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## **Improving sales revenue collection by reducing the losses in central regional electricity distribution networks<sup>1</sup>**

by

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One of the bases for increasing the efficiency of operation of the electricity transmission and distribution companies is to reduce the total losses up to the allowed level. Concerned authorities have paid much attention on this matter.

The Mongolia's Sustainable Energy Sector Strategy provides that the total losses in electricity network will be reduced by up to 15 %.

In the past years, the technical and non-technical losses of electricity distribution network have considerably exceeded the allowed level, which negatively influenced not just the electricity sector but also the economy. The extent of losses could lead distribution companies to bankruptcy. To address the problem, the Energy Regulatory Authority has set the maximum level of losses allowed of distribution companies and started to undertake monthly and quarterly monitoring. As a result of this and those of other technical measures implemented by distribution companies, electricity losses were reduced and sales revenue collection rate increased.

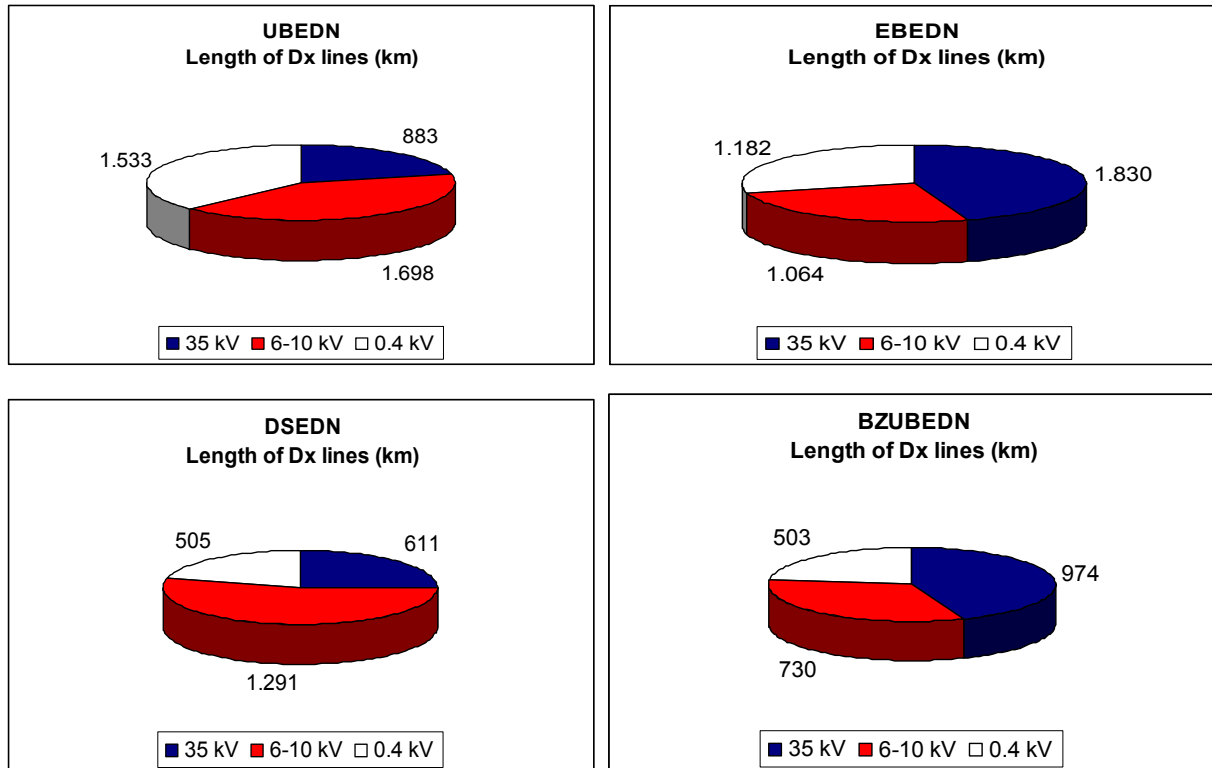
In Mongolia, 90% of electricity is generated by the five coal fired thermal power plants located in the central region. The total installed capacity in the central region is 779.5 MW. The average peak load is about 470 MW, which is about 60% of the total installed capacity.

