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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N W I C P C

NORTH -WESTERN INTERNATIONAL CLEANER PRODUCTION and ENVIRONMENTAL MANAGEMENT CENTRE

FINAL REPORT

DEMO-PROJECT for Cleaner Production Assessment in the North-West Russia

UNIDO Project TF/RUS/01/001 – Strengthening of the International Cleaner Production and Environmental Management Centre –Part 1

UNIDO Contract No. 2002/179

Saint - Petersburg
2002

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1. GENERAL BACKGROUND

Within the framework of the UNIDO project for North-Western region of Russia «Strengthening of the International Cleaner Production and Environmental Management Centre» (Project № TF/RUS/01/001 & US/RUS/01/115) the demonstrational project of «Cleaner Production Assessment» programe is realized in Saint-Petersburg. This project is oriented to implementation of new environmentally clean and energy efficient technologies into the systems of engineering infrastructure of non-residential objects.

1.1 Project summary and objectives

The program of Cleaner Production is implemented by the North-Western International Cleaner Production and Environmental Management Centre (NWICPC, St. Petersburg) via international network of specialized national Cleaner Production centres under assistance of Cleaner Production and Environmental Management Branch of United Nations Industrial Development Organization (UNIDO). One of the goals of the program is the implementation of resource and energy saving technologies, reduction of resource consumption via modernization of industry and implementation of new systems of management.

NWICPC, executing its own mission in the area of Cleaner Production (CP), based on the conception of specialized agencies of UN (UNIDO/UNEP), consisting in creative approach to solve the problems concerning protection of the environment, realizes the advancement of the resource and energy saving technologies and fulfils the realization of the CP Conception in the form of demo (pilot) projects on implementation of appropriate innovation technologies on the enterprises and organizations of the North-Western Federal region of the Russian Federation (RF) on the basis of bilateral cooperation agreements on the project of CP.

The Conception of CP includes: energy and resource saving; industrial modernization on the basis of implementation of the modern environmental appropriate technologies, including high-tech; implementation of quality and environmental management standards ISO 9000 and ISO 14000; advancement of the of high technical and environmentally clean production in the internal and external markets; reduction of wastes and emissions during process of production, training of specialists on implementation of Cleaner Production., Advancing given conception, Centre wishes to reduce antropogenic impact on environment from industrial activity and to assist the rising of efficiency of regional enterprises, improvement their statement on the market of products and services.

The object of realization of Demo-project on "Implementation of new environmentally clean and energy efficient technologies into the systems of engineering infrastructure of non-residential objects of St. Petersburg" is "ICAR" Ltd., on the basis of cooperation agreement between company and Centre.

The main goal of the project is to exposure possible mechanisms and methods on implementing of energy and resource saving, modern environmentally clean technologies, as well as automatization of control systems and optimization of engineering infrastructure on the example of universal business centre with subsequent formation of recommendations on replication of results on the objects of social and budget sphere, culture, business and trade centres of North-Western region of RF.

1.2 Main goals and stages of CP implementation

The main goal of realizable Demo-project is to conduct the inspection of engineering infrastructure of chosen object, analyzing of control system and consumption of energy supply, formation of recommendations on modernization of engineering infrastructure with the purpose of reduction resource consumption and implementation of environmentally clean and resource saving technologies and equipment.

The main stages of realization of project:

1. Global analysis of technical -economic and financial indices of energy supply consumption of enterprise;
2. Conduction of inspection of engineering infrastructure of enterprise;
3. Assessment of possibility on modernization of engineering infrastructure with application of energy saving environmentally clean technologies, as well as automatization of control systems and on energy supply consumption;
4. Assessment of possible application of different technologies on the engineering objects;
5. Working out suggestions on modernization of engineering infrastructure via process flowsheet of recommended solutions;
6. Pilot realization of suggested process flowsheet on the basis of the modern resource saving technologies;
7. Assessment of forecast outcome on implementation;
8. Forming of control system for results of implementation of the project.

1.3 Proposed results

As a case of proposed results, it is expected forming of lines on modernization of engineering infrastructure of enterprises with suggestion of concrete solutions, focused on the resource saving and reduction of harmful impact on the environment.

The accent is emphasized on quick-recoupment of relatively low-cost arrangements with subsequent replication of obtained experience. The question on mandatory realization of recommendations should be adjusted with enterprises on the initial stage of project realization.

2. CHARACTERISTIC OF CP IMPLEMENTATION OBJECT

Corporation "ICAR" (International College of Art Restauration) was selected as a focus for the study in the field of adaptability of CP concept from number of enterprises of NWICPC Eco-cluster.

As a result of conducted repair and reconstruction work the historical appearance of the building completely restored. The part of the building that hadn't artistic value was reconstructed and on its basis the business centre was created.

2.1 Characteristic of the company

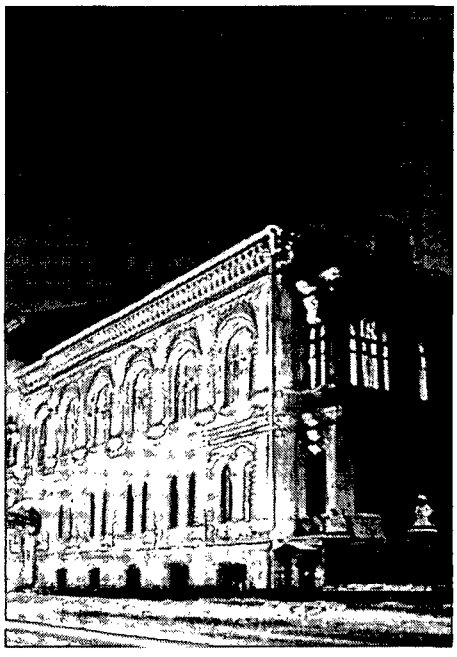
The company was established in 1990 to manage the group of buildings of prince Kotshubei's mansion (Saint-Petersburg, Konnogvardejskij boulevard, 7) were mainly offices and restaurants are located.

The buildings are situated in the historical center of the city that is in the books of the Governmental Committee on the Problems of Conservation of Monuments (KGIOP). It is a monument of Federal (All- Russian) significance. According to the results of nonprofit contest conducted by KGIOP, the building was given to the "ICAR" on the definite conditions (realization of repair and reconstruction work, usage of the building as a cultural and educational center with the right to give premises on sub- lease).

