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ENERGY AUDIT
IVENERGO POWER PLANT NO. 3
IVANOVO
RUSSIA

Prepared for

US AGENCY FOR INTERNATIONAL DEVELOPMENT
Washington, D C 20253

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The contents of this report include recommendations based on data provided by the client organization, measurements made on site, calculations and engineering judgement The conclusions reached were based on a limited engagement of less than ten days duration at the enterprise and not an exhaustive engineering analysis Hagler Bailly Services, Inc certifies that this report conforms to the level of best commercial practice for industrial energy audits of similar level of effort, as conducted in the United States This report has been prepared under the guidance of a registered Professional Engineer, licensed to practice in the United States

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SECTION 1

EXECUTIVE SUMMARY

Cost-effective energy efficiency measures can result in large savings for an industrial enterprise, thus releasing money spent on energy for other important uses by the management of the enterprise These cost savings can help to make the enterprise stronger, more productive and more competitive

One of the programs sponsored by the United States Agency for International Development (USAID) is the Energy Efficiency and Market Reform Project for Russia (Contract No CCN-0020-C-00-152-00) As part of this project, a team of engineers from East West Energy Agency in Moscow, led by Hagler Bailly carried out site activities at the Ivanovo CHP No 3 facility in the Ivanovo Region Their objectives were to work with the enterprise personnel and technical personnel from Ivenergo and to identify opportunities for improvements in energy efficiency of the various industrial processes at Ivanovo CHP No 3

During the site visit, a vast amount of data was collected on the operating characteristics of the facility, the equipment installed, and the energy usage Metering and measurements were done at key locations to determine the energy usage levels and operating efficiencies of the equipment All of this information was then analyzed by the energy efficiency experts and evaluated for areas of potential improvements These evaluations resulted in some recommendations for implementing cost-effective modifications to improve the energy efficiency of the enterprise

Based on the recommendations, the estimated overall savings for all energy efficiency measures for CHP #3 is 6 454 million rubles per year Table 1 is a summary of these recommendations The table shows each recommended measure and includes the estimated costs and benefits, together with the simple payback for implementing these measures

The management of Ivanovo CHP No 3 should review these energy efficiency measures and the costs and benefits of each A decision on the measures to be implemented and the determination of the financing for these should occur as soon as possible Following that, the specifications for equipment and business plans for implementation will be written These will be used in determining the financing arrangements Once approved, the energy efficiency measures will be procured and installed

The primary objectives of this General Energy Survey, agreed with the management of Ivenergo, is the evaluation of efficiency of the application of adjustable electric drive for feeding and network pumps

The following assumptions were made for the evaluations of the efficiencies of the various approaches

1 The following power tariffs available at the moment of energy survey were used in the analysis

- sale prices 460 rubles per kWhour,
- for own needs 67 rubles per kWhour

2 Conversion rate of USD to rouble was 1 USD = 5,700 rubles

3 Bank interest on loans and inflation rates were not considered in repayment calculations

(simple repayment)

Table 1

Recommended Energy Efficiency Measure
for
Ivanovo CHP No. 3

No	Description of Measure	Units of Measure	Annual Energy Savings	Annual Savings in Rubles	Cost of Measure	Simple Payback in Years
1	Adjustable speed drive at SE2500-I80	Mwh	3 700	6 454 million	2 155 million R	18 months

Section 2

Introduction

The purpose of conducting the energy audit at Ivanovo CHP No 3 was to collect and analyze appropriate data and information about the enterprise and the energy usages within the facility then use this information to make recommendations on cost-effective measures to increase the efficiency level of the plant The process involved the collection of historical use of electricity, gas, coal and other fuels and their associated costs It also involved some metering and measurements of key energy using equipment at the facility This was done using the most current and sophisticated energy auditing equipment available

Section 3

Enterprise Description and Energy Consumption

In order to better understand the overall situation with the enterprise and it's energy use it is important to look at the characteristics operations processes and energy requirements This section provides the description of the enterprise, followed by a description of the facility itself, and then a description of the energy uses and requirements After that is a description of the data collection from the measurements and metering that was done during the energy audit

A Enterprise Description

The primary activity of the enterprise is the generation of heat and electric power for needs of enterprises and communal services of Ivanovo-town The basic equipment is Russian made

The installed plant capacity is 330 MW the heat power is 1,076 GCal
The installed Steam Production Capacity of a Boiler Shop is 2,100 tons per hour
Maximum consumption of natural fuel — 271 tons per hour

Fuel structure in 1996

- coal 30 9%
- gas 68 2%
- boiler oil 0 9%

The rated amount of the Production-Industrial Staff as on January 1, 1997 amounted to 889 people including 118 people provided by contractors

The following equipment was installed at *IvTETs* (Ivanovo Power Plant)

- power boilers No 1 2, 3, 4 and 5 Type TP-87, D=420 t/hour, P=140 kgf/cm^2, t=560°C
- steam turbine PT-60-130/13, Station No 1, electric power — 60 MW, heat production capacity — 139 GCal/hour,
- steam turbine t-110/120-130-3, Station No 2, electric power — 110 MW, heat production capacity — 181 GCal/hour,
- steam turbine PT-80/100-130/13, Station No 3, 4, electric power — 80 MW, heat production capacity — 181 GCal/hour,
- peak-power water-heating boilers PTVM-100, Station No 1, 2 and KVGM-100, Station No 3, 4 with the installed power of 100 GCal/hour each,
- power transformers

No other new equipment has been installed and put into operation ever since the plant was built

A Facility Description

According to the plant personnel, the following statistics reflect the installed and available heat and power from the plant The installed electric power capacity of the plant is 330 MW and the average available power in 1996 was 296 MW The installed heating capacity of the plant is 1,076 GCal/hour while the available heat generating capacity in 1996 was 876 Gcal/hour

Output

Electric power generation

The electric power generation in 1995 and 1996 is shown in the following table

Table 2
Electric Power generation in 1995 and 1996

No	*Parameter*	*Unit*	*1995*	*1996*	*Absolute increase value*	*%*
1	Electric Power generation	Thousand kWh	1 080 378	1 262 657	+182 279	+16 9
2	Power supplied from busbars	Thousand kWh	928,600	1 097 532	+168 932	+18 2

Data relating to electric power generated each month is given in Table 2 and Fig 1

Table 3
Electric power generated each month in 1996 thousand kWh

No	*Month*	*Electric power generated, thousand kWhour*
1	January	165 141
2	February	156 936
3	March	136 802
4	April	100 254
5	May	48,778
6	June	49 760
7	July	52 032
8	August	43 232
9	September	53 888
10	October	141,980
11	November	156 858
12	December	156 996
13	Total per year	1,262 657

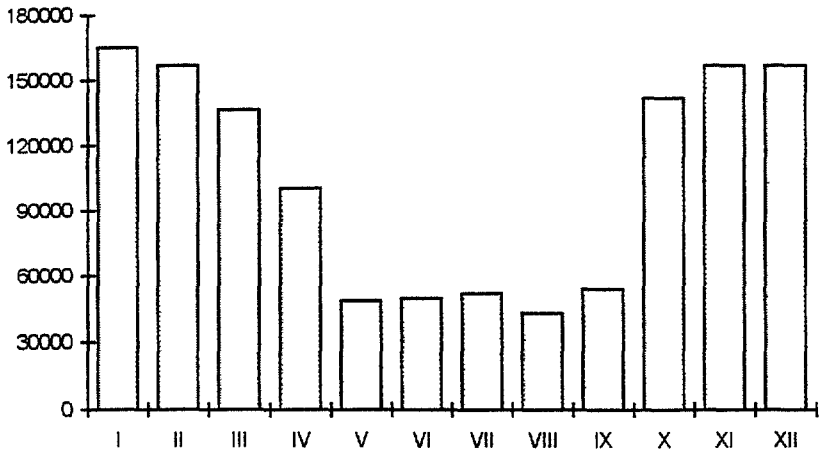

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Fig 1 Dynamics of electric power generation in 1996

Heat Generation

The heat generation in 1995 and 1996 is shown on the following table

Table 4
Heat Power generation in 1995 and 1996

No	*Parameter*	*Unit*	*1995*	*1996*	*Absolute value*	*%*
1	Heat Power generation in the form of	Gcal				
	- hot water		1 565 341	1 692 678	+127 337	+8 13
	- steam for production facilities	GCal	178 421	171 996	-6 425	-3 6

Data relating to heat power generated in each month of 1996 is given in Table 5 and Fig 2

Table 5
Heat power generated each month in 1996 GCal

No	*Month*	*Heat power generated GCal*		
		Total	including hot water	including steam
1	January	298 398	266 615	31 783
2	February	266 673	238 181	28 492
3	March	226 223	200 277	25 946
4	April	175 644	165 409	10 235
5	May	77 222	76 777	445
6	June	80 616	736 620	6 996
7	July	63 247	56 695	6 552
8	August	34 834	33 677	1 157
9	September	58 508	57 319	1 189
10	October	146 122	133 672	12 450
11	November	187 493	166 680	20 813
12	December	249 694	223 756	25 938
13	Total per year	1 864 674	1 692 678	171 996

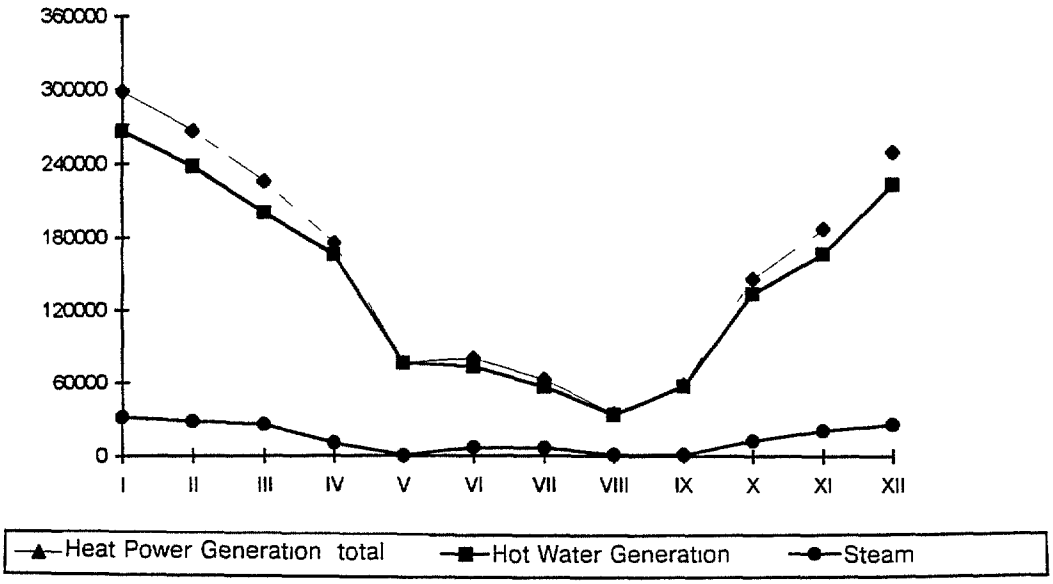


Fig 2 Heat Generation GCal

The connected heat load at the end of 1996 was 685 GCal/hour, which included 567 GCal/hour, steam 112 GCal/hour, and available heat generation capacity in terms of steam is equal to 225 GCal/hour (320 tons per hour)

The average annual actual heat load in 1996 amounted to 212 GCal/hour, whilethe maximum was 462 GCal/hour

The total connected heat load of the Power Plant (*TETs*), including its own needs, at the end 1996 was 597 GCal/hour However, the available heat generation capacity of the Power Plant in terms of hot water amounted to 551 GCal/hour Thus, the deficit of heat power in terms of hot water is equal to 46 GCal/hour

Unit electric power consumption for own needs

The enterprise reported the following information to the energy auditing engineers

The Unit electric power consumption per generated power is equal to 6 55% as compared to 7 16% in accordance with rated parameters The Unit electric power consumption per supplied power is equal to 44 23 kWhour/GCal/hour as compared to 46 29 kWhour/GCal/hour in accordance with rated parameters

In general, 11,561 thousand kWh were saved as compared with rated values, including

- savings in respect of generated electric power — 7,725 thousand kWh
- savings in respect of supplied heat — 3,836 thousand kWh

The above mentioned savings were obtained as a result of power consumption saving for circulating pumps and the heating unit

The unit power consumption for own needs dropped as compared with 1995

- savings in respect of generated electric power — 0 29%
- savings in respect of supplied heat — 0 45 kWh

