PRICE DISCRIMINATION IN
THE URBAN HOUSEHOLD
ELECTRICITY MARKET IN
UKRAINE

by

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Abstract

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Price discrimination is a quite common phenomenon for the energy sector in a market economy. It is justified to avoid marginal cost pricing dilemma for energy providers who are considered to be natural monopolists. Ukraine has been implementing some elements of such discriminatory pricing for urban residents. Although economic theory requires that an efficient regulator follow the inverse elasticity rule, Ukraine practices direct discrimination. This paper analyzes reasons for such a distortion. The model to investigate how social constraints can affect price discrimination policy is developed. Though it does not imply the inverse elasticity rule to be violated its results are highly depended upon parameters of demand. In practice, cost approach prevails. The paper argues that there are no economic or social reasons for existing price differentials; they are simply a legacy from the past.

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INTRODUCTION

During the time of the Soviet Union, energy prices were often affected by certain political considerations. There was a huge bias toward energy consuming industries and lack of stimulus to implement energy saving technologies. Electricity prices were aimed to guarantee the supplier trading advantage. In particular, USSR sold power energy to Europe for various consumer goods that were produced domestically in deficit or were not produced at all. Prices did not reflect the economic costs of energy consumption.

However, in western countries, the energy pricing mechanism works in a different way. Price discrimination is a quite common phenomenon for this sector in a market economy. It is justified to avoid the marginal cost pricing dilemma for electricity providers who are considered to be natural monopolists.

Nowadays there is an urgent need for another mechanism to be involved in price determination. Ukraine has been implementing some elements of such discriminating pricing for urban residents. But it seems that the main reason for such a policy is not economic considerations, but rather political ones. Although the development of successful public policy should integrate both economic and social components, attempts to please the electorate can bring a significant distortion into the economy.

One can argue that electricity service in Ukraine can be treated as a semi-public good because of a widespread non-payments practice. However, this approach needs to be discussed conscientiously. The main reason for doubt concerns such an important feature of a public good as

rivalry. It is a particular kind of consumption externality: everyone must consume the same amount of the good and none can affect the others' choice. In a case of energy consumption, rivalry heavily depends on total network capacity. To assure non-rivalry, the network should operate at a high capacity that is prohibitively costly for Ukraine. Low capacity operation causes congestion and electricity becomes a rival good.

An efficient price mechanism should be involved in price determination. Implementing a certain policy for energy pricing, one should take into account that energy in Ukraine is not a public good.

The purpose of this paper is to analyze how social constraints can affect price discrimination policy, using the example of Ukrainian urban residential sector of energy industry. Economic theory requires that an efficient policy maker should follow the *inverse* elasticity rule when discriminating. This rule means that the market segment with less elastic demand should be charged more. Such a policy lowers deadweight losses and, thus, increases social welfare. The regulator in Ukraine practices *direct* elasticity discrimination: less elastic demand, those of the households that use elastic stoves, is charged less. This contradiction is explained by a certain social constraint. The author tries to figure out whether that explanation is sufficient. In this paper I will argue that there are no economic or social reasons for existing price differentials; they are simply a legacy of the past.

This paper provides a graphical and empirical analysis of different approaches toward price discrimination in energy distribution. Section 1 introduces the discussed questions. The literature review is incorporated in Section 2 and 3. The theoretical aspects of pricing in a case of a natural monopoly are discussed in Section 2. Price discrimination as an alternative approach toward pricing a natural monopoly is presented in Section 3. Section 4 describes major players in the Ukrainian energy market and

existing problems. Two benchmark models of price discrimination are presented in Section 5. An analysis of the Ukrainian practice of price discrimination can be found in Section 6.

NATURAL MONOPOLY – PRICING DILEMMA

Before the issue of price discrimination is addressed a theoretical background for this discussion should be provided. The purpose of this section is to answer the question some readers might ask: why discriminate at all. It introduces the concept of natural monopoly for energy distribution and explains how price discrimination is justified in this respect. The literature review is incorporated into the section and presents a traditional neoclassical approach toward the analyzed problem.

2.1. Natural monopoly

The term natural monopoly refers to the industry if

$$C(\sum_i Y_i) < \sum_i C(Y_i), \quad i \geq 2$$

where Y_i is output, $C(Y_i)$ - the cost function, and i - the number of firms.

This condition means that a single firm can produce the market quantity at lower cost than two or more firms. The most common case is a natural monopoly with a declining average cost (Figure 1). Nevertheless, sometimes due to demand natural monopoly can appear in a industry with a U-shaped average cost curve as well (Waterson M., 1991, p. 15-18).
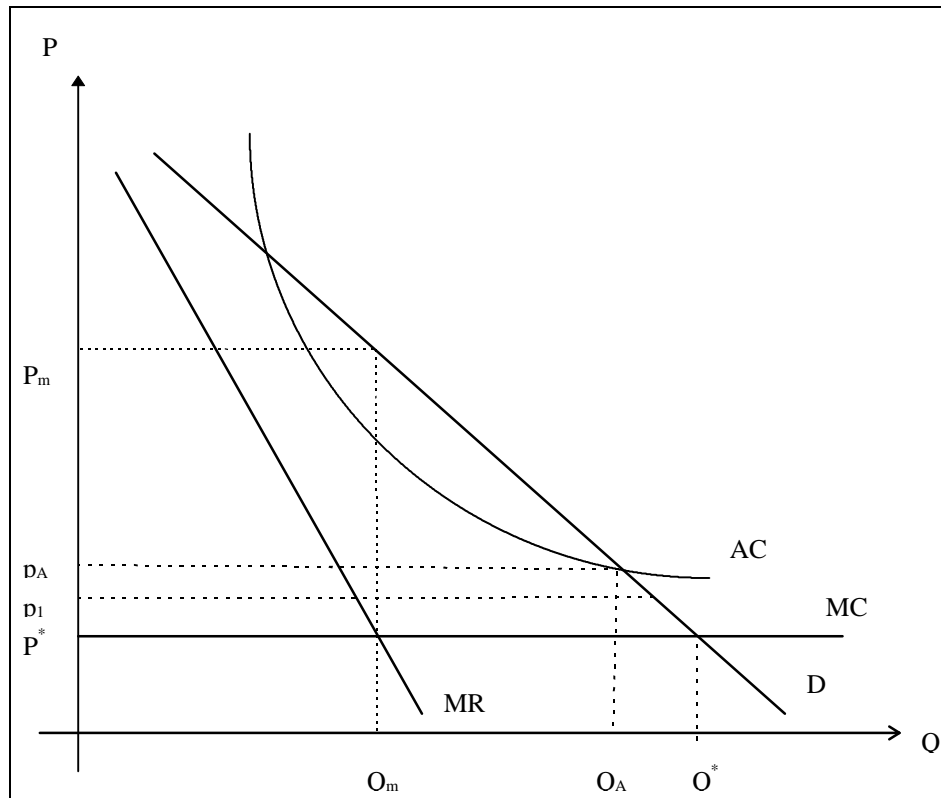
Figure 1. Natural monopoly with constant marginal cost.

