NVE

Report from the NVE Tariff team visit to Ethiopia November 1999

Rolv Bjelland
Arne Venjum

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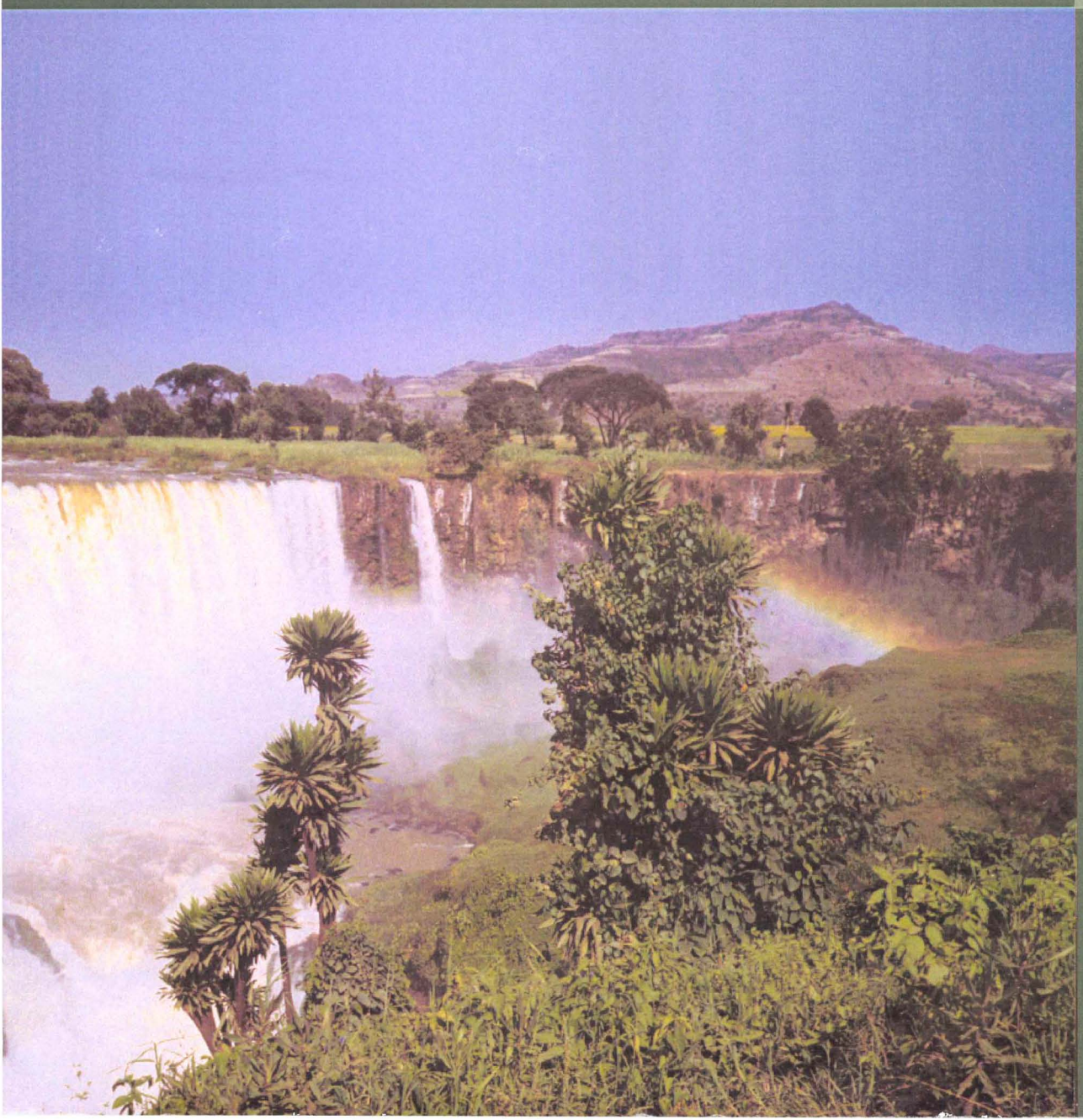

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Norwegian Water Resources and Energy Directorate

1999

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Summary: The report sums up conclusions of a 2 weeks visit of NVE to Ethiopia in November 1999. The main objective of the visit was to arrange a workshop on tariff setting principles. The report focuses on basic information about the electricity system in Ethiopia, tariffs setting principles and issues relevant for future organisation of the electricity sector in Ethiopia.

Key subjects: Tariffs, Ethiopia

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1) Introduction

The team consisting of Rolv Bjelland and Arne Venjum from the Norwegian Water Resources and Energy Directorate (NVE), visited Ministry of Mines and Energy (MME) 3-11 November 1999 as a part of the ETH 019 project between MME and NVE, (Legislation and Institutional Strengthening of the Energy Sector). The objective of the visit was to review, present and discuss tariff-setting mechanisms in Ethiopia. During the visit regulatory aspects and institutional matters for the Electricity Sector has also been highlighted.

NOK 180 000 was allocated for the assignment and the terms of reference for the mission is enclosed in annex 1.

The first draft of the report was presented for the Ministry of Mines and Energy 11.11.99 and the comments from the discussion are included in this report.

List of people met during the visit is enclosed as annex 2 and documents received are enclosed as annex 3.

The NVE team will use the opportunity to thank for the warm hospitality received from the Ministry during the stay in Ethiopia.

2) Background – The Electricity System in Ethiopia

2.1 EEPCO

Ethiopian Electric Light and Power Authority (EELPA) was restructured in 1997 and renamed Ethiopian Electric Power Corporation (EEPCO). EEPCO is a public enterprise responsible for generation, transmission, distribution and sale of electricity in Ethiopia. EEPCO has about 8 350 employees, of which 4000 work in Addis Ababa

2.2 Generation

Ethiopia has the following generation capacity in the Inter Connected System (ICS)

Hydropower plant	Comm. Date	Plant Energy (GWH)		Plant capacity (MW)		
		Average	Firm	Units/size	Installed	Dependable
Koka	1960	110	80	3 x 14.33 MW	43	30
Awash II	1966	165	120	2 x 16.00 MW	32	32
Awash III	1971	165	120	2 x 16.00 MW	32	32
Finchaa	1973	634	618	3 x 33.3 MW	100	100
Melkawakena	1990	543	434	4 x 38,25 MW	153	150
Tis Abay	1964	55	55	3 x 3.80 MW	11	3
Total		1 672	1 427		371	347

In addition the ICS system consist of two diesel plants (Alemaya and Dire Dawa) with total installed capacity of 9.8 MW and one geothermal plant (Aluto Langano) with installed capacity of 7.3 MW

The Self Contained System (SCS) has the following generation capacity:

Hydropower plant	Installed capacity MW	Hydro/Diesel	Commissioning year
Yadot	0.35	Hydro	1991
Sor	5.00	Hydro	1992
Demi	0.80	Hydro	1994
Nekempt	2.27	Diesel	1984
Negele Borena	2.15	Diesel	1975
Korem	1.29	Diesel	1983
Ghimbi	1.08	Diesel	1962
Shire	1.04	Diesel	1975
Others	11.50	Diesel	1962-1997
Total	25.48		

The following hydropower generation projects are committed:

Hydropower plant	Installed capacity MW	Firm Energy (kWh/year)	Commissioning year
Tis Abay	73	331	2000
Finchaa 4th Unit	34	137	2001
Gilgel Gibe HHP	184	632	2003
Gojeb HPP	150	364	2004
Tekeze HHP	225	981	2005
Total	666	2 445	

The following hydropower plants are under study:

Name of project	Capacity MW	Completion year of study
Beles HPPS	195	1999
Chemoga Yeda HPPS	440	1999
Halele Werabesa HPPS	374	1999
Total	1 009	

The total hydropower economic exploitable potential in Ethiopia is as large as 30 000 MW

2.3 Transmission

The transmission system consists of 6 000 km lines of 230, 132, 66, and 45 KV. A map of the transmission network is enclosed as annex 4.