Unit fuel consumption

The actual unit consumption of assumed fuel per supplied electric power in 1996 was decreased 6 87 g/kWh compared with 1995 and amounted to 308 91 g/kWh The actual unit consumption of assumed fuel per supplied heat in 1996 was decreased 4 02 kg/GCal as compared with 1995 and amounted to 131 kg/GCal

The above mentioned increased efficiency as compared with 1995 was improved as regards the following parameters

- vacuum in condensers,
- electric power consumption by feeding pumps,
- electric power consumption by dust preparation facilities, draft and blowing,
- effluent gases temperature,
- steam and condensate losses
- losses connected with mechanical burning insufficiency

Production Cost

The actual full cost of 1 kWh of electric power generated in 1995 was 119 29 rubles, and 1 GCal of heat power — 49,899,31 rubles

C Application of adjustable electric drive

The possibility of the use of adjustable electric drive in network and feeding pumps at *Ivanovo TETs-3* Power Plant was thoroughly investigated with the frame work of this survey The basic parameter searched for is the period of simple repayment of such approach The following assumptions were made for the purpose of calculations

1 All electric power saved as a result of use of the adjustable electric drive of the pump is sold under supply tariffs So the resulting savings shall be equal to difference between supply tariffs and the cost of electric power (460 - 67 = 393 rubles/kWhour)

2 The price of adjustable electric drive is evaluated basing on the electric power of pump drive (kW) and a unit price of the drive (USD/kW) The unit price of drive equal to 270 USD/KW was used for the purpose of evaluations

Application of adjustable electric drive for network pumps

All evaluations of repayment was based on service parameters of *SE 2500-180* network pumps provided by *Ivanovo TETs-3* The variant of using adjustable electric drive for one of the available network pumps was analyzed In this case all the other pumps operating with the one equipped with adjustable electric drive are operating with completely open valves (at discharge) It is technically feasible to design a control system which could make it possible to extend adjustable control capabilities to another pumps

In order to obtain a full picture not only the dependence between repayment period and network water flow through a group of network pumps was analyzed but also the effect of pressure in a pressure pipeline The effect of water flow through the group of network pumps was analyzed in the range of 8000 - 11000 m^3/hour with a step at least 500 m^3/hour (9 points) The effect of pressure in a feeding pipeline (after pumps' valves) was analyzed for the pressure values equal to 110, 120 and 130 meters of water column (3 points)

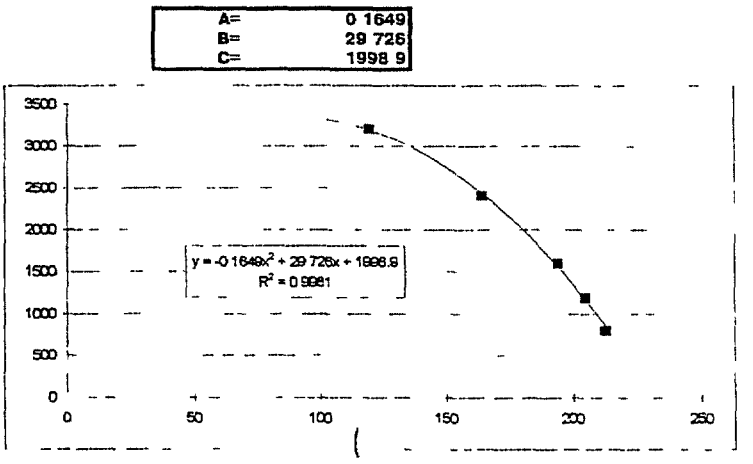
In order to provide a comprehensive analysis of extended data array Microsoft Excel version 5 0a was used Service parameters of the pump and the dependence of its efficiency on consumed electric power was described by mathematic dependence for subsequent mathematical processing (See, Fig 3 and 4)

***SE 2500-180* network pump**

Head, m	213	205	194	164	120
Pump capacity, m^3	800	1,200	1,600	2,400	3,200

The dependence of efficiency on consumed electric power is described by the following equation

$$Q = AH^2 + BH + C \text{ where}$$



Pump capacity m^3	0	700	1 000	2 000
Drive Efficiency	0	0 5	0 65	0 8

The dependence of efficiency on production capacity is described by the following equation

$$Q = AH^2 + BH + C, \text{ where}$$

$$Q = AH^2 - BH + C, \text{ where}$$

A=	-2 47E 07
B=	0 0009
C=	0 0008

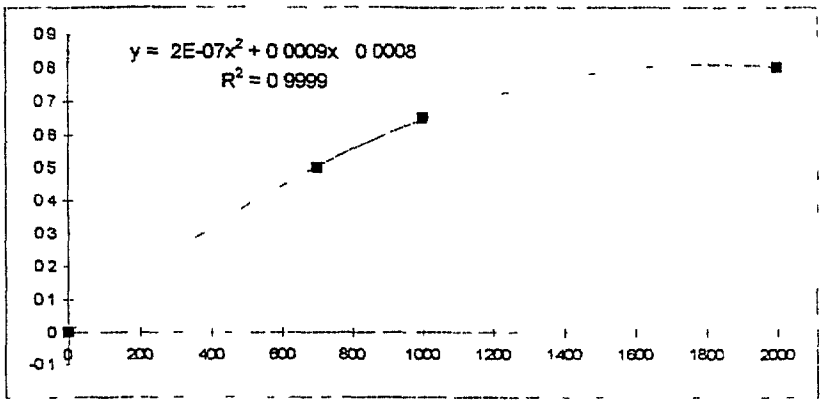
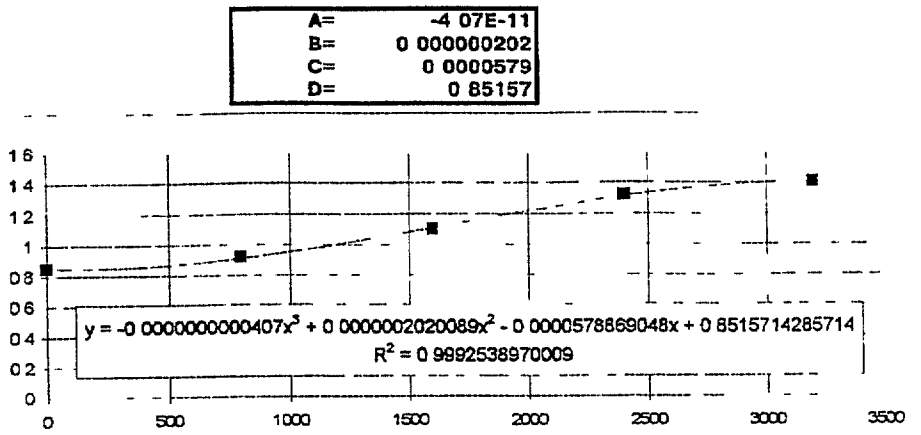


Fig 3 Service parameters of SE 2500-180 network pumps and their mathematic descriptions

Pump capacity m^3	0	800	1 600	2 400	3 200
Power MW	0 85	0 92	1 1	1 32	1 4

The dependence of power on production capacity is described by a polynom of the 3rd degree



Pump capacity m^3	0	800	1 600	2 400	3 200
Head	223	213	194	164	120

The dependence of head on production capacity is described by the following equation

$$Q = AH^2 + BH + C, \text{ where}$$

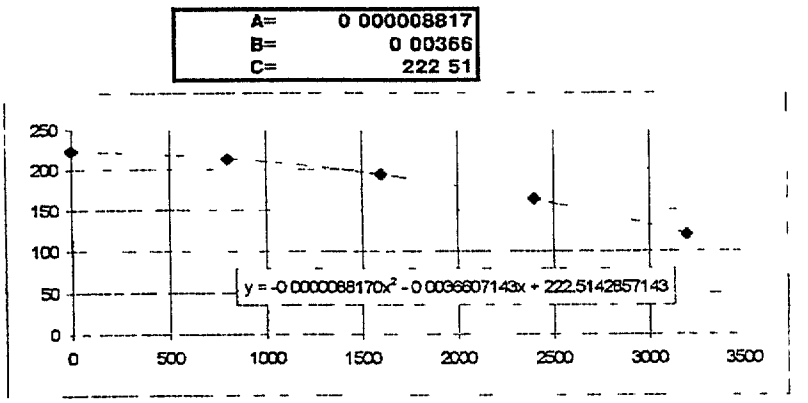


Fig 4 Service parameters of SE 2500-180 network pumps and their mathematic descriptions

In all var ; one general assumption was used that heat is not supplied within the period of four months (J e July, August and September) and in May heating was supplied for 9 days and in October fc 15 days Such supply mode was typical for 1996

A Data Table specially elaborated for the purpose of this Project made it possible to make necessary calculations for all 27 variants (9 x 3) For example, see a print-out of analysis results for one of variants (flow — 9000 m^3/hour, pressure — 120 m of water column in Appendix, Table S1)

See shortened spread-sheets of estimations for various pressure values (110 120 and 130 m w c) and network water flow through the group of pumps (8000, 8500, 9000, 9500, 10000 and 11000 m^3/hour) in Tables S1 - S3-7 in Appendix

The Aggregate Table of Estimations for all variants and curves are given in Fig 5

Water Flow for a group of pumps, m^3/hour	*8,000*	*8,500*	*9,000*	*9,250*	*9,500*	*9,750*	*10,000*	*10,500*	*11 000*
Pressure in pressure pipeline = 110 m w c (peak — 9820 t/hour)	18	22	26	38	56	131	16	16	17
Pressure in pressure pipeline = 120 m w c (peak — 9574 t/hour)	20	27	39	72	252	18	18	18	20
Pressure in pressure pipeline = 130 m w c (peak — 9229 t/hour)	24	42	117	23	21	20	20	22	26

Dependence between repayment period of the introduction of adjustable electric drive and network water flow through the group of network pumps

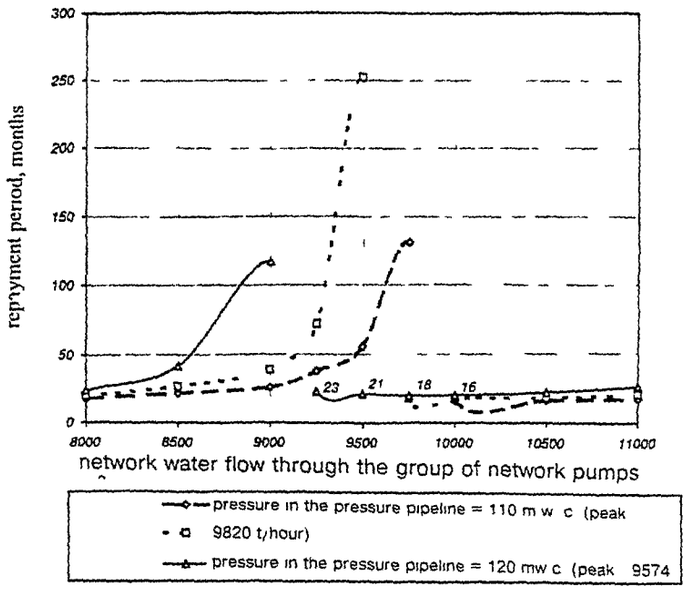


Fig 5 Repayment period in case of the introduction of adjustable electric drive for SE 2500-180 network pumps Ivanovo TETs-3

It ould be noted that an initial attempt was made by engineers to perform the repayment analysis on the basis of the available statistics relating to the operation of the network pumps in 1994 – 1996 T s approach was later rejected The explanation for this is mostly defined by the value of network w er flow through the group of network pumps The decision should not be made to install new equipment by just analyzing the statistic data of passed years, for new heat users are being connected each year and heat supply is growing with every year (including the flow of network water) It is cessary to use development forecasts for the next two - three years

The above should be explained with the following example In the winter of 1996, the operation mode was characterized by simultaneous operation of three pumps with fully opened valves The pressure in the pressure pipeline was about 120 m w c Based on the service parameters, the flow value through the group of three pumps should be equal to about 9500 m^3/hour Thus, the network water flow in 1996 amounted in average to 9500 m^3/hour If adjustable drives were installed, the repayment period for this operation mode is more than 250 months The first off-hand conclusion could be that such variant is hardly practical from economic point of view