This feature of natural monopoly pertains to energy distribution in Ukraine as well as in most other country[1]. There is relatively high cost for running an electric power line to a user but constant or falling marginal cost of supplying the service. As a result, marginal cost is constant or decreasing, and average cost falls as output increases.

2.2. Problems of pricing

In most monopolized industries, resources are not efficiently allocated because the monopoly price is higher than marginal cost and output is low. The general solution of this problem is obvious – a

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[1] Some countries, for example USA, have separated distribution and transmission segments. In such a case, transmission is a natural monopoly (Joskow P. , 1997, p.129).

competitive environment should be introduced.

However, in the case of the natural monopoly this problem can not be solved so easily. In such a market competition is inefficient because of high average cost. On the other hand, unregulated monopoly tends to be inefficient due to the high price - above the marginal cost. Nevertheless, if a regulator forces the natural monopolist to price at the marginal cost the monopoly would stop operating since price is below average cost and firm loses money. Even if a small mark-up $p=p_1$ is allowed demand may not be sufficient to cover the average cost (see figure 1).

If the natural monopoly is not regulated, it charges p_m, sells Q_m units, and makes the maximum profit. This case is the least desirable for society, since social welfare is very low.

Under regulation the efficient solution requires to set $p=p^*=MC$ and sell Q^* units. But, as it has been mentioned, under that condition the monopoly prefers to shut down to escape the losses.

2.3. The first and the second best solutions

Society can keep the monopoly operating and pricing at a marginal cost by subsidizing it with an amount equal to the lost profit. If administration costs are low, and the monopoly is subsidized using efficiently raised tax revenue, society is better off. In this case subsidy is a transfer of wealth, and, thus, has no efficiency implications.

The implication of this solution can be analyzed when the natural monopoly is owned privately and publicly. Direct government ownership allows setting prices equal to the marginal cost if *social welfare rather than profit* is maximized. Great Britain, Sweden, the United States, various Eastern-

block economies have experienced a large share of publicly owned utilities. However, even in countries with established market economies, government monopolies, in practice, provide little evidence of efficient performance (Williamson, 1967; Carlton, 1994, p.860). A strong tendency to overvalue the cost of production can eliminate all potential gains. This phenomenon is called Averch-Johnson effect.

On the other hand, some authors argue that subsidizing a privately owned natural monopoly can be politically unacceptable. In addition there is a real resource cost, since government rarely, if ever, efficiently raises taxes for this purpose (Swann D., 1992, p.66; Carlton D., 1994, p. 871).

Thus, difficulties with practical implementation of marginal pricing make this possibility rather theoretical. As the first best, this approach serves to define a benchmark for the remaining cases.

One way to avoid such a problem is to charge the price equal to the average cost. In this case, a firm can operate without incurring losses. Consumers benefit from such pricing because they may purchase more at a lower price. Although this solution is sub-efficient – the deadweight losses are minimized – the implementation of such second best approach is also doubtful. The main concern relates to the issue whether the regulator can force a producer to operate at a cost-minimizing level of output.

Energy distribution that is recognized as a natural monopoly is a subject to the marginal cost pricing dilemma. This creates tremendous problems both for regulation and pure market operating. The main concern for a regulator is information asymmetry, while competition is inefficient due to high average costs.

PRICE DISCRIMINATION

An alternative approach to keep natural monopoly operating is to allow price discrimination.

3.1. Definition and types

According to D. Swann, price discrimination is defined as

"the charging of different prices for a good to different consumers when the cost of supplying them does not vary

or,

where the cost of supplying them does vary, charging prices which differ by more than the difference in cost"(Swann, 1992, p.67).

The formal way to say this is:

$$\frac{p_k}{MC_k} \neq \frac{p_n}{MC_n}$$

where p is price, MC represents marginal cost, k and n define two different market segments (Stigler G., 1966, p.209).

Economic theory distinguishes three types of price discrimination. First degree or perfect price discrimination implies that every consumer is charged at his reservation price. Thus, the monopolist can capture the whole consumer surplus. The second and third degrees refer to imperfect discrimination when a monopolist can capture only some part of consumer

surplus. The second degree price discrimination is identified when a seller charges different prices per unit for the same product depending on how much units the customer buys (declining-block schedule, two-part tariff, tie-in sale).

The third degree price discrimination describes the case when there are several groups of consumers and each group faces its own price per unit. To be implemented successfully, such a price discrimination requires the following conditions:

- different market segments could be clearly defined;

- price elasticities of demand differ between categories;

- arbitrage is impossible or can be prevented.