The Inter Connected System (ICS) supplies to about 350 cities and towns across the country.

The total losses in transmission and distribution are 19%. The figure for losses is not split between transmission and distribution.

2.4 Distribution

The distribution system consist of 4 500 km of 15 KV lines and 8 000 km of low voltage lines (400 & 220 volt).

Some centres and towns that are not connected to the grid net (ICS) have their electricity supply from local generators, mostly diesel generators. This is named the Self Contained System (SCS).

Connected customers in the Integrated Combined System:

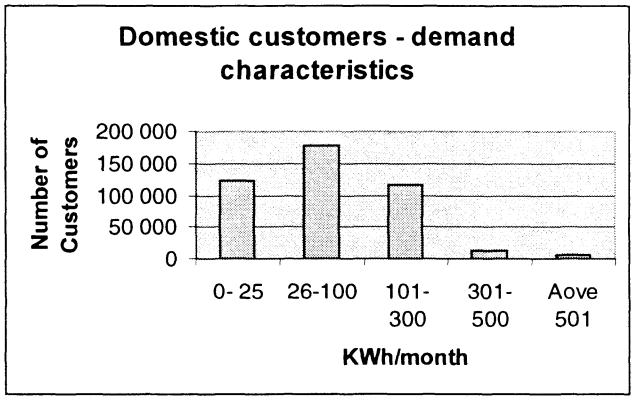
Consumer group	Consumers		Energy billed	
	Number	%	GWh	%
Domestic	439 661	84	537	44.2
Commercial	71 124	14	161	13.2
Industrial	3 281	1.6	542	50.0
Street lightening	778	0.2	7	0.6
Total	519 854	100	1216	100

By June 1998 the number of customers, including EEPCO staff, in the ICS system had reached 551 790

In addition 25 000 customers are connected to the SCS system. 77 % of these customers are domestic and 21 % industries.

The system has a morning peak load and an evening peak. The domestic customers have a significant contribution to the system peak load.

28% of the domestic customers has a demand below 25 kWh a months and 68% has a demand between 26 and 100 kWh/month.



50% of the commercial customers has a demand below 50 kWh/months.

2.5 Demand/Supply and tariff setting

At present the system has no excess supply. A balance between supply and demand is met through restrictions on new connections. Some degree of load shedding has also been used.

The price increase has been significant in the last years with 39.4% increase in 1997 and 32.5% increase in 1998.

The present average tariff is Birr 0.46/kWh or US$ 0.06/kWh. It was informed by EEPCO that the tariff income covers all costs and a return on capital for the electricity supply.

Ethiopia has at present no possibility to export or import through connection to other countries. For the future export to Djibouti, Sudan etc. may be possible.

2.6 Regulation

The Ethiopian Electricity Agency was established by proclamation in 1997. The Agency shall regulate the electricity industry and is accountable to the Ministry of Mines and Energy. The Agency is empowered to:

- issue, suspend and revoke licences for generation, transmission, distribution and sale of electricity
- study and recommend tariffs and supervise implementation
- determine the quality and operational standards of electricity services
- issues certificate of professional competence

The Environmental Impact Assessment in the licensing process has to meet the requirements in the Electricity Regulations and be satisfactory for the Environmental Protection Authority.

3 The Tariff Workshop

A workshop on tariff issues was conducted Thursday 4th November and Friday 5th November 1999. Programme and a list of participants on the workshop are enclosed as annex 5.

Overheads presented by NVE are presented as annex 6. The overheads were presented in the following 4 parts:

1) Session 1a, Electricity pricing in Norway
2) Session 1b, Regulation
3) Session 1c, Transport pricing in Norway
4) Session 3, Tariff principles

During the workshop and subsequent discussion it was concluded that the main challenges in the electricity sector of today are:

- Improved efficiency especially in the distribution sector
- System expansion
- Attraction of capital to invest in new generation
- Rural electrification

The need to unbundle existing vertically integrated operations in the electricity sector was emphasised throughout the workshop

4) Tariff setting principles

The last comprehensive tariff study was made in 1994. Since then tariffs has been revised twice. The present tariffs are of April 1998.

Even though the consumer only will face one electricity price the NVE team will advise the following two price elements to be regarded separately when the electricity price is calculated:

- a transport element (transmission and distribution), and
- a commodity element (generation and trade element).

The reason for this is that we regard the method for calculation of the two elements to be different.

The transport element has to be set in a framework of monopoly economic regulation since transport of electricity is a natural monopoly service. In principle this element can be calculated the same way, independent of whether the electricity sector is deregulated or not. However, unbundling of the cost of transmission and distribution will be needed to be able to calculate the true costs of the transportation as a basis for the regulation. The calculation of the transport element is covered in paragraph 4.2 and some aspects concerning generation tariffs are covered in paragraph 4.3

4.1 Price setting - theoretical aspects.

In a competitive market with profit maximising firms the price should be set equal to the short run marginal cost (SRMC), where SRMC is the increase in costs associated with providing an incremental unit in output using the existing capacity. Based on a theoretical point of view this price setting principle will also be efficient for the society. In a balanced system SRMC = LRMC, which indicates a system with efficient allocation of resources (price = SRMC) and optimal capacity (price = SRMC = LRMC).

LRMC is defined as the increase in costs of expanding the capacity to produce one additional unit. LRMC is more likely to be regarded as an investment criteria for investors, and not a price signal to the consumers to achieve an optimal allocation of existing resources.

4.2 Tariff for transmission and distribution – Transport tariff

In principle several price-setting methodologies can be used concerning transmission and distribution tariffs.

- average cost,
- short run marginal costs (SRMC),
- long run marginal costs (LRMC) or
- monopoly price setting.

Among these possibilities SRMC is to be regarded as the best choice, because this price setting principle will provide an efficient allocation of the resources in the short run, i.e. less waste for the society. In a transmission/distribution system SRMC is the cost of transporting one extra unit in the existing network, i.e. SRMC = the value of marginal loss [price (cent/kWh)* marginal loss (%)*energy out-take (kWh)].

Transportation of energy is characterised as economies of scale. The price setting based on the SRMC-principle will therefor not provide cost recovery. Since cost recovery is a fundamental objective, other tariff components should be established to achieve this objective. Such tariff components could be a fixed charge (for example Birr/month) and/or a load based charge (Birr/kW).

