Russian-Danish Institute of Energy Efficiency “RDIE”
Dansk Energi Analyse A/S

Common energy audit report

Istra 1998

Content:

Introduction ..... **Error! Bookmark not defined.**
Results of energy audit on Russian dairies. ..... **Error! Bookmark not defined.**
1. OJSC "Molkom " city Kaluga 6
1.1Results of energy audit 6
1.2 Minutes of the meeting 8
2. OJSC " Moloko " city Valuiky 10
2.1 Results of energy audit 10
2.2 Minutes of the meeting. 11
3. AOOT"Moloko" Pugachev, Saratovskaya region. 13
3.1 Results of energy audit 13
3.2 Minutes of the meeting: 16
4. OAO "Mikchailovky cheese" settlement Velikomikchailovka, Belgorod region 18
4.1 Results of energy audit 18
4.2 Minutes of the meeting 20
Heating of concentrated product* 21
Repair of oil cooler* 21
5. OAO "Moloko" Proletarsky, Rakityansky district, Belgorod region. 22
5.1 Results of energy audit 22
5.2 Minutes of the meeting 25
6 OAO «Belebey Dairy» , Belebey, Bashkortostan 26
6.1 Results of energy audit 26
6.2 2 Minutes of the meeting 29
7. "Bavlinski molochni zavod" Bavli , Tatarstan 31
7.1 Results of energy audit 31
7.2 Minutes of the meeting 34
8. "Dmitrov Dairy" Moscow region 36
8.1 Results of energy audit 36
8.2 Minutes of the meeting 38
9. AO "Kalugas Cheese" Kaluga 39
9.1 Results of energy audit: 39
9.2 Minutes of the meeting 42
10. "Volokonovsky Dairy", Pyatnitskoe, Belgorod region 43
10.1 Results of energy audit 43
10.2 Minutes of the meeting 46
11. "OAO Belgorodsky molochniy combinat" Belgorod 48
11.1 *Results of energy audit.* 48
11.2 Minutes of the meeting 52
12. "OAO Tuymasamoloko" Tuymasa, Bashkortostan 55
12.1 Results of energy audit 55
12.2 Minutes of the meeting 59

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INTRODUCTION

Energy audits at 12 Russian dairies have been carried out in the period of December 1997 – July 1998 by Russian Danish Institute of Energy Efficiency (RDIEE) and the Danish company Dansk Energi Analyse A/S. This program was financed by the Government of Denmark.

The energy audits were carried out by groups of specialists which consisted of both Russian and Danish representatives.

The energy audit reports were made according to Danish requirements.

All investigated dairies operated with decreased milk processing. All dairies have the same problems, connected with mismatching of designed capacities of equipment to the production volume in conditions of economic decline.

Energy saving activities are taken at all dairies. These activities are connected with limited application of ventilation systems, heat saving for space heating etc.

Different dairies have different results in saving of energy recourses. Though all investigated dairies have equal volumes of raw materials processing (15-30 thousand tons of milk per year), volumes and types of lost energy recourses are quite different.

Comparison of financial losses connected with losses in heat and power supply systems, water supply systems and water treatment systems showed that all losses have the same value for investigated dairies.

The estimation of financial losses is given in table 1 and figure 1. These are losses in different energy supply systems.

It is possible to estimate real financial saving potential in heat energy - up to 33%, in power energy – up to 34% and in water consumption – up to 24%. This estimation can be done according to generalized data, received as the analyses of results of energy audits at the dairies.

Average pay back period of investment, necessary for realization of energy saving projects, is approx. 1,5 year.

70% of energy saving proposals have pay back period under 0,6 year.

It is necessary to mark, that energy saving proposals with little pay back period are given in energy audit reports. These are proposals, which don't require considerable investment.

It is necessary to mark the increase of financial expenses, connected with water systems, especially at the dairies, operating in cities.

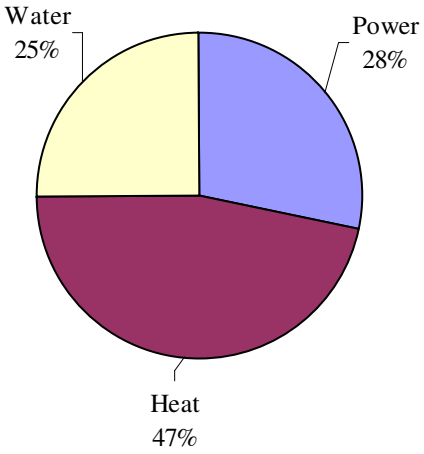
Cost of water from city water supply system is 15 rub/m^3 and more.

35% of power energy is being lost due to the following reasons:
- pumps and ventilation units are to large to the present load.

- Lack of automatic units, which can adapt equipment to daily and seasonal variation of load.

Auxiliary systems consume approx. 70% of power energy, used at the plant. It is necessary to find efficient solutions of energy saving.

Figure 1 Split of potentials for finances saving , connected with energy recourses saving.



The most typical energy saving proposals are:

- installation of condensate systems, - up to 15% of consumed steam can be saved. Pay back period is 0,2-0,6 year.
- Heat insulation of pipelines and protection from precipitation, - the saving is up to 10-20% of the energy consumption. Pay back period is 0,5-0,8 year.
- Application of frequency controllers for motors, used for pump drives in space heating system, water circuit system, hot water supply system, boiler feeding system, fans and blowers. This will save up to 35% of the power energy consumed by these systems, or 25% of total power energy consumption. Pay back period is 1,3- 1,8 year.
- Redesign of compressed air systems as application of small compressors, which are turned off/on automatically with compressed air consumers will save up to 40-60% of consumed energy.
- Application of water circuit systems for rational use of water for washing of equipment and production lines. Application of hoses with tips of smaller diameter with shutoff valve. These measures allow to save up to 35-40% of consumed water. Pay back period is 0,2 –0,8 year.
- It is necessary to replace steam space heating systems and to apply automatic controllers of inside temperature. This will allow to save up to 35% of heat which is used in space heating systems. Pay back period is 1 year.
- Recuperation of secondary heat recourses allows to save up to 5-8% of consumed energy. Pay back period is 1 year.

Energy audit results emphasize the necessity of energy saving proposals, concerning better adaptation of auxiliary systems to the variations of production volumes, especially in conditions of economic decline.

The managers of the dairies have highly appreciated the energy audits. The common problem for all Russian dairies is lack of finances for realization of these proposals.

Part of low cost proposals has been carried out. Recommendations for application of pumps with less capacity are taken into account, when worn-out and old equipment is being replaced.

№	Dairy	Heat energy		Power energy		Water		Total saving	Investment	Average pay back period
		Saving MWh	Consumption MWh	Saving MWh	Consumption MWh	Saving Thous m^3	Consumption Thous m^3	Thous ruble	Thous ruble	Year
1	Bavly	5924	9049	326.2	818	86	110	656.8	1000	1.523
2	V.-Mikhailovka	10967	20812	732	2160	15	114	1223	2146	1.755
3	Kaluga –1	5515	18054	1924	2725	47	191	2299	5445	2.368
4	Tuimasa	14540	38690	592	5661	23.4	172	1880	616	0.328
5	Pygachev	1652	12714	760	2489	32.2	61.2	841	185	0.22
6	Volokonovka	4818	25080	2230	2491	40	218	1437	3405	2.37
7	Belgorod	782	56228	3202	8975	18.3	388	1360	1068	0.785
8	Kaluga – 2	454	3097	140	522	15	18.3	158.2	150	0.948
9	Belebey	48007	78943	2337	8497	50	192	3323	5901	1.776
10	Rakitnoe	4142	16858	731	2593	15	87	468	1231	2.63
11	Valuiki	3062	15084	786	3773	25	145	280	108	0.386
12	Dmitrov	2000	13723	513	1049	112	337	832	400	0.481
	Total:	101863	308332	14273.2	41753	478.9	2033.5	14758	21655	1.467
	Cost in ruble:	***7006913***		***4281900***		***3832000***	***15120813***			
	in % of total sum	***46.3***		***28.3***		***25.3***				

Table 1. Estimation of reserves for energy recourses saving at 12 dairies, where energy audits were carried out.

1. OJSC "Molkom " city Kaluga

1.1 Results of energy audit

The analysis of efficiency of using the power resources at the enterprise was carried out in accordance with the working results of 1996.

The main data about dairy factory. The designing production of enterprise is 320 t of raw milk a day. Mode of operation is twenty four hours. The personnel consists of 347 people working at the factory. The enterprise produces such milk products as butter, dried milk, lactose. The volume of processed raw material in 1996 constituted 8873 t of milk and 184.4 t of cream. There is nowadays the reduction of production. The average daily amount of processed milk in 1996 does not exceed 50 tons. The factory doesn't have its own boiler house and water well. The factory purchases steam and water for the production needs.

Results of inspection. The annual energy resources consumption on the data of commercial meters are: the heat rate - 15 527 Gcal or 18 058 MWh, the electricity consumption – 4 647.5 MWh. The total energy consumption is 22 705.5 MWh.

9 energy saving measures were developed on the results of energy audit: 4 - for electric energy and 5 - for heat. The electricity saving is evaluated as 1672 MWh (36% from the total energy consumption) in amount of 390 mln rbl. (not denominated) with a cost 218 thous.rbl/MWh. The investments will constitute approximately 233 mln rbl, the average payback period - 0.6 year.
The heat saving is evaluated as 4 912 Gcal or 5 713 MWh (about 32 % from the total heat consumption) in amount 716 mln rbl with the cost 149 thous.rbl/MWh. The minimum size of investments is evaluated as 122 mln rbl, the payback period - 0.2 year (Table. 19).
Some suggestions on energy saving (the utilisation of dryer's air heat, the renovation of refrigerating chamber) can demand in this case the non-standard technical solutions and the additional expenses for carrying out the engineering developments, that can result in the increase of investment volume in a few times. To avoid the financial loss with purchasing of heat and water, which constitute correspondingly 680.6 mln rbl for heat and 513.3 mln rbl (not denominated) - for water, it is recommended to build the own boiler and the water well. The expenses for the fulfilment of these suggestions can be determined in the preliminary engineering developments.

Development of energy saving program
The measures for energy saving were developed, the resources for energy saving and the sizes of investments (besides the expenses for the construction of boiler) were evaluated, the calculations of payback periods (section 5, Table 19) were carried out.

List of energy saving proposals:

NN пп	Saving proposal Energy resource	Energy saving	Annual saving	Investment	Pay back period
5.2	***Heat energy***	Gcal/year	Mln. Ruble	Mln. ruble	month
5.2.1	Installation of hot-wells at the condensate collecting system, utilization of condensate from the calorifer of dryer unit for milk preheating before drying.	1215	166	32	2
5.2.2	Repair of the system of heat regeneration after milk drying.	327	48.7	20	5
5.2.3	Utilization of heat energy of hot water after washing of processing equipment.	1302	193.4	30	2
5.2.4	Elimination of losses in the space heating system due to the infiltration of outdoor air.	1510	224.6	20	1
5.2.5	Rational utilization of heat energy of collected condensate, improvement of condensate collecting tank insulation.	558	83.1	20	3
	Total*:*	*4912*	*716*	*122*	
	In MWh:	*5713*			
5.1	***Electric energy:***	MWh			
5.1.1	Restoration of compressor cooling circuit system	941	205.1	20	1
5.1.2	Installation of additional air-compressor of less capacity (up to 4 m^3/min)	231	50.3	60	14
5.1.3	Reconstruction of chambers or replacement with self-contained chambers.	500	109	150	17
5.1.4	Disconnection of 2 transformer substations ТП-1, ТП- 2 during winter period. ***Total :***	116.6 1789	25.4 390	3 233	1
Additional proposals					
5.2.5	Refusal of using external heat supply and building the own boiler house.*		680.6	1400	2.1
5.3	Establishment of own water wells.		513.3	90	3
Total:		***7502***	***2299***	***1845***	

1.2 Minutes of the meeting

MINUTES
of the meeting concerning energy audit results
OAO "Molkom" Kaluga.

RDIEE
Istra

Attendants :
From RDIEE**:**
Odnoral A P., Kolesnikov A.I., Sheina L.S.
from **Dansk Energi Analyse A/S:**
Mogens Johasson, Soren Draborg, Torben Ostergaard
From **OAO "Molkom":**
Nazarov A.V., Samoilov V.V.
From Institute VNIPI energy production**:**
Makhura D.P.

1. Report of energy audit results was delivered.
Energy saving activities were proposed. Investment and pay back periods were estimated.

2. Discussion of the report was held. Representatives of the dairy informed about first results implementation of energy saving activities. An attempt was made to decentralize the air-compressed supply system. It allowed to reduce air losses, to synchronize operation of compressors with processing equipment, and to use compressors with designed capacity of 1-4 kW. There was also a discussion, concerning possibilities of cooling chambers reconstruction, usage of more efficient compressor equipment and automatic control systems of cooling supply at the dairy.

3. Main item for discussion was a question about construction of boiler house. It was decided to consider 3 variants of boiler houses: for 320, 250, 160 tons of processed milk per day. The performer of the project is representative of VNIPI of energy production, GIP Makhura D.P.
One more question is under consideration. It concerns the utilization of combustion products from gas generator instead of steam. It will considerably reduce the capacity of boiler-house.

4. There was a great interest in the proposals of the Danish side, concerning the reconstruction of heat supply system with application of high quality insulation or insulated pipes. In connection with great amount of investment needed, it was decided to make exact estimation of works and to do the feasibility study.

5. Other energy saving proposals were also highly appreciated. They are: utilization of secondary heat recourses - air after milk drying, hot water after washing of processing equipment, ventilation blowout, and utilization of condensate from calorifers of drying unit for milk preheating; heat

insulation of windows and doors for reducing of heat losses due to infiltration; installation of heat controllers in production lines and administrative buildings.

