Calculation of Normative Electricity Losses for Grid Companies




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Regulatory framework for calculating, monitoring and regulating electricity losses (1)

- Georgian law on Electricity and Natural Gas.
- Rules governing Electricity (Capacity) market.
- Decision # 23 issued by the Commission on 18 Sep 2008 about Approving the Rules for Monitoring and Licensing the Activities in the fields of Electricity, Natural Gas and Water Supply.

Regulatory framework of calculating, monitoring and regulating electricity losses (2)

- According to article 5 of Georgian Law on Electricity and Natural Gas, Commission shall approve the amount, as well as the rules for calculating normative losses.

- Rules Governing the Electricity (Capacity) Market regulate the way the actual losses shall be determined in the electricity system, including during the electricity transit.

Regulatory framework for calculating, monitoring and regulating electricity losses (3)

- Methodology for electricity transmission, distribution, pass-through and usage ratemaking.

- According to the ratemaking methodology:

- The cost of normative losses established by the Commission shall be reflected in a corresponding rate if this particular service is entitled to incur such costs as per applicable legislation.

Regulatory framework for calculating, monitoring and regulating electricity losses (4)

- If the actual losses of the transmission and distribution grid are higher than allowed for the given grid, the cost of the difference will not be included during the rate calculation process (the owners of the given grid will not be reimbursed for the surplus losses).

If the actual losses are less than the approved normative losses for the given grid, the Commission is entitled to treat the profit from the difference as a financial asset of the company.

Regulatory framework for calculating, monitoring and regulating electricity losses (5)

- Every year, from April 1 to May 1, each licensed electricity company must file a report with the Commission on their compliance with license terms.

- According to the technical specifications of the reporting procedure, grid companies shall submit quarterly and annual data on actual losses in the grid.

The dynamics of calculating normative losses as per the regulations of the Commission

- *According to decision # 2/2 of 21 Jan 2000:*
  - In the transmission grid (500 - 35 kV) - 10.56 %;
  - In the distribution grids (110 - 35 - 10(6) - 0.4 kV) - 13.0 %.
- *According to decision # 63 of 12 Jul 2002:*
  - In the transmission grid (500 - 35 kV) - 9.96 %;
  - In the distribution grid - 13.0%
- *According to decision # 17 of 11 May 2006:*

  Total loss - 13.2%, including:
  - In the transmission grid - 4.41% (500-220-110-35 kV);
  - In the distribution grid - 2.8% (110 - 35 kV);

    5.99% (10 (6) - 0.4 kV).

Normative and actual electricity losses in distribution company grids (1)

JSC Telasi

- – Normative losses - 12.4%; including:
  - For 110 kV voltage level – 1.17%;
  - For 35 kV voltage level – 0.5%;
  - For 10 (6) kV voltage level – 5.28%;
  - For 0.4 kV voltage level – 5.45%.
- Actual losses in: 2010 - 15.8 %;
  2011 - 13.6%;
  2012 - 10.1%;
  2013 - 7.5%.

Normative and actual electricity losses in distribution company grids (2)