Mongolian central region energy system distributes over 2.1 billion kwh of electricity each year through the electricity distribution network composed of 4298 km 35 kV lines, 4783 km 6-10 kV lines, and 3723 km 0.4 kV lines. These amount to 2000 km electricity distribution lines and about 2140 pieces of substation.

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The length of the distribution lines of 4 main distribution companies are shown below.



The following factors contribute to the high level of losses in electricity distribution:

### 1) Technical loss

- Aging and outdated equipment - 20% of all equipment was installed before 1970 while about 40% was installed before 1980
- High percentage of auxiliary (own) consumption
- Relatively long overhead power lines
- Low consumption - the consumers are geographically dispersedly
- Non-standard (Illegal) connection
- Unequal phase load
- The capacity of transformers does not match the demand (overloading or running without load)

### 2) Electricity meters and measuring devices

- Consumption without meters

- Mechanical meters with low sensitivity and accuracy - not counting at low load and effects of environmental (i.e. temperature, vibration influence, etc.)
- Repositioning of meters by consumers
- Meters not matching the load
- Faults of inspectors (wrong meter reading)

### 3) Commercial loss

Attributable to consumers:

- Illegal, abnormal use or theft
- Connection to the network without informing the supplier
- Non-payment or delays in payment by the consumers

External reasons:

- Unsound management by the supplier
- Non-optimal revenue collection system (without incentives)
- Poverty - consumer's low paying capacity

The distribution losses and sales revenue collection rate of central region distribution companies from 2002-2004 are shown in the tables below.

#### Year 2002

Items	Measuring unit	Ulaanbaatar EDN	Darkhan-Selenge EDN	Erdenet-Bulgan EDN	Baganuur-South east region EDN	Total
Purchased electricity	Mil Kwh	973.1	301.6	879.2	174.2	2,328.1
Loss of line	%	33.30	22.52	4.8	13.37	<b>19.7</b>
	Mil Kwh	324.0	67.9	42.80	23.3	458.0
Billed electricity	Mil Kwh	649.1	233.7	836.6	150.9	1,870.3
Sales revenue	thous.tug	29,687.7	11,747.5	36,102.0	6,843.8	<b>84,381.0</b>
Collected revenue	thous.tug	28,458.5	10,570.6	33,355.2	6,310.7	78,695.0
Revenue collection rate	%	95.86	89.98	92.39	92.21	<b>93.3</b>

#### Year 2003

Items	Measuring unit	Ulaanbaatar EDN	Darkhan-Selenge EDN	Erdenet-Bulgan EDN	Baganuur-South east region EDN	Total
Purchased electricity	Mil Kwh	1,022.0	322.3	908.3	166.7	2,419.3
Loss of line	%	32.88	19.45	4.5	13.06	<b>19.0</b>
	Mil Kwh	336.0	62.7	38.20	21.8	458.7
Billed electricity	Mil Kwh	686.0	259.6	870.1	144.9	1,960.6
Sales revenue	thous.tug	31,684.7	11,087.5	37,432.9	6,679.3	<b>86,884.4</b>
Collected	thous.tug	30,791.8	9,590.1	38,788.3	6,865.8	86,036.0