However, for 1997 the outcome is different With a certain degree of confidence one can say that it would grow The estimated maximum flow through the group of three pumps with the feeding pipeline pressure of 120 m w c is equal to 9574 m^3/hour It means that in the event this value is exceeded these three pumps would not be able to provide required head and the fourth pump should be started-up Since the adjustable drive makes it possible to avoid pressure loss at valves, and in 1996 such losses were practically negligible, the use of adjustable drives was not feasible from economic point of view (with repayment period exceeding 20 years!) But as soon as the fourth pump is started-up, and operators have to crack-down all four valves the maximum hydraulic losses occur and, subsequently the maximum inefficiency of power consumption For example, with the flow rate of

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9750 m^3/hou [illegible] sure of 120 m w c the repayment per [illegible] al to 18 months with a slow increase up t 20 m ths in case flow rate increases up to 11000m /hour When the network water flow rate reaches the next "critical" point (4 x 3191 = 12764 m^3/hour — the maximum output of all four pumps at pressure 120 m w c) economic efficiency of the adjustable drive would decrease

Thus, it is obvious that the shortest repayment period for such variant could be feasible in the event the network water flow rate closely reaches the "critical" point Of course it applies only in the event that this point would be passed anyway

Conclusions In accordance with the above mentioned we think that the matter of installing adjustable electric drive at one of the pumps of *Ivanovo TETs-3* shall be resolved with the consideration of heat consumption trends forecasts for the nearest future On the other hand it should be stressed that current situation at *Ivanovo TETs-3* could be characterized as the maximum beneficial from the point of view of fast repayment for the introduction of the adjustable electric drive (on the condition that network water demand increases soon)

Application of adjustable electric drive in feeding pumps

The analysis of efficiency of the use of adjustable electric drive in feeding pumps was based on service parameters of *PE-500-180 feeding pumps* installed at *Ivanovo TETs-3* These parameters are given at Fig 6 Polynomes of various degrees describing these dependence have been defined

In contract to similar analysis for network pumps based on forecasted development, the analysis of feeding pumps operation was based on available statistics on the operation of feeding pumps for the passed four years (1993, 1994, 1995 and 1996) Such approach may be considered justified, for feed water flow rate is more "conservative" than network water flow rate

Data from Ivenergo's Report on the Operation of Main Equipment in 1993 - 1996 was used (pressure, flow values and service parameters)

The basic assumption was that one of the feeding pumps was equipped with the adjustable electric drive In this case all the other pumps operating with the adjustable one are operating with full-opened valves (at discharge) The Aggregate Repayment Estimations for adjustable electric drive are given in Fig 7 The detailed print-outs of all estimations are given in Tables P1-P4 of Appendix

It could be stated that the adjustable electric drive should be repaid in 31 - 56 months A slight scatter of repayment data is noticeable, but its range is much higher than repayment periods adopted in Russian Power Industry as economically efficient (24 months)

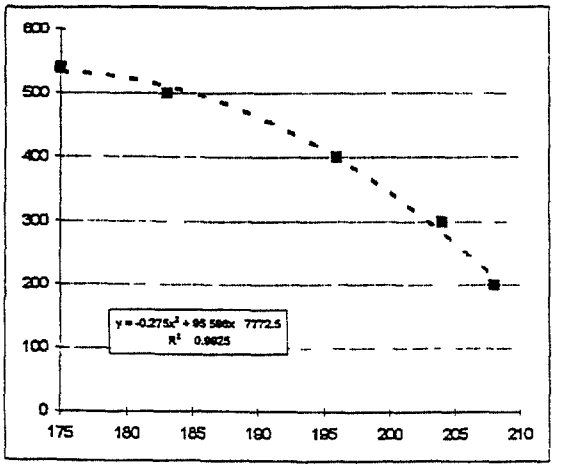
PE-500-180 feeding pumps

Head, atm	175	208	204	196	183
Pump Capacity m^3	540	200	300	400	500

The dependence of production capacity on head is described by the following equation

$$Q = AH^2 + BH + C, \text{ where}$$

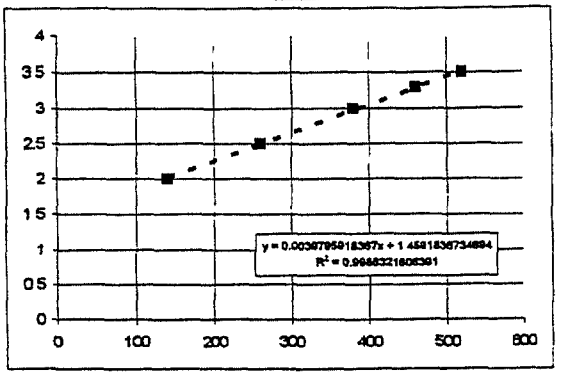
A= -0 275
B= 95 596
C= 7772 5



Pump capacity m^3	140	260	380	460	520
Power MW	2	2 5	3	3 3	3 5

The dependence of power on production capacity is described by a polynom of the 1st degree

A= 3 98E-03
B= 1 45918



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Head, atm	175	208	204	196	183

The dependence of head on production capacity is described by the following equation

$$Q = AH^2 + BH + C, \text{ where}$$

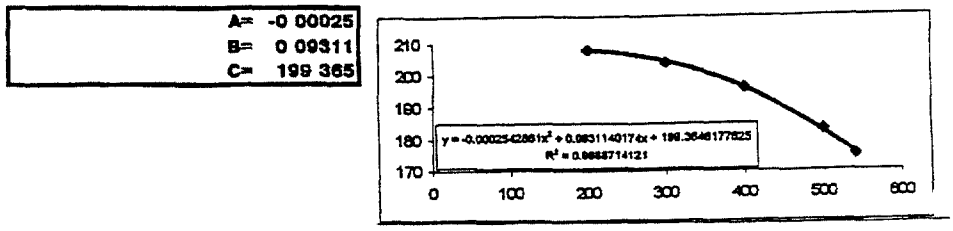

Fig 6 *Service parameters of PE-500-180 feeding pumps and their mathematic descriptions*

Aggregate Repayment Estimations for FEEDING PUMPS

Year	1993	1994	1995	1996
repayment period, months	43	31	56	38

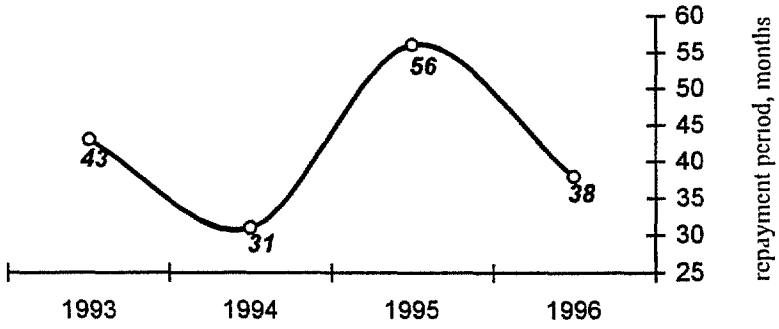

Fig 7 Repayment in the event adjustable electric drive is installed at feeding pumps at Ivanovo TETs-3

Conclusions In accordance with the above mentioned we think that the installation of adjustable electric drive at the feeding pumps of *Ivanovo TETs-3* presently is not feasible Currently, the standard maximum payback period of an energy efficiency measure in the Russian power industry is two years In this light, the introduction of regulated electric drives at the feed pumps of Ivanovo CHP 3 is not advisable at this point The final decision, however, should be made by the enterprise

Section 4

Recommended Energy Efficiency Measures

A Potential Energy Efficiency Measures

The energy auditors investigated as many potential efficiency measures as possible in the time budgeted for the project Subsequent to this the most cost-effective measures are recommended for implementation by the enterprise Some of the potential energy efficiency measures are not reasonable because of the long payback period, or very high initial cost Those measures in the recommended list consist of actions that have simple paybacks of less than 3 years Given the economic conditions in Russia, this seems like the most reasonable maximum time period for the measures to be paid for by the savings

B Recommended Cost-Effective Measures

PROJECT 1 The installation of adjustable electric drive at *SE 2500-180* network pump at *Ivanovo TETs-3*

Objective of the Project — To reduce hydraulic losses at valves, and to provide a stable operation mode for non-adjustable pumps, and to decrease counter-pressure in pumps and, subsequently, to reduce the risk of failure and idle run of the equipment

Justifications

Presently, the operation mode of network pumps is changed (regulated) by the variation of the amount of pumps simultaneously operating and the position of valves at the discharge of pumps In the event that network water flow rate drops, operators crack down valves, thus increasing counter-pressure at the pump and, subsequently, biasing a work point to the left along the performance curve of the pump This type of regulation has some drawbacks, including the following main ones

1 Pressure increase at the discharge of the pump For example, since *SE 2500-180* are axial type pumps, any increase of counter-pressure causes un-rated operation mode for pumps's bearings and, subsequently, their early wear and failure Failures and stops are unavoidable in this case

2 It is impossible to precisely and accurately change operation modes of the group of pumps when they work in parallel In addition to the above mentioned inertia "swaying" and "suppression" of one pump by another are taking place, which also adversely affects the service life of the pump and its reliability

3 Increased electric power losses for the drive related to the fact that in the course of conversion of electric power into hydraulic one a part of hydraulic energy is being lost at valves The above mentioned estimations prove that such electric energy losses may amount up to 20%

The use of adjustable electric drive at one of the pumps would make it possible to provide a stable operation mode for another pumps not equipped with adjustable electric drive with their valves fully cracked open It reduces counter-pressure and provides for a design operation mode of the pump, which, in its turn, substantially increases its reliability In the event that the system is equipped with the adjustable electric drive it would be possible to fast and adequately react to any pressure changes

in the heating system And the main point additional electric power losses are eliminated and saved power is distributed to the users

Capital investments

Expenses for the purchase and installation of the adjustable electric drive were estimated to be at the level of 270 USD per 1 kW of installed power of the drive *SE 2500-180* pump has the electric drive with the power of 1 4 MW Thus, the total capital investments is

1,400 kW x 270 USD/kW = 378,000 USD (2,155 million rubles)

Heating Medium Savings

The saving of electric power is much connected with the operation mode of the heating supply system (outside heat consumption) Basing on a moderately optimistic forecast possible electric power savings would amount (considering pressure 120 m w c , flow rate 9750 m^3/hour, saving 15%, repayment period 18 months) to about 3,700 MWh/ 1,454 1 million rubles / 255 1 thousand USD

Repayment period

The repayment period depends to much extent on the operation mode of the heating supply system Based on a moderately optimistic forecast (considering pressure 120 m w c flow rate 9750 m^3/hour saving 15%) the repayment period should amount to about 18 months

Section 5

Appendix

This appendix contains data and information collected during the on-site activities that was used in the development of the recommended efficiency measures

Table S	Extended Estimations Table for Repayment Periods associated with the installation of adjustable electric drive at the *SE 2500-180* network pump at *Ivanovo TETs-3* (pressure 120 m w c , total water flow for the group of pumps — 9000 m^3/hour)
Table S1-1	Table of Repayment Estimations (main parameters) (network pump, pressure 110 m water column, flow rate — 8000 m^3/hour)
Table S1-2	Table of Repayment Estimations (main parameters) (network pump, pressure 110 m water column, flow rate — 8500 m^3/hour)
Table S1-3	Table of Repayment Estimations (main parameters) (network pump, pressure 110 m water column, flow rate — 9000 m^3/hour)
Table S1-4	Table of Repayment Estimations (main parameters) (network pump, pressure 110 m water column, flow rate — 9500 m^3/hour)
Table S1-5	Table of Repayment Estimations (main parameters) (network pump, pressure 110 m water column, flow rate — 10000 m^3/hour)
Table S1-6	Table of Repayment Estimations (main parameters) (network pump, pressure 120 m water column, flow rate — 10500 m^3/hour)
Table S1-7	Table of Repayment Estimations (main parameters) (network pump, pressure 120 m water column, flow rate — 11000 m^3/hour)
Table S2-1	Table of Repayment Estimations (main parameters) (network pump, pressure 110 m water column, flow rate — 8000 m^3/hour)
Table S2-2	Table of Repayment Estimations (main parameters) (network pump, pressure 120 m water column, flow rate — 8500 m^3/hour)
Table S2-3	Table of Repayment Estimations (main parameters) (network pump, pressure 120 m water column, flow rate — 9000 m^3/hour)