The main activities of "ICAR" company are publishing and exhibiting, and the real estate lease.

2.2 Characteristic of the buildings

General description of the study object:



- Year of construction - 1857
- Year of the last reconstruction - 1996
- Total area - 2 683 m2
- Total area of premises of business center - 1 750 m2
- Palace area - more than 400 m2
- Total area of restaurant - 288.7 m2 (plus winter garden - atrium)
- Central water-supply and drainage system
- Central heating (public corporation "LENENERGO")
- 3 water heaters, total capacity - 8 kilowatt
- Sprinkler and intruder alarm and visualization system.

The Kotshubei's mansion consists of main building, two wings and courtyard.

The palace part of the building "ICAR" was reclaimed to carry out cultural and educational events. The main energy consumers are the business center and restaurant.

Two main offices are located in the business center block:

- News agency "Rosbalt" - 496 m^2;
- All-Russian Governmental TV and Radio Broadcasting Company department "Saint-Petersburg" - 285.6 m2.

Restaurant operator is leasing restaurant. Restaurant is oriented on the service of tourists groups.

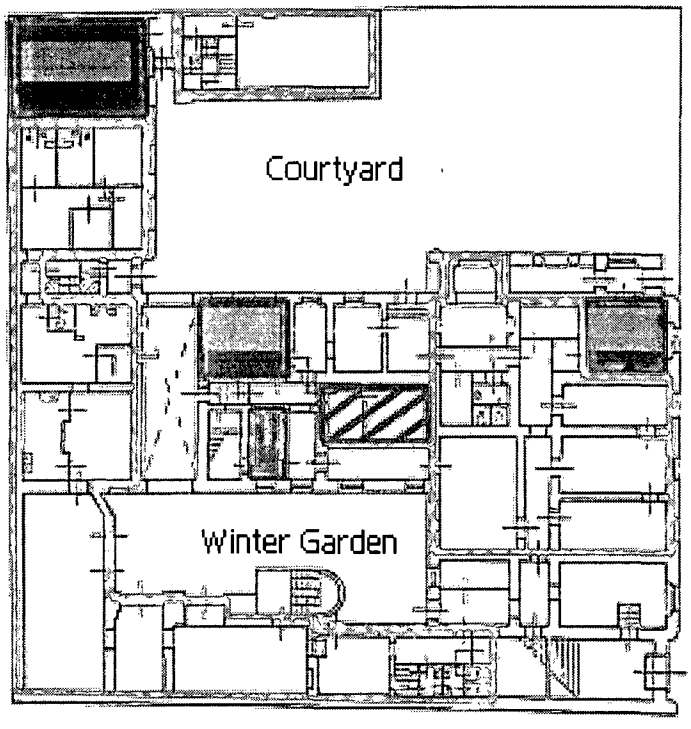
Hot water supply in the system of open water pumping realizes only for production areas of the restaurant. The significant power intensity and sluggishness characterize the system in use. At the time of peak demand the great lack of hot water observed.

On account of different activities of premise lessees of prince Kotshubei mansion the volume of energy consumption was differentiated by the day period and by the power range.

In the autumn-winter period the heating of the covered winter garden is conducted through the portable electric systems of hot air supply, which is noticeably increasing consumption of electricity.

Preliminary analysis of the power supply system, engineering infrastructure and the system of complex management shows the possibility to optimize and modernize engineering infrastructure, the system of control for resources consumption.

Plan 1 and Ground Floor



Auxiliary and utility rooms

Ceritified bank depository

The Tenants

"ROSBALT"

Restaurant

2.3 Engineering infrastructure

The buildings are connected to the network of electrosupply, (electricity supplying public corporation "LENENERGO"), average annual volume of consumption- 250 thousand of kW.

The buildings are equipped by the system of centralized water supply and water removal, the supplier of cold water - state owned enterprise "VODOKANAL", annual volume of cold water consumption- 1000 m^3.

The buildings are equipped by the system of centralized heating (heat supplying public corporation "LENENERGO"), average annual volume of heat energy consumption- 350 Gkcal.

Delivery of hot water into the system of open consumption is realized through three household electric water boilers with total capacity of 8 kW.

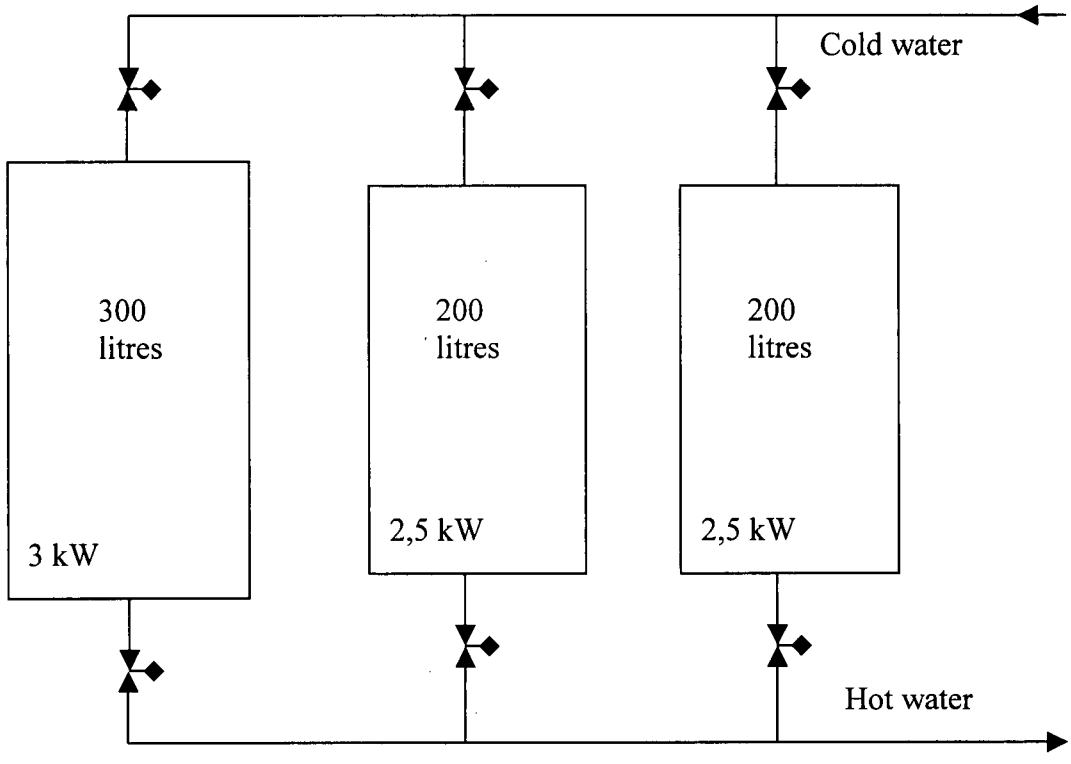
During the preliminary analysis it was established, that the biggest volume of possible optimization of charges and implementation of alternative technologies it is possible to reach in the system of heat supplying system of the buildings.