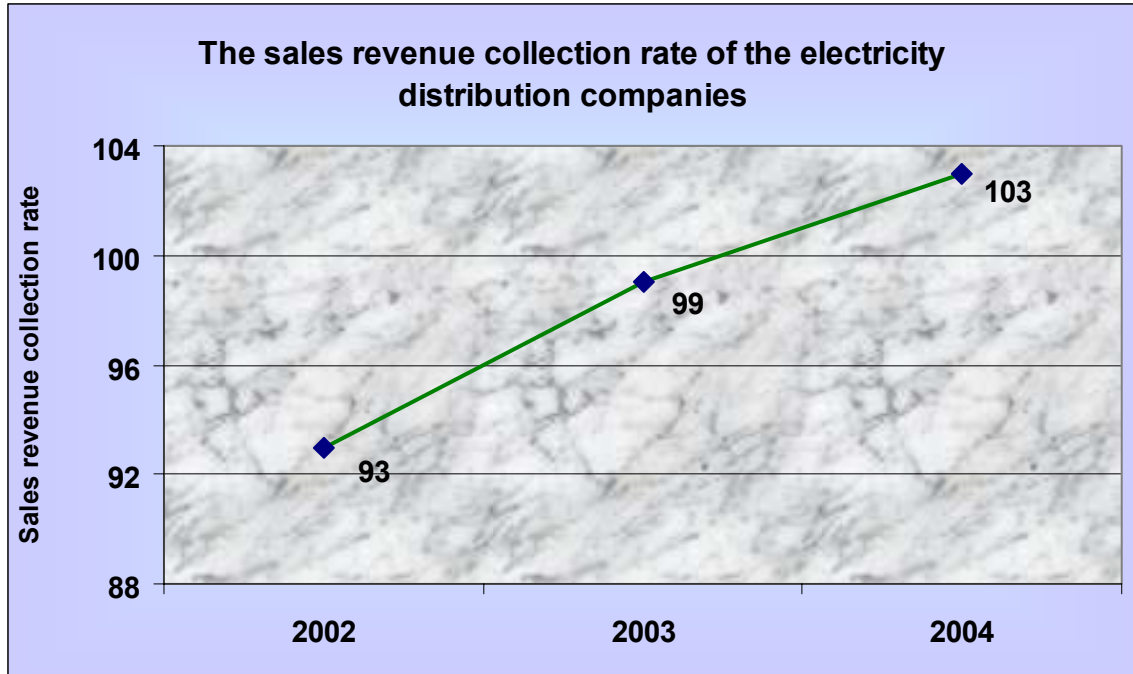
revenue						
Revenue collection rate	%	97.18	86.49	103.62	102.79	<b>99.0</b>

#### Year 2004

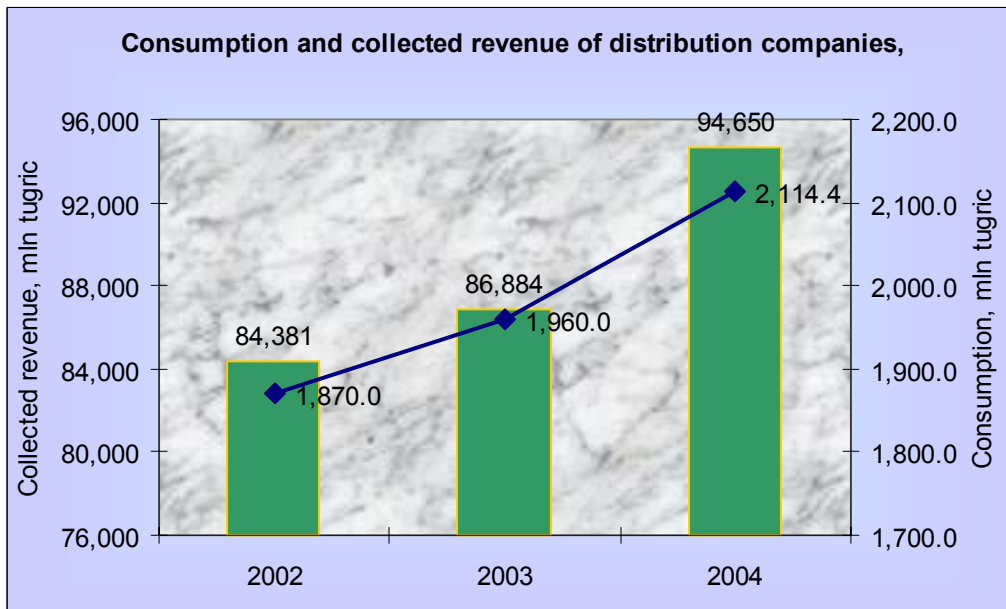
Items	Measuring unit	Ulaanbaatar EDN	Darkhan-Selenge EDN	Erdenet-Bulgan EDN	Baganuur-South east region EDN	Total
Purchased electricity	Mil Kwh	1,079.0	393.9	918.7	169.1	2,560.7
Loss of line	%	30.69	15.03	3.64	13.30	<b>17.4</b>
	Mil Kwh	331.1	59.2	33.50	22.5	446.3
Billed electricity	Mil Kwh	747.9	334.7	885.2	146.6	2,144.4
Sales revenue	thous.tug	34,565.7	14,384.6	38,948.6	6,751.0	<b>94,649.9</b>
Collected revenue	thous.tug	33,698.0	17,239.2	39,948.6	7,019.8	97,905.6
Sales revenue collection rate	%	97.5	119.8	102.6	104.0	<b>103</b>