JSC Energo-Pro Georgia

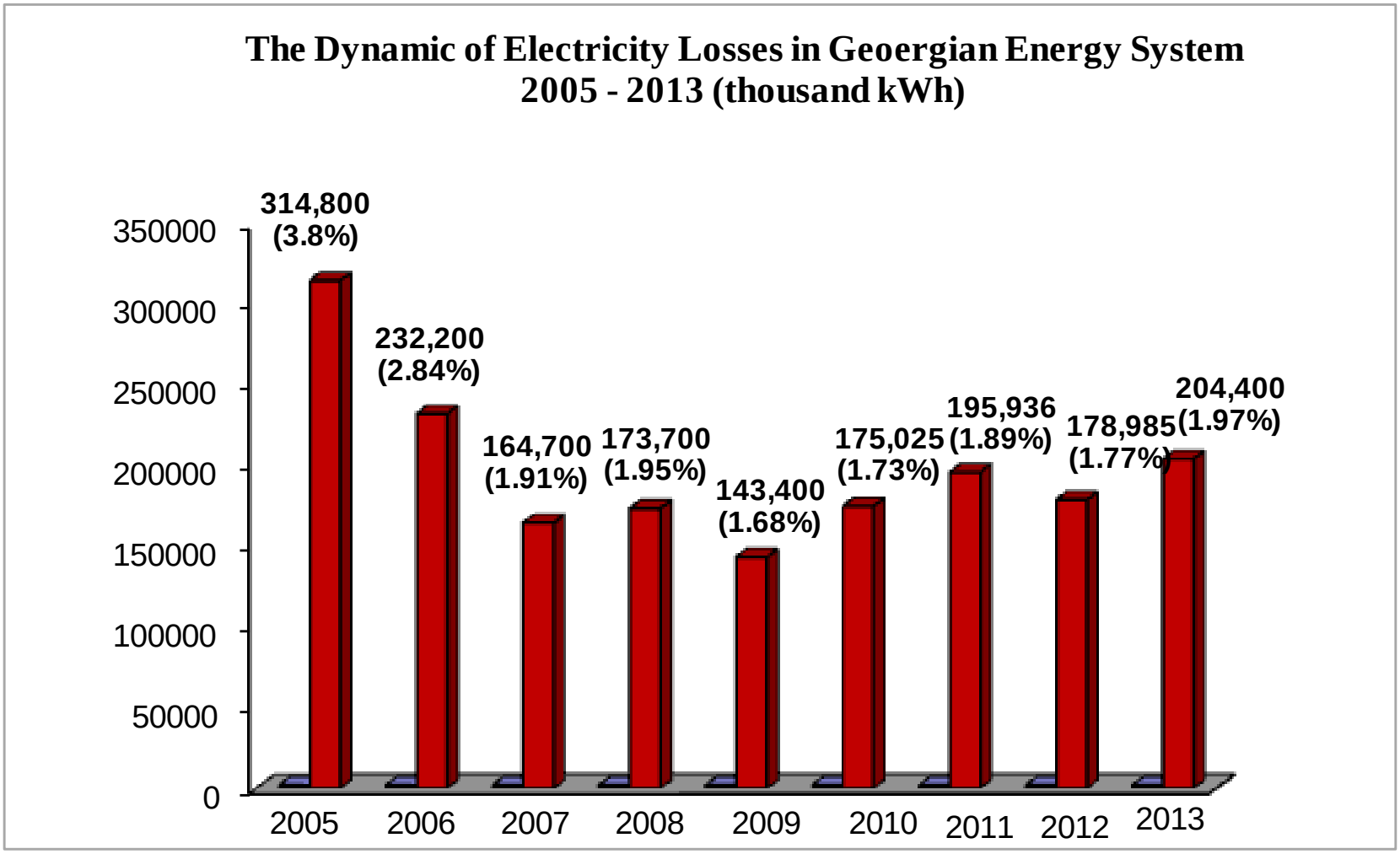
- – Normative Losses - 14.61%; including:
  - For 110 kV voltage level – 2.6%;
  - For 35 kV voltage level – 0.91%;
  - For 10 (6) kV voltage level – 5.0%;
  - For 0.4 kV voltage level – 6.1%.
- Actual losses in: 2010 - 13.2 %;
  2011 – 10.3%;
  2012 – 8.8%;
  2013 – 8.3%.