The standard example of such a type of price discrimination can be illustrated graphically by Figure 2.
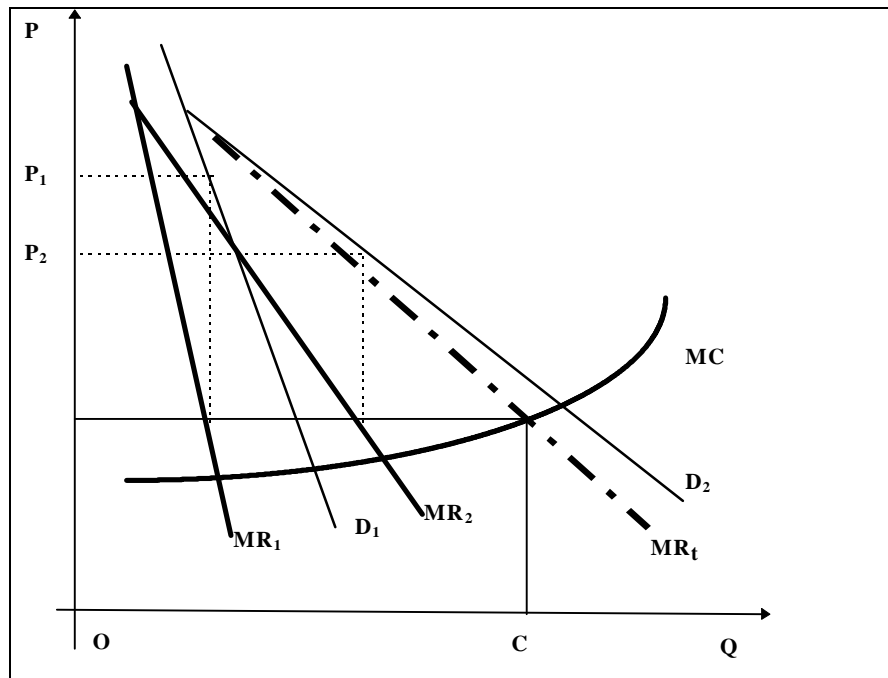
Figure 2. Price discrimination.

Let D_1 and D_2 be the demand curves in two separable markets, with corresponding marginal revenues MR_1 and MR_2. Then if the marginal curves are added horizontally to get MR_t, the curve of aggregated quantities that can be sold at given marginal revenues is obtained. Output would be produced at the point where total marginal revenue equals marginal cost, or OC. This output will be supplied in the two markets at prices P_1 and P_2: at this prices marginal revenues are equal.

3.2. Price discrimination and efficiency

The efficiency consequences of price discrimination were first analyzed by Robinson (1933) and later by Schmalensee (1981), Varian (1985), and Schwartz (1990) through its effect on a total surplus.

Under *perfect price discrimination* to extract the maximum profit a producer would operate until consumers' marginal willingness to pay

equalizes marginal cost. Thus, output is likely to be at a competitive level. In such a case, we can observe a redistribution of the surplus between consumers and the producer without any efficiency distortion.

When other types of price discrimination are implemented the result is not so obvious. Depending on the shapes of the demand and cost curves, discrimination may be better or worse than a simple monopolistic pricing from efficiency point of view.

There are two possible sources of inefficiency. The first is related to the output restriction, and the second is associated with consumption. The last means that there is no way to equalize marginal benefits of different consumers since further reselling is prohibited.

H. Varian has shown that "a necessary condition for efficiency to increase when price discrimination is implemented is that total output increases. If output remains constant or decreases when price discrimination is allowed, total welfare must necessarily decline." (Varian, 1996, p. 11). The mentioned output growth should be large enough to cover consumption inefficiency. Particularly, third degree price discrimination can benefit the society when it allows a small market to be served – which otherwise would not exist. Hausman and MacKie-Mason (1988) examine this question in details.

Another drawback with respect to efficiency can be observed when increasing-block pricing is involved. Due to declining prices a consumer can pay the same amount for a much larger quantity. Thus, this pricing scheme stimulates overconsumption[2].

Although discriminatory prices may be inefficient in allocating a

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[2] From lecture notes of the course "Economics of Regulation" taught by Dnes A. at the EERC Master program in spring, 1999.

commodity among individuals, they do yield a larger revenue than a single price system. Moreover, there is situation, when costs of production are so high that receipts can not cover them unless discrimination is involved.
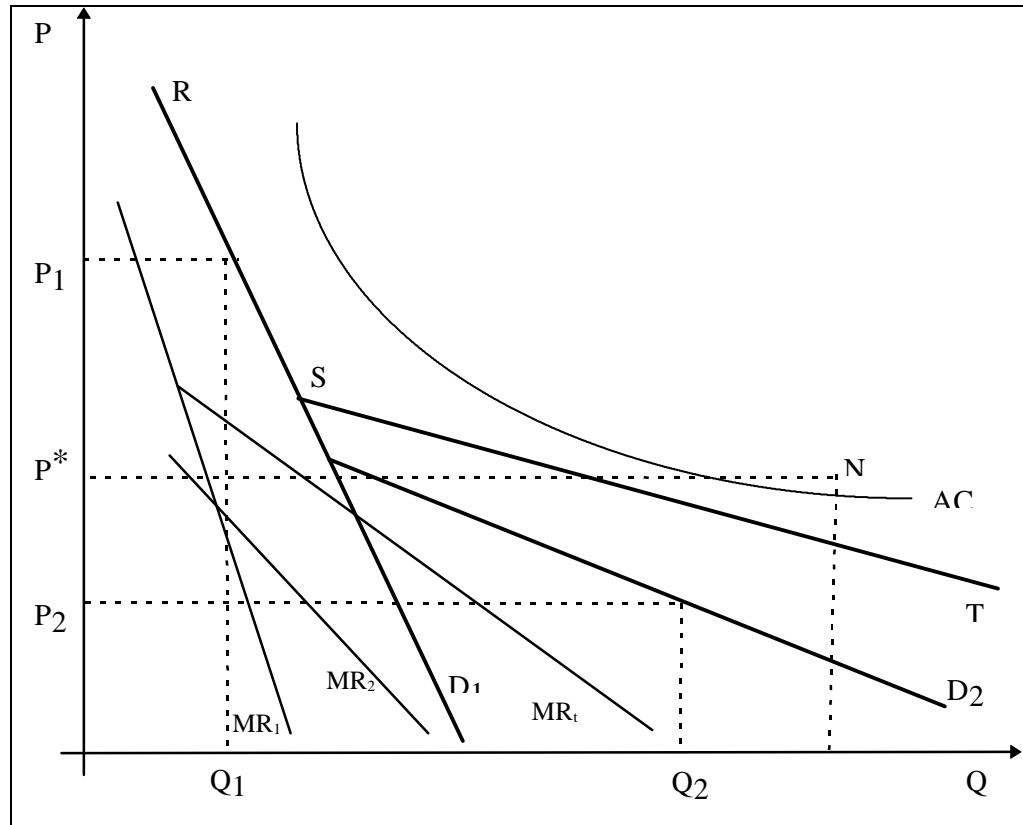
Figure 3. Price discrimination as a way to exist.