The revenue collection rate was calculated by comparison to the billed electricity in the above table and the previous debts and receivables taken from the consumers are also inputted in the calculation.

The electricity distribution companies sales revenue collection and consumption from 2002-2004 is shown in the chart below.



The electricity distribution companies sales revenue collection rate for 2002-2004 is shown in the below chart.



Factors influencing the sales revenue collection:

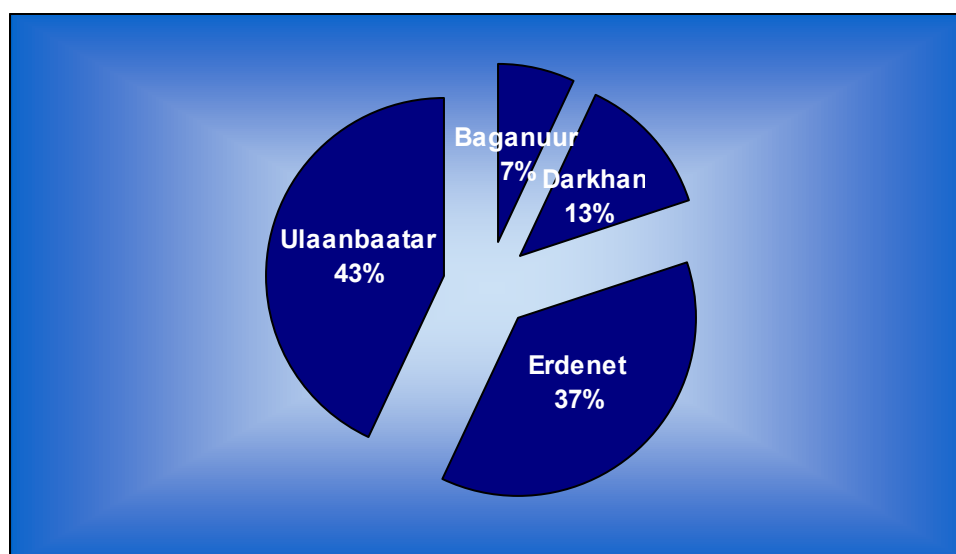
- 1) The actual payment rate by consumers is low. However, due to the measures undertaken in the past years, sales revenue collection rate by the distribution companies increased by 15%.
- 2) The external factors influencing the sales revenue collection are:
  - Delay payment of bill
  - Lack of incentive in the billing revenue collection system
  - Insufficient regulation
  - Poverty

In Mongolia, electricity transmitted to far-flung rural areas with low load of 150-200 Kw has high percentage of line loss and the voltage rate is higher than the allowed level. It is noteworthy that the number of consumers in urban area is increasing, and consequently, the overhead line load is also rising. Without renovation of equipment, companies will encounter serious problems in the distribution of electricity.

In particular, it is necessary to renovate and repair the 0.4 kV lines because these are outdated. This condition is an opportunity for electricity pilferage and increases non-technical loss.

In Mongolia the actual distribution loss is 2 times higher than the allowed level. The loss is about 30% without considering the major consumers, and 70% of the total loss comes from 0.4 kV lines.