A drawback of the SRMC is that this price setting principle will not give adequate long-term signal. This problem can to some extent be solved through a geographical differentiation of a capacity charge (Birr/kW) and the use of an investment charge (see below). Conventional economic and engineering theory does not give clear answers solving the long-term signal problem.

In the energy transport system the use of LRMC price principle should not be recommended. LRMC is difficult to calculate. In a meshed network as the Norwegian we are e.g. hardly able to calculate the LRMC.

4.2.1 Tariffs for interruptible transport of energy (Transportation element)

In general prices should be used to achieve an efficient allocation of limited resources. For example in cases of congestion's (bottlenecks) in the net work capacity charges could be used to balance the system. This will imply to add a capacity charge to the energy price in the defined production deficit area, and lower the energy price in the defined production surplus area to remove the bottleneck. However, because of different reasons, i. a. delay in acting upon price signals, capacity charges are not appropriate related to immediate network capacity problems. It should therefor be considered to introduce tariffs for interruptible transportation of energy to meet this requirement.

Tariffs for interruptible transportation imply that end-users are charged a lower tariff for their out-take of power from the net work, but they take the risk of being disconnected from the net work when capacity problems occurs.

In principle tariffs for interruptible transportation of electric energy can apply to all customers. In practice such tariff are most likely to be applied for large commercial and industrials customers.

4.2.2 Investment contribution. (Transportation element)

When a customer makes a request of being connected to the network this may require new investments or reinforcement of the existing net work. In this case it is worth considering charging the customer for a part of the investment cost. In particular this is relevant when the expected increase in income due to the connection is assumed to be low compared to the investment needed.

If the Network Company expects that other customers wish to be connected in the future and take advantage of the investment, the investment contribution should be allocated to all these customers. If this is the case net work owner and/or the customer must pay the investment up front.

If SRMC is used as a price setting principle, this pricing principle have the drawback that it will not give adequate signals related to long term efficiency. Investment contribution charges may to some extent compensate for the lack of transport prices reflecting long run marginal costs.

4.2.3 Duration of maximum load (Transportation element)

In principle tariff setting should take into account that the duration of maximum load (that is the customers energy out-take for a period of time divided with the customers maximum load out-take within the same period) do vary among the customers.

On certain conditions, it may be claimed that customers who have a short maximum load duration will provide higher network investments in relation to the customers out-take of energy than customers with a long maximum load duration. A tariff structure characterised with only an energy based transportation tariff component will cause an unfair allocation of the network capital costs. The reason for this is that customers with a short duration of maximum load will be allocated a too small portion of the capital costs compared to customers with long maximum load duration.

At least large commercial and industrial customers should face a tariff comprising an energy based transportation component and a load based transportation component.

4.3 Generation tariffs

Generation and sales/trade of energy may be regarded as a competitive activity, and ideally the prices should be set in the market based on supply and demand side interaction. In this situation the use of a traditional SRMC pricing principle is not relevant. Instead the price should be set according to the opportunity cost, i.e. variations in the water value. The water itself is free, but when collected in reservoirs the water may be regarded to have a value because it can be converted into electric energy. From season to season the energy price will change according to the variations in the precipitation, the water level of the reservoir and the demand for electric energy. For the same reasons the value of the water accumulated in the reservoir will also vary over the year. On this background the power companies main challenge is to decide when to generate in order to maximise the present value of the future profit margin, that is to decide whether to exploit the water today, or the alternative, to store the water until the energy price is supposed to be higher. Ideally the energy price should be set according to the above alternative cost considerations.

A present pricing methodology for generation in Ethiopia is based on the principle of pricing according to the LRMC, adjusted to reflect revenue requirements, i.e. cost recovery. In a production system with surplus capacity the LRMC pricing principle can result in too high prices, and in a constrained system too low prices. The LRMC will reflect the cost of next hydropower project in line and this price will normally be higher than the production costs at the existing power plants. The LRMC pricing principle for generation can therefor give more income than needed for cost recovery. If the Single Buyer in the system is in a position to buy to production cost and sell to LRMC, this may make the Single Buyer to a "money machine" and should be taken into account when the regulatory framework for the Single Buyer is prepared.

4.4 Life line tariff for small consumers

The low price for small customers can be achieved by:

i) subsidies from the state budget
ii) cross-subsidies from large to small consumers

We have the understanding that EEPCO is supposed to cover all costs through tariffs without subsidies from the state. The low price for small consumers, domestic category, has therefor to be achieved by a higher price for larger consumers. This can be regarded as an implicit taxation of large users of electricity.

The cross subsidies will give economic distortion and should from a pure economic point of view be reduced as much as possible.

4.5 Tariff issues for future consideration

For the future the following issues could also be considered:

Point based principle for calculation of network cost

The use of this principle implies that the transport tariff refers to the connection point where the customer are connected. This will give access to the whole network system and the customer may enter into an electricity purchase contract with the supplier he may choose. With only a single supplier this is not realistic in Ethiopia to day. However, even in a power system with one supplier point of connection tariffs can be applied. And for the future, after introduction of IPPs it might be realistic that large consumers are allowed to choose alternative suppliers.

Top down principle for transport tariffs

When transport tariffs are calculated a top down principle should be considered. A consequence of this principle is that the transmission and distribution network are divided into voltage levels. The tariffs for each voltage level shall only cover a share of the network cost referring to higher voltage levels. If, for instance, a customer is connected to the distribution network at 45 kV voltage level, the transport tariff should include a relative share of the network cost referring to higher voltage levels, but not costs referring to voltage levels lower than 45 kV.

Time- and geographical differentiation of transport tariffs

The network costs from customer's use of the system will vary according to where the customer is geographically sited and according to the system load level at time of use. Ideally this should be taken into account by differentiated transport tariffs. Roughly, time-differentiation means that the tariff (= the SRMC-based transportation charge) should be "high" in peak load periods and "low" in off-peak periods, while geographical differentiation means that the exit tariff should be lower in areas with production surplus, and relative higher in areas with production deficit.

5) Organisational and structure issues relevant for future tariffs

5.1 Unbundling

Unbundling of generation, transmission and distribution will be important for the future Ethiopian set-up in the energy sector. The unbundling may be done through:

- separation of accounts
- separation by different independent companies with the same owner
- separation by different owners

5.2 Improved accounting and financial management systems

We regard the accounting and financial management system as a key tool for improved efficiency in the electricity sector. Due to limited time it has not been possible for us to study the present system. The following comments are therefore of a general nature.

A main objective of the accounting system will be to identify and allocate costs to different activities and functions within the company.

An appropriate chart of accounts will be the basis for the accounting and management system.

Guidelines and standards has to be made for:

- evaluation of assets
- calculation of depreciation
- capitalisation of investments
- calculation of costs
- distribution of common cost (as overhead and auxiliary activities) to core activities
- calculation of return on capital invested
-

Procedures must be made for how the companies shall report financial and technical data to the Ethiopian Electricity Agency.

It will be important for the Agency to establish a comprehensive database of information from companies' different operations.