This case can be presented as a market with two classes of consumers and respective demand curves for a certain good, D1 and D_2 (Figure 3). By adding these two curves we obtain the total demand curve RST. Without discrimination, there is no production: at any level of output price is higher than average cost described here as AC curve. With discrimination, a quantity Q_1 can be sold at a price P_1, another quantity Q_2 at a price P_2, and the total quantity $Q^*=Q_1+Q_2$ would yield total revenue OQ^*NP_3 at the average price P_3 which even exceeds its cost.

Price discrimination could be an appropriate solution of the problem

of natural monopoly pricing. Second degree price discrimination was proved to be not a good approach: it may stimulate overconsumption. Thus, only third degree price discrimination is discussed.

ENERGY SECTOR IN UKRAINE AND PRICE DISCRIMINATION

The purpose of this section is to introduce the main players and to explain their roles in the energy sector. They are the supplier – Oblenergo, the regulatory body – National Committee on Energy Regulation, and urban residents or households as demanders.

4.1. The supply side

From the Soviet Union Ukraine has inherited a well developed and a highly integrated energy sector, in which the state kept a strong monopoly. This legacy consisted of a broad network of dispatching centers, constituting a whole energetic system of the country. One of these dispatching centers, with all the subsidiary services, transmission stations and high-voltage lines, was located on the Ukrainian territory. Consequently, it became the only monopolist in electricity sector after gaining the independence, although it has remained physically linked to the Russian part of the former system.

Owing to the structural reorganization of the energy power sector for Ukraine, seven energy generating and twenty-seven energy distributing companies (one in each oblast) were created. According to the legislation, four generating and twenty local distributing companies are subject to privatization. However, this market is still far from competition and a transparent price mechanism. The State intends to maintain major transmission lines and five nuclear plants, as well as a controlling share in all distributing companies. The wholesale energy price is claimed to be defined

by supply and demand interactions at free market operations. However, price and, thus, real money inflows are highly affected by National Committee on Energy Regulation (NCER).

The sector initially had a distinct vertical structure. The energy distributing companies, called "Oblenergo", were subordinated to the National Dispatching Center. Their primary task was supplying electricity to the end user. On the basis of the National Dispatcher Center and the company "Ukrenergoperedacha" (transmission agent) the Government created a new company "Ukrenergo" that owns the country's largest hydro- and thermal electricity generating plants (except the nuclear ones), high-voltage transmission network, and dispatching system.

The scheme nowadays of the supply side of the Ukrainian electricity market is described in figure 4. As it is seen, "Energorynok", the specialized branch of "Ukrenegro", buys electricity from all energy generating plants and sells it at wholesale prices to energy distributors. There are two large groups of distributors. Members of the first group – Oblenergoes, are obliged to supply energy at the price set by the regulatory body (NCER). Each of them supplies energy directly to consumers in a particular region of the country. The second group consists of so-called independent suppliers, and their prices are not regulated by NCER. This independent segment is highly concentrated: $CI_{10}=97\%$ (Kyl'nyc'ky O., 1998). The largest independent oligopolists are "Energoatom" (approximately 45% of the whole supply (Kyl'nyc'ky O., 1998)) and "Bari", that take part in nuclear fuel and gas trading. "Energoatom" sells its energy through several other additional intermediaries. Oblenergoes possess the transmission rights on low-voltage network. Thus independent suppliers pay Oblenergoes a fee for transmitting electricity through the network, determined by NCER (Figure 4).

Although the Ukrainian energy power sector has been in a focus of

economists for a long period, many questions about its structure and regulation are still open. The present model, adapted from Great Britain, has definitely improved the industry state: it introduced competitive forces, opened access for independent power producers and distributors, and created horizontal links. However, economic conditions and traditions of competition in Ukraine differ form those in Great Britain. Thus, mechanism that implies only money transactions can not work perfectly when barter and veksel transactions are widely used.

There are two main approaches toward energy market organization. The first one - market - implies price determination to base upon supply and demand interrelation. State does not interfere into delivery processes, as well as pricing schemes. It only possesses antimonopoly regulatory functions. The second approach - administrative - assumes direct government regulation. Ukraine, as often, tries to implement something in between. Energy is delivered to consumers in part according to the direct orders and in part based on business agreements. Government decides in each particular case which scheme and pricing mechanism would be involved (Kucherenko A., 1999). Such a system decreases efficiency and stimulates lobbing.