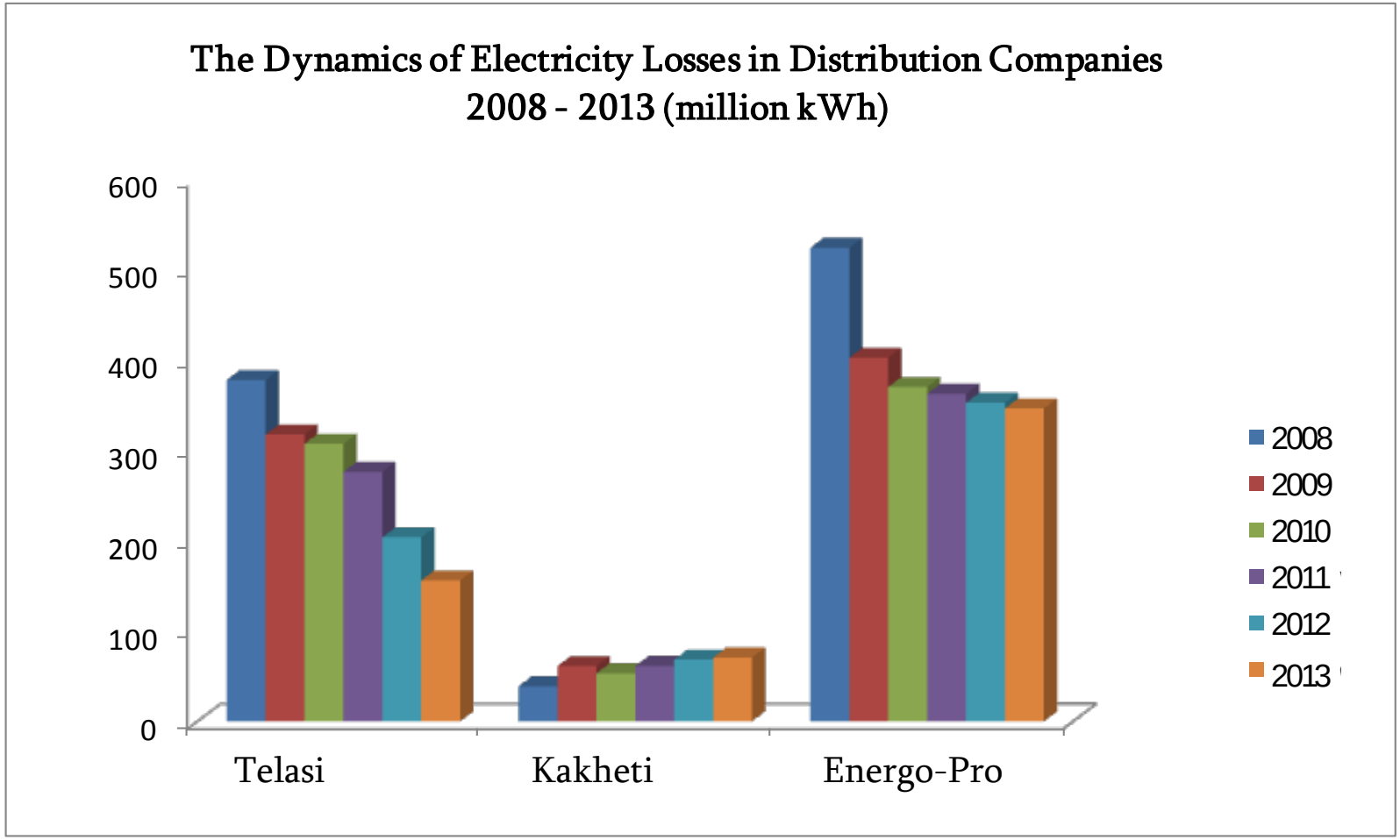
Normative and actual electricity losses in distribution company grids (3)

JSC Kakheti Energy Distribution

- – Normative losses - 10.5%; including:
  - For 10 (6) kV voltage level – 4.5%;
  - For 0.4 kV voltage level – 6.0%.

- Actual losses in: 2010 – 22.3 %;
  2011 – 23.9%;
  2012 – 25.1%;
  2013 – 24.6%.


The Dynamic of Electricity Losses in Geoergian Energy System
2005 - 2013 (thousand kWh)
350000
300000
250000
200000
150000
100000
50000
0
314,800
(3.8%)
232,200
(2.84%)
164,700
(1.91%)
173,700
(1.95%)
143,400
(1.68%)
175,025
(1.73%)
195,936
(1.89%)
178,985
(1.77%)
204,400
(1.97%)
2005
2006
2007
2008
2009
2010
2011
2012
2013


The Dynamics of Electricity Losses in Distribution Companies
2008 - 2013 (million kWh)
600
500
400
300
200
100
0
Telasi
Kakheti
Energo-Pro
2008
2009
2010
2011
2012
2013

Change in Commission decision # 17 of 11 May 2006 (1)

- JSC Energotrans was issued an electricity distribution license. JSV Energotrans owns the following assets:
- 500 kV one-circuit energy transmission line Zekari (substation Zestafoni / substation Akhaltsikhe - 70km);
- 500 kV single-circuit energy transmission line Vardzia (substation Gardabani / substation Akhaltsikhe - 190 km);
- 500 and 220 kV piece of Akhaltsikhe 500/400/220 kV substation;
- Energy transmission line Zekari's 500 kV cell in substation Zestafoni.

Change in Commission decision # 17 of 11 May 2006 (2)

- Energy transmission line Vardzia's 500 kV cell in substation Gardabani.
- 400 kV piece of Akhaltsikhe 500/400/220 kV substation;
- 400 kV back-to-back station (700 MW);
- 400 kV single-circuit energy transmission line Meskheti (substation Akhaltsikhe / Turkish border - 35 km).
- JSC Energotrans filed the calculations of electricity losses in its own grid with the Commission, particularly the following:
  - In 500 kV grid – 17,239,720 kWh;
  - In 400 kV grid – 29,327,307 kWh.

Change in Commission decision # 17 of 11 May 2006 (3)

- The values were received based on the calculations as per the methodologies applicable in Georgia, International Electro technical Commission Standard (IEC 61803 1st edition, 1999-02) - Determination of power losses in high-voltage direct current (HVDC) converter stations as well as the export and re-export data provided in the official letter submitted by the license holder.