6. It is recommended to make a water well and to return to the operation of the autonomous water supply system.

7. Total saving after implementation of energy saving proposals is estimated to be: Danish side 1.787 mln rubles (nondominated) , Russian side - 2.299 mln ruble (nondominated).

Table of energy saving proposals is stated below. The proposals are given in priority of implementation. In numerator – results of energy audit, stated by the Danish side, in denominator - results of energy audit, stated by the Russian side.

Proposal	Saving Mln ruble (Dan/Rus)	Investment Mln ruble (Dan/Rus)	Pay back period (Dan/Rus)
1. Construction of the boiler house *	- /680.6*	- /1500*	- /2.1
4.1 Pipe insulation of heat and steam supply system	806.4/ -**	1 000/ -	1.2/ -
4.2 Elimination of condensate losses (installation of hot-wells)	166/161***	500/2**	3/0
4.3 Regulation of heat supply in the heat supply system.	115/ -	500/ -	4.3
4.4 Utilization of heat of water after washing of equipment	193.4/193.4	30/30	0.2
5.1Insulation of steam supply pipes at the pasteurizes	11.7/ -**	6/ -	0.5
6.1Using of 4-stages evaporation units instead of 2-stages.	36/ -	400/ -	7.1
7.1 Recuperation air system for drying unit	30/48.7	20/20	0.7/0.4
7.2 Milk preheating by the condensate from calorifers	5/5***	30/30	6/6
5.2.4 Elimination of infiltration of outdoor air.	- /224.6****	- /20	- /0.1
5.2.5 Modernization of condensate collecting system, insulation of condensate collecting tanks.	- /81.3	- /20	- /0.25
2.(9.1) Reconstruction of air-compressor house.	47/50.3	160/60	3.4/1.2
3. Reconstruction of cooling system including:			
8.1 Replacement of screw compressors for ice water with piston compressors.	76/ -******	300/ -	3.9/ -
8.2 Natural cooling of ice water.	60/ -*****	100/ -	1.8/ -
8.3 Restoration of circuit cooling system for oil	12.6/205.1	45/20 *)	3.5/0.1
8.4 Using of piston compressors for chambers' cooling	38/ -******	300/ -	7.9/ -
8.5 Automatic temperature control of cooling chambers.	12.6/-******	45/ -	3.5/ -
8.6 Reconstruction of chambers – reducing of dimensions, improving of chambers' insulation.	38/109	500/150	13.2/0.75
8.7 Optimal selection of ice water pumps.	87/ -******	300/ -	3.5/ -
4. Restoration of water well	- /513.3*	- /90	- /0.25
5.(11.1) Disconnection of two transformers during winter.	25.4/25.4	0.3/3	0/0.1
6.(10.1) Regeneration of ventilation blow out	87/ -	300/ -	3.5/ -
TOTAL:	***1 787/2299***	***4 361/5445***	***2.4/2.4***

Marks:
* Estimation of investment in boiler house construction requires designing works.
** Insulation is renovated from time to time on dairy account.
*** Calculation of investment is given in item 5.2.1.
**** Reducing of infiltration losses will allow to create comfortable conditions in the buildings.
***** This system is being used at the plant partially.
****** Estimation of investment in cooling system reconstruction requires designing works.

2. OJSC " Moloko " city Valuiky.

2.1 Results of energy audit

The designing production of enterprise is 100 t of raw milk per day. Mode of operation is twenty four hour. The personnel consists of 276 people working at the factory. The enterprise produces such milk products as butter, dried milk, ice cream, casein. The volume of processed raw – material in 1996 constituted 26004 t of milk and 1843 t of cream.

The annual energy resources consumption on the data of commercial meters are:gas flow rate -1 895 thous.m3 (14700 Gcal or 17 096 MWh), the electricity consumption - 3 773 MWh (Tables 3, 4). The total energy consumption is 20 869 MWh.

6 energy saving measures were developed on the results of energy audit: 2 - for electric energy and 4 - for heat. The electricity saving is evaluated as 342 MWh (9% from the total energy consumption) in amount of 140 mln rbl. (not denominated) with a cost 305 thous.rbl/MWh. The investments will constitute approximately 162 mln rbl, the average payback period 1.6 years. The heat saving is evaluated as 2 737 Gcal or 3 183 MWh (18.6% from the total heat consumption) in amount 176 mln rbl with the cost 34 thous. rbl/ MWh. There is a need for the factory in renovation of apparatus shop (the pasteurising lines). The investments for carrying out the energy saving proposals concerning thermal energy can be determined totally by the expenses for the acquisition and installation of the new production equipment.

The measures for energy saving were developed, the resources for energy saving and the sizes of investment (besides the expenses for renovation of production lines) were evaluated, the calculations of payback periods (section 5, Table 19) were carried out.

Energy saving proposals:

Saving proposal Energy resource	Energy saving	Annual saving	Investment	Pay back period
5.1 *Electric energy*	kWh	Mln rub.	Mln rub	Month
5.1.1 Reconstruction of cooling chambers and cooling system of the plant (designing works are required)	256	78.1	160	24
5.1.2 Disconnection of 1 or 2 transformers with the capacity of 1000 kV (expenses for the activities of organizational matter)	86	26.2	2	1
Total:	***342***	***104***		
5.2 *Heat energy*	Gcal/year			
5.2.1 Repair of boilers and condensate collecting system. Utilization of floating steam heat.	93 318	60.0 12.6	25 11	5 12
5.2.2 Unit for utilization of air heat after milk drying.	1118	44.2	20	6
5.2.3 Utilization of heat energy of hot water after washing of processing equipment.	955	37.8	50	16
5.2.4 Replacement of worn-out processing equipment (designing works are required) Total : in MWh	253 2737 3183	21.0 176		
Total of energy recourses in MWh:	*3525*	*279.9*	*108*	

2.2 Minutes of the meeting.

MINUTES
of the meeting concerning energy audit results
OAO "MOLOKO" Valuiki, Belgorod region

RDIEE
Istra

Attendants :
From RDIEE**:**

Odnoral A P., Kolesnikov A.I., Sheina L.S.
from **Dansk Energi Analyse A/S:**
Soren Draborg, Torben Ostergaard
From **OAO "Moloko":**
Skvorzov I.N.

1. Report of energy audit results was delivered.
Energy saving activities were proposed. Investment and pay back periods were estimated.

2. Discussion of the report was held. The estimation was given to efficiency of cooling chambers reconstruction, to the application of more efficient compressor units and automatic control of cooling system of the plant. Attention was paid to the improving of boilers' characteristics. – reducing of air inflow in economizer. This will allow to increase its coefficient of efficiency on 1,5%. There was a discussion of possibilities of heat losses reducing in condensate collecting system and in space heating system. It was recommended to return condensate from boilers and calorifers into the boiler and to use excess heat of condensate for feed water heating. This will allow to avoid losses with the floating steam.

3. There was a great interest in the proposals of the Danish side, concerning the reconstruction of heat supply system with application of high quality insulation or insulated pipes. In connection with great amount of investment needed, it was decided to make exact estimation of works and to do the feasibility study.

4 Other energy saving proposals were also highly appreciated. They are: utilization of secondary heat recourses - air after milk drying, hot water after washing of processing equipment, ventilation blowout, and utilization of condensate from calorifers of drying unit for milk preheating; heat insulation of windows and doors for reducing of heat losses due to infiltration; installation of heat controllers in production lines and administrative buildings.
.
5. Total saving after implementation of energy saving proposals is estimated to be: Danish side 360 mln rubles (non denominated) , Russian side - 280 mln ruble (not denominated).

Table of energy saving proposals is stated below. The proposals are given in priority of implementation. In numerator – results of energy audit, stated by the Danish side, in denominator - results of energy audit, stated by the Russian side.

Proposal	Saving Mln ruble (Dan/Rus)	Investment Mln ruble (Dan/Rus)	Pay back period (Dan/Rus)
4.1Elimination of air inflow in economizer of the boiler	9/ -	50/ -	5.6/ -
4.2 Boilers' repair, return of condensate into the boiler	60/60	25/25	0.4/0.4
5.2.1 Elimination of losses with floating steam	- /12.6	- /11	- /1
4.3 Pipe insulation of heat and steam supply system	58/ -*	250/ -	4.5/ -
4.4 Regulation of heat supply in the heat supply system.	58/ -	400/ -	6.9/ -
4.5 Utilization of heat of water after washing of equipment	36.7/37.5	50/50	1.4/1.4
5.2.2 Recuperation air system for drying unit	- /44.2	- /20	- /0.5
8.1 Reducing of cooling media temperature in the condenser of cooling unit.	40/ -	- / -	0
8.2 Automatic temperature control of cooling chambers.	9/-	45/ -	5/ -
8.3 Automatic temperature control of cooling systems.	40/ -	450/ -	11.3/ -
8.4 Reconstruction of cooling chambers	23/78.1	450/160	7/2
10. 1 Disconnection of one of two transformers during winter	26.2/26.2	0.3/2	0/0.1
5.2.4 Replacement of old and inefficient equipment.	- /21	- / **	
Total:	***360/280***	***1055/108****	***2.8/ -******

Marks:
* Insulation is renovated from time to time on dairy account.
** Estimation of investment in processing equipment reconstruction requires designing works
*** Pay back period can be estimated after the calculations is made concerning investment for reconstruction .

Pay back period of energy saving activities (which are not connected with expensive reconstruction) does not exceed 0,5 year.

3. AOOT"Moloko" Pugachev, Saratovskaya region.

3.1Results of energy audit

The investigation was carried out in December 1997 by Anatoliy Kolesnikov (RDIEE), and Torben Ostergaard (DEA A/S).

The investigated dairy is one of the largest dairies in Russian Federation. This dairy is able to process up to 500 tons of whole milk per day in dairy products, desiccated milk. In 1997 the dairy processed 17120 tons of whole milk. The milk delivery for processing ranged from 50 to 100 tons per day during the year. In 1996- 1997 there was a small (16%) increase in milk processing.

The plant is equipped with foreign units (units for vacuum milk evaporation VIGAND-8) and Russian (plate-type pasteurizer, dryer PC-1000, steam boilers, compressors, pumps).

In 1997 the dairy produced 981 tons of whole milk products, 267 tons of desiccated milk, 277 tons of nutrition for children, 632 tons of butter, 256 tons of casein, 116 tons of oil. The dairy consumed 2145 th.kWh of energy, 1954 th. m^3 of gas, 45 th. m^3 of water. The plant gets milk for procession from nearby districts.
Rate of energy costs in production value was 7%. The total cost of production in 1997 was 23500 mln.rub/year. Cost of energy is 1029 mln. rbl/year, gas -626 mln rbl/year, water - 672 mln rbl/year)

330 people work at the dairy, including 313 people in production personnel.
The dairy works stable and has good future prospects.

The administration of the dairy takes measures in energy resources saving.

There is a considerable potential for saving:

1. There are 4 high-power steam boilers ДЕ16/14 with the capacity 16 tons of steam per hour. These boilers are designed for plant's capacity. In the conditions of production drop the equipment of the boiler house is working with the average load coefficient of 25-30%. Pumps and fans are working with low efficiency. The use frequency controllers for electromotors allow to save 30-40% of electrical energy. The pay back period is 1.8 year.

The temperature of floating gas is low due to the low load of boilers. This leads to the destruction of the chimney stack. It is necessary to increase the temperature of the gasses and to insulate the gas pass before chimney stack. The saving is estimated to be 40 mln. ruble / year. Necessary investment 10 mln. ruble. Pay back period 3 months.

There is no insulation on the surface of the deaerator, condensate collecting tanks. The restoration of the heat insulation will allow to save 34.5 mln. ruble/year. Necessary investment is 5.4 mln. ruble. Pay back period is 2 months. There are no hot-wells at the steam pasteuriser. The elimination of steam losses by installing of the hot-wells will allow to save 1.34 mln. ruble/year. Investment is 1 mln rubles. Pay back period is 9 months. Restoration of waterproofing and heat insulation of pipes will allow to save 33.8 mln. ruble / year. Investment is 25 mln. rubles. Pay back period is 8 months. It is possible to turn off one of the transformers during winter period. It is recommended to ring the transformer substations. The saving is estimated to be 4 mln ruble/year. Investment 0 (there is a reserve cable line). Pay back period is 0. The insulation of the rosters and use of controller for elecrtical heater will allow to save 5.6 mln ruble/year at the oil production. Investment is 1 mln. rubles. Pay back period is 2 months.

It is possible to collect and return condensate to the boiler-house. The repair of condensate - collecting line will allow to save 164-621 mln. ruble/year. Investment is 17.6 mln. ruble. Pay back period is 2 months.

12 energy saving proposals with different pay back periods were made.

A meeting was held with the managers and chief specialists of the dairy. The saving proposals were discussed. The administration of the dairy highly appreciated the energy audit. They showed their interest in continuing this work.

The list of energy saving proposals is given below:

№	Energy saving proposal,	Annual energy and water saving .		Costs mln. rubles	Pay back period years
			mln. rubles		
1	2	3	4		6
1	<u>Heat energy, Gkal</u> Casein drying. Heat regeneration during the air recycling.	198.0	17.8	2.0	1.5
2	Losses due to the absence of insulation at the deaerator.	186	16.7	3.4	2.4
3	. Losses due to the absence of insulation at condensate collecting tanks.	118	10.6	4.5	3
4	Losses with the floating steam.	263	23.6	1	0.5
5	Boiler operation , insulation of the chimney -stack, bypass of water economizer, steam preheater of water.	226	40	9	2.7
6	Leakage of condensate from the pasteurizer.	5.6	1.34	1	9
7	Losses due to the bad insulation of pipelines.	425	33.8	25	8
8	<u>Electrical energy, thousand kWh</u> Oil production. Heat insulation of heaters.	12	5.6		2
9	Turning off the transformer substation of casein plant during winter period for 5 months, because of the total drop in energy consumption.	8.4	4	0	0
10	The installation of receiver for the air compressor with the capacity of 22 kW. Installation of controller for compressor turning on/off.	4.4	2	5	36
11	<u>Losses of water and condensate, tons</u> Losses due to the cooling of ammonia compressors with running water.	3817	57.2	6.5	1.4
12	Repair of condensate collecting line at the dairy and DRSU.	7473-28348	164 - 621	17.6	1.5
	TOTAL:		**384 - 841**	**75.0**	

3.2 Minutes of the meeting:

MINUTES
of the meeting concerning energy audit results
AOOT "Moloko" Pugachev, Saratov region .