Emphasis should be given to design the database in such a way that it can provide wanted performance indicators, time-series and cross-section data. It will be important for the Agency to get started with this as soon as possible to establish an appropriate database for time series data.

5.3 Open access to main grid, Competition for large industrial consumers.

In the future large consumers should be able to buy electricity from different suppliers than the Single Buyer. If industries have excess capacity from own production they should also be able to feed the electricity into the grid.

This will imply that open and third party access to the grid is made possible.

5.4 Improved efficiency in distribution

Improved efficiency, especially in the distribution, is the most challenging task in the present situation. Utilities in most countries are for the time being very much focusing on this aspect. Efforts should be made to change the utility environment from monopoly to a competitive approach. This can be done by: outsourcing, performance indicators and benchmarking, management contracts, split the distribution in different companies, leasing out distribution asset for private management, privatisation.

The first step could be to use of a combination of management contract, performance indicators and outsourcing.

5.5 Establishment of the regulatory framework

The Ethiopian Electricity Agency will have to develop an appropriate the regulatory framework for the electricity industry.

Different model and approaches for economic regulation of utilities were highlighted during the workshop 4th and 5th November. Overheads from the workshop are enclosed as annex 6 to this report.

The two main models for economic regulation is:

i) cost coverage and rate of return regulation (cost plus regulation)
ii) price or income cap regulation

The cost coverage and rate of return model will cover the cost of the company and will in addition give the company a relevant rate of return. The main drawback of this regulatory model is the lack of incentive for efficiency.

The price-cap or income-cap model will give incentives for the network owner to cur costs to get a higher return on capital.

In Norway the cost coverage and rate of return model was used in 1993 – 1996. At present we have an income cap regulation (1997 – 2001). The reason for NVE to choose the rate of return and cost coverage regulation for the first years of deregulation was that we wanted to build a database of information about the Utilities before a proper income cap could be set.

6) Issues regarding introduction of Independent Power Producers (IPPs)

We will advise the following issues to be emphasised when introducing of IPPs to Ethiopia:

6.1 The necessity of knowledge before negotiations with the IPPs.

Get familiar with the instruments used when introducing IPPs

- Letter of Intent or Memorandum of Understanding
- Implementation Agreement
- Power Purchase Agreement

Nepal and Uganda are countries with experience in introducing IPPs for hydropower. It will be fruitful to learn as much as possible from their experiences and a study visit to these countries may be useful.

6.2 Small projects first if possible

The first deal with an IPP will probably not be very favourable for Ethiopia. This is due to lack of experience when negotiation with the IPP and the fact the IPP will request a higher return on the investment when they are the first IPP in the country. It is therefor wise to start with a small project.

6.3 The BOT (Build Operate Transfer) model should be used.

The BOT model will imply that the hydropower plant is transferred to Ethiopia free of charge after an agreed period. This is a common model for hydropower projects and should be used for Ethiopia. The BOT model is used in Nepal and Uganda. This model will meet the IPPs requirement for profit since they will not have an investment horizon of more than 30 years. The transfer will at the same time be important for Ethiopia to keep the hydropower resources as a national source in the long run. After the reversion, the hydropower plant may be licensed/sold out to the same or an alternative company on competitive conditions.

6.4 Risk and competition

High risk for the IPP will imply a higher requirement for return on the investment and more expensive electricity for Ethiopia. Emphasise should be given to areas where risk can be reduced without too much of drawback for Ethiopia.

If possible it will be wise to:

- make a preliminary feasibility study for relevant projects
- make a screening of possible projects in regard to costs and environment
- create a competitive environment where several IPPs can participate

Nepal has used the above-mentioned approach.

7) Areas relevant for future co-operation with NVE

The following areas may be considered for future co-operation if wanted by MME, NVE and NORAD.

7.1 Tariff issues

This can be done through:

- capacity building for the Ministry and the Ethiopian Electricity Agency
- tariff study and modelling

7.2 Regulatory Framework

Professional co-operation between NVE and the Electricity Agency regarding the future economic regulatory framework since NVE has hands-on experience with regulation of electricity utilities over several years and the electricity Agency is about to start.

7.3 Assistance related to the introduction of IPPs and private participation

It will be important for Ethiopia to be well prepared when negotiating with the IPPs. NVE may assist in the preparation process by drawing on experience from Nepal, Uganda and Norwegian Pippins.

NVE has arranged a study tour to Nepal for a delegation from Uganda in 1998 to give them a better background for introducing IPPs to Uganda. A similar arrangement may be made for Ethiopian experts.

ANNEX 1

Proposal:

a) The team of experts.

We will suggest the team to be composed of two economists and tariff experts from NVE, Mr Arne Venjum and Rolv Bjelland. The CVs for the team are enclosed.

The team has no prior experience from Ethiopia, however, Mr Bjelland has comprehensive experience from other African countries and Mr Venjum is an in depth specialist in tariffs. We regard it as an advantage to be able to draw upon a team from NVE for the assignment to be able to develop the institutional cooperation between Ethiopia and Norway. The drawback of such a solution is, however, that it is difficult for our staff to be out of office for a long period of time. We will therefor suggest duration of the assignment to be two weeks stay in Ethiopia (Preferable week 43 and 44, 25 Okt – 6 Nov) for the team. In addition one-week preparation in Norway is regarded to be needed , a total of 5 weeks input.

b) Tasks

i) Review existing studies.

We are prepared to review the existing tariff studies already made in Ethiopia. We assume that the time will be too limited to review these studies in Ethiopia. We will therefore request your Department to make a copy of the relevant studies, ready to be collected by a NVE representative at your office 13 September.

ii) On the job training

We look forward to meet and discuss tariff issues with relevant people in Ethiopia. We will advise that a program for such training should be made by MME, and sent us as soon as possible.

iii) Formulate tariff setting mechanisms and future plans for tariff setting

We are prepared to discuss tariff settings mechanism and future plans for tariff setting with local experts and in the workshop.

iv) Conduct workshop

We are prepared to conduct a 2 days workshop to highlight tariff settings mechanisms and principles. We will suggest the workshop to be arranged in the beginning of the last week of the stay.

v) The final document.

We are prepared to make a final draft paper as a summing up on the findings and conclusions during the stay in Ethiopia. We will aim to have the draft ready before we leave for Norway.

ANNEX 2

People met during the visit

Tekola Shimelis, Acting Head Enery Department

Berhanu Feleke, Team Leader Head, Energy Department

Tariku Tafere, Electrical Agency, (standard group)

Yetmyet (Yeti), Energy Department

Bekala Ibrahim, Energy Department

Yohannes Kahsay, Energy Department

Girma Waktola, Energy Department

Zewdie Gebre, Energy Department

Abebe Frede; Electrical Agency (standard group)

Getachew Lema, Energy Department

Kidane Guta, Energy Department

Getahun Mogese (EEPCO), Head of Market and Customer Service Section

Gosaye Mengistu, Acting General Manager, Electricity Agency

ANNEX 3

Documents received

The NVE tariff team received the following documents during the visit:

- Tariff Study, Main Report of January 1994 from Tariff Research and Design Section

- Council of Ministers Regulations no 49/99 of 20th May 1999. Regulations to provide for the regulations of electricity operations.