The current model introduces some positive and negative changes. As the main achievement a higher competitiveness and efficient dispatching system are worth to be mentioned. The main source of imperfections of the current model is that it attempts manually to control market mechanism.
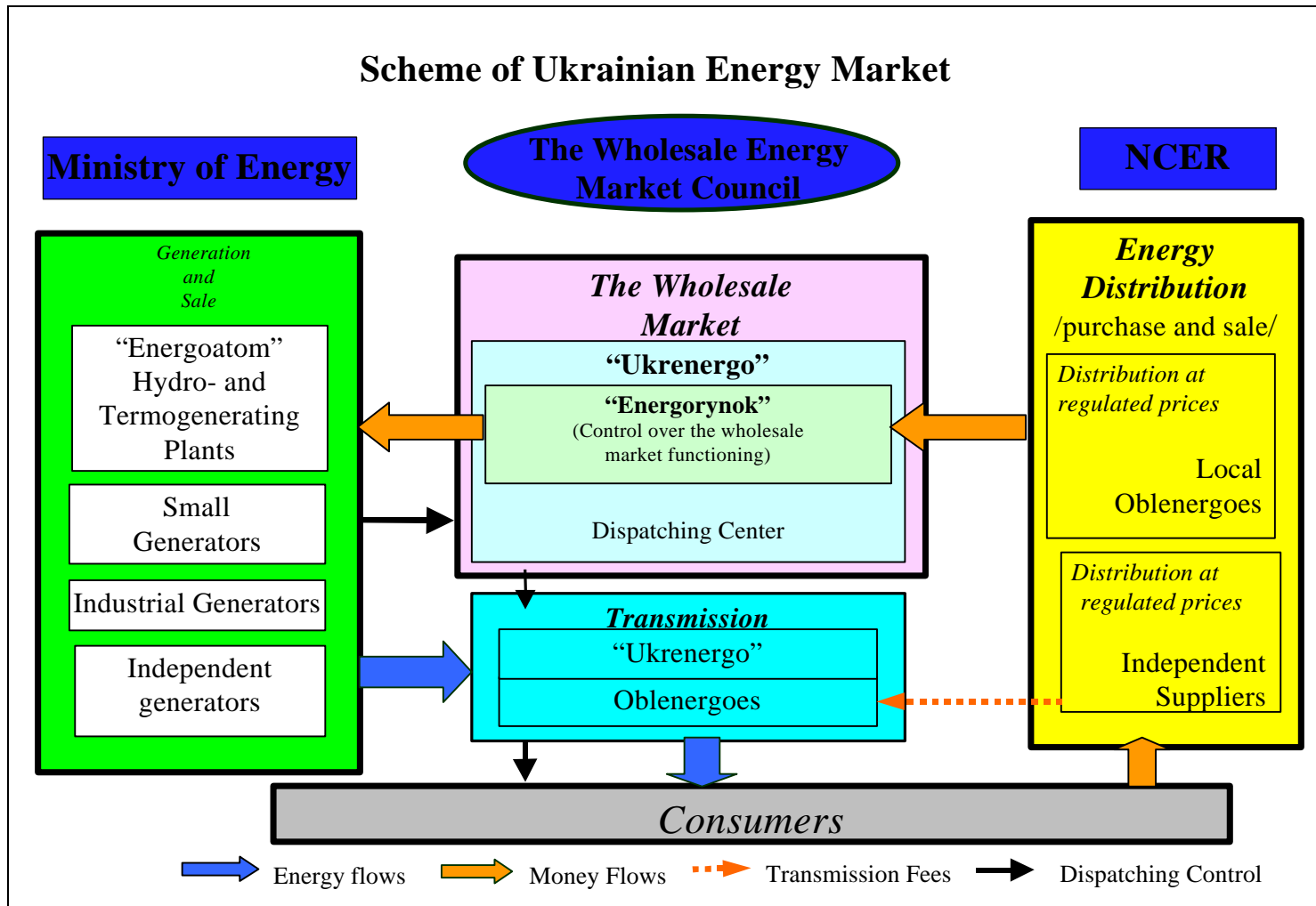
Figure 4. Ukrainian energy market.
Source: Adapted from NCER reports.

4.2. Regulation

Despite the fact that some Oblenergoes were transformed into joint-stock companies (up to 49% of their shares were traded in the open market), this sector is heavily regulated by the state. The main regulatory bodies are Verhovna Rada, the Government, the President, NCER, and local authorities. However, the regulation is highly influenced by lobbies' interests, that create additional problems with payments schemes, cost structures, and the profile of market players.

The whole range of these problems is connected with an issue of privileges. Priviledged groups include consumers from different segments that are legally allowed to pay some part of their bills. This part can vary from 75% to 0%. The weight of privileged groups is about 36% of all customers while they consume about 37% of the total amount energy produced (Ministry of Energy, 1998). 23.7% of privileged groups of consumer possess privileges on the whole amount of energy consumed (NCER, 1999). Such a legal framework causes a situation when some privileged customers consume 1000+ kw/h per mounth. In 1998 suppliers lose about 300 mln hrv due to that factor (NCER, 1999). The most important thing is that in many cases the fiscal sources that permit such redistribution are not clearly defined. Thus, other consumers and suppliers have to take this burden.

4.3. The Demand side

During 1990-1997 the profitability of the energy distribution had decreased from 22.2% to 1.5% in 1996 (Ministry of Energy, 1998). Moreover, it became even negative at the third quarter of 1997. This large fall in profitability was due to the several reasons: overall inflation; the growth rates of fuel prices that exceeded significantly the growth of

electricity prices; dramatic fall in consumption that was due to the decrease in standards of living; extensive privileges; and nonpayments. The last three points are the distinctive features of the demand side in recent years.

In 1998 energy consumption was equal to 130833.4 mln kWh (10350 mln hrv) (NCER, 1999). It is by 2% less than in 1997. Compare to 1995, consumption fall in volume by 8.7% (Ministry of Energy, 1995). However, the rate of fall constantly decreasing. The structure of consumption is quite stable: the main consumers are metallurgy (about 20-25%), resident (about 16-18%), and budget organizations (about 10-14%) (Ministry of Energy, 1995, 1996, 1997).

Only about 80% of the volume is paid by any means and only about 20% - in money terms. As of Jan. 1, 1999 the consumer's debt to the industry increased to 5415 mln hrv that is by 2310 mln hrv higher then the last year (NCER, 1999). The debt structure is as following (in mln hrv): coal mining - 753, chemicals and metallurgy - 669, machinery - 202, agriculture - 593, communal services - 1655, budget organizations - 469, other industries - 1075 (ibid.). As it is seen, communal services (30%), agriculture (11%), and budget organizations (9%) are the main debtors.