Pugachev

Attendants :
From RDIEE**:**
Kolesnikov A.I.
from **Dansk Energi Analyse A/S:**
Torben Ostergaard (took part in the preliminary duscussion in December 1997)
from **AOOT " Moloko ":**
Rudnev J.N., Strelzova Z.N.
Sidorchuk V.B.

1. 1. Report of energy audit results was delivered.
Energy saving activities were proposed. Investment and pay back periods were estimated.

2. Discussion of the report was held. The necessity was stressed to switch to water space heating system, to increase the rate of condensate collecting and returning into the boiler-house. The possibility was indicated of recuperation of gas heat, which is drained into the atmosphere from the casein drying unit.
For better adaptation of auxiliary systems to the daily and seasonal load variation, connected with the production drop, the effective saving solution is application of frequency controllers for the pumps of circuit and hot water supply system, circulating brine pumps, fans and blowers of boilers. This will allow to reduce electric energy consumption of these systems on 35-40%.
Heat losses were indicated. These losses are connected with the absence of heat insulation at the deaerator, condensate collecting tanks; bad insulation of pipelines. Electric energy losses are connected with the use of excess capacities of transformer substations. It was stressed that it is necessary to establish circuit cooling system of ammonia compressor house.
It is recommended to use new inexpensive water treatment by means of chelators for hot water supply system.
3. The Danish side marked the necessity of improving heat insulation of windows and doors (especially in drying plant). This will allow to reduce the heat losses of infiltration. It is recommended to install heat controllers at the production lines and administrative buildings; to apply high quality insulation of pipelines, automatic control of lightning.

4. Though the certain energy saving activities had been implemented, there is still a great potential for saving. The cost of saving is estimated to be approx. 400-800 mln ruble (not denominated)
Table of energy saving proposals is stated below. (It was supposed that the easy works on implementing of energy saving proposals are made by the dairy.)

№ ппп	Proposal	Saving Mln ruble (Dan/Rus)		Investment Mln ruble (Dan/Rus)	Pay back period (Dan/Rus)
		In natural terms	Mln ruble		
1	2	3	4		6
	Heat energy ***Gcal***				
1	* Casein drying. Air recirculation after dryer.	198.0	17.8	2.0	1.5 мес
2	*Heat insulation of deaerator. .	186	16.7	3.4	2.4 мес.
3	* Heat insulation of condensate collecting tanks.	118	10.6	4.5	3 мес.
4	* Installation of hot-wells, reducing of losses with the steam	263	23.6	1	0.5 мес.
5	** To increase the temperature of flue gas above the temperature of point of condensation , to improve insulation of chimney. To apply frequency controllers for the motors for better adaptation of boilers to the low load.	226	40	9 + cost of frequency controllers	2.7 months To clarify the frequency controlling .
6	* Elimination of losses of condensate heat from pasteurizes.	5.6	1.34	1	9
7	** To restore heat insulation of pipelines.	425	33.8	25	8
	Electric energy ***thous. KWh***				
8	* To insulate the roasters chambers in the oil production, to apply capacity control of electric heaters.	12	5.6		2
9	* To ring the transformer substations at the low-voltage side and disconnect the transformer in casein plant for five months during winter period.	8.4	4	0	0
10	*** To install the receiver with higher capacitance for the air compressor with the capacity of 22 kW and to apply on-off compressor control.	4.4	2	5	36
	Losses of water and condensate, tons				
11	*To install circuit cooling system for ammonia compressors.	3817	57.2	6.5	1.4
12	*To repair the line of condensate collecting	7473-28348	164 - 621	17.6	1.5
	Total:		***384 - 841***	***75.0***	

Marks:

* the proposal doesn't require great expenses and has small pay back period that does not extend 8 months.
** the proposal requires engineering works and estimation of investment in construction requires designing works.

4. OAO "Mikchailovky cheese" settlement Velikomikchailovka, Belgorod region

4.1 Results of energy audit

OAO "Moloko" is situated in settlement Velikomikchailovka, Belgorod region. The main product of the plant is cheese "Poshechonsky" and other products are: butter, lactose, dried whey and dried milk ex. fat. The dairy operates round – the – clock. The dairy has 183 employees.

Design capacity of the dairy is 200 tons of handled milk per day. At present milk delivery for processing reduced in 3-4 times. In summer milk delivery doesn't exceed 100 tons per day, in winter milk delivery reduces to 10-30 tons/day.

In 1997 the dairy processed 14.641 tons of whole milk. The dairy produced 230 tons of butter, 1127 tons of cheese, 410 tons of dried whey and dried milk ex. fat, 9 tons of lactose. Total cost of production in 1997 was 25.733 thousand denominated rubles.

The plant is equipped with Russian and import equipment. Processing equipment of main energy consumption is: 3 vacuum milk evaporation VIGAND-4000 and one - VIGAND-2000, one unit for milk drying A1-OP4, separators, pasteurizes etc.

The dairy has its own boiler-house. The boiler-house is equipped with four boilers with the capacity 6,5 and 4 tons of steam per hour and working press 10 bar, main fuel – natural gas.

The dairy is supplied with electric energy from 3 transformer substations with total capacity of 3.420 kVA.

The plant is supplied with the water from private wells. The dairy has the sewage disposal plant.

The cold energy is supplied from the ammonia compressor house. The compressor house is equipped with 5 ammonia compressors with total designed capacity of motors 616 kW. Cooling system of processing equipment and chambers is brine system. Cooling system of compressors is water circulate system with a cooling tower.

Main consumers of heat energy are: processing equipment – 18%, space heating system of the dairy – 14%, CIP – 10%. Heat energy losses, that exceed standards – approx. 40%. The largest consumers of electric energy : cooling equipment –39%, pumps – 19%, ventilators and blowers – 12%.

The total energy consumption in 1997 was 22.972 MWh/year, of which 20.812 MWh/year (17.895 Gcal/year) – consumption of heat energy (natural gas) and 2.160 MWh/year – consumption of electric energy. Energy consumption is stated in the tables 2.1 and 2.2 of the report.

Twenty energy saving proposals were made as the result of energy audit. Twelve of these proposals refer to the saving of heat energy. Total saving of heat energy is 10.961 MWh/year (9.401 Gcal/year) or 54% of total heat energy consumption. The value of saving is 974.000 RR, investments – 1.351.000 RR, average pay back period – 1,4 years.

Eight energy saving proposals refer to electric energy saving. It makes 732 MWh/year or 34% of total consumption. Value of saving is 249.000 RR, investment – 795.000 RR, average pay back period– 3,2 years.
There are some places at the dairy where too much water is consumed. It is manual washing of equipment and cheese. The water saving is estimated to be about 15.000 m^3/year.

The administration of the dairy highly appreciated the energy audit. They showed their interest in continuing this work and implementing the energy saving proposals.

The list of energy saving proposals is given in the table.

	Gas saving [Gcal/year]/ [MWh/year]	Power saving [MWh/year]	Cost saving [rbl/year]	Investment [rbl]	Pay back time [years]
Combustion control	170 / 200		18.000	40.000	2,3
Insulation of pipes	3.940 / 4.600		409.000	300.000	0,7
Condensate return systems	670 / 780		69.000	200.000	2,9
Heat control systems	1.720 / 2.000		178.000	400.000	2,3
Reconstruction of ventilation system	121 / 140		12.000	100.000	8
Utilisation of blowing off the steam	236 / 275		24.000	5.000	0,2
Filtration equipment	1410 / 1.640		146.000	250.000	1,7
Preheater reestablishment	300 / 350		31.000	5.000	0,2
Increase of product concentration	93 / 108		10.000	10.000	0,5
Heating of concentrated product	10 / 12		1.000	1.000	1
Utilisation of hot drained water	543 / 630		56.000	30.000	0,5
Decrease of hose diameter, using of tips	194 / 226		20.000	10.000	0,5
Repair of oil cooler		35	12.000	10.000	0,8
Process cooling control		80	27.000	150.000	5,6
Storage temperature control		80	27.000	80.000	3,0
Ammonia compressor control		250	85.000	300.000	3,5
Insulation of chambers and doors		80	27.000	100.000	3,8
Compressor control system etc.		28	10.000	20.000	2
Using of frequency controllers		93	32.000	100.000	3,2
Disconnection of transformers in winter		86	29.000	35 000	1,2
Total	9.401 / 10.961	732	1.223.000	2.146.000	1,8

Besides the factors of excessive energy consumption, stated in the table, there is a very important factor of high energy intensity of production. This factor is the production drop and as the result – underload of equipment. The energy consumption for the needs of the dairy (space heating, lightning, hot and cold water supply) and support of other production departments (cooling chambers, washing of the equipment) is not less than 40 % of total energy consumption.

A number of energy saving measures are not feasible because of the large pay back period. It happens because of the low prices for energy in comparison with the world prices. The rate of energy costs in total costs of product was only 5,9 % in 1997.

4.2 Minutes of the meeting

MINUTES
of the meeting concerning energy audit results
OAO "Mihailovsky cheese"
Velicomihailovka, Kaluga

Velicomihailovka
Attendants :
From RDIEE**:**
Sheina L.S.
From **OAO** "Mihailovsky cheese"**:**
Anohin E.V., Chicherin S.M.

1. 1 Report of energy audit results was delivered.
Energy saving activities were proposed. Investment and pay back periods were estimated.

2. . Discussion of the report was held.
It was recommended to make the repair of insulation of all parts of heat supply system and condensate collecting system, to make the reconstruction of condensate collecting system in order to avoid heat losses and provide maximal condensate return into the boiler and in the system of hot water supply. There was also a discussion, concerning possibilities of automatic control in the heat supply system.
It was stressed that the heat exchangers for evaporation units should not be used unfunctionally.
The analysis was made, concerning the possibilities of energy consumption reducing in the ammonia compressor house by means of automatic control of compressor operation and temperature automatic control of cooling chambers and processing equipment. It is recommended to repair the heat insulation of cooling chambers.

The possibilities of considerable energy saving were indicated. These possibilities are connected with application of frequency controllers for the motors of pumps of water and cold supply systems, fans and blowers working on varying duty, often with underload. The attention was paid to the fact that there are great electric energy losses, connected with excess capacity of operating transformer substations. The potential was estimated in water and heat energy saving in the process of equipment washing and in cheese production .

3. After the implementation of energy saving activities, the saving is estimated as 1.223 mln not denominated ruble.
Table of energy saving proposals is stated below.

Proposal	Saving Mln ruble	Investment Mln ruble	Pay back period
Combustion control**	18.000	40.000	2,3
Insulation of pipes*	409.000	300.000	0,7
Condensate return systems***	69.000	200.000	2,9
Heat control systems***	178.000	400.000	2,3
Reconstruction of ventilation system***	12.000	100.000	8
Utilisation of blowing off the steam*	24.000	5.000	0,2
Filtration equipment***	146.000	250.000	1,7
Preheater reestablishment*	31.000	5.000	0,2
Increase of product concentration *	10.000	10.000	1
Heating of concentrated product*	1.000	1.000	1
Utilisation of hot drained water*	56.000	30.000	0,5
Decrease of hose diameter, using of tips*	20.000	10.000	0,5
Repair of oil cooler*	12.000	10.000	0,8
Process cooling control*	27.000	150.000	5,6
Storage temperature control**	27.000	80.000	3,0
Ammonia compressor control**	85.000	300.000	3,5
Insulation of chambers and doors***	27.000	100.000	3,8
Compressor control system etc.**	10.000	25.000	2,5
Using of frequency controllers**	32.000	100.000	3,1
Disconnection of two transformers*	29.000	30. 000	1

Marks:
* the proposal doesn't require great expenses and has small pay back period that does not extend 1 year.
** the proposal has large pay back period, that is connected with the production drop and low prices for energy recourses.
*** the proposal requires engineering works and estimation of investment in construction.

5. OAO "Moloko" Proletarsky, Rakityansky district, Belgorod region.

5.1 Results of energy audit

OAO "Moloko" is situated in Proletarsky, Rakityansky district, Belgorod region**.** The main products of the dairy are: milk, kefir, sour cream, cottage cheese, butter, dried milk and dried milk ex. fat. The dairy operates round – the – clock. The dairy has 205 employees.

Design capacity of the dairy is 200 tons of handled milk per day. At present milk delivery for processing reduced in 3-4 times. In summer milk delivery doesn't exceed 100 tons per day, in winter milk delivery reduces to 20-30 tons/day.

In 1997 the dairy processed 21.288 tons of whole milk. The dairy produced 611,4 tons of whole milk products, 476 tons of butter, 1731 tons of dried milk and dried milk ex. fat. Total cost of production in 1997 was 29.559 thousand denominated rubles.

The plant is equipped mainly with Russian equipment. Processing equipment of main energy consumption is: vacuum milk evaporation VIGAND-8000, unit for milk evaporation BPA4-1000, separators, pasteurisers etc.

The dairy has its own boiler-house. The boiler-house is equipped with four boilers DE-6.5/14, main fuel – natural gas.

The dairy is supplied with electric energy from 5 transformer substations with total capacity of 3.640 kV.

The dairy has its own wells. The water is supplied from these wells. The dairy has the sewage disposal plant.