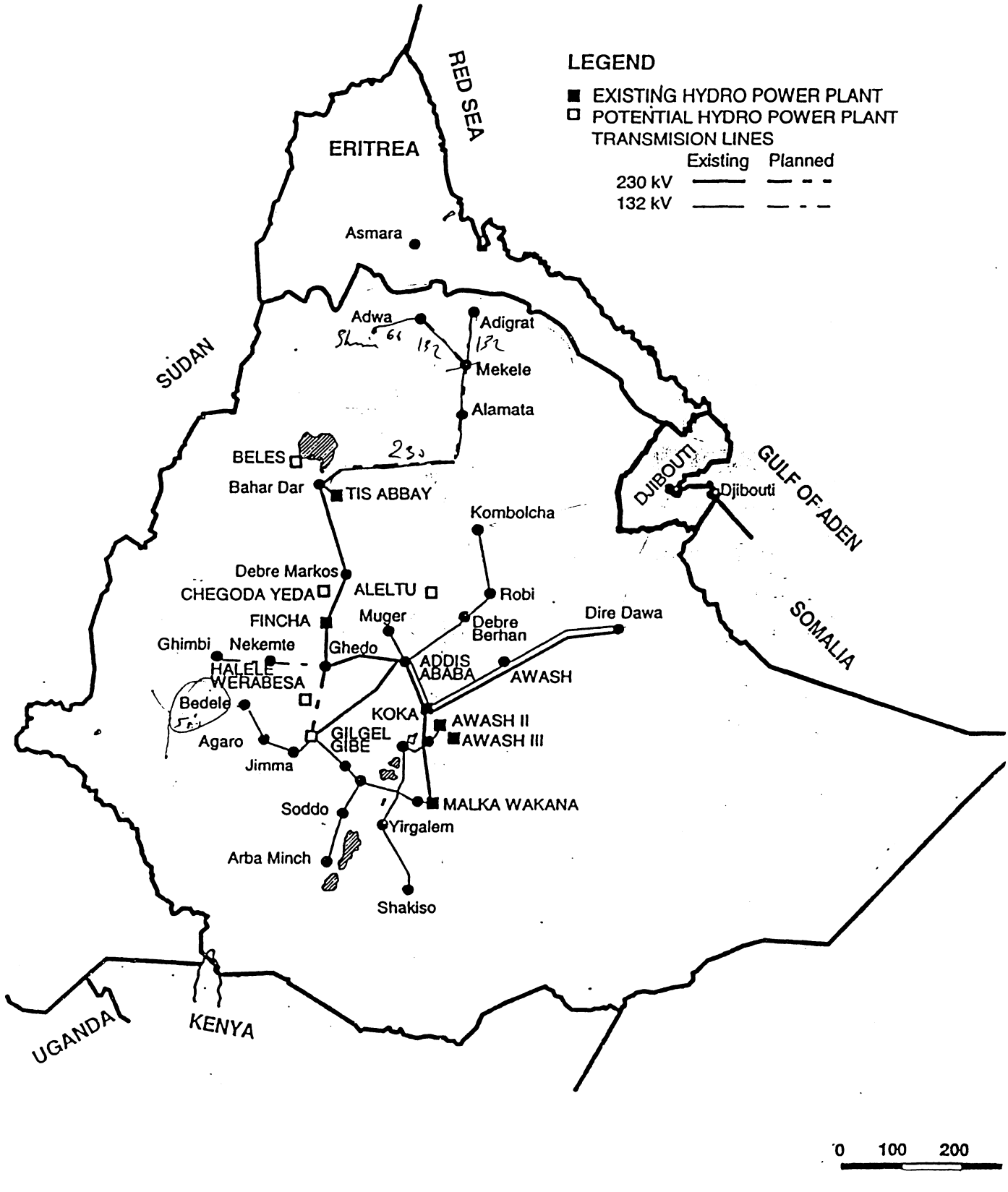
- Issues in Power Sector Reform. A report of September 1999 prepared by Getahun Moges Kifle.

- Ethiopian Electric power corporation (EEPCO): Electricity tariffs and energy saving information, of April 1998.

- Facts in brief 1998, Etrhiopian Electric Power Corporation (EEPCO)

EELPA ICS SYSTEM

ANNEX 4



WORKSHOP ON TARIFF SETTING AND REGULATION IN ELECTRICITY SECTOR IN ETHIOPIA

Thursday 4th November
Opening, by MOME

0900 - 1130 Session I (1 ½ hours)
Energy and network pricing in a unbundled system, an example from Norway; by NVE

1130 – 1200 Break for coffee/tea

1200 – 1230 Session II (1 ½ hours)
- Presentasjon of the electricity system and tariff structure in Etiopia;
- Shortcomings and challenges connected to the present tariff structure in Ethiopia.

By Getahun Moges (EEPCO)

1230 – 1400 Lunch

1400 – 1530 Session III (1 ½ hour)
Tariff settings mechanisms and principles, by NVE.

1530 – 1545 Break

1545 - 1700 Discussion on challenges in the present situation in Ethiopia

Friday 5th November

0900 – 0930 Options for restructuring the electricity sector, by NVE

0930 –1000 Discussion on the electricity sector organisation

1000 – 1030 Break

1030 – 1200 Working groups

1200 – 1230 Presentations from the working groups

1200 – 1400 Lunch

1400 – 1600 Discussion of future principles for tariff setting in Ethiopia and the way forward

1600 Conclusions and winding up

List of participants on the Tariff Workshop held on November 4 – 5, 1999

Place: Energy Department Premise, MME
Addis Ababa, Ethiopia

No.	Name of Participant	Organization	Position
1.	Mr. Dereje Negussie	MME	Expert
2.	Mr. Teshome Kasse	MME	Expert
3.	Mr. Kifle Tekletsadik	MME	Team Leader
4.	Mr. Abebe Ferede	MME	Expert
5.	Mr. Zewdie Gebre	MME/ED	Team Leader
6.	Mr. Kidane Guta	MME/ED	Expert
7.	Mr. Samson Mengistu	MME/ED	Expert
8.	Mr. Mammuye Tefera	MME/ED	Expert
9.	Mrs. Tirgaleme Markos	MME/ED	Expert
10.	Ms. Yetmyet Berhanu	MME/ED	Expert
11.	Mr. Getachew Lemma	MME/ED	Expert
12.	Mr. Yohannes Kahsay	MME/ED	Expert
13.	Mr. Girma Waktola	MME/ED	Expert
14.	Mrs. Bekala Ibrahim	MME/ED	Expert
15.	Mr. Berhanu Feleke	MME/ED	Team Leader
16.	Mr. Getahune Moges	EEPCO	Marketing Head
17.	Mr. Kinfe Berhe	EEPCO	Expert
18.	Dr. Zenebe Tesfaye	EEPCO	Division Manager
19.	Mr. Mekuria Lemma	EEPCO	Expert
20.	Mr. Eshetu Chala	MME	Expert
21.	Mr. Belete Berhanu	MME	Expert