Table S2-4	Table of Repayment Estimations (main parameters) (network pump, pressure 120 m water column, flow rate — 9500 m^3/hour)
Table S2-5	Table of Repayment Estimations (main parameters) (network pump, pressure 120 m water column, flow rate — 10000 m^3/hour)
Table S2-6	Table of Repayment Estimations (main parameters) (network pump, pressure 120 m water column, flow rate — 10500 m^3/hour)
Table S2-7	Table of Repayment Estimations (main parameters) (network pump, pressure 120 m water column, flow rate — 11000 m^3/hour)
Table S3-1	Table of Repayment Estimations (main parameters) (network pump, pressure 130 m water column, flow rate — 8000 m^3/hour)
Table S3-2	Table of Repayment Estimations (main parameters) (network pump, pressure 130 m water column, flow rate — 8500 m^3/hour)
Table S3-3	Table of Repayment Estimations (main parameters) (network pump, pressure 130 m water column, flow rate — 9000 m^3/hour)
Table S3-4	Table of Repayment Estimations (main parameters) (network pump, pressure 130 m water column, flow rate — 9500 m^3/hour)
Table S3-5	Table of Repayment Estimations (main parameters) (network pump, pressure 130 m water column flow rate — 10000 m^3/hour)
Table S3-6	Table of Repayment Estimations (main parameters) (network pump, pressure 130 m water column, flow rate — 10500 m^3/hour)
Table S3-7	Table of Repayment Estimations (main parameters) (network pump, pressure 130 m water column, flow rate — 11000 m^3/hour)
Table P1	Table of Repayment Estimations based on data of 1993 (feeding pump)
Table P2	Table of Repayment Estimations based on data of 1994 (feeding pump)
Table P3	Table of Repayment Estimations based on data of 1995 (feeding pump)
Table P4	Table of Repayment Estimations based on data of 1996 (feeding pump)

Table S1-1

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*SE2500-180*
Capacity, m^3/hour	2500
Electric Drive Power	1 40

		It is assumed that					Variant of the installation of adjustable electric drive					
							Pumps without adjustable electric drive		Pumps with adjustable electric drive			
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	Average pressure in the system (after the valve) m w c	Total water flow rate for a group of Pumps m^3/hour	Consumed power MWhour	Rated flow with pressure in the system m^3/hour	Electric power for a basic drive MWhour	Water flow m^3/hour	Electric power for the adjustable electric drive MWhour	Consumed electric power per month TOTAl MWhour	Electric power savings per month MWhour
January	31	3	31	110 00	8,500	3 088	3 273	2 082	1,953	536 74	2618 37	469 39
February	29	3	29	110 00	8,500	2,889	3,273	1,974	1,953	502 11	2449 44	139 10
March	31	3	31	110 00	8,500	3,088	3,273	2,082	1,953	536 74	2618 37	469 [illegible]4
April	30	3	30	110 00	8,500	2,988	3,273	2,014	1,953	519 43	2533 91	454 [illegible]4
May	31	3	9	110 00	85,500	896	3 273	604	1,953	155 83	760 17	136 [illegible]7
June	30	0	30	110 00	0	0	3,273	0	0	0 00	0 00	0 00
July	31	0	31	110 00	0	0	3,273	0	0	0 00	0 00	0 00
August	31	0	31	110 00	0	0	3 273	0	0	0 00	0 00	0 00
September	30	0	30	110 00	0	0	3, 73	0	0	0 00	0 00	0 00
October	31	3	15	110 00	85,500	1,494	3,[illegible]73	1,007	1,953	259 71	1266 95	227 1[illegible]
November	30	3	30	110 00	85,500	[illegible] 988	3 273	,014	1,953	519 43	2533 91	154 1
December	31	3	31	110 00	85,500	3,088	3,[illegible]73	[illegible],082	1,9[illegible]3	536 74	2618 36	469 39
						20,519		15,914		4,104	20018	

Electric power savings per year, TOTAL, MWhour	***3119 15***	***19 608***
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year, TOTAL, billion rubles	***0 902***	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	378,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	2 1546	
Repayment period (not considering banking interest rate on loans), months	***22***	

Table S1-2

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*SE2500-180*
Capacity, m^3/hour	2500
Electric Drive Power	1 40

		It is assumed that					Variant of the installation of adjustable electric drive: Pumps without adjustable electric drive		Pumps with adjustable electric drive			
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	Average pressure in the system (after the valve) m w c	Total water flow rate for a group of Pumps m^3/hour	Consumed power MWhour	Rated flow with pressure in the system m^3/hour	Electric power for a basic drive MWhour	Water flow m^3/hour	Electric power for the adjustable electric drive MWhour	Consumed electric power per month TOTAL MWhour	Electric power savings per month MWhour
vJanuary	31	3	31	110 00	8,000	3 040	3 273	2,082	1,453	406 78	2188 71	551 21
February	29	3	29	110 00	8 000	2 844	3,273	1,974	1,453	380 54	2327 87	515 65
March	31	3	31	110 00	8,000	3,040	3,273	2,082	1,453	406 78	2188 41	551 21
April	30	3	30	110 00	8,000	2,942	3,273	2,014	1,453	393 66	2408 14	533 43
May	31	3	9	110 00	8,000	8,82	3,273	604	1,453	118 10	722 44	160 03
June	30	0	30	110 00	0	0	3,273	0	0	0 00	0 00	0 00
July	31	0	31	110 00	0	0	3,273	0	0	0 00	0 00	0 00
August	31	0	31	110 00	0	0	3,273	0	0	0 00	0 00	0 00
September	30	0	30	110 00	0	0	3,273	0	0	0 00	0 00	0 00
October	31	3	15	110 00	8,000	1,471	3,273	1,007	1,453	196 83	1204 07	266 71
November	30	3	30	110 00	8,000	2,942	3,273	2 014	1 453	393 66	2408 14	533 13
December	31	3	31	110 00	8,000	3,040	3,273	2,082	1,453	406 78	2488 41	551 21
						20 199		15 914		3,110	19 024	

Electric power savings per year, TOTAL, MWhour	*3,662 88*	*23 028*
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year, TOTAL, billion rubles	*0 902*	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	378,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	2 1546	
Repayment period (not considering banking interest rate on loans), months	*18*	

Table S1-3

Adjustable Drive Efficiency Estimations3

Object	*Ivanovo TETs-3*
Pumps	*SE2500-180*
Capacity, m^3/hour	2500
Electric Drive Power	1 40

		It is assumed that					Variant of the installation of adjustable electric drive: Pumps without adjustable electric drive		Pumps with adjustable electric drive			
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	Average pressure in the system (after the valve) m w c	Total water flow rate for a group of Pumps m^3/hour	Consumed power MWhour	Rated flow with pressure in the system m^3/hour	Electric power for a basic drive MWhour	Water flow m^3/hour	Electric power for the adjustable electric drive MWhour	Consumed electric power per month TOTAL MWhour	Electric power savings per month MWhour
January	31	3	31	110 00	8,000	3,118	3,273	2,082	2,453	690 94	2772 58	345 45
February	29	3	29	110 00	8,000	2 917	3,273	1,974	2,453	646 37	2593 70	323 16
March	31	3	31	110 00	8,000	3,118	3,273	2 082	2,453	690 94	2772 58	345 45
April	30	3	30	110 00	8,000	3,117	3 273	2,014	2,453	668 66	2683 14	334 41
May	31	3	9	110 00	8,000	905	3 273	604	2,453	200 60	804 93	100 29
June	30	0	30	110 00	0	0	3,273	0	0	0 00	0 00	0 00
July	31	0	31	110 00	0	0	3,273	0	0	0 00	0 00	0 00
August	31	0	31	110 00	0	0	3,273	0	0	0 00	0 00	0 00
September	30	0	30	110 00	0	0	3,273	0	0	0 00	0 00	0 00
October	31	3	15	110 00	8,000	1 509	3 273	1 007	2,453	334 33	1341 57	167 15
November	30	3	30	110 00	8 000	3,017	3 273	2,011	2,453	668 66	2683 14	334 31
December	31	3	31	110 00	8,000	3,118	3,273	2,082	2,453	690 94	2772 58	345 45
						20,720		15,914		5 282	21 197	

Electric power savings per year, TOTAL, MWhour	***2,295 58***	***14 428***
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year, TOTAL, billion rubles	***0 902***	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	378,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	2 1546	
Repayment period (not considering banking interest rate on loans) months	***29***	

Table S1-4

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*SE2500-180*
Capacity, m^3/hour	2500
Electric Drive Power	1 40

		It is assumed that					Variant of the installation of adjustable electric drive: Pumps without adjustable electric drive		Pumps with adjustable electric drive			
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	Average pressure in the system (after the valve) m w c	Total water flow rate for a group of Pumps m^3/hour	Consumed power MWhour	Rated flow with pressure in the system, m^3/hour	Electric power for a basic drive MWhour	Water flow m^3/hour	Electric power for the adjustable electric drive MWhour	Consumed electric power per month TOTAL MWhour	Electric power savings per month MWhour
January	31	3	31	110 00	9,500	3,128	3,273	2,082	2,953	868 82	2950 45	177 51
February	29	3	29	110 00	9,500	2,926	3,273	1 974	2,953	812 77	2760 10	166 06
March	31	3	31	110 00	9,500	3,128	3 273	2,082	2,953	868 72	2950 45	177 51
April	30	3	30	110 00	9,500	3,027	3,273	2,014	2,953	840 79	2855 27	171 79
May	31	3	9	110 00	9,500	9,08	3,273	604	2,953	252 24	856 58	51 54
June	30	0	30	110 00	0	0	3,273	0	0	0 00	0 00	0 00
July	31	0	31	110 00	0	0	3 73	0	0	0 00	0 00	0 00
August	31	0	31	110 00	0	0	3,273	0	0	0 00	0 00	0 00
September	30	0	30	110 00	0	0	3,273	0	0	0 00	0 00	0 00
October	31	3	15	110 00	9 500	1 514	3 273	1 007	2 9 3	420 40	1427 64	85 89
November	30	3	30	110 00	9,500	3,027	3,273	2,014	2,953	840 79	2855 27	171 79
December	31	3	31	110 00	9,500	3,128	3 273	2 082	2,953	868 72	2950 45	177 51
						20,786		15,914		6 642	22 557	

Electric power savings per year, TOTAL, MWhour	1,179 61	7 418
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year, TOTAL, billion rubles	0 464	
Unit cost of the drive, USD/kW	270	
Total cost of the drive USD	378,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	2 1546	
Repayment period (not considering banking interest rate on loans), months	56	

Table S1-5

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*SE2500-180*
Capacity m^3/hour	2500
Electric Drive Power	1 40

		It is assumed that					Variant of the installation of adjustable electric drive: Pumps without adjustable electric drive		Pumps with adjustable electric drive			
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	Average pressure in the system (after the valve) m w c	Total water flow rate for a group of Pumps m^3/hour	Consumed power MWhour	Rated flow with pressure in the system m^3/hour	Electric power for a basic drive MWhour	Water flow m^3/hour	Electric power for the adjustable electric drive MWhour	Consumed electric power per month TOTAL MWhour	Electric power savings per month MWhour
January	31	3	31	110 00	10,000	3 968	3,273	3 122	180	221 88	3,344 32	623 88
February	29	3	29	110 00	10,000	3 712	3,273	2,921	180	207 56	3,128 56	583 63
March	31	3	31	110 00	10,000	3,968	3 273	3,128	180	221 88	3,344 32	623 88
April	30	3	30	110 00	10,000	3,840	3,273	3,022	180	214 72	3,236 44	603 75
May	31	3	9	110 00	10,000	1,152	3,273	907	180	64 42	970 93	181 13
June	30	0	30	110 00	0	0	3,273	0	0	0 00	0 00	0 00
July	31	0	31	110 00	0	0	3 273	0	0	0 00	0 00	0 00
August	31	0	31	110 00	0	0	3 273	0	0	0 00	0 00	0 00
September	30	0	30	110 00	0	0	3,273	0	0	0 00	0 00	0 00
October	31	3	15	110 00	10,000	1,920	3,273	1,511	180	107 36	1,618 22	301 88
November	30	3	30	110 00	10,000	3,840	3,273	3,022	180	214 72	3,236 44	603 75
December	31	3	31	110 00	10,000	3,968	3,273	3,122	180	221 88	3,344 32	623 88
						26 369		23,872		1 696	25,568	

Electric power savings per year, TOTAL, MWhour	**4145 76**	**17 378**
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year, TOTAL, billion rubles	**1 629**	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	378,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	2 1546	
Repayment period (not considering banking interest rate on loans), months	**1s6**	