Thus, the heat supplying system of Kotshubei's mansion was inspected in details and analyzed.

2.4 Hot water supply system

The building has an independent system of hot water supply consisting of three boilers of accumulative type, connected in parallel with two boilers, each two hundred litres and one boiler-three hundred litres, accordingly, thermal capacity three and two and a half Watts for the third one. The boilers of the Italian firm "TERMEX" are connected to the pipeline of transmission of cold water.

The structure of the scheme includes working and reserve water-measured units P-100.sch.25 and 1-100.sch.50. The technical concordance on the units of the account № 1240 was given by state owned enterprise "VODOKANAL" in October 4, 2001.



The boilers are adjusted on the temperature of hot water of 55 C. Since the unit of the account is not separately provided for hot water and the electricity supply meter is not

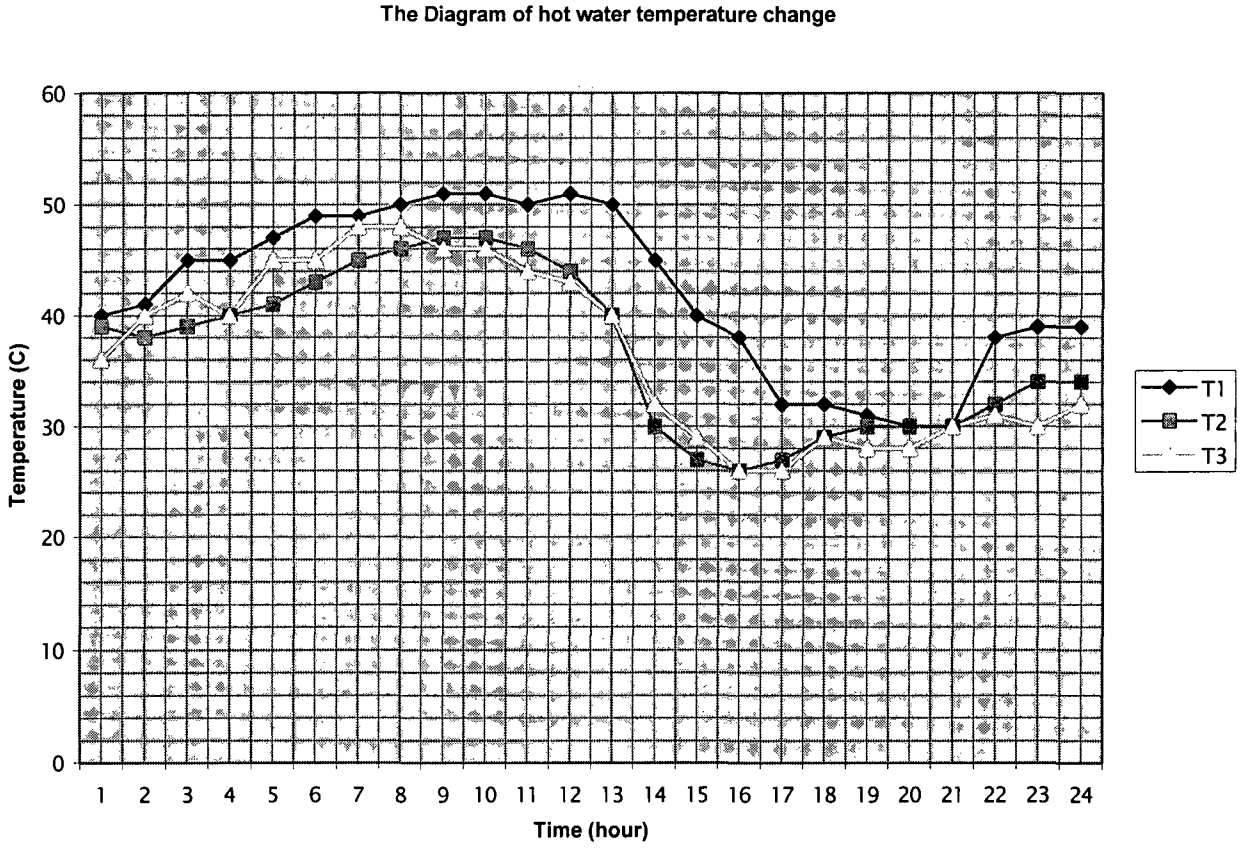
separately installed on the boilers, that's why the charge of the electric power on the system of hot water supply was defined by calculation method.

In the period from June 23 till June 25, 2002 the temperature measurements of hot water after he boilers were made with periodicity one measurement in hour. The period of measurements covered both days off, and working days. The estimated time of heating for two hundred and three hundred liter boilers at temperature of cold water of 12 degrees makes:

t_{200} = 4,93 hours

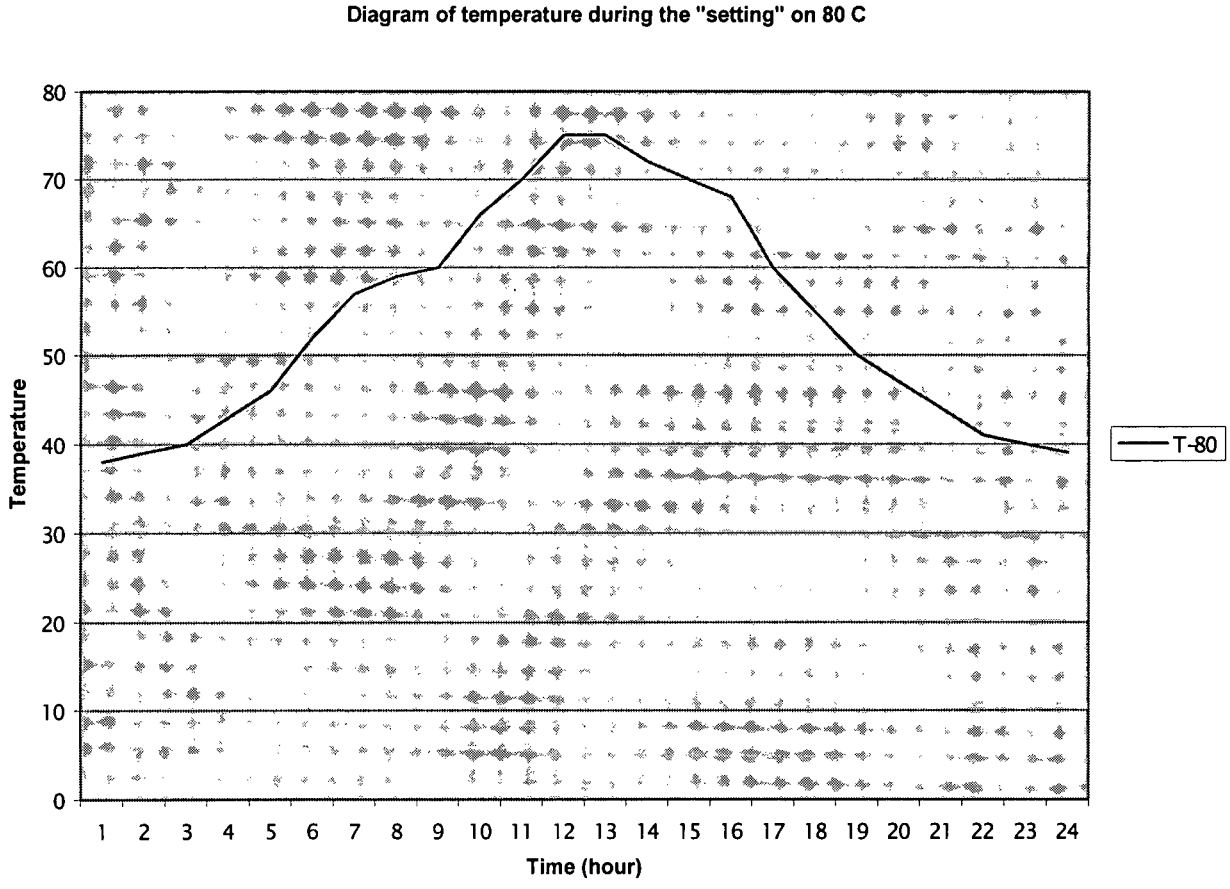
t_{300} = 7,72 hours.

The common diagram on hot water temperature change is shown on the picture.



In area of 12 p.m.- 2 a.m. the charge of hot water is reduced practically up to zero. By 8-9 a.m. water in boilers is warmed up to the adjusted temperature, the electric power is disconnected and moves only for compensation of thermal losses. From 11 a.m. till 2 p.m. there is a charge of hot water saved up during night, and with the beginning of charge the electric power again is included. From 3 p.m. the temperature of hot water falls down and till 9 p.m. is at level of 28-29 degrees. For this period the charge of hot water in a building is maximal and boilers have not time to warm up the water. From 9 p.m. till 2 a.m. the charge water is a little bit reduced also temperature of hot water grows up to 32-34 degrees. Maximal setting on temperature which can be set on boilers of "TERMEX" firm makes 80 degrees, however proceeding from reasons of long term work of the equipment (it is known, during the rising of surrounding temperature on 10 degrees, the corrosion processes go twice faster) service companies recommend to set the fixed temperature on value of 55 degrees.

Let's consider a case when the maximal temperature in boilers would reach 80 C. Then by 11 a.m. hot water during summer time would be heated up to 75 C and in winter time up to 65 C, due to this, it would suffice till 17. Thus, the value of the minimal temperature in system would rise up to 40-45 C.



However, the probability of the equipment failure will considerably raise also the boilers will consume electric energy 24 hours per day. From the analysis of the temperature diagrams it is possible to draw a conclusion, that the average charge of hot water makes about one thousand and two hundred litres per day, and the maximum of consumption falls down to evening hours. At a temperature maximum of 55 degrees in the summer time the operating time of boilers averages 19 hours per day and 22 hours in the winter time, at temperature of cold water of 3-4 degrees. At a temperature maximum of 80 degrees the operating time of boilers both in summer and in winter and will make 24 hours per day. It is evident from the mentioned above, that the total energy spent for maintenance of hot water supply system makes 4560 kWh per summer month and 5280 kWh per winter month. Thus, there is a constant infringement of sanitary norms on which the temperature of hot water shouldn't be lower than 57 C, and also building norms 2.04.01-85 - the temperature of hot water shouldn't be lower than 60 C. At the established tariff for the electric power 0,98 rub\kWh expenses for hot water supply of a building make for one year of 57860 rubles per one year without taking into account the means necessary on repair and restoration of designed protection of boilers. In view of increase of the tariff planned from July 17, this figure will increase a minimum by 10%.

2.5 Heat supply system

The building is provided with a heat from the heat-main of heat station #14 of public corporation "LENENERGO" (the agreement on heat supplying # 31303, limiting rate is 3,25 t/hour). The heat supply system is closed double-cycle.