Electrical pricing in an unbundled system

an example from Norway

Ethiopia November 1999

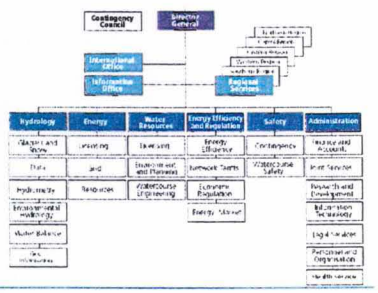
By Rolv Bjelland and Arne Venjum
Norwegian Water Resources and Energy Directorate

Outline of presentation:

* **Short presentation of NVE and legal framework**
  (The Norwegian water resource and energy Directorate)
* **Basic information on the Norwegian electricity system**
* **Restructuring and deregulation, pricing of electrical energy to end users**
* **Monopoly control**
* **Transport pricing**

Organization

Ministry of Petroleum and Energy



NVE's areas of work

- Hydrology
- Water resources administration
- Energy administration
- Energy efficiency and market regulations
- Safety and contingency
- International co-operation
- Information and public relations
- Regional services

Legal framework:

(1 of 4)

* Watercourses

Licence needed for:

* **Acquisition of waterfalls**
  (Acquisition Act)
* **Regulation of water courses**
  (Water Regulation Act)
* **Measures with impacts for watercourses**
  (Water Use Act)

Legal framework:

(2 of 4)

* Electrical Installation exceeding 22kV

Licence required for each project.
(Energy Act)

* Area Licence for distribution

A general Area Licence needed for distribution lines and transformers at 22 KV and less.
(Energy Act)

Legal framework:
(3 of 4)

* **Regulation of trade and transport of electricity** (Energy Act)
  - **Framework for trade of electricity**
  - **Monopoly regulation of transport fee for electricity (fee for transmission and distribution of electricity)**

Basic information:

- 99% hydro based power production
- approx. 110 - 120 TWH annual production
- 27 000 MW installed capacity
- approx. 500 power generating plants (above 1MW)
- the 10 largest plants represent 20 TWH

Basic information:

- approx. 200 electrical distribution utilities in Norway. Most of them are owned by municipals or county municipals
- many of the distribution utilities are small
- approx. 1/3 of the utilities have production

Basic information:

In addition to the distribution network we have:

- approx. 20 regional networks and one central grid, all connected.
- The state owned company "Statnett" is responsible for the central grid
- All networks are interconnected and there are also interconnections to Sweden/Denmark

Be aware of:

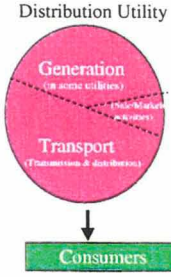
After restructuring through the 1990 Energy Act the distribution Utilities have 2 separate activities:

1) Natural monopoly activities
   - Distribution/transmission of electricity

2) Competitive activities
   - Selling electrical energy
   - Generation (for some utilities not all)

Before Restructuring

Distribution Utility



* The utility could transfer all costs to consumers
* Obligation to supply customers
* Integrated accounts
* No real sale/marketing activity by the utilities
* No access to alternative suppliers for consumer

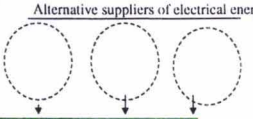
Consumers

After Restructuring

Distribution Utility

* Unbundling and third party access to network
* Consumer access to alternative suppliers of energy (no alternative for transport services)
* Obligation to connect customer to network
* More sale maketing activities in utilities
* New challenges:
  - prising of energy to customer
  - risk exposure

Alternative suppliers of electrical energy



Consumers

Be aware of:

After restructuring the consumer of electricity will face two prices:

1) one price for transport of electricity from the distribution utility in his area

2) one price from the supplier of energy. This might be from the distribution Utility in his area or from another supplier.

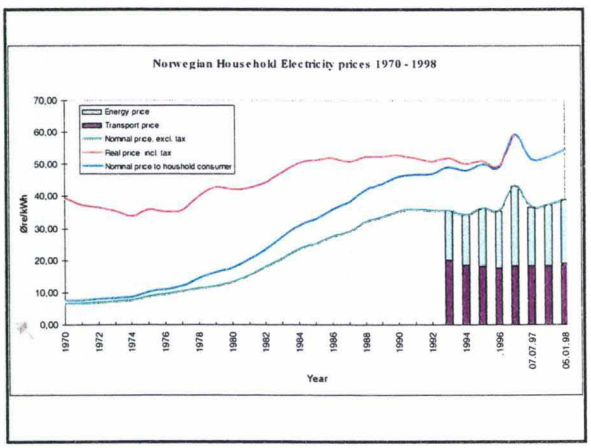


Figure for how a consumer can change supplier

Competition/third part access

Present situation:

- Hourly meter reading for all customers above 500 000 kWh/year
- Network owners responsible for all metering data
- adjusted system load profile used to calculate hourly values for customers without hourly meter reading
- no fees associated with supplier changes
- weekly change of supplier possible for retail customers

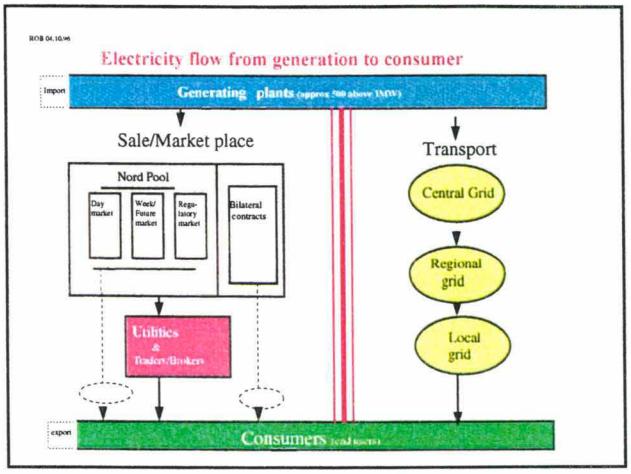
Conclusion regarding energy price to consumer in Norway:

Energy element determined in market according to supply and demand for energy

Profit regulation of electricity transport

an example from Norway

Ethiopia November 1999



Basic assumptions

- Economic efficiency is improved by introducing market prices and competition wherever applicable
- But, if there are natural monopolies or dominating actors, regulation is necessary to promote economic efficiency

Objectives of the Norwegian Regulator

- Economic efficiency
- Security of supply
- Safeguard consumer interests:
  - promote competition in generation and supply
  - regulate the network as a natural monopoly

Unbundling - a necessary condition

- Separation of competitive activities (generation and supply) from monopoly activities (transmission and distribution)
- Different levels of separation
  - accounting
  - legal organisation
  - ownership

→ have consequences for the regulatory design

Unbundling

Separation of activities and accounts

* Separate accounts for monopoly- and market-based activities in Utilities
* Each utility has to report to NVE in a standardised and computerised set-up
* Necessary account information from each utility is submitted to NVE on diskette.