The cold energy is supplied from the ammonia compressor house. The compressor house is equipped with 3 ammonia compressors with total designed capacity of motors 255 kW. Cooling system of processing equipment and chambers is brine system. Cooling system of compressors – water circuit system with a cooling tower.

Main consumers of heat energy are: processing equipment – 58%, space heating system of the dairy – 12%, washing of processing equipment – 8%. Heat energy losses, that exceed standards – approx. 15%. The largest consumers of electric energy : processing equipment – 20%, cooling equipment – 39%, pumps – 28%, fans – 6%.

The total energy consumption in 1997 was 19.451 MWh/year, of which 16.858 MWh/year/year (14.495 Gcal/year) – consumption of heat energy (natural gas) and 2.593 MWh/year – consumption of electric energy. Energy consumption is stated in the tables 2.1 and 2.2.

19 energy saving proposals were made as the result of energy audit. 10 of these proposals refer to the saving of heat energy. Total saving of heat energy is 4.142 MWh/year (3.352 Gcal/year) or 24,5% of total heat energy consumption. The value of saving is 242.000 RR, investment – 476.000 RR, average pay back period – 2 years.

8 energy saving proposals refer to electric energy saving. It makes 731 MWh/year or 28% of total consumption. Value of saving is 226.000 RR, investment – 755.000 RR, average pay back period – 3.3 year.

The administration of the dairy highly appreciated the energy audit. They showed their interest in continuing this work and implementing the energy saving proposals.

The list of energy saving proposals is given in the table.

	Gas saving [Gcal/year]/ [MWh/year]	Power saving [MWh/year]	Cost saving [rbl/year]	Invest-ment [rbl]	Pay back time [years]
Insulation of pipes	299 / 590		34.000	50.000	1,5
Condensate return systems	290 / 337		20.000	50.000	1,7
Heat control systems	725 / 843		49.000	300.000	6,0
Reconstruction of ventilation system	193 / 225		13.000	20.000	1,5
New pasteurise in milk department	125 / 145		8.000	5.000	0,6
Preheater reestablishment	1.118/1.300		76.000	10.000	0,1
Increase of milk concentration	480 / 560		33.000	20.000	0,6
Heating of concentrated milk	26 / 30		2.000	1.000	0,5
Utilisation of hot drained water	58 / 67		4.000	10.000	2,5
Utilisation of technology condensate	38 / 45		...3.000	10.000	3,3
Process cooling control		100	31.000	100.000	3,2
Storage temperature control		20	6.000	20.000	3,3
Compressor control		100	31.000	200.000	6,5
Brine pump control		132	41.000	20.000	0,5
Butter storage's reconstruction		120	37.000	200.000	5,4
Cooling tower pump control		69	21.000	15.000	0,7
Cooling tower pump replacement		37	11.000	50.000	4,5
Using of frequency controller		67	21.000	100.000	4,8
Disconnection of two transformers in winter		86	27.000	50 000	1,9
Total	3.352/ 4.142	731	468	1.231	2,6

Besides the factors of excessive energy consumption, stated in the table, there is a very important factor of high energy intensity of production. This factor is the production drop and as the result – underload of equipment. The energy consumption for the needs of the dairy (space heating, lightning, hot and cold water supply) and support of other production departments (cooling chambers, washing of the equipment) is not less than 40 % of total energy consumption.

A number of energy saving measures are not feasible because of the large pay back period. It happens because of the low prices for energy in comparison with the world prices. The rate of energy costs in total costs of product was 3.6 % in 1997, because the energy rate for the dairy is low – less than 200 RR/MWh, when the energy rate for other consumers – 310 RR/MWh. The dairy has this discount because it pays for energy regularly.

5.2 Minutes of the meeting

MINUTES
of the meeting concerning energy audit results

OAO "Moloko" Proletarsky, Rakityansky district, Belgorod region.

Proletarsky
Attendants :
From RDIEE**:**
Sheina L.S.
From **OAO "Moloko":**
Padyukov V.G., Chernyih A.G. , Semenov N.I,.

1. Report of energy audit results was delivered.
Energy saving activities were proposed. Investment and pay back periods were estimated.

2. Discussion of the report was held.
It was recommended to make the repair of insulation of all parts of heat supply system and condensate collecting system, to make the reconstruction of condensate collecting system in order to avoid heat losses and provide maximal condensate return into the boiler and in the system of hot water supply. There was also a discussion, concerning possibilities of automatic control in the heat supply system.
It is recommended to reconstruct the input system of ventilation as a system of additional air space heating. Also it was recommended to reconstruct system of processing equipment washing for recuperation of secondary energy recourses. It was stressed that the preheaters of evaporation units should not be used for condensate cooling.
The analysis was made, concerning the possibilities of energy consumption reducing in the ammonia compressor house by means of automatic control of compressor operation and temperature automatic control of cooling chambers and processing equipment. It is recommended to rebuild the cooling chamber for butter storage.

The possibilities of considerable energy saving were indicated. These possibilities are connected with application of frequency controllers for the motors of pumps of water and cold supply systems, fans working on varying duty, often with underload. The attention was paid to the fact that there are great electric energy losses, connected with excess capacity of operating transformer substations.
The potential was estimated in water and heat energy saving in the process of equipment washing and in cheese production .

3. After the implementation of energy saving activities, the saving is estimated as 468 mln not dominated ruble.

Table of energy saving proposals is stated below.

Proposal	Saving Thous ruble/year	Investment Thous ruble/year	Pay back period (year)
Insulation of pipes**	34.000	50.000	1,5
Condensate return systems***	20.000	50.000	1,7
Heat control systems***	49.000	300.000	6,0
Reconstruction of ventilation system***	13.000	20.000	1,5
New pasteurise in milk department*	8.000	5.000	0,6
Preheater reestablishment*	76.000	10.000	0,1
Increase of milk concentration*	33.000	20.000	0,6
Heating of concentrated milk*	2.000	1.000	0,5
Utilisation of hot drained water**	4.000	10.000	2,5
Utilisation of technology condensate**	...3.000	10.000	3,3
Process cooling control**	31.000	100.000	3,2
Storage temperature control**	6.000	20.000	3,3
Compressor control**	31.000	200.000	6,5
Brine pump control*	41.000	20.000	0,5
Butter storage's reconstruction***	37.000	200.000	5,4
Cooling tower pump control*	21.000	15.000	0,7
Cooling tower pump replacement**	11.000	50.000	4,5
Using of frequency controller**	21.000	100.000	4,8
Disconnection of two transformers in winter**	27.000	50 000	1,9
Total	468	1.231	2,6

Marks:
* the proposal doesn't require great expenses and has small pay back period that does not extend 1 year.
** the proposal has larger pay back period, that is connected with the production drop and low prices for energy recourses.
*** the proposal requires engineering works and estimation of investment in construction requires designing works.

6 OAO «Belebey Dairy», Bashkortostan

6.1 Results of energy audit

The investigation was carried out at the dairy on 15-20 of June 1998.

AO "Belebeiski molochni kombinat" is situated in Belebey city in the Baskortostan Region. There are plants of milk and medical production at the dairy. The dairy project capacity is 600-800 ton of milk per day. At present the handled amount of milk is decreased by 100 ton of milk per day. The handled amount of milk in 1997 was 57.104 ton, the volume of the production was about 9,6 thousand ton, total cost of this production was 101.739 thousand denominated rubles. The dairy plant can produce about 60 kinds of products. The main production is: milk products, butter, cheese, dried milk, dried pachta, dried whey and medical solutions for injections.

The dairy had 628 employees in 1997.

The dairy has its own boiler-house. The boiler-house is equipped with three boilers ДЕ 25/14, main fuel – natural gas.
The dairy is supplied with electric energy from 7 transformer substations with total capacity of 5.800 kVA.

The plant is supplied with the water from six private wells. The plant uses the town sewerage for drained water.

Distribution of heat energy between consumers is: processing equipment -19%, space heating system of the dairy -10%. The largest consumers of electric energy are:– ammonia compressors – 25%, pumps – 30%, ventilators & blowers – 22%.

The dairy had a total energy consumption of 87.436 MWh/year 1997 of which 78.943 MWh/year was natural gas and 8.493 MWh/year was electricity. The total water consumption is 190 th.m^3 in 1997 according to the plant information. The energy consumption splits are shown is table 2.1 and 2.2.of the report. In two collection centers for milk the electricity consumption was 632 MWh/year in 1997.

The cold energy is supplied from the ammonia compressor house. The compressor house is equipped with 11 ammonia compressors with total designed capacity of motors 1.560 kW. Cooling system of processing equipment and chambers is brine system. Cooling system of compressors is water circulate system. The power consumption of ammonia compressors is 25% of the total power consumption.

In the energy audit twenty one energy saving proposals have been identified. Eleven of the energy saving proposals concerns heat energy savings. The total gas and heat saving potential is calculated to be 48.007 MWh/year or about 61% of the consumption. The value of the energy and partly water saving potential is 2.593.000 rubles and the investment is calculated to be 3.941.000 rubles which corresponds to a 1,5 year pay back time in average.

The nine remaining energy saving proposals concern electricity savings. The total electricity saving potential is calculated to be 2.737 MWh/year or 32% of the total consumption. The value of the saving potential is 729.000 rubles and the investment is calculated to be 1.960.000 rubles which leads to a 2,7 year pay back time in average.

The saving possibilities of water are estimated as 50.000 m^3 per year or 190.000 rbl. Three saving water proposals are placed in heat energy saving proposals and don't need additional investments. One proposal (№12.1) practically doesn't demand investment too.

The list of energy saving proposals is given in the table.

	Gas/heat saving [MWh/year]	Power saving [MWh/year]	Water saving [m^3/year]	Cost saving [rbl/year]	Invest-ment [rbl]	Pay back time [years]
Combustion control	1.600			51.000	40.000	0,8
Insulation of pipes	19.700			1.020.000	1.500.000	1,5
Condensate return systems	3.900		18.000	340.000	500.000	1,5
Condensate release valves	7.900		5.000	450.000	30.000	0,1
Heat control systems	7.900			410.000	1.000.000	2,4
Filtration equipment	2.600	- 100		110.000	250.000	2,3
Evaporator unit for chemical water	2.800			146.000	500.000	3,4
Utilization of spray drier heat	675			35.000	100.000	2,8
Heating of concentrated product	22			1.000	1.000	1
Utilization of hot drained water	240			12.000	10.000	0,9
Decrease of diameter and using of tips	670		18.000	18.000	10.000	0,2
Cooling storage closure		310		80.000	0	0
Recycling of cold air		420		108.000	100.000	0,9
Elimination of chamber leakage		210		54.000	100.000	1,9
Increase of load coefficient		360		92.000	0	0
Cooling process and storage control		210		54.000	500.000	9,3
Compressor control		315		81.000	500.000	6
Air leakage's / compressor control		87		22.000	40.000	1,8
Circulating system with cooling tower		280		72.000	150.000	2,1
Using of frequency controller		645		166.000	570.000	3,4
Using condensate after evaporate unit			9.000	5.000	1.000	0,2
Total	48.007	2.337	50.000	3.323.000	5.901.000	1,8

Main reasons of energy losses:

Heat losses: - bad insulation of pipelines, absent or inefficient system of condensate collecting, lack of system for utilization of secondary energy recourses, lack of heat control system and automatic control of heat supply.

Electric energy:- bad insulation of parts of cooling supply system and cooling chambers, lack of automatic control of ammonia compressors, inefficiency of circuit cooling system (lack of spray cooling units), mismatching of motors designed capacities with the capacity of equipment

Water:- losses of condensate from most part of processing equipment, excess consumotion of water in washing of processing equipment, losses in cooling system.

Besides the factors of excessive energy consumption, stated in the table, there is a very important factor of high energy intensity of production. This factor is the production drop and as the result – underload of equipment. The energy consumption for the needs of the dairy (space heating, lightning, hot and cold water supply) and support of other production departments (cooling chambers, washing of the equipment) is not less than 40 % of total energy consumption.A number of energy saving measures are not feasible because of the large pay back period. It happens because of the low prices for energy in comparison with the world prices. The rate of energy costs in total costs of product was only 4,8 % in 1997.

6.2 Minutes of the meeting

MINUTES
Of the meeting concerning energy audit results

OAO "Belebey Dairy" Belebey, Bashkortostan

Attendants :
From RDIEE**:**
Sheina L.S.
from **OAO "Belebey Dairy":**
Lukmanov N.M., Lenkevich E.T., Zubritsky V.N..

1. Report of energy audit results was delivered.
Energy saving activities were proposed. Investment and pay back periods were estimated.

2. Discussion of the report was held.
It was recommended to make the repair of insulation of all parts of heat supply system and condensate collecting system, to make the reconstruction of condensate collecting system in order to avoid heat losses and provide maximal condensate return into the boiler and in the system of hot water supply. It is necessary to install automatic control in the heat supply system. It is stressed that it is possible to utilize hot drained water and to reduce heat energy and water consumption in the process of equipment washing.

The analysis was made, concerning the possibilities of energy consumption reducing in the ammonia compressor house by means of automatic control of compressor operation and

temperature automatic control of cooling chambers and processing equipment. It is recommended to repair the heat insulation of cooling chambers.
The attention was paid to the imperfection of existing circuit cooling compressor system. It is recommended to use spray unit in the system water cooling.

The possibilities of water consumption reduction were discussed. The reduction can be made by means of improving condensate return system, and using of manual washing of processing equipment.

After the implementation of energy saving activities, the saving is estimated as 3.323 mln not denominated ruble.
Table of energy saving proposals is stated below.