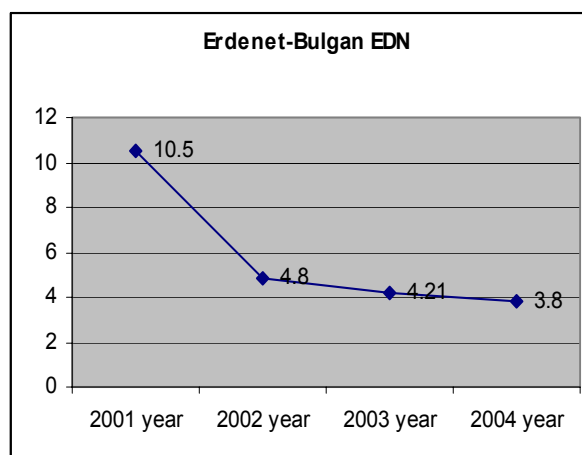
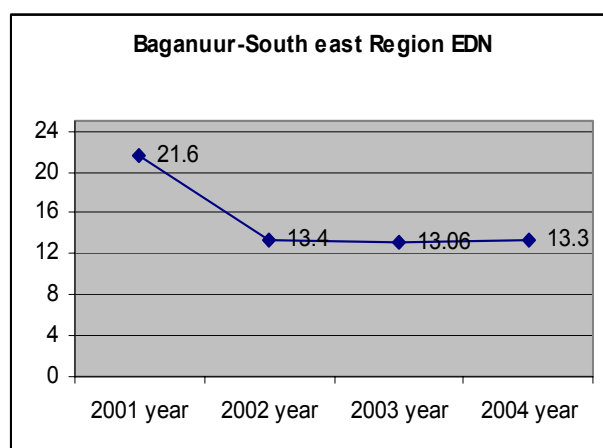
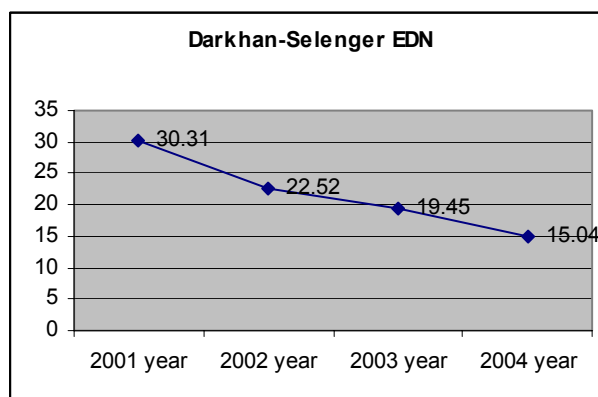
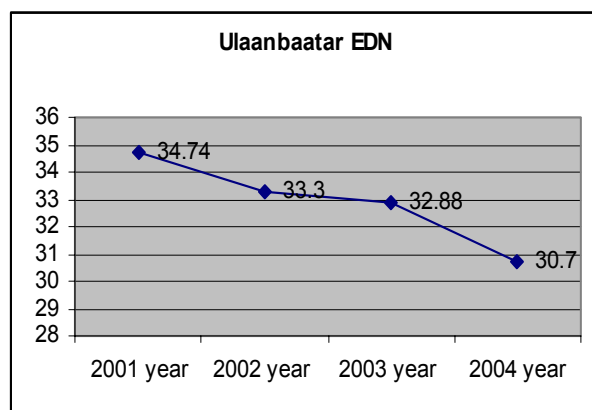
The share of the 4 main distribution companies in electricity market is shown in the chart below:



Although the Ulaanbaatar electricity distribution network covers about 43% of the total distribution in central region, its distribution loss accounts for 75% of the total loss. This clearly indicates that more measures must be undertaken to reduce its distribution loss.

Seventy percent (70%) of the total consumers is composed of entities and enterprises while 30% consists of households.

The losses of distribution companies from 2001-2004 are shown below:

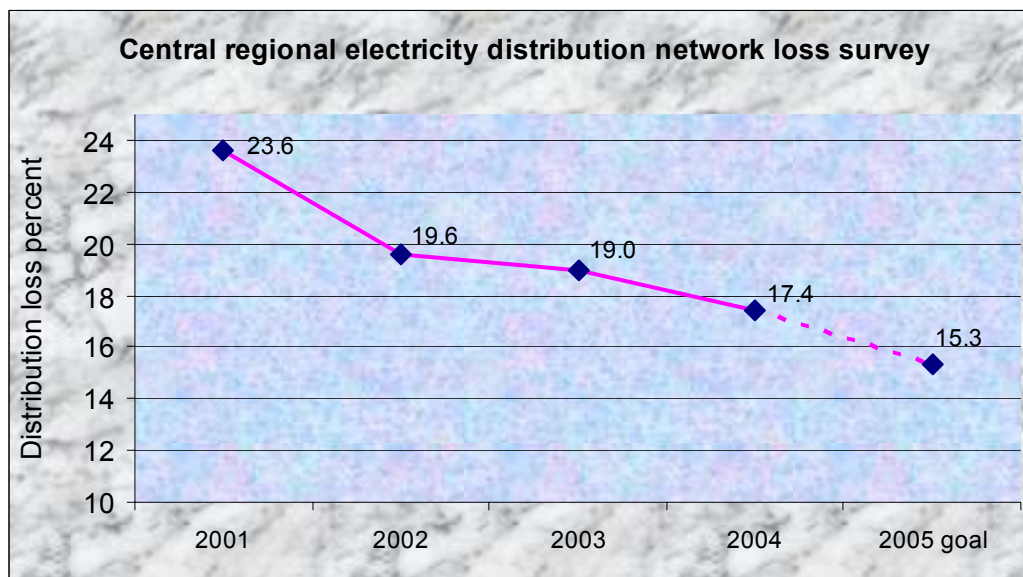


Central regional distribution network

<sup>1</sup>	Item	Unit	2001	2002	2003	2004	2005 goal
1	Purchased electricity	Mil Kwh	2431.9	2328.1	2419.3	2560.7	2594
2	Energy	Mil Kwh	568.9	457.3	458.7	446.3	397.7
	Percentage of distribution network loss	%	<b>23.6%</b>	<b>19.6%</b>	<b>19.0%</b>	<b>17.4%</b>	<b>15.3%</b>

3	Electricity sale	Mil Kwh	1845	1870.4	1960.5	2114.4	2196.3
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The central regional electricity distribution network's loss from 2001-2004 is shown on the next chart:



From the above, one can see that the central regional electricity distribution network loss has reached 17.4% in 2004, a 6.2% reduction (i.e. 122.6 thousand Kwh equal or 5.7 billion tugric) compared to the loss in 2001.

In summary, these are the measures implemented to reduce technical loss in the last three years:

1. Installed new electricity meters with high accuracy on the bordering point of ownership of transmission and distribution companies
2. Have started replacement of consumers' meters to meet international standards, that is, accuracy of 0.5-1.0; implemented monitoring on validation of meters.
3. Undertaken measures to distribute evenly the phase loads of 6-10 transformers, to replace the old transformer by a new one with capacity fit to consumption
4. LV overhead line length was reduced and replaced, and meters were unified at the main room and installed in sealed boxes in ger area. The Ulaanbaatar EDN has implemented this in 54 objects with 4500 consumers, and as a result, sales revenue collection increased from 25-40% up to 90-95 %.
5. Introduced rule for increasing the reactive power coefficient. In 2004, UBEDN measured  $\cos \varphi$  on 120 entities billed 1.2 mil kwh of electricity on 78 consumers with low indices and collected 65.7 mil tugric.



6. Began the replacement of strip conductors by covered conductors. The newly constructed substations in 2004 and the 36 old substations were renovated and a total of 8428 pieces of consumer meters have been unified and re-installed in a separate room. 83.4 km 0.4 kV overhead lines were replaced by covered conductors.
7. Started to introduce prepaid meters and installed devices to allow remote reading of meters.
8. The Energy Regulatory Authority has set the maximum level of loss allowed of distribution companies and started to implement monthly and quarterly monitoring and evaluation of activities of distribution companies.

Although the distribution companies have been taking necessary actions to reduce electricity loss, particularly, the UBEDN Company which covers over 40% of the distribution in central region, 70% of the total loss needs technical and management reform, which in turn, requires much investment.

If the UBEDN company could eliminate non-technical losses, which amounts to about 160.0 million kwh each year, It would save 7.5 billion tugrics and be able to finance the required investment within a very short period of time and make a profit of similar amount.