Efficiency studies

Efficiency is estimated by comparing utilities.
A utility is efficient if output can
be produced by as little input as possible

Output from a Utility is measured by:

- number of customers
- energy supplied
- km lines

Input is measured by:

- capital invested
- cost of man-hour
- energy losses in network
- other running costs

Monopoly Control Systems for transport of electricity

Regulation systems for transmission and distribution:

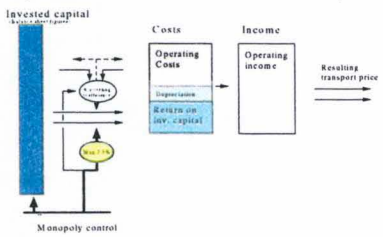
* 1993 - 1996
  rate of return & cost coverage regulation
  (Control of monopoly profit)

* from 1997 on
  permitted income regulation
  (a general efficiency requirement of 2%)

* from 1998 on
  permitted income regulation
  (with efficiency requirement for each utility 1.5%- 4.5%)

Rate of return & cost coverage regulation

(1993 - 1996 for all network levels)



Permitted Income regulation

* The new regulation model shall last for 5 years

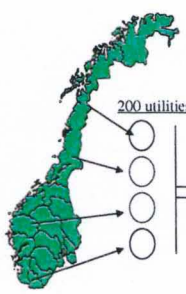
* Permitted income 1998 = Income cap for 1997, adj. for infl.
  + adjusted for increase in volume transported
  - efficiency requirement. (1.5% - 4.5%)

* Permitted income 1999-2001 - same procedure as for 1998

NVE NORWEGIAN WATER RESOURCES AND ENERGY ADMINISTRATION

Permitted income

(transmission & distribution)



200 utilities

For each utility

Average operating cost 94/95
Average losses 94/95
Depreciation 95
8.3 % return on capital

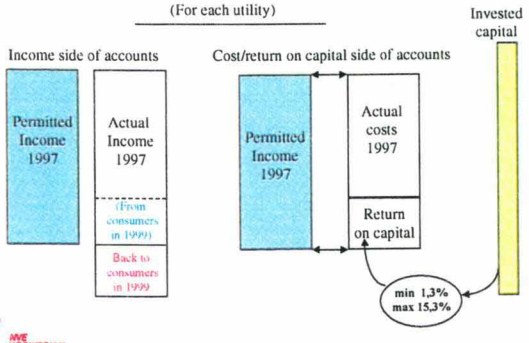
EBL requirement 2%

Permitted income 1997

NVE NORWEGIAN WATER RESOURCES AND ENERGY ADMINISTRATION

Annual accounts related to Permitted income

(For each utility)



NVE NORWEGIAN WATER RESOURCES AND

Measures to follow up the monopoly activity

- The monopoly control system
- Unbundling; separate accounts for monopoly activities
- Performance indicators and bench-marking
- Efficiency studies of utilities
- Follow up visits to utilities
- Handling of disputes between network and customers or between different network

Different performance indicators:

1) - indicators for cost structure analysis

2) - indicators specifying costs related to output

3) - indicators for utility structure

1) -Performance indicators for cost structure analysis

Some examples:

- salary expenses in % of operating cost

- miscellaneous expenses in % of operating cost

2) Performance indicators for cost related to output:

Operating cost:
- operating cost per pr kWh
- operating cost per customer
- operating cost per m electricity line

Capital cost: (depreciation & return on capital)
- capital cost per kWh
- capital cost per customer
- capital cost per m electricity line

3) Performance indicators for utility structure:

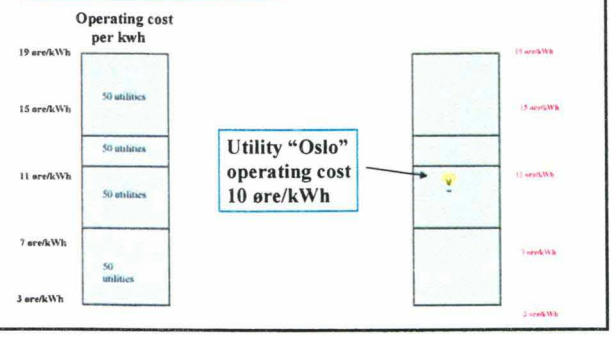
- energy per customer

- meter electricity line per customer

- cable in % of total network

- % of low voltage lines

Methodology - performance indicators



Transport tariffs in Norway

Ethiopia November 1999

Open and non-discriminating access to networks.

- In the Norwegian Energy act this right is provided in one single sentence:

"Owners of electricity networks are obliged to place the capacity of the network at disposal for other electricity utilities and for producers and consumers of electricity by tariffs and conditions regulated by the authorities".

Transmission tariffs - objectives

- Non-discriminating access
- Minimize transaction costs in electricity trading
- Efficient utilization of the network
- Long term efficiency - efficient location of new generation and loads and efficient investment in new network capacity
- Provide sufficient income to the network
- Fair and cost-reflective tariff-structure

Non - discriminating tariffs and regulation

- Public tariffs - covering all network-services
  - both third party and utility own use of network should meet the same tariffs and access conditions - "unbundling" of tariffs
- Rules for setting disputes regarding tariffs and access conditions
- Regulatory authority
  - rule and guidelines
  - handling of disputes

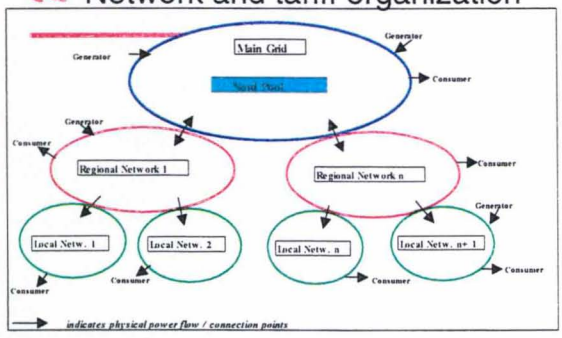
Transmission tariff system - open access

- Transmission tariffs must be independent of commercial trading agreements
  - The tariffs are paid to network owners at the point of connection to the network and are independent of specific power contracts.
  - Transmission prices can although be calculated for each connection point based on expected or actual power flows.
- The tariff system must cover the whole market from generators to end-use customers
- All network owners must have an obligation

Point of Connection Tariffs

- Tariffs refer to network connection-points and are independent of power contracts
- Tariffs in the different networks are co-ordinated
- The tariff paid at any connection-point gives access to the national interconnected system and all sub-systems including low-voltage
- Tariffs are paid both at entry and exit points
- Losses are bought by the network and costs are included in the tariff

Network and tariff organization



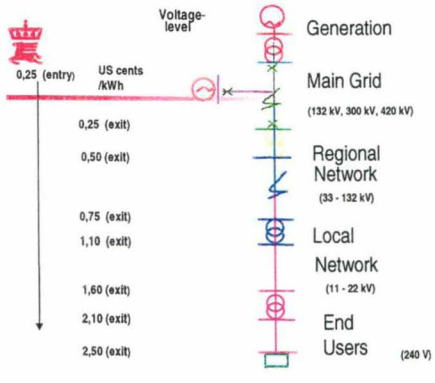
Tariffs and voltage levels

- Lower voltage networks pay to higher voltage level networks
- Connected lower voltage networks and end-use customers pay the same tariff
- Generators pay the same residual charges regardless of voltage level
- For end-use customers residual charges increase with decreasing voltage level

Network prices 1993-98

NETWORK TARIFFS 1993 - 1998, øre/kWh

	1993	1994	1995	1996	1997	1998
Medium industri. (1,6 GWh, 400 kW)	12,5	11,6	11,6	11,1	11,8	12,3
Small industrial (160 MWh, 40 kW)	17,7	16,0	16,0	14,8	15,6	16,0
Households (18 000 kWh)	20,2	18,6	18,2	17,6	18,4	19,1



Tariff setting mechanisms and principles for tariff setting.