Proposal	Saving Thous. ruble	Investment Thous. ruble	Pay back period
Combustion control**	51.000	40.000	0,8
Insulation of pipes*	1.020.000	1.500.000	1,5
Condensate return systems***	340.000	500.000	1,5
Installation of hot- wells *	450.000	30.000	0,1
Heat control systems **	410.000	1.000.000	2,4
Using of filters for evaporat.***	110.000	250.000	2,3
Utilization of distillator heat***	146.000	500.000	3,4
Utilization of air heat from dryer ***	35.000	100.000	2,8
Heating of concentrated product *	1.000	1.000	1
Utilisation of hot drained water*	12.000	10.000	0,9
Decrease of hose diameter, using of tips*	18.000	10.000	0,2
Conservation of chambers*	80.000	0	0
Recirculation of cold air in chambers***	108.000	100.000	0,9
Elimination of leakage in chambers ***	54.000	100.000	1,9
Increase of load coefficient of ammon. compressor*	92.000	0	0
Automation of cooling processes. **	54.000	500.000	9,3
Automation of ammonia compressors**	81.000	500.000	6
Automation of air compressors. **	22.000	40.000	1,8
Modernization of cooling tower system.***	72.000	150.000	2,1
Using of frequency controllers**	166.000	570.000	3,4
Condensate return after evaporators *.	5.000	1.000	0,2
Total:	3.323.000	5.901.000	1,8

Marks:

* the proposal doesn't require great expenses and has small pay back period that does not extend 1 year.
** the proposal has larger pay back period, that is connected with the production drop and low prices for energy recourses.
*** the proposal requires engineering works and estimation of investment in construction requires designing works.

7. "Bavlinski molochni zavod" Bavli , Tatarstan

7.1 Results of energy audit

The investigation was carried out at the dairy on 22-25 of June 1998.

OAO "Moloko" is situated in the small town Bavly, Tatarstan. The main products of the dairy are: milk, kefir, sour cream, cottage cheese, cream, butter and casein. The dairy operates round – the – clock. The dairy has 114 employees.

The peak capacity of the dairy is about 100 tons of handled milk per day. At present milk delivery reduces to 40 ton/day.

In 1997 the dairy processed 9.076 tons of whole milk. The dairy produced 845 tons of milk, 291 tons of butter, 181 tons of cream, 92 tons of cottage cheese, 90 tons of sour cream, 391 tons of kefir and yogurt and 66 tons of dried casein. In 1998 the production of milk products increased on 16% comparatively with the same period of 1997.

The plant is equipped with Russian equipment. Processing equipment of main energy consumption is: separators, pasteurizes, one unit for casein drying etc.

The dairy has its own boiler-house. The boiler-house is equipped with four boilers E-1/ 9 with the capacity one ton of steam per hour , main fuel – natural gas.

The dairy is supplied with electric energy from the town network.

The plant is supplied with the water from two private wells. The dairy uses the town sewage disposal plant.

The cold energy is supplied from the ammonia compressor house. The compressor house is equipped with 2 ammonia compressors with total designed capacity of motors 150 kW. Brine and "ice water" are used for cooling of processing equipment and chambers. Compressors are cooled with the running water.

Main consumers of heat energy are: processing equipment – 13%, space heating system of the dairy – 15%, CIP – 7%. Heat energy losses, that exceed standards – approx. 50%. The largest consumers of electric energy are: processing equipment – 7%, cooling equipment –39%, pumps – 35%, air compressors – 9%.

The total energy consumption in 1997 was 9.867 MWh/year, of which 9.049 MWh/year (7.780 Gcal/year) – consumption of heat energy (natural gas) and 818 MWh/year – consumption of electric energy. Energy consumption is stated in the tables 2.1 and 2.2 of the report.

Sixteen energy saving proposals were made as the result of energy audit. Ten of these proposals refer to the saving of heat energy. Total saving of heat energy is 5.924 MWh/year (5.094 Gcal/year) or 65% of total heat energy consumption. The value of saving is 312.000 RR, investments – 790.000 RR, average pay back period – 2,5 years.

Five energy saving proposals refer to electric energy saving and one proposal is directed to saving of water. One of these proposals allows to save three recourses: heart energy, electric energy and water. The energy saving is 326,2 MWh/year or 40% of the total power consumption. Value of saving is 53.000 RR, investment – 110.400 RR, average pay back period– 2,1 years.

The using circulate water system allows to save approx. 72/000 m^3/year or 234.000 RR per year. At present this proposal is not feasible because the plant has free water.

The administration of the dairy highly appreciated the energy audit. They showed their interest in continuing this work and implementing the energy saving proposals.

The list of energy saving proposals is given in the table.

	Gas/heat savng [MWh/year]	Power saving [MWh/year]	Water saving [m^3/year]	Cost saving [rbl/year]	Invest-ment [rbl]	Pay back time [years]
Combustion control	360			8.000	50.000	6,3
Installation of economiser	540			13.000	200.000	15,4
Insulation of pipes, tank etc.	3.000			98..000	250.000	2,5
Space heating system	180		1.000	11..000	30.000	2,7
Condensate return systems	720		3.500	58.000	50.000	0,9
Condens. release in cond.return syst.	210		1.000	17.000	3.000	0,2
New pasteuriser	720	180	2.500	78.000	200.000	2,7
Condensate release valve	18		0,02	1.000	1.000	1
Utilisation of hot drained water	70			2.000	1.000	0,5
Decrease of hose diameter, using tips	106		5.000	26.000	5.000	0,2
Insulation of brine tank		0,2		40	400	10
Cooling process and storage control		32		5.200	50.000	9,6
Compressor control		63		10.000	20.000	2
Insulation of cooling chamber		30		5.000	20.000	4
Air leakage's / compressor control		21		3.400	20.000	5,9
Creation of circulate system			72.000	324.000	100.000*)	0,3
Total	5.924	326,2	14.000	332.840	900.400	3
Total, including circulate system			86.000	656.840	1.000.400	1,5

Besides the factors of excessive energy consumption, stated in the table, there is a very important factor of high energy intensity of production. This factor is the production drop and as the result – low load of equipment. The energy consumption for the needs of the dairy (space heating, lightning, hot and cold water supply) and support of other production departments (cooling chambers, washing of the equipment) is not less than 60 % of total energy consumption.

A number of energy saving measures are not feasible because of the large pay back period. It happens because of the low prices for energy in comparison with the world prices.

7.2 Minutes of the meeting

MINUTES
of the meeting concerning energy audit results
OAO "Bavlinski molochni zavod " Bavli, Tatarstan. .

Attendants :
From RDIEE**:**
Sheina L.S.
From **OAO** "Bavlinski molochni zavod ":
Valiahmetov R.A., Ganiev F.M., Valiahmetov R.A.

1. Report of energy audit results was delivered.
Energy saving activities were proposed. Investment and pay back periods were estimated.

2. Discussion of the report was held.
It was recommended to make the repair of insulation of all parts of heat supply system and condensate collecting and returning systems, to make the reconstruction of condensate collecting system and reconstruction of heating unit in the space heating system. It is necessary to install automatic control of boiler operation. It is stressed that it is possible to utilize hot drained water and to reduce heat energy and water consumption in the process of equipment washing. The analysis was made, concerning the possibilities of energy consumption reducing in the ammonia compressor house by means of automatic control of compressor operation and temperature automatic control of cooling chambers and processing equipment. It is recommended to repair the heat insulation of cooling chambers.
The attention was paid to the installation of circuit cooling compressor system.

After the implementation of energy saving activities, the total saving is estimated as 333 mln not denominated ruble; total saving, including circuit compressor cooling system – 657 mln not dominated ruble.

Table of energy saving proposals is stated below.

Proposals	Value of sdaving [thous.rub/ year]	Investment [thous. rub]	Pay back period [year]
Combustion control **	8.000	50.000	6,3
Installation of economiser ***	13.000	200.000	15,4
Insulation of pipes, tank etc. **	98.000	250.000	2,5
Space heating system **	11.000	30.000	2,7
Condensate return systems ***	58.600	50.000	0,9
Condens. release in cond.return syst.**	17.000	3.000	1,8
New pasteuriser**	78.000	200.000	2,7
Condensate release valve *	1.000	1.000	1
Utilisation of hot drained water *	2.000	1.000	0,5
Decrease of hose diameter, using tips *	26.000	5.000	0,2
Insulation of brine tank **	40	400	10
Cooling process and storage control **	5.200	50.000	9,6
Compressor control **	10.000	20.000	2
Insulation of cooling chamber **	5.000	20.000	4
Air leakage's / compressor control **	3.400	20.000	5,9
Creation of circulate system **	324.000	1100.000	0,3
Total:	332.840	900.400	2,7
Total ,including circuit system:	656.840	1.000.400	1,5

Marks:
* the proposal doesn't require great expenses and has small pay back period that does not extend 1 year.
** the proposal has larger pay back period, that is connected with the production drop and low prices for energy recourses.
*** the proposal requires engineering works and estimation of investment in construction requires designing works.

8. "Dmitrov Dairy" Moscow region

8.1 Results of energy audit

For the last several years the volume of production release has decreased greatly because of the reduction of whole milk supplies for processing. That is why the load of technological equipment is much lower than nominal standard.

In 1997 the dairy took for the processing from 169 to 1274 tons of milk per month. Unsteady milk delivery has seasonal dependency and this decreases the saving potential of equipment.

The dairy was built in 1968, it was reconstructed in 1990-1992. A lot of primary and ancillary equipment have great deterioration; modernization or repair is necessary, but the dairy does not have necessary financial resources for that.

In 1997 the dairy processed 6607 tons of milk, produced 1037 tons of pasteurized milk, 354 tons of dairy products, 113 tons of sour cream, 254 tons of cottage cheese, 140 tons of butter, 18 tons of cheese, 43 tons of casein. At this period the dairy consumed 1049000 kWh/hour of energy, 1766000m3 of gas, 337000 m3 of water.

102 people are in the staff of the dairy, including 87 employees in production personal.

The administration of the dairy takes activities in energy resources saving, but there is still great potential for saving. As the result of the investigation the activities of energy saving were defined, based on calculations. General activities are stated below

The installation of power supply with frequency regulation at the electromotors of ventilation units for intake and outblow of air will save 33000kWh/year; pay back period 2,4 year.
The use of method of "chelators" for boiler feed water producing saves 100000 rbl/year, pay back period 0,5 year.
Condensate collecting and returning to the boiler feed system will save 65000 rbl/year, pay back period - 1 year
The dairy consumes much water, - up to 1000m3 per day, that considerably exceeds the standards. The reduction of water consumption on 30% will save 344000 rbl/year
Rational use of heat energy at different sections of the production gives the saving more than 2200000 kWh/year, average pay back period 1 year.

Applying and renewing of heat insulation of the pipelines and equipment will save approximately 200.000 kWh/year of energy, average pay back period 1,5 year.
The elimination of heat leakage as the result of modernization and repairment of ventilation system and other activities will save more than 1000000 kWh/year, pay back period 1 year.
Rational use of cold energy and elimination of cold leakage will save 67000 kWh/year of energy
The implementation of air compressors and reconstruction of out-dated system of compressed air production will save 67.000 kWh/year of energy.

As the result of energy audit, that was carried out, 23 activities of energy and water saving were proposed. The realization of these activities will let the dairy to save more than 4000000 kWh, value of energy saving is approximately 2000000 ruble. Major part of these activities does not need considerable financial expenses and can be carried out in the nearest future, economical effect of their realization can be achieved within 1 year.

Administration of the dairy and managers of the services showed their interest in this investigation, - energy audit, gave possible assistance for its qualitative fulfillment. The results of this energy audit and the activities of energy saving were discussed at the joint final meeting. This investigation was highly estimated and declared as very necessary one.

The administration of this dairy as well as others realize all necessity and expedience of the works, concerning energy saving and they show the interest in future cooperation with **RDIEE** and **"Dansk Energi Analyse A/S"** in the field of energy efficiency and they express their gratitude to the Government of Denmark for participating in implementing these activities in Russia.

Energy saving proposal:

Description of energy saving proposal	Saving of steam [kWh/year]	Saving of electric energy [kWh/year]	Saving of water [m^3/year]	Value of saving [1000 rub/year]	Investment [1000 rub]	Pay back period [year]
** to equip the electromotors of ventilation units for intake and out blow of air with power supply with frequency regulation.	-	33.000	-	18,5	45	2,5
* To utilize the method of "chelators" for boiler feed water producing.	-	-	-	100	50	0,5
** to accumulate condensate and use it in the boiler feed system.	-	-	9.000	65	60	1
* To reduce the consumption of running water on 30%.	-	-	100.000	344	170	0,5
*To install hot-wells at the processing equipment.	2 млн.	-	2.700	250	60	0,25
*To install a new compressor with capacity of 5 kW in the milk receiving area. To reduce the operating time of compressor house.		60.000	-	20	10	0,5
* To install regulating dampers in the pipes of exhaust ventilation in order to decrease the filtration losses when there is no need to use ventilation.	-	420.000	-	53	5	0,1

Marks:
* - Pay back period is up to 0,5year;
** - Pay back period is more than a year.

8.2 Minutes of the meeting

MINUTES
of the meeting concerning energy audit results
at AO «Dmitrov Dairy»
Dmitrov, Moscow region

Attendants:
from "RDIEE":
Kolesnikov A.I., Ivanov N.S.;
from AO «Dmitrov Dairy»:
Dyibin S.V.

1. Report of energy audit results was delivered.
Energy saving activities were proposed. Investment and pay back periods were estimated.

2. Discussion of the report was held.
The following questions were discussed:
- possibility of purchasing the frequency controllers for motors of fans of boiler fans.
- application of chelators for treatment of feed water for boilers.
- necessity of condensate return into the system of feed water for boilers.
- considerable reducing of feed water application in the cooling process of products.
- installation of additional autonomous compressor of less capacity at the plant of milk reception.
- prevention of hot air leakage from heated areas.
- other questions, concerning energy saving.

3. Energy audit report will be used for planning of works on energy saving. Some energy saving proposals requires detailed elaboration for estimation of investment size.

4. Management of the dairy is interested in questions of investment and cooperation with Danish companies for purchasing of modern efficient equipment.