Table S1-6

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*SE2500-180*
Capacity m^3/hour	2500
Electric Drive Power	1 40

		It is assumed that					Variant of the installation of adjustable electric drive: Pumps without adjustable electric drive		Pumps with adjustable electric drive			
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	Average pressure in the system (after the valve) m w c	Total water flow rate for a group of Pumps m^3/hour	Consumed power MWhour	Rated flow with pressure in the system m^3/hour	Electric power for a basic drive MWhour	Water flow m^3/hour	Electric power for the adjustable electric drive MWhour	Consumed electric power per month TOTAl MWhour	Electric power savings per month MWhour
January	31	3	31	110 00	10,500	4033	3 273	3,122	680	263 46	3,385 91	647 55
February	29	3	29	110 00	10 500	3773	3 273	2,921	680	246 47	3,167 47	605 77
March	31	3	31	110 00	10,500	4033	3 273	3 122	680	263 46	3,388 91	64755
April	30	3	30	110 00	10,500	3903	3,273	3,022	680	254 97	3,276 69	626 66
May	31	3	9	110 00	10,500	1171	3,273	907	680	76 49	983 01	188 00
June	30	0	30	110 00	0	0	3,273	0	0	0 00	0 00	0 00
July	31	0	31	110 00	0	0	3 273	0	0	0 00	0 00	0 00
August	31	0	31	110 00	0	0	3 273	0	0	0 00	0 00	0 00
September	30	0	30	110 00	0	0	3,273	0	0	0 00	0 00	0 00
October	31	3	15	110 00	10,500	1952	3,273	1 511	680	127 48	1,638 34	313 33
November	30	3	30	110 00	10,500	3903	3,273	3 022	680	254 97	3,276 69	626 66
December	31	3	31	110 00	10,500	4033	3 273	3,122	680	263 46	3,385 91	647 55
						26,803		23,872		1 696	25,886	

Electric power savings per year, TOTAL, MWhour	***4,303 05***	***18 038***
Difference in Sale/Supply prices, rubles/kWhour	393	
Incomes for distributed saved electric power per year, TOTAL, billion rubles	***1 629***	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	378,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	2 1546	
Repayment period (not considering banking interest rate on loans), months	***16***	

Table S1-7

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*SE2500-180*
Capacity, m^3/hour	2500
Electric Drive Power	1 40

		It is assumed that					Variant of the installation of adjustable electric drive: Pumps without adjustable electric drive		Pumps with adjustable electric drive			
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	Average pressure in the system (after the valve) m w c	Total water flow rate for a group of Pumps m^3/hour	Consumed power MWhour	Rated flow with pressure in the system m^3/hour	Electric power for a basic drive MWhour	Water flow m^3/hour	Electric power for the adjustable electric drive MWhour	Consumed electric power per month TOTAL MWhour	Electric power savings per month MWhour
January	31	4	31	110 00	11,000	1 088	3 273	3 1	1179	347 03	3,469 48	618 14
February	29	1	29	110 00	11 000	3 8 4	3, 73	, 3 1	1179	3 4 61	3,24 64	78 6
March	31	4	31	110 00	11,000	4,088	3 73	3 1	1179	347 03	3,969 48	618 14
April	30	4	30	110 00	11,000	3,956	3,273	3,022	1179	335 84	3 357 56	598 20
May	31	4	9	110 00	11 000	1 187	3 273	907	1179	100 75	1,007 27	179 46
June	30	0	30	110 00	0	0	3 273	0	0	0 00	0 00	0 00
July	31	0	31	110 00	0	0	3,273	0	0	0 00	0 00	0 00
August	31	0	31	110 00	0	0	3,273	0	0	0 00	0 00	0 00
September	30	0	30	110 00	0	0	3 273	0	0	0 00	0 00	0 00
October	31	4	15	110 00	11,000	1 978	3 273	1 511	1179	167 92	1,678 78	299 10
November	30	4	30	110 00	11,000	3,956	3,273	3,022	1179	335 84	3,357 56	598 20
December	31	4	31	110 00	11,000	4,088	3,273	3,122	1179	347 03	3,469 48	618 14
						27 163		23,872		1 696	25,886	

Electric power savings per year, TOTAL, MWhour	**4 107 62**	**17 218**
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year, TOTAL, billion rubles	**1 629**	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	378,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	2 1546	
Repayment period (not considering banking interest rate on loans), months	**17**	

Table S2-1

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*SE2500-180*
Capacity, m^3/hour	2500
Electric Drive Power	1 40

		It is assumed that					Variant of the installation of adjustable electric drive: Pumps without adjustable electric drive		Pumps with adjustable electric drive			
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	Average pressure in the system (after the valve) m w c	Total water flow rate for a group of Pumps m^3/hour	Consumed power MWhour	Rated flow with pressure in the system m^3/hour	Electric power for a basic drive MWhour	Water flow m^3/hour	Electric power for the adjustable electric drive MWhour	Consumed electric power per month TOTAL MWhour	Electric power savings per month MWhour
January	31	3	31	120 00	8,000	3,040	3,191	2,085	1,617	189 40	2,574 43	465 19
February	29	3	29	120 00	8,000	2 844	3,191	1 951	1,617	457 83	2408 34	435 18
March	31	3	31	120 00	8,000	3,040	3 191	2,085	1 617	489 40	2,574 43	465 19
April	30	3	30	120 00	8,000	2,942	3 191	2,018	1,617	473 61	2491 39	450 19
May	31	3	9	120 00	8,000	882	3,191	605	1,617	142 08	747 42	135 06
June	30	0	30	120 00	0	0	3,191	0	0	0 00	0 00	0 00
July	31	0	31	120 00	0	0	3,191	0	0	0 00	0 00	0 00
August	31	0	31	120 00	0	0	3,191	0	0	0 00	0 00	0 00
September	30	0	30	120 00	0	0	3,191	0	0	0 00	0 00	0 00
October	31	3	15	120 00	8,000	1,171	3 273	1,007	1 453	196 83	1,204 07	266 71
November	30	3	30	120 00	8 000	2,942	3,273	2,014	1,453	393 66	2408 14	533 43
December	31	3	31	120 00	8,000	3,040	3,273	2,082	1,453	406 78	2488 41	551 1
						20 199		15 929		3 456	19 385	

Electric power savings per year, TOTAL, MWhour	***3,302 16***	***20 378***
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year, TOTAL, billion rubles	***1 298***	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	378,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	2,1546	
Repayment period (not considering banking interest rate on loans), months	***20***	

Table S2-2

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*SE2500-180*
Capacity, m^3/hour	2500
Electric Drive Power	1 40

		It is assumed that					Variant of the installation of adjustable electric drive: Pumps without adjustable electric drive		Pumps with adjustable electric drive			
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	Average pressure in the system (after the valve) m w c	Total water flow rate for a group of Pumps m^3/hour	Consumed power MWhour	Rated flow with pressure in the system m^3/hour	Electric power for a basic drive MWhour	Water flow m^3/hour	Electric power for the adjustable electric drive MWhour	Consumed electric power per month TOTAL MWhour	Electric power savings per month MWhour
January	31	3	31	120 00	8,500	3,088	3,191	2,085	2,117	635 86	2,720 89	366 86
February	29	4	29	120 00	8 500	2,889	3,191	1,951	2,117	594 84	2,545 35	343 20
March	31	3	31	120 00	8,500	3,088	3,191	2,085	2,117	635 86	2,720 89	366 86
April	30	3	30	120 00	8,500	2,988	3,191	2,018	2,117	615 35	2,633 12	355 03
May	31	3	9	120 00	8 500	896	3,191	605	2,117	184 61	789 94	106 51
June	30	0	30	120 00	0	0	3 191	0	0	0 00	0 00	0 00
July	31	0	31	120 00	0	0	3,191	0	0	0 00	0 00	0 00
August	31	0	31	120 00	0	0	3,191	0	0	0 00	0 00	0 00
September	30	0	30	120 00	0	0	3,191	0	0	0 00	0 00	0 00
October	31	3	15	120 00	8,500	1 494	3,191	1,009	2 117	307 68	1,316 36	177 52
November	30	3	30	120 00	8,500	2,988	3,191	2,018	2,117	615 35	2,633 12	355 03
December	31	3	31	120 00	8,500	3,088	3,191	2,085	2,117	635 86	2,720 89	366 86
						20,519		15,940		4,861	20,802	

Electric power savings per year, TOTAL, MWhour	*2,473 87*	*15 298*
Difference in Sale/Supply prices, rubles/kWhour	393	
Incomes for distributed saved electric power per year TOTAL, billion rubles	*0 958*	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	378,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	2,1546	
Repayment period (not considering banking interest rate on loans), months	*27*	

Table S2-3

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*SE2500-180*
Capacity, m^3/hour	2500
Electric Drive Power	1 40

							Variant of the installation of adjustable electric drive					
		It is assumed that					Pumps without adjustable electric drive		Pumps with adjustable electric drive			
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	Average pressure in the system (after the valve) m w c	Total water flow rate for a group of Pumps m^3/hour	Consumed power MWhour	Rated flow with pressure in the system, m^3/hour	Electric power for a basic drive MWhour	Water flow m^3/hour	Electric power for the adjustable electric drive MWhour	Consumed electric power per month TOTAL MWhour	Electric power savings per month MWhour
January	31	4	31	120 00	9,000	3,118	3 191	2,085	2,617	807 34	2,892 37	225 66
February	29	4	29	120 00	9,000	2 917	3 191	1,951	2,617	755 25	2,705 76	211 10
March	31	4	31	120 00	9,000	3 118	3,191	,085	2 617	807 34	2,892 37	225 66
April	30	4	30	120 00	9,000	3,017	3,191	2,018	2,617	781 29	2,799 06	218 38
May	31	4	9	120 00	9,000	905	3,191	605	2,617	234 39	839 72	65 51
June	30	0	30	120 00	0	0	3,191	0	0	0 00	0 00	0 00
July	31	0	31	120 00	0	0	3,191	0	0	0 00	0 00	0 00
August	31	0	31	120 00	0	0	3,191	0	0	0 00	0 00	0 00
September	30	0	30	120 00	0	0	3,191	0	0	0 00	0 00	0 00
October	31	4	15	120 00	9,000	1 509	3,191	1,009	2,617	390 65	1,399 53	109 19
November	30	4	30	120 00	9 000	3,017	3,191	2,018	2,617	781 29	2,799 06	218 38
December	31	4	31	120 00	9,000	3,118	3,191	2,085	2,617	807 34	2,892 37	225 66
						20,720		15,940		6,172	22 113	

Electric power savings per year, TOTAL, MWhour	***1,499 55***	***9 418***
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year, TOTAL, billion rubles	***0 589***	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	378,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	2,1546	
Repayment period (not considering banking interest rate on loans) months	***44***	

Table S2-4

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*SE2500-180*
Capacity, m^3/hour	2500
Electric Drive Power	1 40

		It is assumed that					Variant of the installation of adjustable electric drive: Pumps without adjustable electric drive		Pumps with adjustable electric drive			
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	Average pressure in the system (after the valve) m w c	Total water flow rate for a group of Pumps m^3/hour	Consumed power MWhour	Rated flow with pressure in the system m^3/hour	Electric power for a basic drive MWhour	Water flow m^3/hour	Electric power for the adjustable electric drive MWhour	Consumed electric power per month TOTAl MWhour	Electric power savings per month MWhour
January	31	3	31	120 00	9,500	3,128	3 191	08	3,117	1 003 56	3,088 59	39 38
February	29	3	29	120 00	9,500	2,926	3 191	1,951	3 117	938 81	2,889 33	36 83
March	31	3	31	120 00	9,500	3 128	3,191	,085	3 117	1,003 56	3 088 59	39 38
April	30	3	30	120 00	9,500	3,027	3,191	2,018	3,117	971 19	2,988 96	38 10
May	31	3	9	120 00	9,500	908	3 191	605	3,117	291 36	896 69	11 43
June	30	0	30	120 00	0	0	3,191	0	0	0 00	0 00	0 00
July	31	0	31	120 00	0	0	3 191	0	0	0 00	0 00	0 00
August	31	0	31	120 00	0	0	3,191	0	0	0 00	0 00	0 00
September	30	0	30	120 00	0	0	3 191	0	0	0 00	0 00	0 00
October	31	3	15	120 00	9,500	1,514	3,191	1,009	3,117	485 59	1,191 48	19 05
November	30	3	30	120 00	9,500	3,027	3,191	2 018	3,117	971 19	2,988 96	38 10
December	31	3	31	120 00	9,500	3,128	3 191	2,085	3,117	1,003 56	3,088 59	39 38
						20 786		15,940		7,672	23,613	