Rolv Bjelland and Arne Venjum
Norwegian Water Resources and Energy Directorate
Workshop on Electricity Network Tariffs

Objectives for transmission pricing

- economic efficiency
- give location signals
- investment signals i transmission system
- cost recovery
- simplicity
- politically implementable

Economic efficiency

- signaling the cost leads to efficient decisions
- short run (day to day) efficiency (capital fixed)
- requirement: price = marginal cost

Locational signals

- give signal to the power stations and demand where to locate
- long term signals

Investment signals

- signal the need for investment in the transmisson system
- an alternativ to move planned investment in generation or on the demand
- can be based on differences in the MC in adjacent nodes
- Problems
  - ex ante/ex post problems (fig.)
  - transmission owership and investmest are divided in different companies

Cost recovery

- transmission tariffs must be set to allow cost recovery
- regulator set the allowed level of revenue
- allowed revenue is greater then recovered from "signalling" prices

Simplicity

- efficient pricing is not enough
- the price signals should be acted upon
- therefor: transmission prices should be understandable
- problem:
  - transmisson pricing is complicated based on MC prinsciples

Politically implementable

- the tariff prinsiples must be polictically aceptable
- changes can be phased in over some years

Policy issues with implication for tariff setting

- **the organisation of the energy system**
- **uniform tariff all over the country or not**
- **cross subsidies between consumer groups**

The price of electricity to end user can be regarded to have two elements

- Energy element
- Transportation element

Transport pricing - alternative approaches

- Pro rata according to capacity requirements
- Point to point capacity
- Point tariff

Price setting - alternatives

- Price = monopoly pricing
- Price = average cost
- Price = short run marginal cost (SRMC)
- Price = long run marginal cost (LRMC)

LRMC - problems

- In a production system with surplus capacity LRMC can result in too high prices - in a constrained system too low prices
- LRMC is difficult to calculate, big geografical variations
- Customers in areas with capacity constraints will pay a relativly high tariffs, while customers in areas with surplus capacity will pay a relative lower price. This can be unfair.

13

Criteria for economic effiency

- correct pricing of the transmission services

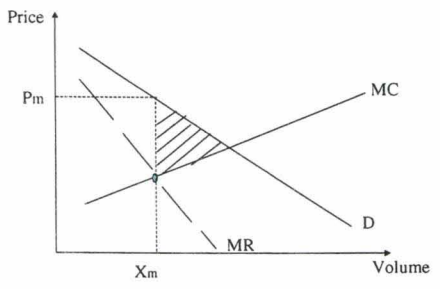
14

Price-setting

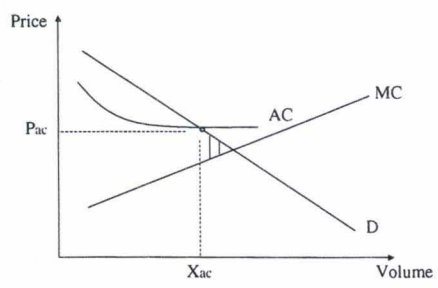
- Alternatives
  - Price = marginal cost
  - Price = monopoly pricing
  - Price = average cost

15

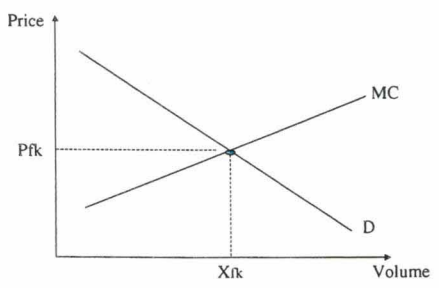
MONOPOLY- PRICING



AVERAGE-COST PRICING

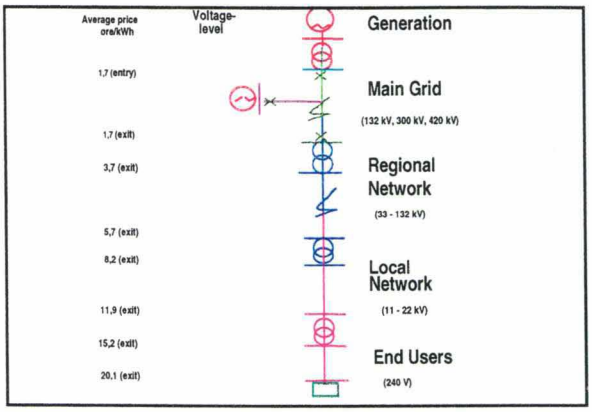


MARGINAL COST PRICING



Conclusion

- Price = marginal cost is most efficient
- Problem:
  - this price do not cover network cost
  - how do we handle this situation



Tariff structure

- Usage dependent charges
  - shall vary according to the customer's takeout or input of power
- Other charges
  - shall not vary with the customer's takeout or input of energy

Usage dependent charges

- Loss component
  - energy-dependent
  - marginal loss
  - time- and space-differentiated
- Capacity component
  - "clear the market"

Other charges

- Fixed component
- Load component
- no price signal function
- shall ensure the network owner's cost coverage

Practical definition - Central grid

- Loss component (øre/kWh)
  - Marginal cost
  - time- and point-differentiated
  - symmetrical
- Capacity component (øre/kWh)
- Load components (kr/MW)
  - the load base should not be predictable by the customer

Practical definition - Distribution networks

- Loss component (øre/kWh)
  - higher then marginal cost
  - contains a share of the fixed costs
  - not time- and point-differentiated
- Fixed component (NOK/year)
  - shall at least cover metering, settlement, invoicing etc.
- Load component (kr/kW)
  - Based on customer's max. load in one or several month of the year
- Volume-differentiated tariff for low-voltage outflow

Interruptable transmission

- Loss component
  - equal marginal loss
  - time-differentiated
- Fixed component
  - equal cost related to metering, settlement, invoicing etc.
- Load component
  - must be lower then the load comp. for regular transmission
- Network owner is obliged to run disconnection tests

Tariffs for input from generation

- Loss component
  - shall reflect marginal cost
  - shall be point related
- Load component
  - same for all generators
  - central grid tariff shall serve as a reference
  - load base is equal to generators available winter capacity

One-time payment

- Connection fee
- Investment contribution

Most common disputes

- Investment contribution. Connection fee
- Fixed charges
- Load charges in areas with production surplus

Costs to be included in network charges

- **Operation and maintenance**
- **overhead**
- **depreciation on invested capital**
- **network losses**
- **rate of return on invested capital**

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