Change in Commission decision # 17 of 11 May 2006 (4)

Calculation principle - 500 kV

- On 500 kV voltage side:
  ΔW500 = ΔWZekari + ΔWVardzia+ ΔWOU
- ΔWZekari - energy loss in transmission line Zekari
  (= 3,441,040 kWh);
- ΔWVardzia - energy loss in transmission line Vardzia
  (= 9,400,088 kWh);
- ΔWOU - Energy for own use
  (= 4,398,592 kWh);

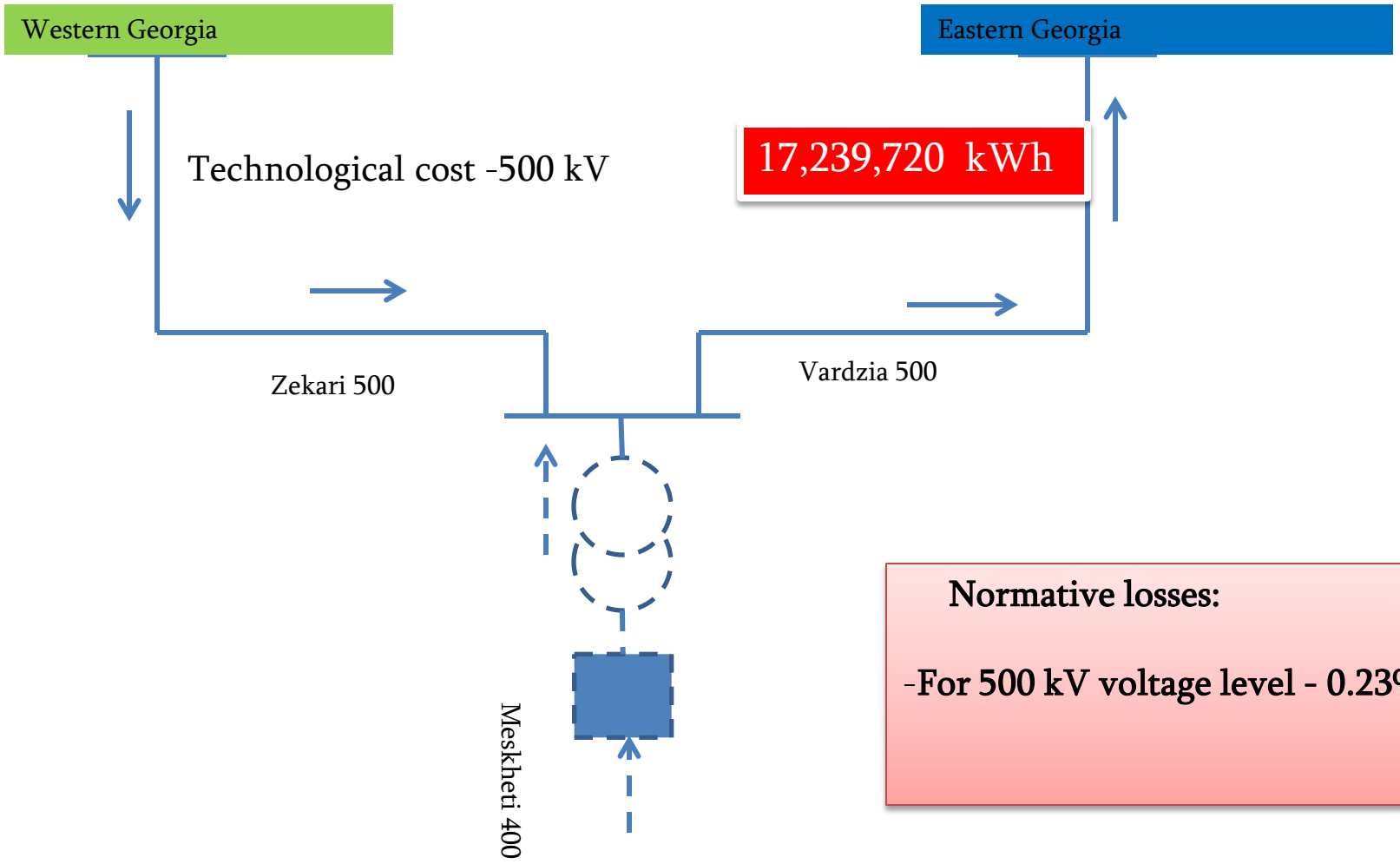
Change in Commission decision # 17 of 11 May 2006 (5)

Calculation principle - 400 kV

- On 400kV voltage side:
  ΔW400 = ΔWMeskheti+ ΔWSC + ΔW SCC + ΔWHVDC400 + ΔWHVDC500
- ΔWVardzia - energy loss in transmission line Meskheti (= 1,611,744 kWh);
- ΔWSC - Energy loss in synchronous capacitors (= 6,045,792 kWh);
- ΔWSCC - Energy loss in the transformers with synchronous capacitors (= 1,552,179 kWh);
- ΔWbtb - energy loss in back-to-back station
  ΔWHVDC400 + ΔWHVDC500 = ΔWBTB = 20,117,592 kWh.