Electric power savings per year, TOTAL, MWhour	***261 65***
Difference in Sale/Supply prices rubles/kWhour	393
Incomes for distributed saved electric power per year, TOTAL, billion rubles	***0 103***
Unit cost of the drive USD/kW	270
Total cost of the drive USD	378,000
Current exchange rate rouble/USD	5,700
Total price of the Drive billion rubles	2,1546
Repayment period (not considering banking interest rate on loans) months	***252***

1 648

Table S2-5

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*SE2500-180*
Capacity, m^3/hour	2500
Electric Drive Power	1 40

		It is assumed that					Variant of the installation of adjustable electric drive					
							Pumps without adjustable electric drive		Pumps with adjustable electric drive			
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	Average pressure in the system (after the valve) m w c	Total water flow rate for a group of Pumps m^3/hour	Consumed power MWhour	Rated flow with pressure in the system m^3/hour	Electric power for a basic drive MWhour	Water flow m^3/hour	Electric power for the adjustable electric drive MWhour	Consumed electric power per month TOTAL MWhour	Electric power savings per month MWhour
January	31	4	31	120 00	10 000	3 968	3,191	3,128	426	267 42	3,394 96	573 4
February	29	4	29	120 00	10,000	3,712	3,191	2 926	426	250 16	3,175 93	536 5
March	31	4	31	120 00	10,000	3 968	3 191	3,128	426	267 42	3,394 96	573 24
April	30	4	30	120 00	10,000	3,840	3,191	3,027	426	258 79	3,285 45	554 75
May	31	4	9	120 00	10,000	1,152	3,191	908	426	77 64	985 63	166 42
June	30	0	30	120 00	0	0	3,191	0	0	0 00	0 00	0 00
July	31	0	31	120 00	0	0	3 191	0	0	0 00	0 00	0 00
August	31	0	31	120 00	0	0	3,191	0	0	0 00	0 00	0 00
September	30	0	30	120 00	0	0	3,191	0	0	0 00	0 00	0 00
October	31	4	15	120 00	10,000	1,920	3 191	1 513	426	129 40	1,612 72	277 37
November	30	4	30	120 00	10,000	3,840	3,191	3,027	426	258 79	3,285 45	554 75
December	31	4	31	120 00	10,000	3,968	3,191	3,128	426	267 42	3,394 96	573 24
						26,369		23,911		2,044	25 955	

Electric power savings per year, TOTAL, MWhour	***3809 26***	***15 938***
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year, TOTAL, billion rubles	***1 497***	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	378,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	2,1546	
Repayment period (not considering banking interest rate on loans), months	***18***	

Table S2-6

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*SE2500-180*
Capacity, m^3/hour	2500
Electric Drive Power	1 40

		It is assumed that					Variant of the installation of adjustable electric drive					
							Pumps without adjustable electric drive		Pumps with adjustable electric drive			
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	Average pressure in the system (after the valve) m w c	Total water flow rate for a group of Pumps m^3/hour	Consumed power MWhour	Rated flow with pressure in the system m^3/hour	Electric power for a basic drive MWhour	Water flow m^3/hour	Electric power for the adjustable electric drive MWhour	Consumed electric power per month TOTAL MWhour	Electric power savings per month MWhour
January	31	4	31	120 00	10,500	4,033	3,191	3,128	926	334 62	3,462 17	571 29
February	29	4	29	120 00	10,500	3,773	3 191	2,926	926	313 03	3,238 80	534 43
March	31	4	31	120 00	10,500	4,033	3,191	3,128	926	334 62	3,462 17	571 29
April	30	4	30	120 00	10,500	3,903	3,191	3,027	926	323 83	3,350 48	552 86
May	31	4	9	120 00	10,500	1,171	3,191	908	926	97 15	1,005 14	165 86
June	30	0	30	120 00	0	0	3,191	0	0	0 00	0 00	0 00
July	31	0	31	120 00	0	0	3 191	0	0	0 00	0 00	0 00
August	31	0	31	120 00	0	0	3,191	0	0	0 00	0 00	0 00
September	30	0	30	120 00	0	0	3,191	0	0	0 00	0 00	0 00
October	31	4	15	120 00	10,500	1,952	3,191	1,513	926	161 91	1,675 24	276 13
November	30	4	30	120 00	10,500	3,903	3 191	3,027	926	323 83	3,350 48	552 86
December	31	4	31	120 00	10,500	4,033	3,191	3,128	926	334 62	3,462 17	571 29
						26 803		23 911		2 558	26,469	

Electric power savings per year, TOTAL, MWhour	3,796 32	15 888
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year, TOTAL, billion rubles	1,492	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	378,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	2,154 6	
Repayment period (not considering banking interest rate on loans) months	18	

Table S2-7

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*SE2500-180*
Capacity m^3/hour	2500
Electric Drive Power	1 40

		It is assumed that					Variant of the installation of adjustable electric drive					
							Pumps without adjustable electric drive		Pumps with adjustable electric drive			
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	Average pressure in the system (after the valve) m w c	Total water flow rate for a group of Pumps, m^3/hour	Consumed power MWhour	Rated flow with pressure in the system, m^3/hour	Electric power for a basic drive MWhour	Water flow m^3/hour	Electric power for the adjustable electric drive MWhour	Consumed electric power per month TOTAL MWhour	Electric power savings per month MWhour
January	31	4	31	120 00	11,000	4 088	3,191	3,128	1,425	440 35	3,567 90	519 72
February	29	4	29	120 00	11,000	3,824	3 191	2,926	1,425	411 94	3,337 71	486 19
March	31	4	31	120 00	11,000	4,088	3,191	3 128	1,425	440 35	3 567 90	519 72
April	30	4	30	120 00	11,000	3 956	3,191	3,027	1 425	426 15	3,452 81	502 95
May	31	4	9	120 00	11,000	1,187	3 191	908	1,425	127 84	1,035 84	150 89
June	30	0	30	120 00	0	0	3 191	0	0	0 00	0 00	0 00
July	31	0	31	120 00	0	0	3,191	0	0	0 00	0 00	0 00
August	31	0	31	120 00	0	0	3,191	0	0	0 00	0 00	0 00
September	30	0	30	120 00	0	0	3 191	0	0	0 00	0 00	0 00
October	31	4	15	120 00	11,000	1,978	3 191	1,513	1,425	213 07	1,726 40	251 48
November	30	4	30	120 00	11 000	3,956	3,191	3 027	1 425	426 15	3,452 81	502 95
December	31	4	31	120 00	11,000	4 088	3,191	3,128	1 425	440 35	3,567 90	519 72
						27,163		23,911		3,367	27,277	

Electric power savings per year, TOTAL, MWhour	***3,453 60***	***14 448***
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year, TOTAL, billion rubles	***1 357***	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	378,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	2,1546	
Repayment period (not considering banking interest rate on loans), months	***20***	

Table S3-1

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*SE2500-180*
Capacity, m^3/hour	2500
Electric Drive Power	1 40

		It is assumed that					Variant of the installation of adjustable electric drive: Pumps without adjustable electric drive		Pumps with adjustable electric drive			
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	Average pressure in the system (after the valve) m w c	Total water flow rate for a group of Pumps m^3/hour	Consumed power MWhour	Rated flow with pressure in the system m^3/hour	Electric power for a basic drive MWhour	Water flow m^3/hour	Electric power for the adjustable electric drive MWhour	Consumed electric power per month TOTAL MWhour	Electric power savings per month MWhour
January	31	3	31	130 00	8,000	3 040	3,076	2,084	1,847	600 66	2,684 18	3 5 45
February	29	3	29	130 00	8,000	2,841	3,076	1,949	1,847	561 91	2,511 00	332 52
March	31	3	31	130 00	8,000	3,040	3,076	2 084	1,817	600 66	2 684 18	3 5 45
April	30	3	30	130 00	8 000	2,912	3,076	2,016	1,847	581 28	2 597 39	313 98
May	31	3	9	130 00	8,000	882	3 076	605	1,817	174 39	779 8	103 19
June	30	0	30	130 00	0	0	3,076	0	0	0 00	0 00	0 00
July	31	0	31	130 00	0	0	3,076	0	0	0 00	0 00	0 00
August	31	0	31	130 00	0	0	3 076	0	0	0 00	0 00	0 00
September	30	0	30	130 00	0	0	3,076	0	0	0 00	0 00	0 00
October	31	3	15	110 00	8,000	1 471	3, 73	1,007	1,4 3	196 83	1,204 07	266 71
November	30	3	30	110 00	8,000	2,942	3 273	2 014	1,453	393 66	2,408 14	533 43
December	31	3	31	110 00	8 000	3,040	3,273	2,082	1,453	406 78	2,488 41	551 21
						20 199		15,922		3 923	19,845	

Electric power savings per year, TOTAL, MWhour	**2,841 95**	**17 858**
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year TOTAL, billion rubles	**1 117**	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	378,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	2 1546	
Repayment period (not considering banking interest rate on loans), months	**24**	

Table S3-2

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*SE2500-180*
Capacity, m^3/hour	2500
Electric Drive Power	1 40

		It is assumed that					Variant of the installation of adjustable electric drive					
							Pumps without adjustable electric drive		Pumps with adjustable electric drive			
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	Average pressure in the system (after the valve) m w c	Total water flow rate for a group of Pumps m^3/hour	Consumed power MWhour	Rated flow with pressure in the system m^3/hour	Electric power for a basic drive MWhour	Water flow m^3/hour	Electric power for the adjustable electric drive MWhour	Consumed electric power per month TOTAL MWhour	Electric power savings per month MWhour
January	31	3	31	130 00	8 500	3,088	3,076	2,084	2,347	767 59	2,851 11	236 65
February	29	3	29	130 00	8,500	2,889	3,076	1,919	2,347	718 07	2,667 17	221 38
March	31	3	31	130 00	8,500	3,088	3,076	2,084	2,347	767 59	2,851 11	236 65
April	30	3	30	130 00	8,500	2 988	3,076	2,016	2,347	742 83	2,759 14	229 01
May	31	3	9	130 00	8,500	896	3,076	605	2,347	222 85	8[illegible]7 74	68 70
June	30	0	30	130 00	0	0	3 076	0	0	0 00	0 00	0 00
July	31	0	31	130 00	0	0	3,076	0	0	0 00	0 00	0 00
August	31	0	31	130 00	0	0	3,076	0	0	0 00	0 00	0 00
September	30	0	30	130 00	0	0	3,076	0	0	0 00	0 00	0 00
October	31	3	15	110 00	8,500	1,494	3,273	1,008	2,347	371 42	1 379 57	114 51
November	30	3	30	110 00	8 500	2,988	3,273	2,016	2,347	742 83	2,759 11	229 01
December	31	3	31	110 00	8,500	3,088	3,273	2,084	2,347	767 59	2,851 11	236 65
						20,519		15,922		3 923	19 845	

Electric power savings per year, TOTAL, MWhour	1,572 57	9 878
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year, TOTAL, billion rubles	0 618	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	378,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	2 1546	
Repayment period (not considering banking interest rate on loans), months	42	

Table S3-3

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*SE2500-180*
Capacity, m^3/hour	2500
Electric Drive Power	1 40

		It is assumed that					Variant of the installation of adjustable electric drive: Pumps without adjustable electric drive		Pumps with adjustable electric drive			
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	Average pressure in the system (after the valve) m w c	Total water flow rate for a group of Pumps m^3/hour	Consumed power MWhour	Rated flow with pressure in the system m^3/hour	Electric power for a basic drive MWhour	Water flow m^3/hour	Electric power for the adjustable electric drive MWhour	Consumed electric power per month TOTAL MWhour	Electric power savings per month MWhour
January	31	3	31	130 00	9,000	3,118	3,076	2,084	2,847	960 16	3,043 67	74 35
February	29	3	29	130 00	9,000	2,917	3,076	1 949	2,847	898 21	2,847 31	69 56
March	31	3	31	130 00	9,000	3,118	3,076	2,084	2,847	960 16	3,043 67	74 35
April	30	3	30	130 00	9 000	3,017	3,076	2,016	2,847	929 19	2,945 49	71 95
May	31	3	9	130 00	9,000	905	3,076	605	2,817	278 76	883 65	21 59
June	30	0	30	130 00	0	0	3,076	0	0	0 00	0 00	0 00
July	31	0	31	130 00	0	0	3 076	0	0	0 00	0 00	0 00
August	31	0	31	130 00	0	0	3,076	0	0	0 00	0 00	0 00
September	30	0	30	130 00	0	0	3,076	0	0	0 00	0 00	0 00
October	31	3	15	110 00	9,000	1,009	3,273	1,008	2,847	464 59	1 472 75	35 98
November	30	3	30	110 00	9,000	3,017	3,273	2,016	2,847	929 19	2,945 49	71 95
December	31	3	31	110 00	9,000	3 118	3,273	2,084	2,847	960 16	3,043 67	74 35
						20,720		15,929		7,341	23,269	