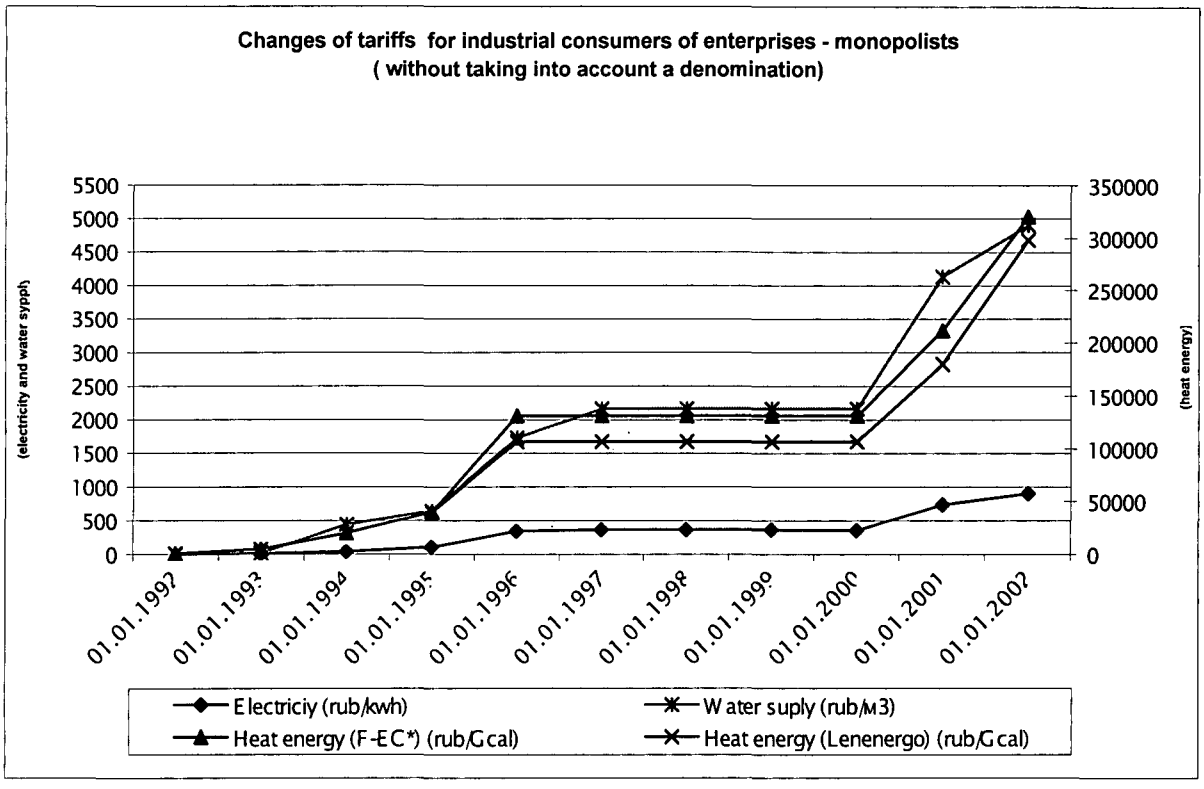
Finnish Company Peterko Ltd. during reconstruction and restoration of the building carried out designing and assembling of the system in 1994. The thermal station is located on the 1st floor. The heat exchanging device "Alpha Laval" 35 LA-10 with the nominal capacity of 250 kW is installed there. The resistance of the heat exchanger in each cycle is 1,03 kg/sm2 and 1,99 kg/sm2 correspondingly. The internal cycle is made of copper pipes; the heating radiators are aluminium and have discrete regulators. Pumps of German Company "Grundos" provide the circulation in the internal cycle. To rise a reability the second pump is installed in parallel with the main one. The power of the pump can be changed discretely and can be 0,545 kW, 0,33 kW and 0,145 kW. The center of heat calculation is installed in the heat station. Russian converter VST-50 with heat-meter SPT-961, made by "Logika" company replaced the Finnish center of heat calculating Valmet-Ivo7EVL with a water-meter SUOMI-2000 in case of malfunction.
It is necessary to mark high quality of foreign equipment and installation works. There was almost no leaking in the system of internal cycle, replenishment of the system is made about 2 times a year in case of pressure falling, the control of which is carried visually on manometer, installed in heat center. For compensation of temperature extensions the membrane type 50-litre compensator is installed in the system. There were no arrangements of water in the internal cycle, after heating season the system is not dried.

On the basis of reports of heating water consumption for the heating season of 2001-2002 we can conclude that the maximum expenditure of water was on 28.12.01 and has constituted 99 tons of heating water per day. Thus temperature of submitted water was 76 C, and the temperature drop on the heat exchanger was 28 C. With such a weather of outside air and with a weather of the heat carrier 82 C, the heating water consumption was 91 tons per day. The daily average consumption of heat was from 0,96 Gcal/day to 2,06 Gcal/day.

Taking into account the operating tariff the charge for heating water was 69300 rub. for a heating season of 2001-2002. With the new tariff (from 17.07.02), this value was increased by 5-6 %.

3. PROBLEMS OF MODERNIZATION OF HEAT SUPPLY SYSTEMS IN ST. PETERSBURG.

The centralized heat supply system of St. Petersburg has a great many of problems, basic of which are the deterioration of the capital assets and large losses in systems of transportation of a thermal energy, that first of all will require increase of assessments to investment expenditures of monopolists and, therefore, fast rates of growth of the tariffs.



* F-EC – State-run Enterprise "Fuel and Energy Complex"

Besides in conditions of forthcoming significant rise of the prices on organic fuel, necessity of attraction of enormous material resources in modernization of the capital assets of the city monopolists (construction of engineering networks, upgrade of generating supplies), progressing requirements for limits of organic fuel the city (budgetary, industrial customers, the housing and communal services) can in general be not able to pay for power resources.

The priority course of solution of energy problems of city is the creation of the coordinated program of the executive authorities of St.-Petersburg actions, oriented at first to assistance in implementing of energy-saving, with fast pay-back technologies in the field of consumption of power resources, including organic fuel, with the precise mechanism of realization and control. Such approach will create objective conditions of necessity of optimization of operation of large city's monopolists.

The Government of Russian Federation has approved the Federal program "Energy Effective Economy" on 2002-2005 years, and in perspective – up to 2010 year (RF Government regulation from 17/11/2001 № 796). The main mechanism of realization of that Program expects creating of regional programs with cofinancing from federal budget.

The project, realized in the building of prince Kotshubei's mansion, is oriented to demonstrate the possibility of implementing of modern, with fast pay-back, environmentally friendly technologies on the objects of municipal services and real economic benefits of their implementing.

The project will be a basis for realization in the city large-scaled measures on implementing of new technologies in systems of power supply of city within the framework of the special target program.

4. DESCRIPTION OF THE PROJECT TECHNICAL ANALYSIS AND PROPOSALS FOR TAKING TECHNICAL DECISIONS.

As a basis for implementation of the demonstration project according to the guidelines of the Chairman of Energy Saving Commission under Chairman of the State Duma of Russian Federation professor Fisenco V.V., the scheme of modernization of the system of hot water supply of a building on a basis of heat-generator, operating resources of internal energy of water (transsonic technology), was selected.

Now such technology has no domestic or foreign analogues by technical and economical characteristics and is most perspective for municipal and home power engineering.