Energy losses in the 500 kV line of JSC Energotrans (6)

Full release through the energy grid on V-XII of 2014 – 7,383,200,000 kWh

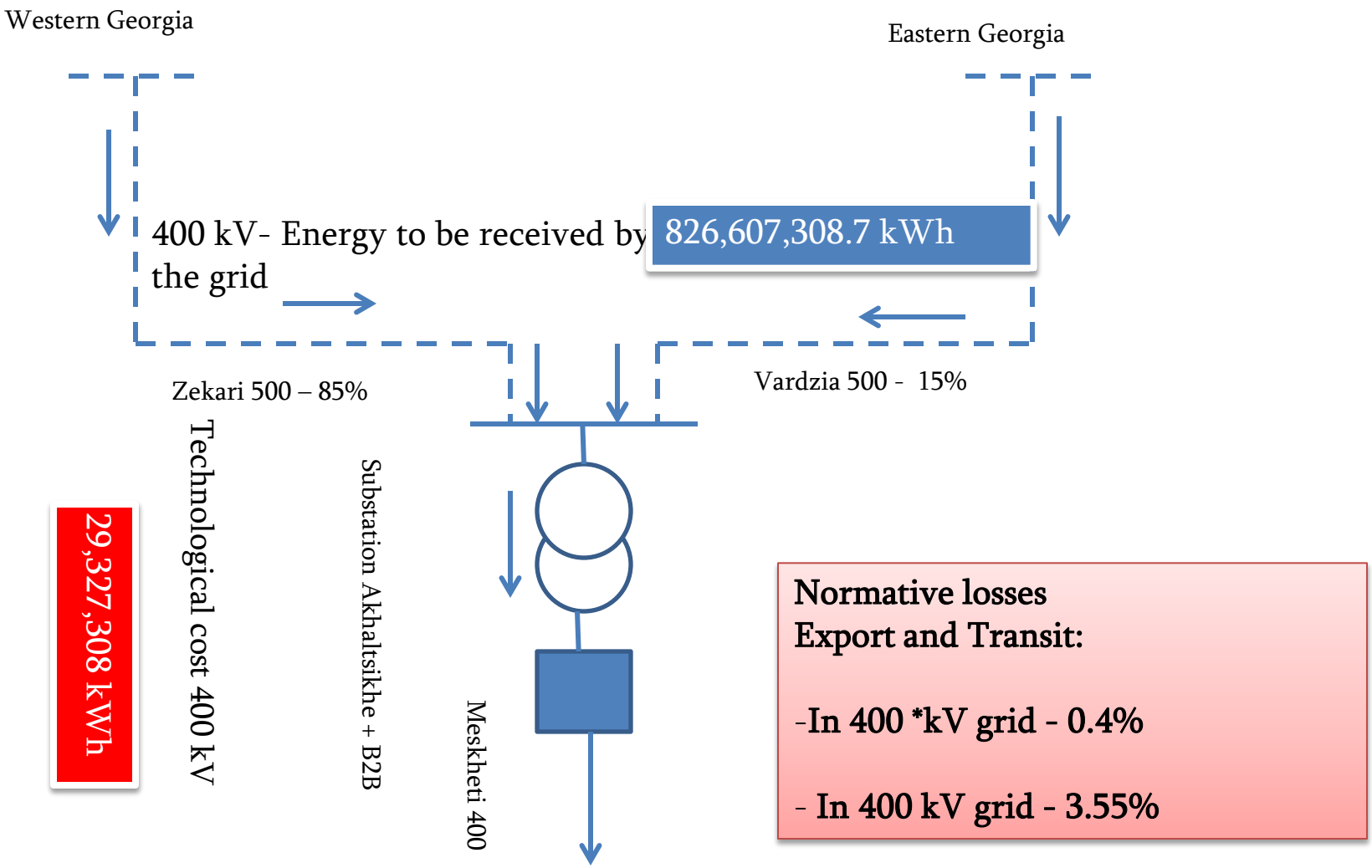


Normative losses:

-For 500 kV voltage level - 0.23%

Energy losses at 400 kV in JSC Energotrans grid (7)