As in the most countries heterogeneous consumers create the energy demand in Ukraine. Usually, consumers are grouped according to the amount of energy consumed, density of distribution along the lines, remoteness from the large nodes, some geographic reasons (for example, mountains). However, in Ukraine, the prime factor, which is used to unite consumers into different groups, is a voltage requirement. The main reason for such classification is that sharp voltage transformation leads to significant losses in a network. In some cases such losses make up about 30% of distributed energy. Thus, it is important to group consumers according to the voltage characteristics. Unfortunately, such important considerations as density of consumers or geographical characteristics are

not taken into account.

The following voltage parameters are distinguished in Ukraine:

- 750 kW and higher
- 750 -220 kW
- 110 kW
- 35-10-6 kW
- 0.4-0.22 kW – residents and public sector.

Another factor that affects prices is a special policy toward the industrial sector, which is dominated by energy-intensive industries: steel, aluminium, machine building, and petrochemicals. In 1997 this sector consumes about 42% of total amount of energy, in particular metallurgy, which is considered to be an important component of Ukrainian export, consumed 20% of total amount of energy.

Based on these criteria, the energy consumers in Ukraine can be united into the following main groups:

- energy sector itself

- industry, I group (750 kW and higher), - this segment includes such industries as metallurgy, petrochemicals, and others;

- industry, II group (below 750 kw), - this segment includes such industries as textile, food processing, paper industry;

- agriculture;

- transport, construction sector;

- residents and public sector.

The last group, in which we are interested, is the second largest segment in Ukraine – about 16-18% of final consumption (Ministry of Energy, 1997).

4.4. Possibility of price discrimination in Ukraine

To study the possibility of discrimination and its effect on efficiency, I will deal with a residential demand. In particular, my research is focused on a demand of urban population, for it answers the necessary requirements needed for discrimination.

There are two groups of consumers in an urban area: residents who have electric stoves and those who have not. It is easy to divide consumers into these groups. Technical characteristics of the electric network make resale between the groups impossible. The cost of supplying energy is the same for both groups, since all residents consume energy at the same level of electric network. So, this segment satisfies all the conditions necessary for price discrimination. The difference in elasticity of these two demands is the only important issue left before we continue. To my point of view, residents with electric stoves are more dependent on electricity in their consumption. Since cooking meals is an everyday necessity and a stove requires a lot of energy, the demand for electricity of that group of consumers is less elastic. Each group is charged differently. In 1996–1998 household with electric stoves paid 5.3 kop/kw, while household that uses gas stoves paid 8.3 kop/kw (NCER, 1996); in 1999 the prices are 8.0 and 11.0 kop/kw respectively (NCER, 1998). Each household has an electric meter and pays the price, which is set by NCER for its particular group. Gas meters are rarely installed, thus households mainly pay a price that reflects a historical average consumption. As it is seen, the existing practice contradicts the theory: the less elastic demand is charges less.

It is worth to be mentioned that this case is not a unique example of discriminating practice in Ukrainian energy sector. There are some attempts to implement peak-load and non-uniform pricing. But they represent traditional well-studied cases and thus are not included in this paper.

The Ukrainian energy power sector is a large sophisticated industry. After a long period of administrative methods of operation it attempts to adopt another course of action. The restructuring process takes place under the condition of the overall crisis. Thus, nonpayments and the race for privileges are widespread phenomena. The urban household energy market possesses all feature of natural monopoly.

THEORETICAL MODELS

To analyze price discrimination in the Ukrainian urban market, I will refer to two benchmark models. The outcome of the first model is the most beneficial for the producer, the second model benefits consumers the most. These two extreme cases are used to show that efficiency rationale restricts pricing policy to an inverse elasticity rule.

In all cases, there are separate markets that are described by the same demand functions and cost function. Both demands are supposed to have the properties of "well behaved" neoclassical functions.

5.1. The model of discriminating monopolist

The case of simple discrimination can be easily found in all major Microeconomics and Industrial Organization texts (see, for example, Carlton, 1994, p. 443-447). It can be modeled in a following way. Let us specify two independent demand functions as $p_1 = D_1(q_1)$ and $p_2 = D_2(q_2)$ where p_2 is considered to be a more elastic demand. The cost function is $TC = f(q_1 + q_2)$. The supplier is assumed to be rational which means that he maximizes his profit. There is no regulation and other limitation. The model is formulated as:

$$\max_{q_1, q_2} \{p_1 q_1 + p_2 q_2 - TC\} \tag{1.}$$

The result of the optimization is described by the *inverse elasticity rule.*

$$\frac{p_i - MC}{p_i} = \frac{1}{e_i} \qquad (2.)$$

or after restating

$$p_i = \frac{MC}{1 - 1/e_i} \qquad (3.)$$

This result tells us that to extract maximum profit from all markets the price in each market should be set inversely proportional to its price elasticity.

There is strong economic reasoning for such relationship. Other things equal, a lower elasticity implies a smaller reduction in profit when the price goes up.

5.2. Ramsey pricing

This case is an example of average cost pricing. The agency regulating the natural monopoly could seek to enforce prices which would maximize consumer surplus but make it possible for the producer to operate in all markets. This condition requires that total profit cover at least average cost of production. F. Ramsey (1927) first derived this model. The solution is similar to optimal monopoly price discrimination: the optimal prices are the monopoly prices scaled down so that profit is equal zero (Baumol, Bradford, 1970; Sharkey, 1982).

Using previous specification, the model can be presented as following:

$$\max_{q_i} \{ \sum_{i=1}^{n} \int_{o}^{q_i} p_i(t)dt - TC(q_1,...,q_n) \} \tag{4.}$$

$$s.t. \sum_{i=1}^{n} p_i q_i = TC(q_1,...,q_n)$$

After deriving the first order conditions, the solution can be presented in such a form:

$$\frac{p_i - MC}{p_i} = \frac{\boldsymbol{l}/(1+\boldsymbol{l})}{\boldsymbol{e}_i} \tag{5.}$$

where $\boldsymbol{l}$ is a Lagrangian multiplier on the break-even constraint. The multiplier $\boldsymbol{l}/(1+\boldsymbol{l})$, called the Ramsey number, does not vary over market segments, so the inverse elasticity rule takes place in this model as well as under the standard monopoly price discrimination condition. The Ramsey number absorbs some degree of monopoly power so that prices differ to the extent which is necessary for the firm to cover its cost.