4.1 Theoretical grounds of the practical recommendations on implementation of transonic technology

As a result of learning peculiarities of driving of the two-phase environments the output was made about possibility of an effective usage of this characteristic of two-phase streams at solution of a number of the practical tasks. Practical usage of the obtained theoretical results has led to creation of transsonic apparatuses and on their basis transsonic technologies in different branches of human activity.

At the same time theoretically even more interesting, and practically even more effective the possibility of obtaining in output of the transsonic apparatus temperature of stream higher, than temperature of heating environment (for example – temperature of steam when it is the heating environment).

The heat exchange between the environments as a result of usage of the jet transsonic device occurs not how it has a place in the usual jet device.

All contributors identified the pressure jump in stream of mixture and users of this event with a condensation jump, i.e. process accompanying by change of entropy. Meanwhile at first theoretically, and then and practically it was demonstrated, that such jump could be isoentropic. The reliable in a wide range of parameters work of devises, with static characteristics and flowing parts calculated from a condition of isoentropic jump, has become a practical confirmation.

It is known from a gas dynamics, that temperature of gas T in any section of stream is more less than temperature of braking To in that section of stream than more speed of stream in this section:

$$\frac{T}{To} = \frac{1}{1 + \frac{k-1}{2} \cdot M^2}$$

k – isoentropic curve index of gas; M – Max index.

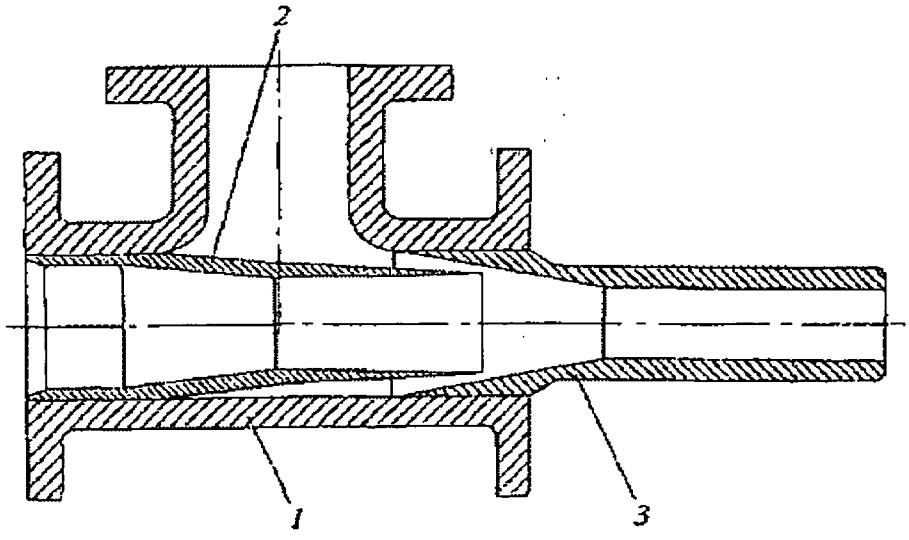
From this dependence for the same gas follows, that the more is index **M** the **T** is less than **To**. As it is known, the isoentropic curve index in homogeneous two-phase mixture

is the function of the isoentropic curve index of gas in mixture **k** and volumetric relation of phases in mixture

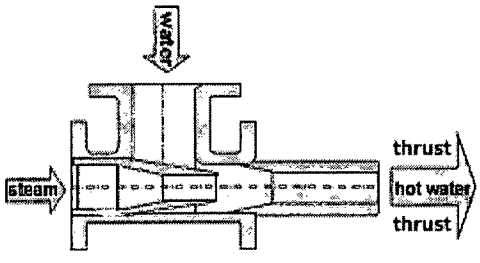
$$\beta = \frac{Vs}{Vs + Vw}$$

Here the isoentropic curve index of two-phase mixture is always more than the isoentropic curve index of gas. It means that with other things being equal **T/To** in two-phase mixture always less than **T/To** of net gas.

Taking into account that by virtue of small values of sound speed in two-phase stream in comparison with single-phase (the net gas), it is possible to make output that in stream of two-phase mixture the ratio of temperatures T/To will be less, than in stream of net gas, because the Max index in stream of two-phase mixture is much greater than the Max index in stream of net gas with the same parameters of stream on an input in the channel.



The flowing part of the device, which consists only of three (or even two) parts: 1 - body - standard t-pipe; 2 - nozzle for a working body (it can be steam, gas or fluid); 3 - mixing camera. If the mixing camera is simultaneously a body, the device consists of body and working nozzle.



More than 60 % of organic fuel are burnt for reception of heat in Russia. Recovery of this heat with the help of "Fisonic" devices considerably allows lowering capital expenses for reconstruction and construction of new generating capacities of steam turbine, gas-turbine and steam-gas-turbine units.

In usual jet devices where in working basis lays heat exchange between streams during their mixture, increase of pressure of transported environment, in case when a working environment is own stream, occurs due to transfer of steam energy during its condensation on cold transported environment. In a basis of an exchange of amount of movement between environments the mechanism of viscous friction on an interface of phases partition. From the molecular point of view process of heat exchange and process of friction are processes which time of a relaxation is proportional to length of free run of molecules.

As it was marked above, in the transonic device in a basis of the mechanism of an exchange of amount of movement the mechanism of elastic interaction of molecules of gas with fine-dispersed drops of a liquid (which size is microns and even the tenth parts of micron). Time of a relaxation of such process proportionally to number of impacts in unit of time - the magnitude that has the order close to Avogadro index. Naturally, such process is dominant above the dissipative processes described above. Thus process of an exchange by amount of movement occurs in such a manner that speed of a sound

$$(a^2 = (\frac{dp}{d\rho})_s)$$

Sharply falls, and speed of a stream sharply grows, adiabatic compressibility of a stream grows also. The stream becomes supersonic on an entrance of a cylindrical part of the chamber of mixture, continuous transition through speed of a sound in the adiabatic channel with constant section is impossible, - and there is a pressure jump. The stream from a supersonic stream with fog-like structure becomes a subsonic stream of a liquid with fine-dispersed drops of superheated steam. There is not a process of steam condensation (there is not enough time for this purpose), but collapse of steam space in isoentropic pressure jump. Thus deeper transformation of internal energy of steam takes place, than it would be with its independent expansion.