5. It was declared rational to continue the cooperation in decision-making concerning the energy efficiency and implementation of energy efficiency technologies.

Energy saving proposals:

	Proposal	Value of saving Rub/year	Investment [rub]	Pay back period year
1	Heat insulation of gas pipes fort flue gases, - extension of operating time of chimney stack.	40.000	10.000	¼
2	to equip the electromotors of ventilation units for intake and out blow of air with power supply with frequency regulation.	18.500	45.000	2,5
3	To utilize the method of "chelators" for boiler feed water producing.	100.000	50.000	1/2
4	to accumulate condensate and use it in the boiler feed system.	110.000	70.000	2/3
5	To install hot-wells at the processing equipment.	250.000	60.000	1/4
6	To establish the space heating system of compressor house.	40.000	10.000	1/4
7	To install additional air-compressor in the milk receiving area.	20.000	20.000	1
8	To reduce the consumption of running water for cooling processes.	300.000	100.000	1/3
9	To implement saving activities to prevent leakage of the hot air from heated areas.	130.000	20.000	1/6
	Total :	1.008.500	385.000	1/2

9. AO "Kalugas Cheese" Kaluga.

9.1 Results of energy audit:

The volume of production release has decreased due to the reduction of raw material supply. That is why the load of technological equipment is much lower than nominal standard, that leads to inefficient work of the equipment.

The out-dated equipment should be replaced with more efficient equipment. The production lines should be reconstructed. Energy of cold should be used at the dairy. But the dairy doesn't have necessary financial means. The work of equipment modernization will be done in several stages.

In 1997 the dairy produced 280 ton of various products. At this period the dairy consumed 522.000 kWh of energy, 336.980 m^3 of gas, 18.300 m^3 of water. During the heating season the dairy delivers part of the heat energy to other plants. 67 people work at the dairy. The interchange of workshops is 1,2. There is a great potential for saving of water, heat and cold energy at the plant. The administration of the dairy is aware of the necessity for efficient usage of energy recourses. The dairy has a plan for replacement of the out-dated equipment with the modern efficient equipment.

Energy saving proposals were defined during the investigation. All these proposals are based on calculations. Main proposals are stated below:

Energy saving proposals:

1. Installation of new steam boiler with the capacity of 50 kg of steam per hour. Installation of water boiler with the capacity of 20 m^3 of hot water per one shift. This will allow to save 314.000 kWh of heat energy (16.960 rbl.). Pay back period is 2 years.

2. Insulation of boiler, two tanks in the boiler house, steam and hot water pipes will save 140.000 kWh of heat energy (5.200 rbl.). Pay back period is 3 years/

3. Insulation and sectioning of operating cooling chambers at the main dairy and the department will save 45.000 kWh of electrical energy (18.000 rbl.). Pay back period is 2 years.

4. The replacement of ammonia cooling equipment with the equipment of less capacity will save 95.000 kWh of electrical energy and 7.000 m^3 of water (71.000 rbl.). Pay back period is 0,6 year.

5. The elimination of excessive water consumption will save not less than 2.000 m^3 of water (13.000 rbl.). Pay back period is 0,5 year.

6. Reduction of water consumption for washing of walls and floors in the production department will save 2.000 m^3 (13.000 rbl.). Pay back period is 0,5 year.

7. The repair of toilets, taps and other fittings will save 2.000 m^3 of water (13.000 rbl.). Pay back period is 0,3 year.

As the result of energy audit, 11 energy and water saving proposals were made. The realization of these proposals will let the dairy save 140.000 kWh of electrical energy, 454.000 kWh of heat energy, 15.000 m^3 of water. Value of energy saving is approximately 158.000 rubles.

Administration of the dairy and managers showed their interest in energy audit. They gave possible assistance for its qualitative fulfillment. The results of this energy audit were discussed at the joint final meeting. This energy audit was highly appreciated and declared as very necessary one.

Energy saving proposals:

Proposal	Saving of electric energy [kWh/year]	Saving of water [m^3/year]	Saving of heat energy [kWh/year]	Value of saving [1000 rub/year	Investment [1000 rub]	Pay back period [year]
4.1. Installation of new water/ steam boiler	-	-	314.000	16.960	35.000	2
4.2. Insulation of steam and hot water pipes	-	-	110.000	4.114	12.000	3
4.3. Insulation of boiler and two tanks in the boiler house	-	-	30.000	1.122	3.000	3
6.1. Insulation and sectioning of operating cooling chambers at area 1	25.000	-	-	10.000	20.000	2
6.2. The replacement of ammonia cooling equipment with freon equipment.	55.000	2.000	-	35.000	20.000	0,6
6.3. Insulation and sectioning of operating cooling chambers at area 2.*	20.000	-	-	8.000	16.000	2
6.4. The replacement of ammonia cooling equipment with freon equipment..*	40.000	5.000	-	36.000	20.000	0,6
9.1. Replacement of incandescent lamps with more efficient lamps.	16.400			6.560	6.000	1
10.1 Elimination of excessive water consumption	-	2.000	-	13.000	6.000	0,5
10.2. Replacement of condenser of ammonia cooling unit with more efficient one.*	-	2.000	-	8.000	8.000	1
10.3. Elimination of water leakage in toilets.	-	2.000	-	13.000	4.000	0,3
10.4. Reduction of water consumption for washing of walls and floors in the production department	-	2.000	-	13.000	6.000	0,5
Total	*140.000*	*15.000*	*454.000*	*158.196*	*150.000*	

Marks:
* These proposals refer to "Kaluga -1".

Realization of those proposals will allow to save 140000 kWh of electric energy, 454000 kWh of heat energy, 15.000 m^3 of water, value of this saving is estimated to be 158 mln ruble.
It is necessary to replace the old processing equipment and to reconstruct production lines and utilization of cold.
The management of the dairy was interested in energy audit. The management assisted in carrying it out.

9.2 Minutes of the meeting

MINUTES
Of the meeting concerning energy audit results
at AO «Kaluga Cheese»

Attendants :
From RDIEE**:**
Ivanov N.S. Sheina L.S. ;
from **Dansk Energi Analyse A/S**:
Torben Ostergaard;
from AO «Kaluga Cheese» :

1. Report of energy audit results was delivered.
Energy saving activities were proposed. Investment and pay back periods were estimated.

2. Discussion of the report was held.
The following questions were discussed:

- potential of energy saving;
- expediency of replacement of steam boilers with a boiler of less capacity.
- necessity of hear insulation repair
- necessity of modernization of cooling units and whole system of cold production and distribution.
- necessity of works on heat insulation and sectioning of cooling chambers.
- application of modular system of cooling chambers.
- potential of water saving in processes of equipment cooling and technological usage
- general questions of rational water usage.

3. Energy saving proposals of Danish side were highly appreciated. They are: reduction of heat energy losses, improvement of working conditions.

- installation of heat energy controllers in the production area and in the administrative buildings.
- reconstruction of ventilation system in the production area.
- implementation of automatic control system of lightning.
- application of a new construction of windows and doors.

4. Energy audit results were declared as relevant. They will be used by the management of the dairy in current work and in planning works on energy saving.

List of energy saving proposals:

№ пп	Proposal	Saving Thous ruble/year	Investment Thous ruble/year	Pay back period (year)
1	Installation of new water/ steam boiler	16.960	35.000	2
2	Insulation and sectioning of operating cooling chambers	10.000	20.000	2
3	The replacement of ammonia cooling equipment with freon equipment.	35.000	20.000	0,6
4	Elimination of excessive water consumption.	13.000	6.000	0,5
5	Repair of waste tanks, valves, taps and other accessory.	13.000	4.000	0,3
6	Insulation of steam and hot water pipes	4.100	12.000	3
7	Replacement of condenser of ammonia cooling unit with more efficient one.*	8.000	8.000	1
8	Insulation and sectioning of operating cooling chambers*	8.000	16.000	2
9	The replacement of ammonia cooling equipment with freon equipment..*	36.000	20.000	0,6
	Total:	144.000	141.000	

Marks:
* These proposals refer to "Kaluga -1", they can be as content of 2 stage of cooling equipment modernization

5. It is necessary to continue the cooperation in decision-making concerning energy saving and implementation of energy saving technologies.

10. "Volokonovsky Dairy", Pyatnitskoe, Belgorod region

10.1 Results of energy audit

The investigated dairy is one of the largest dairies in Russian Federation. This dairy is able to process up to 270 tons of whole milk per day in desiccated and evaporated milk. In 1997 the dairy processed 18486 tons of whole milk and 800 tons of desiccated milk. The milk delivery for processing ranged from 30 to 90 tons per day during the year. In 1996- 1997 there was a small drop in whole milk processing, but the production of evaporated milk increased due to the use of desiccated milk.

The plant is equipped with foreign units (units for vacuum milk evaporation VIGAND-8, and Russian (plate-type pasteuriser, air-dryer VRA-4 , steam boilers, compressors, pumps).

In 1997 the dairy produced 34.300 cans with evaporated milk (0,4 kg each), 85 tons of desiccated milk, 717 tons of whole milk products. The dairy consumed 2.491 MWh of energy,4.763.000 m^3 of gas, 218.000 m^3 of water. The plant is situated in the countryside in the region of power supply from atomic power stations. The dairy has reduced rates for energy recourses. It stimulates the problem of energy saving in a less degree.
Rate of energy costs in production value was 2.1%. Total cost of production in 1997 was 104.389 mln. ruble/year. Cost of energy is 564 mln. rbl/year, gas - 1417 mln rbl/year, water - 212 mln rbl/year). 587 people work at the dairy, including 513 people in production personnel.
The dairy works stable and has good future prospects.

The administration of the dairy takes measures in energy resources saving. But there is a considerable potential for saving:

1. A new steam boiler-house with 2 boilers is implemented at the dairy. The capacity of boilers are 25 tons steam / per hour each. These boilers are designed for plant capacity. Due to the total drop in production in Russia, modern equipment of the boiler house operates with average coefficient of load 40%. Pumps and fans are operating with low efficiency. The use of frequency controllers for fans' and pumps' drives allows to save 596000 kWh of electrical energy. The pay back period is 1-2 years.

Heat recuperation of steam from second stage of vacuum steam ejector of Vigand-8, vacuum crystallizer for evaporated milk, heat of floating steam from the boilers during evaporated milk preparation. Heat recovery will allow to save 3.008.670.000 kWh/year of heat energy. Pay back period is 6 months.

Reconstruction of the steam space heating system to water heating system will allow to avoid heat losses of condensate and floating steam. It will save 246.556.000 kWh /year of heat energy. Pay back period is 1.8.

Increasing the rate of desiccated milk from 10% to 20% during milk regeneration before preparation of evaporated milk. It will save 1.563.000.000 kWh/year of heat energy. Pay back period 0.1.

There are 4 transformer substations at the plant. Total capacity of operating transformers is 3110 kW, peak capacity of consumption is less than 1000 kW. The ringing of transformer substations with low-voltage cable and turning off the transformers with low load will allow to save 84.972 kWh/year. Pay back period is 1.3.

The combined production of electrical and heat energy is possible at this plant. The reducing cooling system, which throttles steam from 14atm. to 7-8 atm., should be replaced by turbo generator with back pressure 200 kW. This will allow to generate 1.440.000 kWh/year of electrical energy additionally. Pay back period is 1.3 year. It is possible to collect and return to the boiler house 50 % of lost condensate.

12 energy saving proposals with different pay back periods were made.

A meeting was held with the managers and chief specialists of the dairy. The saving proposals were discussed. The administration of the dairy highly appreciated the energy audit. They showed their interest in continuing this work.

List of energy saving proposals:

Proposal	Saving of heat energy [kWh/year	Saving of electric energy [kWh/year]	Saving of water [m^3/year]	Value of saving [1000 rub/year	Investment [1000 rub]	Pay back period [year]
1	2	3	4	5	6	7
4.1: Reconstruction of the steam space heating system to water heating system	246556		1348	27.000	50.000	1.8
6.2,: recuperation of steam from second stage of vacuum steam ejector of Vigand-8 and vacuum crystallizer	2.546.970			205.000	100.000	0.5
6.3: recuperation of steam heat from the boilers of syrup preparation.	461.700			37.200	15.000	0.5
6.4: Increasing the rate of desiccated milk up to 20% during milk regeneration before preparation of evaporated milk	1.563.000			134.000	2000	0.1
7.1: Heat recuperation of steam from second stage of vacuum steam ejector of Vigand-8, heat recuperation of floating steam from the during unit BPT-4, heat recuperation of condensate from air preheater of milk drying unit BPA-4	884			70.2	160.000	2 year after the increasing of production volumeup to 1200 ton/year
8.1 Replacement cooling towers with the spray water circuit cooling system.		110.000		29.400	275.000	9.3
8.2: Installation of circuit cooling system for ammonia and air compressors.			30000	30.000	50.000	1.7
11.1: Disconnection of unloaded transformers and ringing of transformer substations at the low-voltage side.		84972		23.000	29.400	1.3
11.2: application of frequency controllers for fans' drives , and motors of circuit brine cooling system.		596000		161.000	191.000	1.2
11.3: replacement of the reducing cooling system by turbogenerator with backpressure for generating additional electric energy.		1.440.000		392.000	500.000	1.3
12.1: Application of chelators for treatment of boiler feed water instead of system of chemical treatment.				435.800	50.000	0.1

A meeting was held with the managers and chief specialists of the dairy. The saving proposals were discussed. The administration of the dairy highly appreciated the energy audit. They showed their interest in continuing this work.

10.2 Minutes of the meeting

MINUTES
of the meeting concerning energy audit results
"Volokonovsky Dairy", Pyatnitskoe, Belgorod region

Attendants :
From RDIEE**:**
Kolesnikov A.I.
from **Dansk Energi Analyse:**
Torben Ostergaard (took part in the preliminary meeting in March 1998)
from *"Volokonovsky Dairy":*
Kirnosov N.I. , Agibalov A.I,
Grebenkin S.I.