Thus, if for service to be provided price distortion is needed it is more efficient to load the larger burden of distortion on the market segment with less elastic demand. Such policy leads relatively smaller output contractions and hence relatively modest dead-weight losses (all else equal).

As it is seen, *efficient discrimination whether it is beneficial either for producers or consumers should satisfy inverse elasticity rule.*

PRICE DISCRIMINATION – UKRAINIAN MODEL

As it can be observed, the inverse elasticity rule describes the essence of price discrimination: the more sensitive demand is the lower price should be charged. The pricing policy in the explored Ukrainian market rather follows the opposite principle: households with gas stoves, whose demand is more elastic (as it was mentioned above), are charged a higher price.

6.1. Price discrimination as declared by Ukrainian officials

The regulatory authority, that determines price, explains this fact by social concerns. If Ramsey pricing model focuses upon total consumer surplus, in other words it protects consumers as a whole, the model that Ukraine claims to implement emphasizes some kind of equal opportunities for different consumer segments.

This model attempts to account for the following social factor: people should not be penalized for using electric stoves in terms of a higher price.

The opponents of regulation with respect to such reasoning can point that it is market forces but not government that should solve this problem. However, the market solution would require to substitute an electric stove by a gas one if a consumer is better off with letter.

There are several reasons why such substitution is not desirable.

Despite the fact that it is prohibitively costly, for the purpose of our analysis we can omit the case of direct cost since it is simply a choice

between two capital streams. If the cost of purchase and installation of the gas stove is less than the difference in payments with two kinds of stoves for the same consumer, there is an incentive for him to substitute. This situation provides no support for governmental intervention in a form of pricing policy.

Nevertheless, there are indirect costs of such substitution that determine reasons for electric stoves to be more desirable from social point of view.

- <u>Safety concerns.</u> – There is a perception that houses with gas pipes installed are more likely to be subject to fire.

- <u>Gas pipes are not always available.</u> – In particular location (mountings, swamps) an installation of gas pipes is prohibitively costly or even not possible at all.

- <u>Technical requirements for some types of buildings.</u> – It is prohibited by technical standards to install gas stoves in public and some multistoried buildings.

- <u>Legacy from the past (old dwellings).</u>

Thus, pricing policy, that is claimed to be implemented in the Ukrainian urban residential market, is aimed to force such a condition:

payments for gas plus payments for electricity for the household with a gas stove should be equal to payments for electricity for the family that uses an electric stove.

To model this requirement some assumption about relationship between the demands for gas and for electricity should be made. Since gas is used as a factor in energy production they are likely to be complements: increase in gas price causes energy price goes up, which, in turn, reduce

consumption of both commodities. So, it is quite logical to assume constant proportion z between payments for gas and electricity in families that use a gas stove. This assumption is as good as any other but it let us avoid unnecessary complications.

The model that formalize these policy considerations can be presented as following, using previously mentioned terms:

$$\max_{q_1,q_2} \{p_1 q_1 + p_2 q_2 - TC\} \tag{6.}$$

$$s.t. \ z / n * p_1 q_1 = 1 / k * p_2 q_2$$

where n is a number of families with gas stoves, k is a number of families that use electric stoves, and z is the constant described in previous paragraph.

The first-order conditions are:

$$\begin{cases} \P L / \P q_1 = \P p_1 / \P q_1 q_1 + p_1 - MC + l \ z / n(\P p_1 / \P q_1 * q_1 + p_1) \\ \P L / \P q_2 = \P p_2 / \P q_2 q_2 + p_2 - MC - l \ / k(\P p_2 / \P q_2 * q_2 + p_2) \\ z / np_1 q_1 = 1 / kp_2 q_2 \end{cases} \tag{7.}$$

$$\Rightarrow \begin{cases} p_1 = \dfrac{MC}{(1 - 1/e_1)(1 + l \ z / n)} \\ p_2 = \dfrac{MC}{(1 - 1/e_2)(1 - l \ / k)} \\ z / np_1 q_1 = 1 / kp_2 q_2 \end{cases} \tag{8.}$$

As it is seen, in our case an "equality" distortion scales discriminating prices disproportionally, opposite to the Ramsey case when multiplier is the same. Thus it might be the case that p_2 appears to exceed p_1 although demand in the first segment is less elastic.

This process is limited by the constraint

$$1 - l / k > 0 \qquad (9.)$$

If substitute l by known parameters, it is possible to show that meaning of this constraint is the following: the price at the larger market could be as high as it is allowed by the limit of the revenue that be extracted from the smaller market.

Since $e_1 < e_2$ for $p_1 < p_2$ the following inequality should be satisfied

$$\frac{MC}{(1 - 1/e_1)(1 + l \, z / n)} < \frac{MC}{(1 - 1/e_2)(1 - l / k)} \qquad (10.)$$

$$\Rightarrow \frac{(1 - 1/e_2)}{(1 - 1/e_1)} < \frac{(1 + l \, z / n)}{(1 - l / k)} \qquad (11.)$$

from $e_1 < e_2$ obtain $\dfrac{(1 - 1/e_2)}{(1 - 1/e_1)} > 1$ thus

$$\frac{(1 + l \, z / n)}{(1 - l / k)} \gg 1 \qquad (12.)$$

As soon as $l, z, k, n > 0$ we can guarantee that

$$\frac{(1 - l \, z / n)}{(1 - l / k)} > 1 \qquad (13.)$$

However, it does not mean that (11) would be true. Thus, even "equality" policy does not automatically imply that households using electric stoves should be charged less per quantity consumed.

6.2. Practice

Whatever attractive for social purposes these policy considerations might be their practical implementation in Ukraine leaves no doubt that the existing prices do not satisfy either efficiency or equity requirements.