A project to reduce distribution loss and improve sales revenue collection has been implemented by Ulaanbaatar EDN under a soft loan of USD 18232.4 from the World Bank.

The following measures have to be implemented to reduce the losses of distribution network:

1. To commercialize electricity distribution networks and privatize their management
2. To introduce the state-of-the-art equipment that fit international standards
3. To have a unified registration (and a database) for transformers and meters
4. To establish "Consumer Affairs" centers
5. To introduce new methods and approaches to promote electricity sales
6. To provide the consumers with meters owned by the UBEDN Company
7. To introduce new sales revenue collection system
8. To create laws and regulations dealing with electricity pilferage

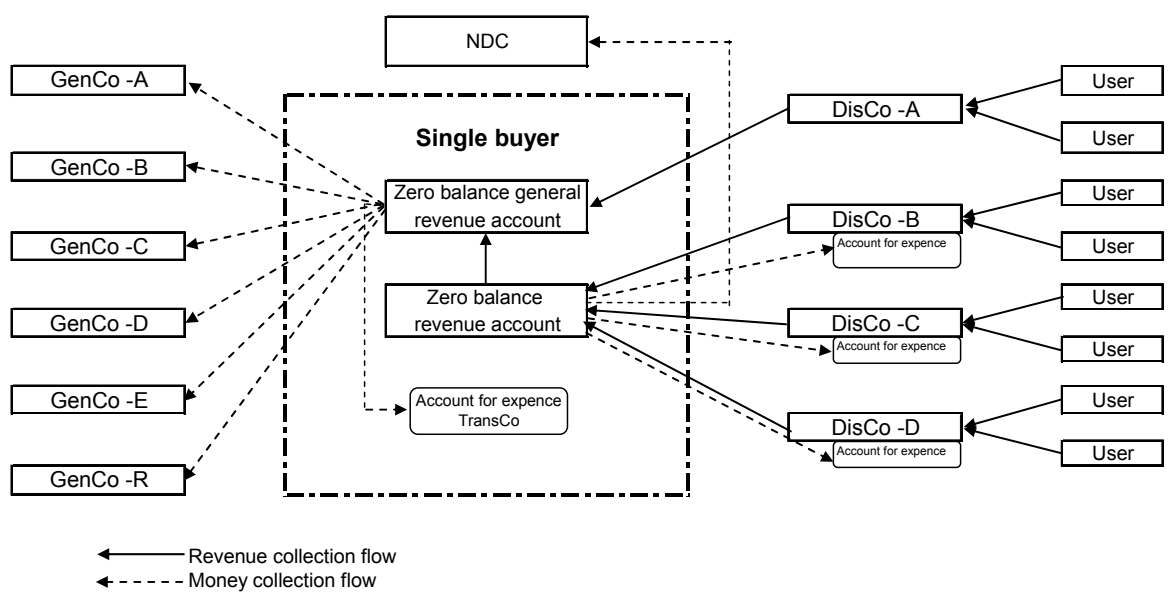
### **Results of implementation of the "Single Buyer" model**

The Single Buyer Model was used as an operational model in central regional energy system of Mongolia since 1 September 2002. This model, which was introduced to adapt to the Mongolia's specific condition and features, created a new energy payment system. It has allowed forging of agreements with commercial banks to make prompt sales.

In detail, cash flows from consumers settled through the "zero balance" account of distribution companies and further settled through "zero balance" account of

transmission company (CRETc) based on a predefined formula and coefficients agreed by 70% of all licensees participating in the model, and then distributed to power generating companies. In accordance with this model, cash allocation is made automatically by bank transfer without external influence or intervention from any entity.

The principal scheme for allocating the revenues is:



Before adoption of the “Single Buyer” model the power plants encountered financial difficulties and were unable to effect payment of coal to the coal mines.

The power plants were able to get just 75% of the sales. In addition, over 40% of the payments were settled through offsets. Since the inception of the SBM model, the revenue collection has increased yearly and reached 97% in 2004 and the level of offsets were down to 14.9%.

“Single Buyer” model sales revenue collection rate and level of offsets