1. Report of energy audit results was delivered.
   Energy saving activities were proposed. Investment and pay back periods were estimated.

2. Discussion of the report was held.
   The necessity was marked to replace the existing space heating system with water space heating system, to increase the rate of condensate collecting and returning into the boiler house. It is marked the possibility of heat recuperation of steam from second stage of vacuum steam ejector of Vigand-8, vacuum crystallizer for evaporated milk, and boilers for syrup preparation.
   For better adaptation of auxiliary systems to the daily and seasonal load variation, connected with the production drop, the effective saving solution is application of frequency controllers for the pumps of circuit and hot water supply system, circulating brine pumps, fans and blowers of boilers.. This will allow to reduce electric energy consumption of these systems on 35-40%.
   Heat losses are indicated. These losses are connected with the use of excess capacities of transformer substations.

It is stressed the possibility of application of combined heat and electric energy production after the replacement of the reducing cooling system by turbogenerator with backpressure for generating additional electric energy. The feasibility of this proposal will increase with the increasing energy costs.

3. The Danish side marked the good operating conditions of boiler house and heat insulation of pipelines. Also it was marked the necessity of heat insulation improvement of windows and doors for reducing of heat losses from infiltration, and installation of heat controllers in production areas and administrative building. It is necessary to apply the automatic control of lightning.
4. The possible value of saving after the implementation of energy saving activities is estimated to be approx. 500 mln not dominated rubles.

List of energy saving proposals:

Proposal	Saving of heat energy [kWh/year	Saving of electric energy [kWh/year]	Saving of water [m^3/year]	Value of saving [1000 rub/year	Investment [1000 rub]	Pay back period [year]
1	2	3	4	5	6	7
4.1**: Reconstruction of the steam space heating system to water heating system	246556		1348	27.000	50.000	1.8
6.2* : recuperation of steam heat from second stage of vacuum steam ejector of Vigand-8 and vacuum crystallizer	2.546.970			205.000	100.000	0.5
6.3* : recuperation of steam heat from the boilers of syrup preparation.	461.700			37.200	15.000	0.5
6.4* : Increasing the rate of desiccated milk up to 20% during milk regeneration before preparation of evaporated milk	1.563.000			134.000	2000	0.1
7.1***: : Heat recuperation of steam from second stage of vacuum steam ejector of Vigand-8, heat recuperation of floating steam from the during unit BPT-4, heat recuperation of condensate from air preheater of milk drying unit BPA-4	884			70.2	160.000	2 year after the increasing of production volume up to 1200 ton/year
8.1***: Replacement cooling towers with the spray water circuit cooling system.		110.000		29.400	275.000	9.3
8.2**: Installation of circuit cooling system for ammonia and air compressors.			30000	30.000	50000	1.7
11.1* : Disconnection of unloaded transformers and ringing of transformer substations at the low-voltage side.		84972		23.000	29.400	1.3
11.2* : application of frequency controllers for fans' drives , and motors of circuit brine cooling system.		596000		161.000	191.000	1.2
11.3*** replacement of the reducing cooling system by turbogenerator with backpressure for generating additional electric energy.		1.440.000		392.000	500.000	1.3
12.1**: Application of chelators for treatment of boiler feed water instead of system of chemical treatment. (It is necessary to do detailed engineering work)				435.800	50.000	0.1

Marks:

* the proposal doesn't require great expenses and has small pay back period that does not extend 1,5 year.

** the proposal requires engineering works and estimation of investment in construction requires designing works
*** The proposal can be realized in the future.

The dairy will try to realize energy saving proposals.

11. "OAO Belgorodsky molochniy combinat" Belgorod

11.1 Results of energy audit.

The investigation was carried out at the dairy in May 1998 by Anatoliy Kolesnikov (RDIEE), Nicolay Ivanov (RDIEE) and Toorben Ostergaard (DEA A/S).

The investigated dairy is one of the best dairies in Russian Federation. This dairy is able to process up to 700 tons of whole milk per day in dairy products, desiccated milk and evaporated milk. In 1997 the dairy processed 42587 tons of whole milk. Milk delivery for processing ranged from 50 to 200 tons per day during the year. In 1996- 1997 there was a small (13%) increase in milk processing.
Besides the dairy products, other products such as juices, margarine are produced.
The plant is equipped with foreign units (units for vacuum milk evaporation VIGAND-8, separators, pasteurizers, packing machines TETRA PAC) and Russian (plate-type pasteurizer, dryer PC-1000, four stages vacuum film evaporator A.29208.000, steam boilers, compressors, pumps).

Total cost of production in 1997 was 141162 mln. rub. : 706 tons of butter, 2031 tons of margarine, 980 tons of mayonnaise, 1259 tons of desiccated milk, 16000 tons of pasteurized and sterilized milk and other products. The dairy consumed 8975 MWh of energy, 6.656.000 m^3 of gas, 388.000 m^3 of water. The plant is situated in the center of Belgorod region and the plant gets raw material from nearby districts.
Rate of energy costs in production value was 3.9%. Cost of energy (without VAT) is 2761 mln. rbl/year, gas -1886 mln rbl/year, water - 1742 mln rbl/year)

806 people work at the dairy, including 663 people in production personnel.
The dairy works stable and has good future prospects.

The administration of the dairy takes measures in energy resources saving. The potential of energy saving in dairy processing is not very large, because after the raw material storaging the processing lines operate in nominal conditions.

There is a great potential of energy saving in auxiliary systems, because they are designed for larger volume of production. Annual consumption diagram of raw material, gas and electrical energy shows, that there is no direct connection between energy recourses consumption and production volume.
There is a considerable potential for saving:

The boiler house equipment operates with average coefficient of load 28% (three boilers ДКВР 10/13 +1 in reserve). Production engineers don't pay much attention to the reduction of peak loads of the boiler house. Pumps and fans are operating with low efficiency. The use of frequency controllers for fans' and pumps' drives allows to save 500000 kWh of electrical energy. The pay back period is 1-2 years.

Scheme modernization and frequency controllers of motor rotation are necessary to use in the cooling circuit systems of compressors and desiccated milk plant. This will allow to save 1174 th. kWh of power energy, pay back period is 1-1.3 year.
Air compressed system needs the repairing and maintenance. It will save approx. 220000 kWh of power energy. Pay back period is 0.4 year.
There are no heat insulation at the condensate collecting tank and steam dampers. The milk dryer does not have hot wells. The steam from the units of milk evaporation is drained into the atmosphere. All these things cause great heat losses. Pay back period is 0.3 - 3.8 year.
There are financial losses due to the increase of prices for water and chemical water treatment. These losses are connected with excessive water consumption. (Though the dairy water consumption satisfies the standards of NIIMOLPROM). It is necessary to use circuit cooling system with cooling tower instead of running water. It is necessary to increase the ratio of condensate, returning to the boiler house. The heat is lost and the volume of chemically treated water increases due to the losses of condensate. It is possible to reduce the water consumption on 18000 m^3/year. It will save 155000 th. rub/year.
Five high - power transformers are operating with low coefficient of load. This leads to large total losses of no-load operation. It is recommended to ring the transformer substations. This will save 350000 kWh of power energy. Pay back period is 0.7 year.
The combined production of power and heat energy is possible at this plant. The reducing cooling system, which throttles steam from 13atm. to 5-8 atm., should be replaced by turbogenerator with backpressure 200 kW. This will allow to generate 1010000 kWh/year of power energy additionally. Pay back period is 1.5 year.

It is recommended to use frequency controllers for the pump drives in the space heating and hot water supplying systems, in the circuit cooling systems (brine and water). Frequency regulation allows to use high-power pump equipment more efficiently. It is important for the high-power electromotors to reduce the load in case of the restarting of the equipment.

21 energy saving proposals with different pay back periods were made.

A meeting was held with the managers and chief specialists of the dairy. The saving proposals were discussed. The administration of the dairy highly appreciated the energy audit. They showed their interest in continuing this work.

Lists of energy saving proposals:

№ ппп	Proposal	Saving of heat energy [kWh/year	Saving of electric energy [kWh/year]	Saving of water [m^3/year]	Value of saving [1000 rub/year	Investment [1000 rub]	Pay back period [year]
1	2	3	4	5	6	7	8
4.1	Repair and replacement of valves at the steam pipeline in the milk drying plant.	85 000			7100.	5000	0.7
4.2	Heat insulation of pipe at the line of milk pasteurizing and replacement (repair) of steam valve.	20650			1700	2000	1.2
4.3	Heat insulation of steam dampers in the boiler house.	220 000.			18500	3000	0.2
4.4	Heat insulation of condensate collecting tank in the boiler house.	180 000			15000	10000.	0.7
4.5	Application of frequency controllers for the drive of the boiler feeding pump.		100000		18000	40000	2.2
4.6	Application of frequency controllers for the drive of boiler fans.		115000		42504	39000	1.
5.1	Installation of condensate collecting tank, condensate pump and mounting of part of the condensate circuit line after the pasteurizers.	183000		2650	55000	20000	0.36.
6.1	Application of open-type heat exchanger for utilization of steam heat after vacuum steam ejector of drying unit.	55824		75	5172	20000	3.8.
6.2	For the better adaptation of circuit cooling system to the operation of drying units , it is recommended to use frequency controllers for motor rotation of circulating pumps. It is necessary to install bypass with a damper for water cooling in the cooling tower when drying plant is out of service.		240000		88600	80000	1
7.1	Installation of automatic hot-wells after the steam registers of air heater for dryers PC-	33727			3000	1000	0.3

	1000						
7.2	Installation of distance control valve at the steam pipeline of air dryer PC- 1000	4000			350	1000	3
8.1	Modernization of circuit cooling system at the compressor house..		934000		345000	100000	0.3
8.2	Application of frequency controllers for the drive of the boiler feeding pump of the cooling compressor system.		210000		77490	94500	1.3
9.1	Repair and maintenance of air compressed system.		220000		81000	30000	0.37
11.1	Installation in the basement of cooling compressor automatic system for lightning control with the infrared detector.		16000		5900	1000	0.2
12.1	Disconnection of unloaded transformers with the capacity of 1000 kW and ringing of transformer substations at the low-voltage side.		350000		129000	80000.	0.7.
12.2	replacement of the reducing cooling system by turbogenerator with backpressure for generating additional electric energy.		1010000		335000	500000	1.5
12.3	Heat insulation of the drying chamber for motors drying.		7300		2700	1200	0.45
13.1	Application of ice water cooling system from ammonia compressor house in the system of margarine production for products cooling.			11500	90380.	40000	0.5
13.2	Application of a new type of bearings with higher temperature of operation in pumps of evaporating units.			1440	14328	1100	0.1
13.3	Replacement of valve in the waste tank in the toilet.			2600	26150.	200	0.1

Value of energy saving is estimated to be 1360 000 thous. ruble/year, 75% of these proposals don't need large sum of investment.

11.2 Minutes of the meeting

MINUTES
of the meeting concerning energy audit results

AO "Belgorod Dairy " Belgorod

Attendants :
From RDIEE**:**
Kolesnikov A.I.
from **Dansk Energi Analyse:**
Torben Ostergaard (took part in the preliminary meeting in may 1998)
from **AO "Belgorod Dairy":**
Maslennikov N.I., Sherbakov A.D., Khudoshin V.I.,
Panfilov V.I., Galaev V.F., Luneva A.M.

1. Report of energy audit results was delivered.
   Energy saving activities were proposed. Investment and pay back periods were estimated.

2. Discussion of the report was held.
   The necessity and possibilities were discussed, concerning the reconstruction of circuit water supply system, feasibility of balancing the load of boiler house at the operation of evaporation and dryer units for reducing the number of operating boilers and reducing of energy consumption of operating auxiliary boiler equipment. The possibilities were discussed concerning the reducing of energy consumption of air compressor-house due to the elimination of losses in the compressed air supply system. A considerable potential of energy saving is shown. Application of frequency controllers for motor rotation of pumps in the water and cold supply system, fans, operating in varying duty often with low load. The potential of saving was estimated concerning the reducing of water consumption for cooling with running water and increasing of condensate returning, elimination of disturbances.
   High capacity auxiliary equipment should be adapted to the low volume of production and changing loads. Great electric energy losses are indicated. They occur due to excess capacities of transformer substations.

   The combined production of electrical and heat energy is possible at this plant The reducing cooling system should be replaced by turbogenerator with backpressure. This will allow to generate additional electrical energy. The feasibility of this proposal will increase when energy costs increase.

3. The proposals of Danish side were highly appreciated. They refer to reducing of energy consumption. These proposals indicate the possibility of utilization of secondary heat recourses at the evaporation and drying units, utilization of hot water after equipment washing ; heat insulation improvement of windows and doors for reducing of heat losses from infiltration, and installation of heat controllers in production areas and administrative building. It is necessary to apply the automatic control of lightning.

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4. After the implementation of energy saving activities, the saving is estimated as 1000 mln not denominated ruble.

A table of energy saving proposals is stated below.

