenses, purchased power, material and other services, wages and salaries, depreciation and decommissioning cost included into required revenue analysis

Fuel Expense

Fuel amounts could be estimated by a production costing model based on amounts of heat and electricity required by generation called by forecasts Using these fuel amounts combined with projected fuel prices, fuel cost is calculated

Purchased Power/Exports

Purchased power is defined as the net purchased power which is the difference between imports and exports LPC exports a considerable amount of electric energy to neighboring countries

Material and Other Services

Material and other services represents the relatively large component of operating expenses following fuel expenses

Wages and Salaries

Our observation is that salaries and wages are not growing fast enough to keep up with inflation

Depreciation

Installed costs for generation capacity in $/kW for various countries are readily available An average figure could be used along with the remaining life of LPC power plants to estimate the book value of existing facilities Book values for transmission/distribution networks for the electric and heat system could be estimated as well Straight line depreciation method could be used over the remaining life of power and heat systems assets The same applies to gas facilities

Separation of Operating Expenses for Electricity and Heat

Operating expenses for generating, transmitting and distributing electricity and heat are to be separated Fuel expenses should be separated and generally should not be more than what is required for a dedicated facility Since, fuel expenses represent by far the largest component of operating expenses, all other operating expenses could be separated using fuel expense ratio

Allowance for Non-Payment

Because of country's independence and the transitional state of its economy from centrally planned to market economy, the restructuring of industrial sector is underway Industrial customers are paying their electric and heat bills slowly and in some cases are not paying at all As

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a result of this, accounts receivable amount is very high This issue is being addressed under different task in this assistance program For the purpose of this example no allowance should be made for non-payments It is our recommendation that all energy utilities should be proactive in solving this problem to bring this issue under control It is our recommendations that these utilities, together with representatives of their large clients, find a mutually agreeable solution

D.3.2 Operating Income

Operating income is equal to revenues minus expenses (not including interest) It is a measure of the profitability of the organization and in cost-based tariff setting for regulated monopolies, it is usually determined by the allowable real rate of return on fixed assets This rate of return could be in the range of 5 to 12 percent per year

D.3 3 Capital Investment and Loans

Capital investments in this analysis are for generating facilities for electricity and heat Also, they are for new transmission and distribution facilities as well as replacements of elements in the electric, heat and gas networks

D.3.4 Investment, Debt Service and Loan balance

Investments in the generation, transmission and distribution facilities in the electricity, heat and gas sectors should be considered in this analysis Debt service in a year is the sum of principal amount to be paid for that year, plus chargeable interest Loan balance at the end of a given year is the loan balance from previous year less the principal

D.4 Financial Statements

The three main financial statements should be prepared and projected over the 5-year period These statements are income statement, balance sheet and sources and applications of funds

D.4.1 Income Statement

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This statement represent activities in a pre-defined year Activities consist of revenues from sales, operating expenses, operating income, interest, taxes and net income Projection of income statement should be prepared for at least 5 year period

Revenues

Revenues are generated from selling electricity, heat, natural gas, other services and exports less imports

Expenses

Expenses include fuels, purchased power, materials and other services, wages and salaries, depreciation, and decommissioning Purchased power is defined here as imports less exports

Operating Income

Operating income is defined here as revenues less expenses It is the income from this operation before taxes and interest

Interest

This category represents interest payments to foreign banks including EBRD and World Bank and to domestic banks

Taxes

Taxes include retail price regulation fund, corporate tax, and tax on immovables Corporate taxes are calculated at the determined rate by the GoL It is applied to operating income before taxes minus Interest charges

D.4.2 Balance Sheet

The balance sheet is an accounting statement representing the financial picture for each energy utility at the end of a financial period It is based on assets equal to equity and liability Assets consist of fixed assets and current assets Equity and liability consists of equity, long term debt, and current liabilities

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Fixed Assets

The necessary increase in the book value of existing assets to achieve financial objectives should be determined for the base year of the study Net fixed assets are estimated for electricity and heat sectors combined as well as being separate A separate evaluation should be made for the natural gas as well Fixed assets in operation, accumulated depreciation, planned investment and depreciation should be addressed

The separate assets by energy sector are to be used in computing required revenues and ultimately cost-based tariffs for electricity, heat and gas