Export + total volume of transit V-XII of 2014 - 797,280,000 kWh



Normative losses
Export and Transit:

-In 400 *kV grid - 0.4%

- In 400 kV grid - 3.55%

Change in Commission decision # 17 of 11 May 2006 (8)

- The following values of normative energy losses (including own usage of substations) shall be approved for JSC Energotrans (shown in percentages):

- From the date of complete release of the electricity imported and generated by all plants through Georgian electricity grid:
  - For 500 kV voltage level - 0.23%;
  - For 400 kV voltage level - 0.4%*;

Change in Commission decision # 17 of 11 May 2006 (9)

- During the export and/or transit of the electricity, in order to export and transit the electricity, after fully received in JSC Energotrans 400 kV grid:
  - For 400 kV voltage level - 3.55%*.

- *Shall be used only by JSC Energotrans 400 kV grid (energy transmission line Meskheti + Akhaltsikhe substation back-to-back station) when importing electricity.

The definition of electricity normative losses

- Electricity normative losses are economically justified and documented electric energy technology costs on transporting electricity and include technical losses, as well as own usage costs for operating substations and losses associated with metering instrument errors.

The procedure for calculating normative electricity losses (1)

Goals and Objectives

- Establishes the principles of calculating the normative values of energy losses in the grid during energy transmission and distribution.

- The calculated (established) cost of normative energy losses are to be reflected in electricity transmission and distribution rates, as per established procedures, or shall be reimbursed by the users of the grid in accordance with the cost of electricity consumed by them.

Rule for determining losses (2)

a) Average actual loss (l^f_{aver}) for the three years prior to the test year shall be determined

$$l^f_{aver} = \frac{1}{3}(l_{T-2} + l_{T-3} + l_{T-4})$$

b) Average annual trend indicator for the three years prior to the test year (T – 1) shall be determined (pic. 3) with the following formula:

$$t_{aver.} = \frac{1}{2}\left[\frac{(l_{T-4} - l_{T-3})}{l_{T-4}} + \frac{(l_{T-3} - l_{T-2})}{l_{T-3}}\right]$$

c) Shall be determined according to the following average annual trend indicator of the loss:

$$l_p = (1 - t_{aver})l^f_{aver}$$

საქართველოს ენერგეტიკისა და წყალმომარაგების მარეგულირებელი ეროვნული კომისია

The rule for determining the loss (3)