№ пп	Proposal	Saving Thous ruble/year	Investment Thous ruble/year	Pay back period (year)
0	**1**	**5**	**6**	**7**
4.1*	Repair and replacement of valves at the steam pipeline in the milk drying plant.	7100	5000	0.7
4.2*	Heat insulation of pipe at the line of milk pasteurizing and replacement (repair) of steam valve.	1700	2000	1.2
4.3*	Heat insulation of steam dampers in the boiler house.	18500	3000	0.2
4.4*	Heat insulation of condensate collecting tank in the boiler house.	15000	10000	0.7
4.5**	Application of frequency controllers for the drive of the boiler feeding pump.	18000	40000	2.2
4.6**	Application of frequency controllers for the drive of boiler fans.	42504	39000	1
5.1**	Installation of condensate collecting tank, condensate pump and mounting of part of the condensate circuit line after the pasteurizers.	55000	20000	0.36
6.1***	Application of open-type heat exchanger for utilization of steam heat after vacuum steam ejector of drying unit.	5172	20000	3.8.
6.2**	For the better adaptation of circuit cooling system to the operation of drying units , it is recommended to use frequency controllers for motor rotation of circulating pumps. It is necessary to install bypass with a damper for water cooling in the cooling tower when drying plant is out of service.	88600	80000	1
7.1*	Installation of automatic hot-wells after the steam registers of air heater for dryers PC-1000	3000	1000.	0.3
7.2***	Installation of distance control valve at the steam pipeline of air dryer PC- 1000	350	1000	3
8.1**	Modernization of circuit cooling system at the compressor house..	345000	100000	0.3
8.2**	Application of frequency controllers for the drive of the boiler feeding pump of the cooling compressor system.	77490	94500	1.3
9.1*	Repair and maintenance of air compressed system.	81000	30000	0.37
11.1*	Installation in the basement of cooling compressor automatic system for lightning control with the infrared detector.	5900	1000	0.2
12.1**	Disconnection of unloaded transformers with the capacity of 1000 kW and ringing of transformer substations at the low-voltage side.	129000	80000	0.7
12.2***	replacement of the reducing cooling system by turbogenerator with backpressure for generating additional electric energy.	335000	500000	1.5

12.3*	Heat insulation of the drying chamber for motors drying.	2700	1200	0.45
13.1**	Application of ice water cooling system from ammonia compressor house in the system of margarine production for products cooling.	90380	40000	0.5.
13.2**	Application of a new type of bearings with higher temperature of operation in pumps of evaporating units.	14328	1100	0.1
13.3*	Replacement of valve in the waste tank in the toilet.	26150	200	0.1
Total:		1360000		

Marks:

* the proposal doesn't require great expenses and has small pay back period that does not extend 8 months.
** the proposal requires engineering works and estimation of investment in construction requires designing works.

*** The proposal can be realized in further perspective.

The dairy is planning to realize most of these proposals.

12."OAO Tuymasamoloko" Tuymasa, Bashkortostan

12.1 Results of energy audit

The investigation at the dairy was carried out in April 1998 by Anatoliy Kolesnikov from RDIEE. For the transferring of skills and knowledge of energy audit, the following people from AO "Electroneftegas", city Oktyabrskiy, Bashkortostan took part in investigation: Kadirov R.R., Dadonov A.A., Bahtin N.M., Nigmatulin R.M. They were trained in RDIEE at the Danish training courses of energy audit.

In AO "Electroneftegas" the department was established for carrying out energy audit at the plants of this region.

The investigated dairy is one of the largest dairies in Bashkortostan, which is part of the Russian Federation. This dairy is able to process up to 350 tons of whole milk per day in cheese, butter and desiccated milk. In 1997 the dairy processed 29291 tons of whole milk. The milk delivery for processing ranged from 30 to 150 tons per day during the year. In 1996-1997 there was a small drop in natural milk processing. The plant is equipped with foreign units (units for vacuum milk evaporation VIGAND-8, Danish unit for air drying of milk ANAGIDRO) and Russian (plate-type pasteurizer, steam boilers, compressors, pumps).

In 1997 the dairy produced 844 tons of butter, 746 tons of cheese and 951 tons of desiccated milk. The dairy consumed 5.661 MWh of energy, 5.869.000 m3 of gas, 172.069.000 m3 of water. The plant uses low rate for energy resources. This stimulates the problem of energy saving in a less degree. Rate of energy costs in production value was 6,6%. (At the production value of 57793 mln. rbl/year (in 1997г) costs of energy is 1395 mln. rbl/year, gas -1614 mln rbl/year, water - 827 mln rbl/year). 436 people work at the dairy, including 386 people in production personnel.

The dairy works stable and has good future prospects.

The administration of the dairy takes activities in energy resources saving, but there is still great potential for saving.

1. There are no hot-wells in the system of condensate collecting. Steam with condensate is sent to the condensate-collecting tank and after the barbotage through water it is discharged into the atmosphere. The steam losses of condensate tank are estimated to be 1.5 tons/hour.= 13140 tons/year. Heat energy losses are 8357 Gcal/year. 9719190 kWh 39980 GJoule. Financial losses - 783 mln.rbl/year.

2. The deaerator, tank accumulator of hot water supplying system and tank of condensate collecting(a deaerator cell is used for this aim) don't have any heat and waterproofing insulation. Installation of the deaerator inside the wooden block will protect it from precipitation and wind forcing (but there will be still infiltrational heat losses, as this protection is inefficient).

The losses of the tanks, mentioned above, are estimated:
Deaerator and condensate collecting tank: 1093 MWh , value of losses - 88.1 mln.rbl/year.
Tank accumulator of hot water: 80 MWh, value of losses 6.48 mln.rbl/year
Total sum : 94.6 mln.rbl./year.

3. The calculations show that it is possible to collect and return 30% of condensate to the boiler feed system. The losses of 30% of condensate in technological processes, in the boiler of water heating system at the main technological building and in the system of space heating and the leakage with the ejected steam are estimated to be 15000m^3/year from the total 46,5 10^3 t of condensate. The cost of treatment of 1 m^3 water is about 7000rbl/m^3. The cost of water from city water supplying system is 4800 rbl/m^3, the cost of water discharging into the sewage system - 2400*0.82=1968 rbl/m^3. Total value of losses for 1m3 of condensate is 13800 rbl/m3. Total costs of lost condensate - 207 mln. rbl/year.

4. The gates of car washing department and milk delivery department don't have motorized system of gates closing. Gates with the area of 45 $м^2$ are open during 30% of time. The inside temperature is 8-10^oC, outside temperature during the heating period is –6.6 ^oC.
Heat losses are about 2678 MWh/year and has a value of 59.5 mln. rbl/year.

5. Pumps of water recycling supply of cold water and brine (all types "Д290/30" of 37kW) In connection with the production drop during winter period of little milk delivery and night period of reduction of technological load (70% of time) it will be efficient to replace the operating pumps with the pumps with less capacity K90/35 with the consumption up to 120m^3/hour and lift 35m.water spout. This will save approximately 35 kW of capacity for three pumps. Annual energy saving will be 215 MWh or 53 mln.rbl/year.

6. Air ejector fan and blast air fan work in the range of small coefficient of efficiency when the steam boilers operate with the low load (annual average load of boilers is about 40%). Electromotors also have low cosφ. (table 9.1) The motors are only half loaded.
The installation of frequency regulation (HVAC) for power supplying system of electromotors of air ejector fans and blast air fan in connection with the low load of electromotors (up to 30%).
Total capacity of operating motors is 85kW. Energy losses are estimated to be 43% : 320 MWh per year. or 79.4 mln.rbl/year. Investment for buying the frequency regulation is 127.500 mln.rbl.. Pay back period is 1.6 year.

16 energy saving activities with different pay back periods were proposed.

On 22 of June 1998 the energy audit report was given to the dairy administration. A meeting was held with the managers and chief specialists of the dairy. At this meeting the saving proposals of energy audit group were discussed. The administration of the dairy highly appreciated the work which was carried out, they showed their interest in continuing this work. Part of the proposed activities were carried out.

Energy saving proposals:

Proposal	Saving of electric energy [kWh/year]	Saving of water [m^3/year]	Saving of heat energy [kWh/year]	Value of saving [1000 rub/year	Investment [1000 rub]	Pay back period [year]
1	2	3	4	5	6	7
4. Installation of hot-wells at the condensate collecting system, for preventing of heat losses with the floating steam.	9719190			783000	4000	0.01
4.2 Insulation of deaerator, condensate collecting tank, and accumulator in the hot water supply system.	1093220			94600	40000	0.5
4.3 Replacement of damaged condensate pipe of the condensate collecting tank.	23260			1870	1000	0.5
4.4 Insulation of the boiler for water preheating and installation of hot-wells.	868700			69600	3000	0.05
4.5 Installation of additional condensate collecting system and increasing the condensate rate on 30%.	1134000			220000	120	0.5
4.6 Mechanization of gates closing at the area of cars washing and at the area of milk reception.	744320			59.5	70	1.2
6.1 Utilization of water from the forepump of the 2 stage of evaporation units for feeding of circuit cooling systems.			2400м ^{3}/год	17.2	35	2
6.2 Utilization of heat of floating steam for water preheating in the hot water supply system in the milk drying plant. The coefficient of regeneration is 0.6	965300			77200	250000	3.2
7.1 instead of pump Д390/40 to install a pump with less capacity in the of water supply system.		214500		53000	60000	1.1

7.2. To ban using of running water for cooling of evaporation units in the milk drying plant.			21000	150000	0	0
7.3 To restore the heat insulation at the area of approx. 60 m^2 at the parts of dairy cooling system.		14000		53000	60000	1.1
8.1 To eliminate the leakage of compressed air at the seal of damper in the pipeline not far from the main building at the side of compressor house.		43800		10797	0	0
9.1 To install multirate meter TACOM- type in the control system of electric energy consumption.				139500	20000	0.2
9.2 To apply frequency controllers for the motor rotation of the fans and blowers in the boiler house.		320000		79400	127500	1.6
9.3 To apply frequency controllers for motors of ice water and brine supply system and circuit water compressor system.		A alignment is necessary Saving is approx. 35% of energy consumption				
10.1 To apply chelators for for preventing of scaleformartion during water preheating.				148000	50000	0.3

22.06.1998г. the energy audit report was given to the management of the dairy. A meeting was held with the management and chief specialist of the dairy. Energy audit proposals were discussed during this meeting. Management of the dairy highly appreciated energy audit. Part of the proposals have been realized

12.2 Minutes of the meeting

MINUTES
Of the meeting concerning energy audit results
OAO "Tuimazamoloko" Tuimaza
Bashkortostan

Attendants :
From RDIEE**:**
Kolesnikov A.I.
From **AO «Electroneftegas»:**
Dadonov A.A.
From **OAO "Tuimazamoloko":**
Khasanshin R. V., Shakirov Sh.A,
Karshakova Z.G., Khvostov V.A.

2. Report of energy audit results was delivered.
   Energy saving activities were proposed. Investment and pay back periods were estimated.

3. Discussion of the report was held. The possibility was discussed concerning the increasing the rate of condensate collecting and returning. For reducing of losses of heat and chemically treated water. The losses were estimated, connected with application of running water cooling in the milk drying plant. The necessity was indicated connected with implementation of frequency controllers for motor rotation of the pumps in circuit system and hot water supply system, boiler feeding pumps, fans and blowers of the boiler house for better adaptation to the variation of daily and season load.
4. The necessity was indicated concerning the replacement of pump in water supply system. The losses were indicated, connected with the insulation absence at the condensate collecting tank , deaerator and absence of hot-wells after the steam consumers. It was indicated that it is necessary to restore the heat insulation at the parts of ammonia cooling plant.
5. It was marked that the expenses grew, connected with city water supply system and water cleaning system. It was suggested that less expensive methods of water treatment in the hot water supply system and boiler house should be used. The efficiency was indicated, connected with application of multirate meter, fixing the maximum of energy consumption.
6. After implementation of energy saving proposals the value of saving is estimated to be 1880 mln. of not denominated ruble.

Table of energy saving proposals:

Proposal	Saving of electric energy [kWh/year]	Saving of water [m^3/year]	Saving of heat energy [kWh/year]	Value of saving [1000 rub/year	Investment [1000 rub]	Pay back period [year]
1	2	3	4	5	6	7
4. Installation of hot-wells at the condensate collecting system, for preventing of heat losses with the floating steam.	9719190			783000	4000	0.01
4.2 Insulation of deaerator, condensate collecting tank, and accumulator in the hot water supply system.	1093220			94600	40000	0.5
4.3 Replacement of damaged condensate pipe of the condensate collecting tank.	23260			1870	1000	0.5
4.4 Insulation of the boiler for water preheating and installation of hot-wells.	868700			69600	3000	0.05
4.5 Installation of additional condensate collecting system and increasing the condensate rate on 30%	1134000			220000	120	0.5
4.6 Mechanization of gates closing at the area of cars washing and at the area of milk reception.	744320			59.5	70	1.2
6.1 Utilization of water from the forepump of the 2 stage of evaporation units for feeding of circuit cooling systems.			2400m^3 /year	17.2	35	2
6.2 Utilization of heat of floating steam for water preheating in the hot water supply system in the milk drying plant. The coefficient of regeneration is 0.6	965300			77200	250000	3.2
7.1 instead of pump Д390/40 to install a pump with less capacity in the of water supply system.		214500		53000	60000	1.1
7.2. To ban using of running water for cooling of evaporation units in the milk drying plant.			21000	150000	0	0
7.3 To restore the heat insulation at the area of		14000		53000	60000	1.1

approx. 60 m^2 at the parts of dairy cooling system.						
8.1 To eliminate the leakage of compressed air at the seal of damper in the pipeline not far from the main building at the side of compressor house.		43800		10797	0	0
9.1 To install multirate meter TACOM- type in the control system of electric energy consumption.				139500	20000	0.2
9.2 To apply frequency controllers for the motor rotation of the fans and blowers in the boiler house.		320000		79400	127500	1.6
9.3 To apply frequency controllers for motors of ice water and brine supply system and circuit water compressor system.		A alignment is necessary Saving is approx. 35% op energy consumption				
10.1 To apply chelators for preventing of scaleformartion during water preheating.				148000	50000	0.3
Total:				1880 mln not denominated ruble		

Marks:

- the proposal doesn't require great expenses and has small pay back period that does not extend 8 months.

** the proposal requires engineering works and estimation of investment in construction requires designing works.

*** The proposal can be realized in further perspective.

The dairy has already started the implementation of energy saving activities. Part of these activities has been implemented.