In the conclusion we shall stop on the description of the phenomenon already becoming a subject of practical interest of many collectives, working on reception of thermal energy from water with the help of the various devices using for generation of heat electric energy of drives of pumps. Thus practically received thermal energy exceeds brought energy of the electric motor. The part of inventors has patented their inventions: the Russian patents: 2045715; 2142604; 2061195; 2132517: 2115027; 2114326; 2127832. Many work without the patent.

Each of authors describes the physical processes lying in the basis of used phenomenon in their own way. They are: quantum generation, and "cold thermonuclear", and vortex flows, and cavitation effects.

All of them do not describe in full those real processes, which underlie work of "heat generators". It is possible to explain that not only at separate inventions, but even at the same in various models and various conditions the various working efficiency of devices is realised, and it is far from theoretically possible.

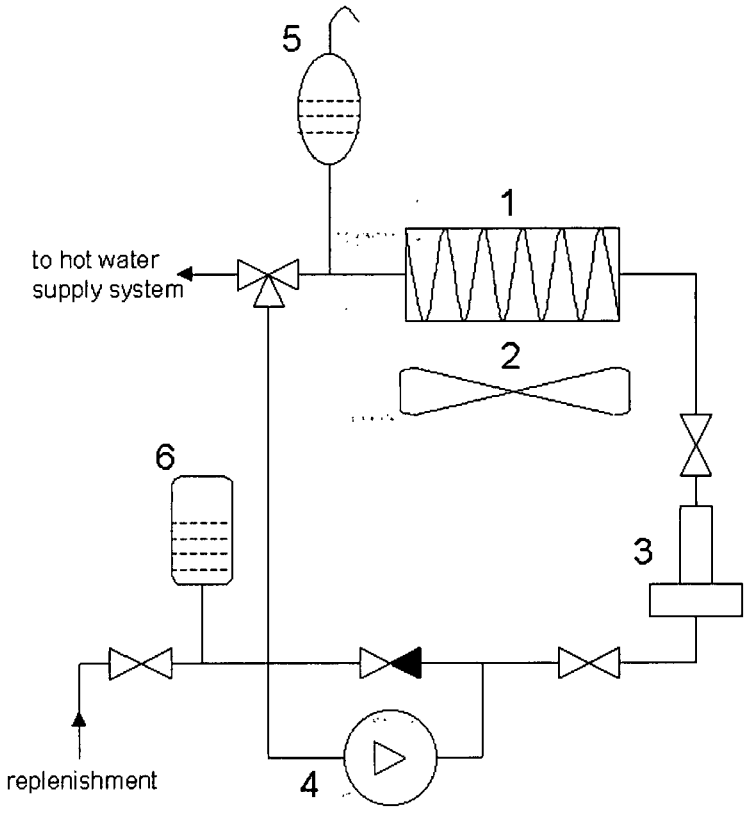
Features of two-phase streams lay in a basis of functioning of all similar devices, first of all property of their increased compressibility, and in all available devices pressure jump is more or less effectively realised.

As the experiments, which have been carried out in Russia and in USA, have shown that thermal capacity in a stream behind the device based on transonic technology more than in 8 times exceeded the capacity of the electric motor of the pump brought to a stream. The problem, however, also includes having time to gather this heat before molecular connections will be restored in the pump, and temperature of a stream will be lowered. It is necessary to notice that the brought capacity may be not a capacity of the electric motor of the pump. All "Fisonic" devices regardless of their purpose realise effect of reception of additional heat from water.

4.2 Installation of heat-generators into the hot water supply systems.

Because of there is no possibility to receive steam and bring it to "Fisonic" device, it was improved. For receiving a steam electrodes with the maximum capacity of 6 kW was installed inside the device. For maintenance of needs of a building in heating and hot water and bringing it up to nominal parameters (60 C) it is offered to establish such heat generator on the basis of transonic technology.

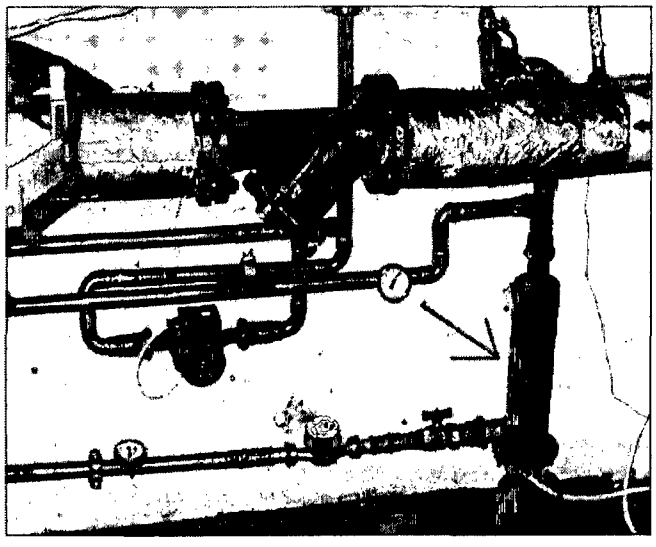
Scheme of connection of the device



1. Calorifer
2. Ventilator
3. Heat-generator
4. Starting pump
5. Expansion tank and gas removal
6. Tank of replenishment and support of the pressure

Connection is made in such a manner that will allow systems to function both in new, and in former regime that will provide double reliability at work.