Current Assets

The primary components of current assets are cash, accounts receivable, and inventory Current assets except cash mean all assets that could be converted to cash during twelve month of normal course of business The account that violates this definition is accounts receivable The accounts receivable represents unpaid electric and heat bills and portion of them are not expected to be paid

Equity

Equity is defined in this analysis to be equal to net fixed assets These utilities are government organizations and don't have an outstanding stocks or shareholders

Debt

A sum of money owed by one person or organization to another Organizations incur debt through raising capital for operation or future expansion Debt is an essential part of all modern, capitalist economies

Current Liabilities

The term *current liabilities* signifies all liabilities that will become due and payable within 12 months The current liabilities include short-term loans, accounts payable, and other

D.4 3 Sources and Applications of Funds

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This statement is basically a cash flow statement This statement is based on the equality of sources and applications of funds Sources include internal generation, government sources and borrowing On the other hand applications consist of investment, debt service, taxes, change in working capital and change in cash

Internal Generation

This category represents funds that are generated from internal sources It consists of operating income as defined previously, depreciation and other

Borrowing

Borrowing is assumed to come from two different sources, foreign including EBRD and the World Bank and domestic sources

Investment

Capital investment represents capital required and invested in additions and improvements in the generation, transmission and distribution areas of electricity, heat and natural gas

Debt Service

Debt service consist of principal and interest payments for outstanding foreign and domestic loans

Taxes

Taxes are discussed in detail in the income statement section Under sources and applications only the total is used

Change in Working Capital

This account represents change in working capital other than cash It is calculated as the difference between current assets and current liabilities

Change in Cash

This amount is calculated to be equal to the difference in cash and banks between reference year and subsequent year

D.5 Key Financial Performance Criteria

The financial performance criteria used as a basis for determining the appropriate tariff levels for electricity and heat included the following

- Operating ratio (depreciation included in operating expenses)
- Current ratio
- Cash generation ratio
- Debt service coverage ratio
- Debt/equity ratio
- Accounts receivable (outstanding in days)
- Number of times interest earned ratio
- Rate of return on net fixed assets

Operating Ratio

Operating ratio is defined as the ratio between operating expenses and operating revenues

Current Ratio

This ratio is defined as current assets over current liabilities This ratio is likely to be high in the immediate analysis One of the main reasons is accounts receivable currently being at a very high level

Cash Generation Ratio

The cash generation ratio is a measure of the ability of an organization to meet its capital expenditure requirements through its own cash generation For a given year, it is defined as internal cash generation divided by investment and debt service requirements Internal cash generation is the difference between revenues and sum of expenses less depreciation, debt service and taxes Generally this ratio should be over 60 percent

Debt Service Coverage Ratio

This ratio is expressed as operating income, as defined above, over debt service This ratio is an indication of how well a financial entity can cover its debt service and shows its ability to sustain certain debt level This ratio should be greater than 1

Debt/Equity Ratio

For entities with stable earnings, such as public utilities, the ratio could be as high as 70 30 It is preferred that the debt part be less than 60 percent and the equity portion be greater than 40 percent

Accounts Receivable (Outstanding in Days)

Accounts receivable is expressed as a ratio of annual revenues in number of days Between billing and collection, 45 to 60 days are usually allowed It is our recommendation here that actual bills be sent monthly and customer are expected to pay in 2 to 3 weeks from bill issuance date This will improve companies' cash flow and would serve as an important vehicle in customer's education and accountability

Number of Times Interest Earned Ratio

This ratio between operating income and payable interest in a given year

Rate of Return on Net Fixed Assets

The rate of return on net fixed assets, one of the results of this analysis, is itself a key financial criterion

The rate of return on net fixed assets is a measure of the profitability of the organization The rate of return on net fixed assets in a given year is equal to the operating income (i e , revenues minus expenses, or gross profits) divided by the value of net fixed assets For cost-based tariff regulation of monopolies, it is common to select an allowable rate of return on net fixed assets For a given value of net fixed assets, this value determines the allowable operating income

D 6. Recommendations for the Revenue Requirement Analysis

Base Case Results

Projected income statements, balance sheets and sources and uses statements for electricity and heat generation, transmission and distribution are based on a certain set of assumptions defining the base case

Generation, transmission and distribution systems for electricity, heat and gas systems are analyzed separately, and separate revenue requirement projections for these energy sectors are made to calculate electric, heat and gas tariffs This issue is discussed more in tariff methodologies