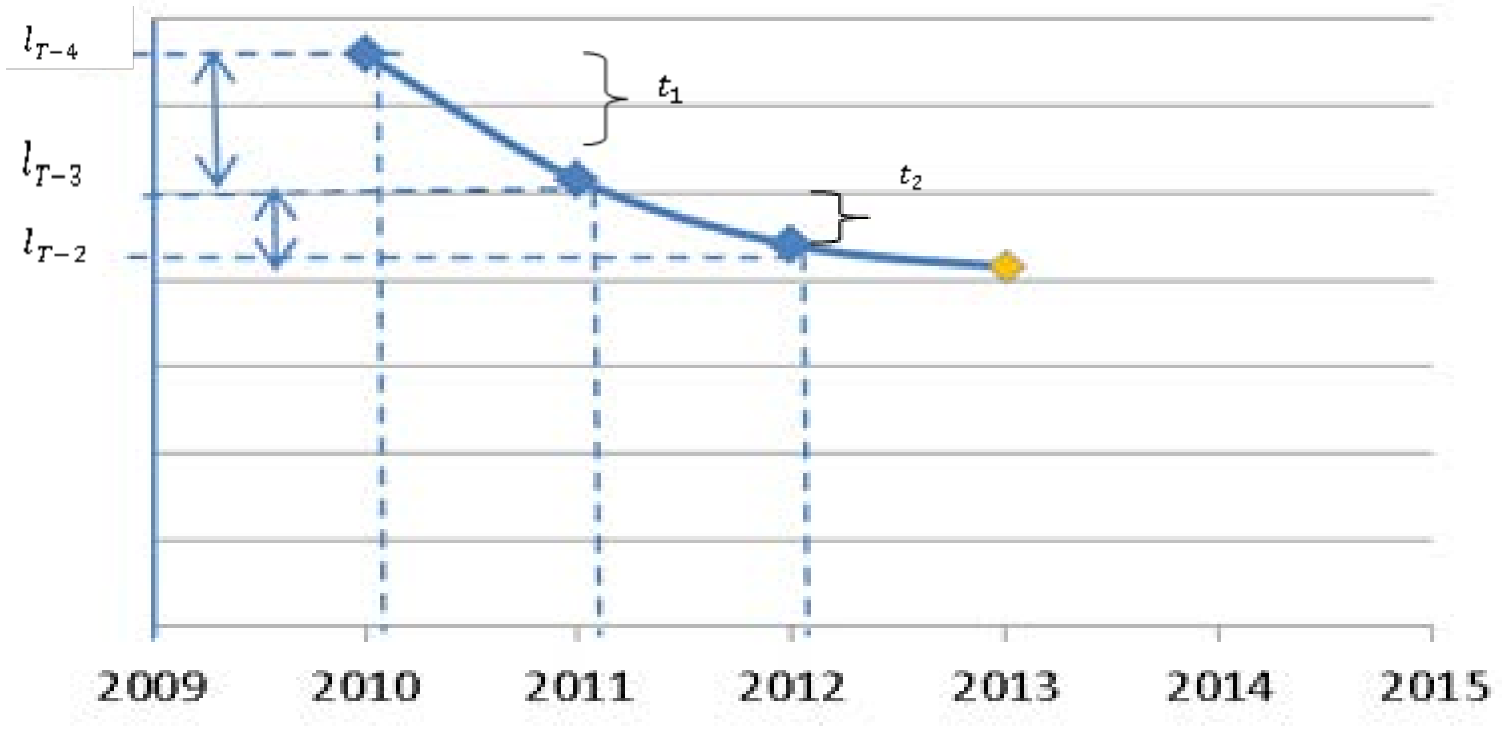
First regulation period

T-4	T-3	T-2	T-1	T	T+1	T+2	T+3	
2010	2011	2012	2013	2014	2015	2016	2017	2018
l_{T-4}	l_{T-3}	l_{T-2}	l_{T-1}	l_T	l^n	l^n	l^n	

l^f_{aver}

T-4	T-3	T-2	T-1	T
2014	2015	2016	2017	2018
l_{T-4}	l_{T-4}	l_{T-2}	l_{T-1}	

Average annual trend calculation (4)



საქართველოს ენერგეტიკისა და წყალმომარაგების მარეგულირებელი ეროვნული კომისია

Rule for determining losses (5)

d) The "wait" period of the test year – lv, will be compared with the actual value of the test year l^f_{T-1} and the smallest of them will be selected for the future regulated period (T + 1, T + 2 and T + 3) as a target value (normative loss).

$$MIN\left(l_v, l^f_{T-1}\right) = l^m_{T+1,\dots T+3}$$

e) If the three year trend before the test year shows upward movement and the average value of the trend is $t_{aver} \leq 0$, or the grid company does not have a three year prior history, then the following is used:

- Comparative (benchmarking) analysis methods (trend indicator of other similar companies or a historic indicator of the same company).
- Calculation of loses using standardized methodology or certified software.

Principles for determining actual losses (6)

- ***Receiving in the grid***

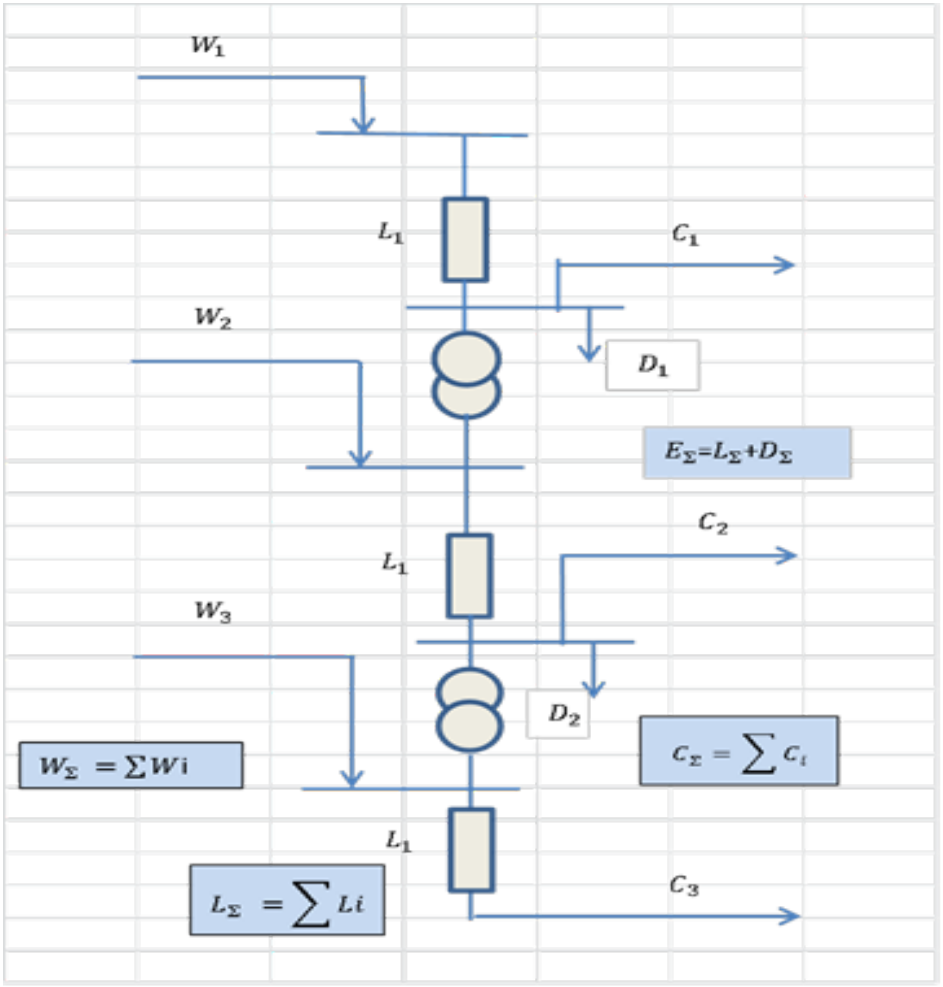
- WΣ – Total electricity (kWh) received in the transmission or distribution grid by the transmission or distribution license holder;