Electric power savings per year, TOTAL, MWhour	***494 08***	***3 108***
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year TOTAL, billion rubles	***0 194***	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	378,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	2 1546	
Repayment period (not considering banking interest rate on loans), months	***134***	

Table S3-4

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*SE2500 180*
Capacity m^3/hour	2500
Electric Drive Power	1 40

							Variant of the installation of adjustable electric drive					
		It is assumed that					Pumps without adjustable electric drive		Pumps with adjustable electric drive			
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	Average pressure in the system (after the valve) m w c	Total water flow rate for a group of Pumps m^3/hour	Consumed power MWhour	Rated flow with pressure in the system m^3/hour	Electric power for a basic drive MWhour	Water flow m^3/hour	Electric power for the adjustable electric drive MWhour	Consumed electric power per month TOTAL MWhour	Electric power savings per month MWhour
January	31	3	31	130 00	9,500	3,128	3,076	3,125	270	288 49	3,413 76	-285 80
February	29	3	29	130 00	9,500	2,926	3,076	2,924	270	269 88	3,193 52	-267 36
March	31	3	31	130 00	9,500	3,128	3 076	3,1 5	270	288 49	3,413 76	-285 80
April	30	3	30	130 00	9,500	3,027	3,076	3,024	270	279 19	3,303 64	-276 58
May	31	3	9	130 00	9,500	908	3,076	907	270	83 76	991 09	-82 97
June	30	0	30	130 00	0	0	3 076	0	0	0 00	0 00	0 00
July	31	0	31	130 00	0	0	3,076	0	0	0 00	0 00	0 00
August	31	0	31	130 00	0	0	3,076	0	0	0 00	0 00	0 00
September	30	0	30	130 00	0	0	3 076	0	0	0 00	0 00	0 00
October	31	3	15	110 00	9,500	1 514	3,273	1,512	270	139 59	1,651 82	-138 9
November	30	3	30	110 00	9,500	3,027	3 273	3,024	270	279 19	3,303 64	-276 58
December	31	3	31	110 00	9 500	3,128	3 73	3,125	270	288 49	3 113 76	-285 80
						20,786		23,893		2,206	26 099	

Electric power savings per year, TOTAL, MWhour	-1,899 19	-7 958
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year, TOTAL, billion rubles	-0 746	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	378,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	2 1546	
Repayment period (not considering banking interest rate on loans), months	-34	

Table S3-5

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*SE2500-180*
Capacity m^3/hour	2500
Electric Drive Power	1 40

		It is assumed that					Variant of the installation of adjustable electric drive: Pumps without adjustable electric drive		Pumps with adjustable electric drive			
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	Average pressure in the system (after the valve) m w c	Total water flow rate for a group of Pumps m^3/hour	Consumed power MWhour	Rated flow with pressure in the system m^3/hour	Electric power for a basic drive MWhour	Water flow m^3/hour	Electric power for the adjustable electric drive MWhour	Consumed electric power per month TOTAL MWhour	Electric power savings per month MWhour
January	31	4	31	130 00	10,000	3,968	3,076	3,125	771	343 45	3,468 72	499 48
February	29	4	29	130 00	10,000	3,712	3,076	2,924	771	321 29	3,244 93	467 25
March	31	4	31	130 00	10 000	3,968	3,076	3,125	771	343 45	3,468 72	499 48
April	30	4	30	130 00	10,000	3 840	3,076	3,024	771	332 37	3,356 83	483 37
May	31	4	9	130 00	10,000	1 152	3 076	907	771	99 71	1 007 05	145 01
June	30	0	30	130 00	0	0	3,076	0	0	0 00	0 00	0 00
July	31	0	31	130 00	0	0	3,076	0	0	0 00	0 00	0 00
August	31	0	31	130 00	0	0	3 076	0	0	0 00	0 00	0 00
September	30	0	30	130 00	0	0	3,076	0	0	0 00	0 00	0 00
October	31	4	15	110 00	10,000	1,920	3,273	1,512	771	166 18	1,678 41	241 68
November	30	4	30	110 00	10,000	3,840	3,273	3 024	771	332 37	3,356 83	483 37
December	31	4	31	110 00	10,000	3,968	3,273	3,125	771	343 45	3,468 72	499 48
						26 369		23,893		2 626	26,519	

Electric power savings per year, TOTAL, MWhour	***3,319 12***	***13 898***
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year, TOTAL, billion rubles	***1 304***	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	378,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	2 1546	
Repayment period (not considering banking interest rate on loans), months	***20***	

Table S3-6

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*SE2500-180*
Capacity, m^3/hour	2500
Electric Drive Power	1 40

							Variant of the installation of adjustable electric drive					
		It is assumed that					Pumps without adjustable electric drive		Pumps with adjustable electric drive			
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	Average pressure in the system (after the valve) m w c	Total water flow rate for a group of Pumps m^3/hour	Consumed power MWhour	Rated flow with pressure in the system m^3/hour	Electric power for a 'basic drive MWhour	Water flow m^3/hour	Electric power for the adjustable electric drive MWhour	Consumed electric power per month TOTAL MWhour	Electric power savings per month MWhour
January	31	4	31	130 00	10,500	4 033	3,076	3,125	1,271	443 25	3,568 52	464 94
February	29	4	29	130 00	10,500	3,773	3 076	2,924	1,271	414 65	3,338 29	434 94
March	31	4	31	130 00	10,500	4,033	3 076	3,125	1,271	443 25	3,568 52	464 94
April	30	4	30	130 00	10,500	3,903	3 076	3,024	1,271	428 95	3,453 41	449 94
May	31	4	9	130 00	10,500	1,171	3,076	907	1,271	128 68	1,036 09	134 98
June	30	0	30	130 00	0	0	3,076	0	0	0 00	0 00	0 00
July	31	0	31	130 00	0	0	3,076	0	0	0 00	0 00	0 00
August	31	0	31	130 00	0	0	3,076	0	0	0 00	0 00	0 00
September	30	0	30	130 00	0	0	3,076	0	0	0 00	0 00	0 00
October	31	4	15	110 00	10,500	1,952	3,273	1,512	1 271	214 47	1,726 70	224 97
November	30	4	30	110 00	10,500	3 903	3,273	3,024	1,271	428 95	3,453 41	449 94
December	31	4	31	110 00	10,500	4,033	3,273	3,125	1,271	443 25	3,568 52	464 94
						26,803		23,893		3,389	27,282	

Electric power savings per year, TOTAL, MWhour	***3,089 58***	***12 938***
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year, TOTAL, billion rubles	***1 214***	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	378,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	2 1546	
Repayment period (not considering banking interest rate on loans), months	***22***	

Table S3-7

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*SE2500-180*
Capacity m^3/hour	2500
Electric Drive Power	1 40

		It is assumed that					Variant of the installation of adjustable electric drive: Pumps without adjustable electric drive		Pumps with adjustable electric drive			
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	Average pressure in the system (after the valve) m w c	Total water flow rate for a group of Pumps m^3/hour	Consumed power MWhour	Rated flow with pressure in the system, m^3/hour	Electric power for a basic drive MWhour	Water flow m^3/hour	Electric power for the adjustable electric drive MWhour	Consumed electric power per month TOTAL MWhour	Electric power savings per month MWhour
January	31	4	31	130 00	11,000	4,088	3,076	3,125	1,770	577 31	3,702 58	385 03
February	29	4	29	130 00	11 000	3,824	3 076	2,924	1 770	540 06	3,463 70	360 19
March	31	4	31	130 00	11,000	4,088	3,076	3,125	1,770	577 31	3,702 58	385 03
April	30	4	30	130 00	11,000	3,956	3,076	3,024	1,770	558 68	3,583 14	372 61
May	31	4	9	130 00	11,000	1,187	3,076	907	1,770	167 61	1,074 94	111 78
June	30	0	30	130 00	0	0	3,076	0	0	0 00	0 00	0 00
July	31	0	31	130 00	0	0	3 076	0	0	0 00	0 00	0 00
August	31	0	31	130 00	0	0	3,076	0	0	0 00	0 00	0 00
September	30	0	30	130 00	0	0	3,076	0	0	0 00	0 00	0 00
October	31	4	15	110 00	11,000	1,978	3 273	1 512	1,770	279 34	1,791 57	186 31
November	30	4	30	110 00	11 000	3 956	3,273	3,024	1,770	558 68	3,583 14	372 61
December	31	4	31	110 00	11,000	4,088	3,273	3,125	1,770	577 31	3,702 58	385 03
						27 163		23,893		4 414	28,307	

Electric power savings per year, TOTAL, MWhour	***2,558 62***	***10 718***
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year, TOTAL, billion rubles	***1 006***	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	378,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	2 1546	
Repayment period (not considering banking interest rate on loans), months	***26***	

1993

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*PE500-180*
Capacity, m^3/hour	500
Electric Drive Power	4 00
Analyzed year	1993

		It is assumed that		For pumps operating in the amount of								
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	units	Average pressure in after valves atm	Average pressure in the system (after the valve) atm	Pressure loss at the valve atm	Actual water flow rate for a group of Pumps m^3/hour	Estimated water flow rate for a group of Pumps m^3/hour	Water flow rate for a single Pump m^3/hour	Power of a sindle pump, MW	Consumed totally per month MWhou
January	31	3	31	3	197 40	176 00	21 40	1,147	1,147	382	2 98	6,652 59
February	29	3	29	3	192 50	176 00	16 50	1,318	1,318	439	3 21	6,696 78
March	31	3	31	3	193 80	176 00	17 80	1,279	1,276	425	3 15	7,035 80
April	30	3	30	3	200 50	176 00	24 50	1,012	1,018	339	2 81	6,069 55
May	31	2	31	2	195 70	176 00	19 70	805	807	404	3 07	4,560 96
June	30	2	30	2	197 40	176 00	21 40	763	765	382	2 98	4,291 99
July	31	2	31	2	201 40	176 00	25 40	655	652	326	2 76	4,101 69
August	31	2	31	2	192 00	176 00	16 00	893	889	444	3 23	4,802 44
Septembe r	30	2	30	2	189 70	176 00	13 70	937	932	466	3 31	4,771 05
October	31	3	31	3	196 40	176 00	20 40	1,189	1,185	395	3 03	6,765 39
November	30	3	30	3	192 00	176 00	16 00	1,331	1,333	444	3 23	6,971 29
December	31	3	31	3	196 00	176 00	20 00	1,205	1,200	400	3 05	6,809 14
											TOTAL	69,529

1993

Variant of the installation of adjustable electric drive											
Pumps without adjustable electric drive					Pumps with adjustable electric drive						
Rated flow with pressure in the system m^3/hour	Amount of operating pumps	(Amount of days in operation per month)	Power of a single pump MW	Electric power consumed per the drive MW hour	Water flow m^3/hour	Generated head atm	(Amount of days in operation per month)	Electric power for the adjustable electric drive MWhour	Electric power consumed per the drive MW hour	Consumed electric power per month TOTAL MWhour	Consumed electric power per a single drive W hour
534	2	31	3 58	5,333	79	176 00	31	1 43	1,060 83	6,394 23	258 36
534	2	29	3 58	4,989	250	176 00	29	2 00	1,393 50	6,382 81	313 96
534	2	31	3 58	5,333	208	176 00	31	1 84	1,371 91	6,705 31	330 49
534	1	30	3 58	2,581	484	176 00	30	3 22	2,321 23	4,901 91	1,167 64
534	1	31	3 58	2,667	273	176 00	31	2 10	1,560 49	4,227 19	333 77
534	1	30	3 58	2,581	231	176 00	30	1 93	1,387 58	3,968 26	323 73
534	1	31	3 58	2,667	118	176 00	31	1 54	1,147 2_ 8	3,813 98	287 71
534	1	31	3 58	2,667	355	176 00	31	2 47	1,838 93	4,505 63	296 81
534	1	30	3 58	2,581	398	176 00	30	2 70	1,942 92	4,523 60	247 44
534	2	31	3 58	5,333	117	176 00	31	1 54	1,144 97	6,478 37	287 02
534	2	30	3 58	5,161	265	176 00	30	2 06	1,485 91	6,647 27	324 02
534	2	31	3 58	5,333	132	176 00	31	1 58	1,179 09	6,512 49	296 65
			TOTAL	**47,226**			**366**	**TOTAL**	**17,835**	**65,061**	