The residential prices for each kind of consumers are determined by the following procedure. At the beginning the rental price is calculated and after that it is multiplied by a certain coefficient to get price for the "preferential" household (those using an electric stove).

This coefficient was defined in the past – in time of the Soviet Union. It was calculated how much gas and electricity each group of residents consumes on average and what prices should be to equalize spendings. The proportion p_1/p_2 has been used till present for further calculation. When prices for inputs goes up by a certain rate the regulator agency multiplies the existing residential prices by the same rate.

This approach could be justified only if we assume that previous prices were "correct" and the average consumption has not changed. However, both these assumptions are false. In Soviet times, electricity prices were used as a target for trading, industrial, and, partially, social policies. They did not reflect the full cost of production. The second sub-condition is also incorrect. After Independence, residential consumption fell. In 1995 urban residents consumed about 26134.3 mln Kw/h, in 1996 – 16714.2, in 1997 – 16292.8 (Ministry of Energy, 1995, 1996, 1997a).

Nevertheless, the old proportion is still in use. When new retail price is calculated to obtain prices for each group, it is multiplied by corresponding coefficients.

The retail price the residents face is calculated according to the

formula (NCER, 1997):

$$P_r = P_w k + P_t$$

where P_r – retail price

P_w – wholesale price

k – technical coefficient

P_t – price, which Oblenergo charges for its service.

The wholesale price is determined at the wholesale market on a competitive basis. Thus, energy producers earn zero economic profit. The price for energy transmitted and distributed by Oblenergo is regulated by NCER. It is set to be equal to the costs, that Oblenergo reports divided by the quantity of electricity it is supposed to supply. Under such conditions, Oblenergoes have a huge potential to earn extra profit. To get it they need to provide "overestimation" of their costs and "underestimation" of the future supply (Figure 5).
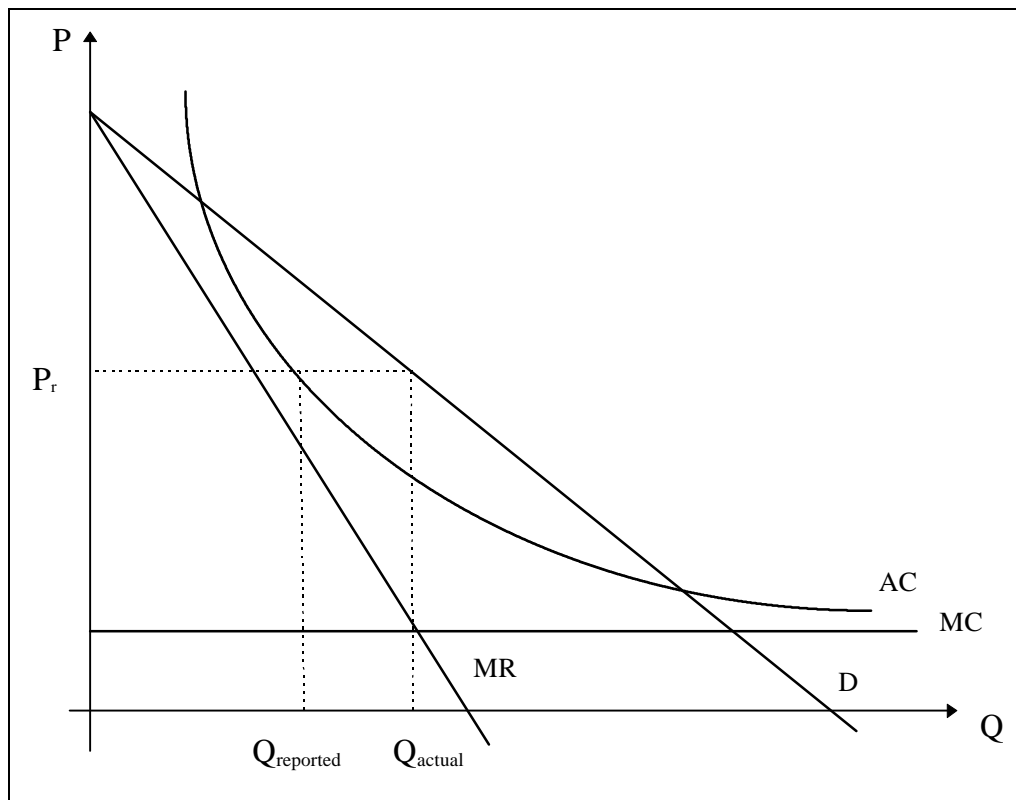
Figure 5. Optimal pricing.

   For obvious reasons, data that could directly justify support or reject these hypothesis estimations are not available to the public. However, there is some indirect evidence that the above assumptions may be true. According to the data by the Ministry of Statistics in March 1999, the personnel of the energy sector earn the highest average monthly wage among other industries – 385.96 hrv, whereas the average wage in the entire economy was 166,61 hrv (Facts and Comments, p.6). According to the Ministry of Energy, in 1998 at least 300 mln hrv of abnormal profit were accumulated at the accounts of Oblenergoes (Companion, 1999). And at least some Oblenergoes did supply more energy than they had planned in 1998.

CONCLUSIONS

Price discrimination can take different forms from the very desirable for the consumer to those that benefit producers the most. The choice of a certain model is highly affected by the environment. Who are winners and losers, whether the information needed to implement this model is available, does it provide enough stimulus to guarantee efficiency. This is only a small list of questions that should be addressed.

The model that is claimed to be implemented in Ukraine is an attempt to balance between equity and efficiency. Although it does not exactly imply the inverse elasticity principle to be violated its results are highly depended upon parameters of demand.

In practice, cost approach prevails. It is quite simple and close to the pure monopoly case with price difference explained by traditions. Although the government in a form of "priviledge burden" extracts some part of the extra profit of Oblenergoes this doubtful advantage could not compensate losses from inefficient consumption. Both under- and overconsumtion distores the entire economy. This policy sharply reduces incentives for energy conservation and capital investment.

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