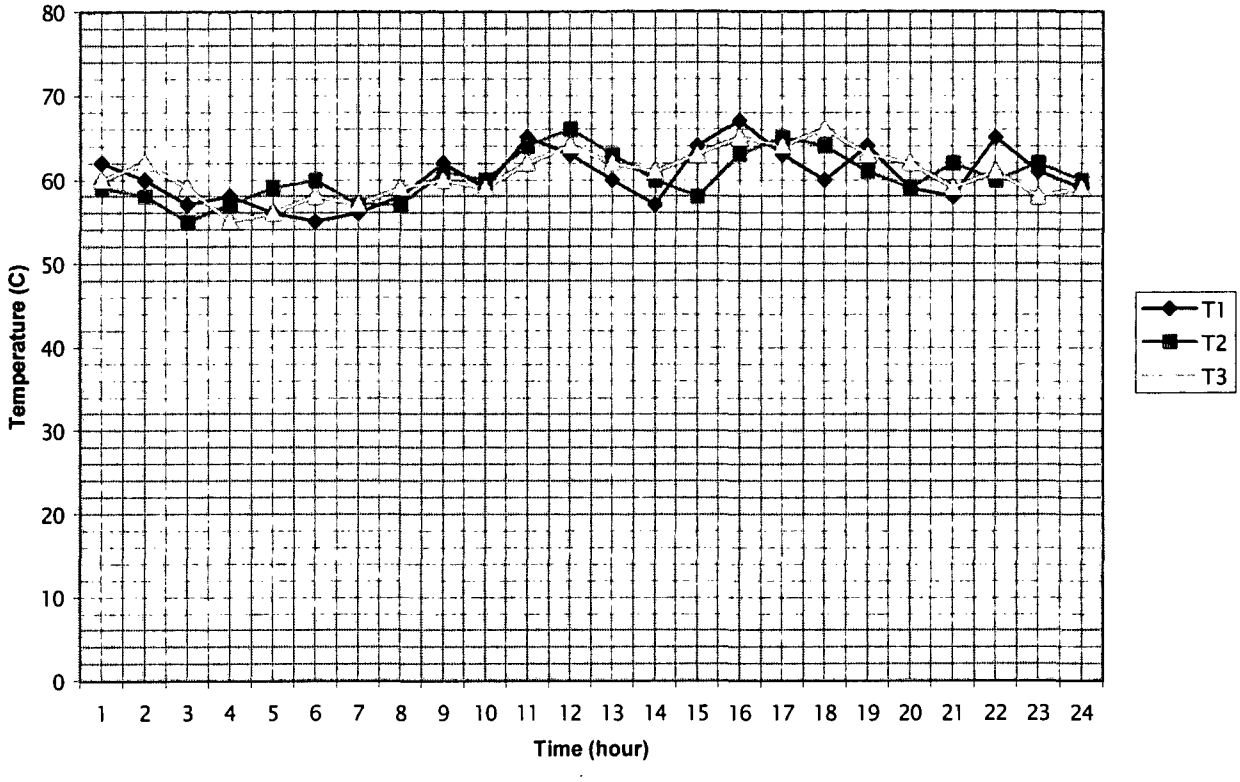
In a summer mode heat generator works on the closed contour giving heat produced in heat exchanger. During the work in winter with the purpose of decrease of the heating waters charges the temperature of water for hot water supply system up to nominal temperatures occurs.



Comparative characteristics of new and the previous hot water systems show that:

- The mean daily temperature of hot water on boilers outlet is 31-32 °C; but at the same time the temperature is not stable and changes during twenty-four hours;
- The average daily temperature of hot water on water heat-generator outlet is 60 °C.(see diagram below);
- Miniature heat-generator is easy build in (see picture photo) into supply pipeline system; but boilers need separated space (room).

The Diagram of hot water temperature change



"Fisonic" device, in contrast to electric boilers, come to nominal temperature in ~20 min. And using accumulating tank (in our case – boilers) work for 9,5 hours per day with maximal capacity (summer months).
Here we can calculate expenses for hot water supply.

6 kW x 9,5 h = 57 kWh x 30 days = 1710 kWh

As you remember the previous system consumed 4560 kWh per summer month.
The economy will be **4560-1710 = 2850 x 0,98 rub = 2793 rub** per month (in summer)
In relative figures: the consumption of electric energy will reduce in 2.67 times.
Let's count this expenses for winter months. (Heat generator will work for 11 hours)

6 kW x 11 h = 66 kWh x 30 days = 1980 kWh

The economy is **5280 – 1980 = 3300 x 0,98 rub = 3234 rub** per month (in winter)

The total economy for 1 year will be (approximately):

(2793 x 6) + (3234 x 6) = 36 162 rub

And all sanitary-technical standards are maintained (hot water temperature in the system is not less then 55-60 °C), which has not been fulfilled because of insufficient power of boilers.

Unfortunately this Demo-project was held in summer, and we couldn't test this device in heating system. But the results achieved in case of hot water supply system give us ground to suggest that usage of "Fisonic" device in heating system will produce sufficient economy of energy and therefore costs saving.

5. CONCLUSION

As a result of this demo-project the inspection of engineering infrastructure of chosen object and analyzing of control system and consumption of energy supply was conducted, formation of recommendations on modernization of engineering infrastructure with the purpose of reduction resource consumption and implementation of environmentally clean and resource saving technologies and equipment was made.

The inspection discovered that:

- In hot water supply system
  Restaurant is the main consumer of hot water and existing hot water supply system, based on 3 boilers can't cope with its task when during maximum consumption (13:00-23:00, especially during banquets and other events: Fridays, Saturdays 19:00-24:00).

- In heating system
  The main problems are: necessity of using of high volumes of heating water and low temperature of this heating water in the input. Therefore we have insufficient heating of the building and raise of payments to "Lenenergo".

In basis of modernization of the hot water and heat supply system of office buildings was putted a unique domestic heat generating installation. The installation belongs to category non-traditional ways of energy generation and uses a **water**

interior energy resource. Now such technology has no domestic or foreign analogues by technical and economical characteristics.

As a result of implementation of "Fisonic" device the economy of energy, and therefore money, only in hot water supply system came to 36 162 rub per year (~60%). And additionally the quality of hot water supply system was improved.

Also we can note the next advantages of Fisonic Equipment:

- No downtime for installation - fast, easy bypass, or parrallel retrofit.
- Easy, instant, on-demand operation
- Small installation footprint and much less metal-intensive than conventional equipment
- Higher proportional energy output
- Substantial (up to 70%) energy savings
- Lower capital costs for modernisation (30 – 90% lower)
- Lower maintenance costs due to ease of service and regulation
- Better ecological perspective due to elimination of heat pollution and a cut in toxic emissions

Fisonic Equipment can be effectively used to replace or modernize:

1. Residential and industrial heating and hot water supply systems.

2. Self-pumping heat exchangers installed on existing water and steam lines provide heating and pumping thrust and large volume hot water supply on demand in commercial, multiple-residential, industrial, or institutional applications.

3. A large number of industrial technological cycles (chemical, food processing, pharmaceutical, petroleum and other industries), modern building and construction.

From the everything described above we can make a conclusion that using of "Fisonic" device for modernisation of hot water supply and heating systems helps to safe energy and therefore has the ecological and economical basis for its implementation.

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