Electric power savings per year, TOTAL, MWhour	***4,467 62***	***6 438***
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year, TOTAL, billion rubles	***1 756***	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	1,080,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	6 156	
Repayment period (not considering banking interest rate on loans), months	***43***	

1994

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*PE500-180*
Capacity m^3/hour	500
Electric Drive Power	4 00
Analyzed year	1994

	It is assumed that		For pumps operating in the amount of									
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	units	Average pressure in after valves atm	Average pressure in the system (after the valve) atm	Pressure loss at the valve atm	Actual water flow rate for a group of Pumps m^3/hour	Estimated water flow rate for a group of Pumps m^3/hour	Water flow rate for a single Pump m^3/hour	Power of a sindle pump, MW	Consumed totally per month Mwhour
January	31	3	31	3	193 40	176 00	17 40	1,293	1,289	430	3 17	7,074 47
February	29	3	29	3	189 80	176 00	13 80	1,396	1,395	465	3 31	6,910 73
March	31	3	31	3	199 50	176 00	23 50	1,061	1,061	354	2 87	6,399 81
April	30	2	30	2	191 00	176 00	15 00	905	908	454	3 27	4,703 28
May	31	2	31	2	198 50	176 00	22 50	737	735	368	2 92	4,348 58
June	30	2	30	2	198 50	176 00	22 50	733	735	368	2 92	4,208 30
July	31	1	31	1	204 00	176 00	28 00	439	285	285	2 59	1,928 53
August	31	1	31	1	200 00	176 00	24 00	350	347	347	2 84	2,112 15
September	30	2	30	2	205 40	176 00	29 40	524	522	261	2 50	3,596 34
October	31	2	31	2	200 00	176 00	24 00	692	693	347	2 84	4,224 30
November	30	3	30	3	199 80	176 00	23 80	1,050	1,049	350	2 85	6,156 72
December	31	3	31	3	196 30	176 00	20 30	1,189	1,189	396	3 04	6,776 40
											TOTAL	**58,440**

1994

Variant of the installation of adjustable electric drive											
Pumps without adjustable electric drive					Pumps with adjustable electric drive						
Rated flow with pressure in the system m^3/hour	Amount of operating pumps	(Amount of days in operation per month)	Power of a single pump MW	Electric power consumed per the drive MW hour	Water flow m^3/hour	Generated head atm	(Amount of days in operation per month)	Electric power for the adjustable electric drive MWhour	Electric power consumed per the drive MW hour	Consumed electric power per month TOTAL MWhour	Consumed electric power per a single drive W hour
534	2	31	3 58	5,333	221	176 00	31	1 89	1,407 86	6,747 26	333 21
534	2	29	3 58	4,989	327	176 00	29	2 34	1,626 74	6,616 05	294 68
534	1	31	3 58	2,667	528	176 00	31	3 53	2,622 93	5,289 63	1110 18
534	1	30	3 58	2,581	374	176 00	30	2 57	1,851 40	4,432 08	271 20
534	1	31	3 58	2,667	201	176 00	31	1 82	1,353 22	4,019 92	328 66
534	1	30	3 58	2,581	201	176 00	30	1 82	1,309 57	3,890 25	318 06
534	0	31	3 58	0	285	176 00	31	2 15	1,597 03	1,597 03	331 50
534	0	31	3 58	0	347	176 00	31	2 43	1,809 46	1,809 46	302 69
534	0	30	3 58	0	522	176 00	30	3 48	2,508 51	2,508 51	1,087 83
534	1	31	3 58	2,667	159	176 00	31	1 67	1,245 45	3,912 15	312 15
534	1	30	3 58	2,581	515	176 00	30	3 43	2,174 98	5,052 65	1,104 06
534	2	31	3 58	5,333	121	176 00	31	1 55	1,153 47	6,486 87	289 53
							366	TOTAL	20,958	52,356	

Electric power savings per year, TOTAL, MWhour	***6,083 75***	***10 418***
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year, TOTAL, billion rubles	***2 391***	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	1,080,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	6 156	
Repayment period (not considering banking interest rate on loans), months	***31***	

1995

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*PE500-180*
Capacity, m^3/hour	500
Electric Drive Power	4 00
Analyzed year	1995

	It is assumed that		For pumps operating in the amount of									
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	units	Average pressure in after valves atm	Average pressure in the system (after the valve) atm	Pressure loss at the valve atm	Actual water flow rate for a group of Pumps m^3/hour	Lstimated water flow rate for a group of Pumps m^3/hour	Water flow rate for a single Pump m^3/hour	Power of a sindle pump, MW	Consumed totally per month Mwhour
January	31	3	31	3	198 00	176 00	22 00	1,123	1,123	374	2 95	6,582 57
February	29	2	29	2	190 60	176 00	14 60	913	916	458	3 28	4,567 21
March	31	2	31	2	193 00	176 00	17 00	870	868	434	3 19	4,741 57
April	30	2	30	2	202 00	176 00	26 00	630	634	317	2 72	3,916 64
May	31	1	31	1	199 60	176 00	23 60	350	352	352	2 86	2,129 08
June	30	1	30	1	201 00	176 00	25 00	331	332	332	2 78	2,001 96
July	31	1	31	1	205 00	176 00	29 00	266	268	268	2 52	1,878 56
August	31	1	31	1	202 00	176 00	26 00	317	317	317	2 72	2,023 60
September	30	1	30	1	200 00	176 00	24 00	348	347	347	2 84	2,044 02
October	31	2	31	2	201 80	176 00	25 80	643	640	320	2 73	4,065 49
November	30	2	30	2	191 50	176 00	15 50	899	899	449	3 25	4,675 80
December	31	3	31	3	198 00	176 00	22 00	1,123	1,123	374	2 95	6,582 57
											TOTAL	45,209

1995

Variant of the installation of adjustable electric drive											
Pumps without adjustable electric drive					Pumps with adjustable electric drive						
Rated flow with pressure in the system m^3/hour	Amount of operating pumps	(Amount of days in operation per month)	Power of a single pump MW	Electric power consumed per the drive MW hour	Water flow m^3/hour	Generated head atm	(Amount of days in operation per month)	Electric power for the adjustable electric drive MWhour	Electric power consumed per the drive MW hour	Consumed electric power per month TOTAI MWhour	Consumed electric power per a single drive W hour
534	2	31	3 58	5333	55	176 00	31	1 36	1011 04	6344 45	238 12
534	1	29	3 58	2495	382	176 00	29	2 61	1817 15	4311 81	255 40
534	1	31	3 58	2667	334	176 00	31	2 37	1763 95	4430 65	310 92
534	1	30	3 58	2581	100	176 00	30	1 49	1070 24	3650 91	265 73
534	0	31	3 58	0	352	176 00	31	2 46	1830 55	1830 55	298 52
534	0	30	3 58	0	332	176 00	30	2 36	1699 86	1699 86	302 10
534	0	31	3 58	0	268	176 00	31	2 08	1544 05	1544 05	334 51
534	0	31	3 58	0	317	176 00	31	2 29	1703 38	1703 38	320 22
534	0	30	3 58	0	347	176 00	30	2 43	1751 09	1751 09	292 92
534	1	31	3 58	2667	106	176 00	31	1 50	1119 66	3786 36	279 13
534	1	30	3 58	2581	365	176 00	30	2 52	1815 62	4396 30	279 49
534	2	31	3 58	5333	55	176 00	31	1 36	1011 04	6344 45	238 12
			TOTAL	23,656			366	TOTAL	18,138	41,794	

Electric power savings per year, TOTAL, MWhour	***3,415 19***	***7 558***
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year, TOTAL, billion rubles	***1 342***	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	1,080,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	6 156	
Repayment period (not considering banking interest rate on loans), months	***56***	

1996

Adjustable Drive Efficiency Estimations

Object	*Ivanovo TETs-3*
Pumps	*PE500-180*
Capacity, m^3/hour	500
Electric Drive Power	4 00
Analyzed year	1995

	It is assumed that		For pumps operating in the amount of									
Month	Amount of days in the month	Amount of pumps units	Amount of days in operation per month	units	Average pressure in after valves atm	Average pressure in the system (after the valve) atm	Pressure loss at the valve atm	Actual water flow rate for a group of Pumps m^3/hour	Lstimated water flow rate for a group of Pumps m^3/hour	Water flow rate for a single Pump m^3/hour	Power of a sindle pump, MW	Consumed totally per month Mwhour
January	31	3	31	3	196 70	176 00	20 70	1,178	1,174	391	3 02	6,732 06
February	29	3	29	3	196 36	176 00	20 36	1,188	1,186	395	3 03	6,332 87
March	31	2	31	2	189 00	176 00	13 00	947	944	472	3 34	4,965 51
April	30	2	30	2	199 00	176 00	23 00	727	722	361	2 90	4,169 00
May	31	1	31	1	199 00	176 00	23 00	362	361	361	2 90	2,153 98
June	30	1	30	1	189 90	176 00	13 90	366	464	464	3 31	2,380 48
July	31	1	31	1	199 80	176 00	23 80	352	350	350	2 85	2,120 65
August	31	1	31	1	204 00	176 00	28 00	283	285	285	2 59	1,928 53
Septembe r	30	1	30	1	198 00	176 00	22 00	378	374	374	2 95	2,123 41
October	31	2	31	2	191 50	176 00	15 50	898	899	449	3 25	4,831 66
November	30	3	30	3	200 20	176 00	24 20	1,033	1,031	344	2 83	6,107 19
December	31	3	31	3	199 60	176 00	23 60	1,054	1,057	352	2 86	6,387 24
											TOTAL	**50,233**

1996

Variant of the installation of adjustable electric drive											
Pumps without adjustable electric drive					Pumps with adjustable electric drive						
Rated flow with pressure in the system m^3/hour	Amount of operating pumps	(Amount of days in operation per month)	Power of a single pump MW	Electric power consumed per the drive MW hour	Water flow m^3/hour	Generated head atm	(Amount of days in operation per month)	Electric power for the adjustable electric drive MWhour	Electric power consumed per the drive MW hour	Consumed electric power per month TOTAL MWhour	Consumed electric power per a single drive W hour
534	2	31	3 58	5,333	106	176 00	31	1 50	1,119 56	6,452 96	279 10
534	2	29	3 58	4,989	118	176 00	29	1 54	1,074 15	6,063 46	269 41
534	1	31	3 58	2,667	410	176 00	31	2 77	2,057 45	4,724 15	241 36
534	1	30	3 58	2,581	188	176 00	30	1 77	1,274 52	3,855 20	313 80
534	0	31	3 58	0	361	176 00	31	2 50	1,862 07	1,862 07	291 91
534	0	30	3 58	0	464	176 00	30	3 09	2,226 59	2,226 59	153 89
534	0	31	3 58	0	350	176 00	31	2 45	1,820 02	1,820 02	300 63
534	0	31	3 58	0	285	176 00	31	2 15	1,597 03	1,597 03	331 50
534	0	30	3 58	0	374	176 00	30	2 57	1,852 46	1,852 46	270 95
534	1	31	3 58	2,667	365	176 00	31	2 52	1,876 15	4,542 85	288 81
534	1	30	3 58	2,581	497	176 00	30	3 31	2,385 13	4,965 80	1,141 39
534	1	31	3 58	2,667	523	176 00	31	3 49	2,599 96	5,266 66	1,120 57
			TOTAL	23,484			366	TOTAL	21,745	45,229	

Electric power savings per year, TOTAL, MWhour	*5,003 33*	*9 968*
Difference in Sale/Supply prices rubles/kWhour	393	
Incomes for distributed saved electric power per year, TOTAL, billion rubles	***1 966***	
Unit cost of the drive USD/kW	270	
Total cost of the drive USD	1,080,000	
Current exchange rate rouble/USD	5,700	
Total price of the Drive billion rubles	6 156	
Repayment period (not considering banking interest rate on loans) months	***38***	