$$W_{\Sigma} = \sum_{i=u} W_i$$

- Wi - total electricity (kWh) received at i-voltage level (500, 400, 330, 220,110, 35, 10, 6, 3.3 & 0.4 kV) of the transmission or distribution grid by the transmission or distribution license holder.

საქართველოს ენერგეტიკისა და წყალმომარაგების მარეგულირებელი ეროვნული კომისია

Calculating actual losses (7)



Principles for determining actual losses (8)

- ***Sending from the grid***

- CΣ – Total electricity (kWh) sent out from the transmission or distribution grid and charged by the transmission or distribution license holder;

$$C_{\Sigma} = \sum_{i=u} C_i$$

- Ci - total electricity (kWh) released and charged at i-voltage level (500, 400, 330, 220, 110, 35, 10, 6, 3.3 & 0.4 kV) of the transmission or distribution grid by the transmission or distribution license holder.

Principles for determining actual losses (9)

- L_{Σ} - Total electricity (kWh) losses in the transmission or distribution grid incurred by the transmission or distribution license holder;

$$L_{\Sigma} = W_{\Sigma} - C_{\Sigma} \qquad L_{\Sigma} = \sum_{i=u} L_i$$

- L_i - total electricity (kWh) lost at i-voltage level (500, 400, 330, 220, 110, 35, 10, 6, 3.3 & 0.4 kV) of the transmission or distribution grid by the transmission or distribution license holder.

Principles for determining actual losses (10)

- D_{Σ} - Total of its own electricity used in transmission or distribution substations (kWh);

$$D_{\Sigma} = \sum_{i=u} D_i$$

- D_i - Own usage of electricity at i-voltage level (500, 220, 110, 35, 10 & 6 kV) substations of the transmission or distribution license holder (kWh).

Principles for determining actual losses (11)

- E_{Σ} - Total electricity technological losses (kWh) in the transmission or distribution grid incurred by the transmission or distribution license holder;

$$E_{\Sigma} = \sum_{i=u} E_i \qquad E_{\Sigma} = L_{\Sigma} + D_{\Sigma}$$

- E_i - Total electricity technological cost to the transmission or distribution license holder at i-voltage level (500, 220, 110, 35, 10 & 6 kV) of the transmission or distribution grid (kWh).

Total technological expense in % (12)

- Total electricity technological expense expressed in l^f_{ti} percentages (%) is established according to voltage levels with the following formula:

$$l^f_{ti}\% = \frac{E_i}{W_\Sigma}\ 100\%$$

- Total technological expense expressed in percentages (%) is calculated with the following formula:

$$l_\Sigma = \sum l_i$$

Approving normative losses (13)

- Commission shall review and verify the accuracy of loss calculations presented by the license holder of transmission or distribution. When necessary, filed calculations may be sent to an independent expert for further review.

- If no changes are to be made to reflect forecasted grid loads and performances in transmission or distribution grids for the short-term period, then the normative losses for the transmission or distribution silence holder shall be established for three years.

Approving normative losses (14)

- At the end of each year, the license holders must submit actual values of losses and their structural analysis to the Commission.
- If the license holder's request is justified, it is possible that approved normative losses be adjusted according to voltage levels or any other criteria.

Thank you!

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