Sensitivity Analysis

The following sensitivity analyses are recommended to be conducted for the base case scenario

- Variation in the rate of return on net fixed assets
- Variation of operating costs including fuel cost, wages, and other expenses
- If the analysis were conducted in local currency, then foreign exchange rate would be considered a variable

Appendix E

Commission Restructuring Proposal

1 General

1 1 The State Energy Pricing Commission (hereinafter called Commission) is established and operates in accordance with the Energy Law of the Republic of Lithuania, it is a permanent operating institution having its executive body

1 2 Chairman of the commission, deputy chairman and five commissioners for the 5- year period are proposed by the Government and appointed by the President of the state If needed they could be removed from the chairs by a Presidential Decree

1 3 Commission bases its activities on the Constitution of the Republic of Lithuania, on the national Energy Law, and the laws and decisions of the Government of Lithuania, and by these Bylaws

1 4 Commission operating expenses are covered from the state budget

1 5 Commission is a legal entity, has a stamp with the state symbol and its name and has an account at the State Bank of Lithuania

1 6 Order of organization, meeting and open discussions are set in the operating regulations of the Commission

2 Duties of the Commission

2 1 Commission has the following duties

2 1 1 Develops methodologies for calculating of natural gas and energy prices regulated by the Government of Lithuania

2 1 2 Considers and approves calculation of prices defined in 2 1 1

2 1 3 Submits the above mentioned prices to the Government for the final approval

2 1 4 Analyses main economic issues of the energy sector, including investments

2 1 5 Controls implementation of the energy efficiency programs

2 1 6 Considers, in the area of its competence, complaints of consumers, debates between energy suppliers and consumers and protects consumer interest

2 1 7 Submit proposals and conclusions in its competence to the President of the state, Parliament and the government

2 1 8 Informs society about activities of the Commission, publishes newsletter and other information materials

2 1 9 Organizes open discussions according to the regulations and procedures approved by the Commission

3 Rights of the Commission

3 1 Commission, acting according to its duties, has the following rights

3 1 1 To receive proposals and information from the Governmental ministries, departments and other institutions in the Commission competence area

3 1 2 To ask the economic entities expertise and audit results done on their own expense when considering their proposals for tariff changes and other issues in the Commission competence area

3 1 3 To use funds allocated to the Commission according to the approved budget

4 Responsibility of the Commission

4 1 Activities of the Commission and decisions made should comply with the Lithuanian Law and these Bylaws

4 2 Commission is responsible for the decision made according to the Law It submits proposals and possible decisions to the relevant institutions in order to avoid negative economic consequences in the case of setting certain energy prices and possible ways of covering losses

5 Organization of activities of the Commission

5 1 Chairman and the deputy chairman of the Commission are civil servants, their salaries are set by the President of the State

5 2 Salaries of the members of the Commission are paid from the budget of the Commission The level of the salary is set by the Commission

5 3 Chairman of the Commission

5 3 1 Organizes activities of the Commission and the executive body

5 3 2 Arranges labor contracts with the members of the Commission and members of the executive body

5 3 3 Arranges contracts on supply of services to the Commission as also with experts and auditors working in the Commission competence area

5 3 4 Represents the Commission in all institutions of the Republic of Lithuania

5 3 5 Allocates resources according to the approved budget

5 3 6 Employs staff according to the approved structure of the staff, their salaries according to the existent legal acts valid for civil servants

5 4 In the absence of the Chairman, deputy chairman takes his duties

5 5 The main duties of the executive staff are the following

5 5 1 To prepare proposals to improve tariff setting methodologies

5 5 2 To review electricity, heat and gas tariff calculations, analyze the necessity of the cost incurred and report the results to the Commission

5 5 3 To organize public discussions of the Commission proposals

5 5 4 To check implementation of the energy efficiency programs and present the testing results to the Commission

5 5 5 To prepare public information on the main decisions of the Commission to publish newsletter and other information

6 Final definitions

6 1 Commission consults, when necessary, relevant institutions at municipalities in the area of its competence

6 2 Decision of the Commission is approved if not less than two thirds of the members were present and if the decision received a simple majority of votes In case of equal number of votes decision is made by the vote of Chairman

6 3 Minutes of the meeting are prepared by the secretary and signed by the chairman and the secretary Decisions of the Commission are signed by the chairman

6 4 Commission owns or rents its office