

PN-ALP-993



**SERBIA
EMERGENCY ENERGY EFFICIENCY
PROGRAM**

**SUMMARY OF
ENERGY CONSERVATION MEASURES**

IMPLEMENTED BY



**IN FIVE SERBIAN MUNICIPALITIES
DURING WINTER 2001**

ON BEHALF OF THE
**UNITED STATES AGENCY
FOR INTERNATIONAL DEVELOPMENT**

JUNE 2002

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BACKGROUND

The Republic of Serbia, with Belgrade as capital, is part of the Federal Republic of Yugoslavia, and contains the autonomous provinces of Vojvodina, and Kosovo and Metohija. According to the last available census data (1991), the total population is 9,779,000, of which 1,600,000 reside in Belgrade, the administrative, economic and cultural center of Serbia.

Located in the central part of the Balkan Peninsula, on the most important route linking Europe and Asia, Serbia is referred to as the crossroads of Europe, occupying an area of 88,361 km², and with a population of approximately 10 million people. The international roads and railways passing down its river valleys make up the shortest link between Western and Central Europe, on the one side, and the Middle East, Asia and Africa, on the other.



Serbia's energy consumption, particularly for space heating, imposes serious challenges to the country's recovery. Households and Municipal Institutions are facing difficulties paying for energy/heat, while energy producers- particularly electricity- face supply shortages. Heavy subsidies to the prices of electricity and district heat had exacerbated the situation by encouraging high consumption levels. The budgets of cities and energy enterprises are strained to provide the subsidies, making it difficult to increase energy supplies. Energy efficiency is clearly one of the methods to relieve the supply shortages, while also providing social protection against the inevitable removal of subsidies.

USAID designed the Serbia Emergency Energy Efficiency Program (SEEEP) with the objective of promoting energy efficiency at national level. One of the key elements of the program is the widespread demonstration of financially attractive energy saving technologies, which will attract both private and public investments toward the repetition of the demonstration projects. The anticipated large number of repetitions will in turn have a substantial impact in reducing energy consumption at national level, with a consequent reduction in government expenditures.

The practical implementation of SEEEP consisted in the installation of numerous energy efficiency demonstration projects. For the purpose of evaluating the energy savings achieved by each project, it was decided to use winter season 2000-2001 as the energy consumption baseline period, and winter season 2001-2002 for the measurement of energy consumption after the implementation of the projects.

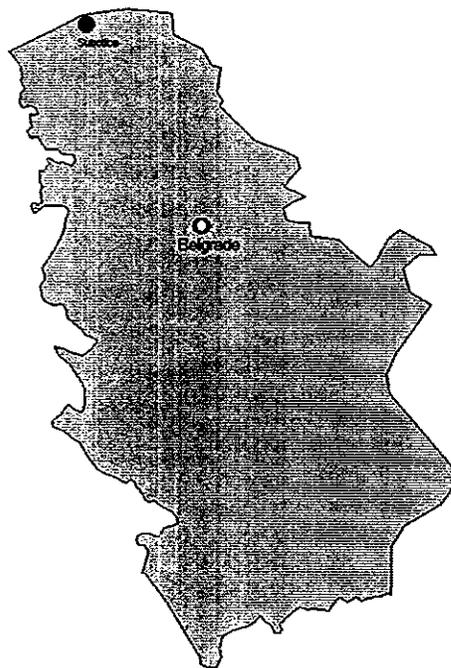
As USAID contractor for SEEEP, during Spring - Summer 2001 Nexant performed a rapid assessment of the potential thermal and electric energy savings achievable in selected institutional buildings, to use as demonstration projects throughout Serbia.

The assessment identified five Serbian Municipalities as the most suitable for the demonstration projects. From North to South, these Municipalities are: SUBOTICA, ZRENJANIN, KRAGUJEVAC, KRUSEVAC, and NOVI PAZAR.

This is a brief summary of the demonstration projects implemented in these Municipalities.

MUNICIPALITY OF SUBOTICA

Subotica is located 195km north of Belgrade, on the Hungarian border, and has approximately 150,000 inhabitants. The town lies in the watershed of the Danube and the Tisa rivers. In 1743 the town received a licensed country-town status and an administration based on civil organization. The real development of Subotica came with the completion of the Szeged-Subotica railway line in 1869. From the 1880s the town's industry started to play an increasingly significant role in Serbia's economy, today Subotica is one of the country's most important towns as well as a major industrial and agricultural center.

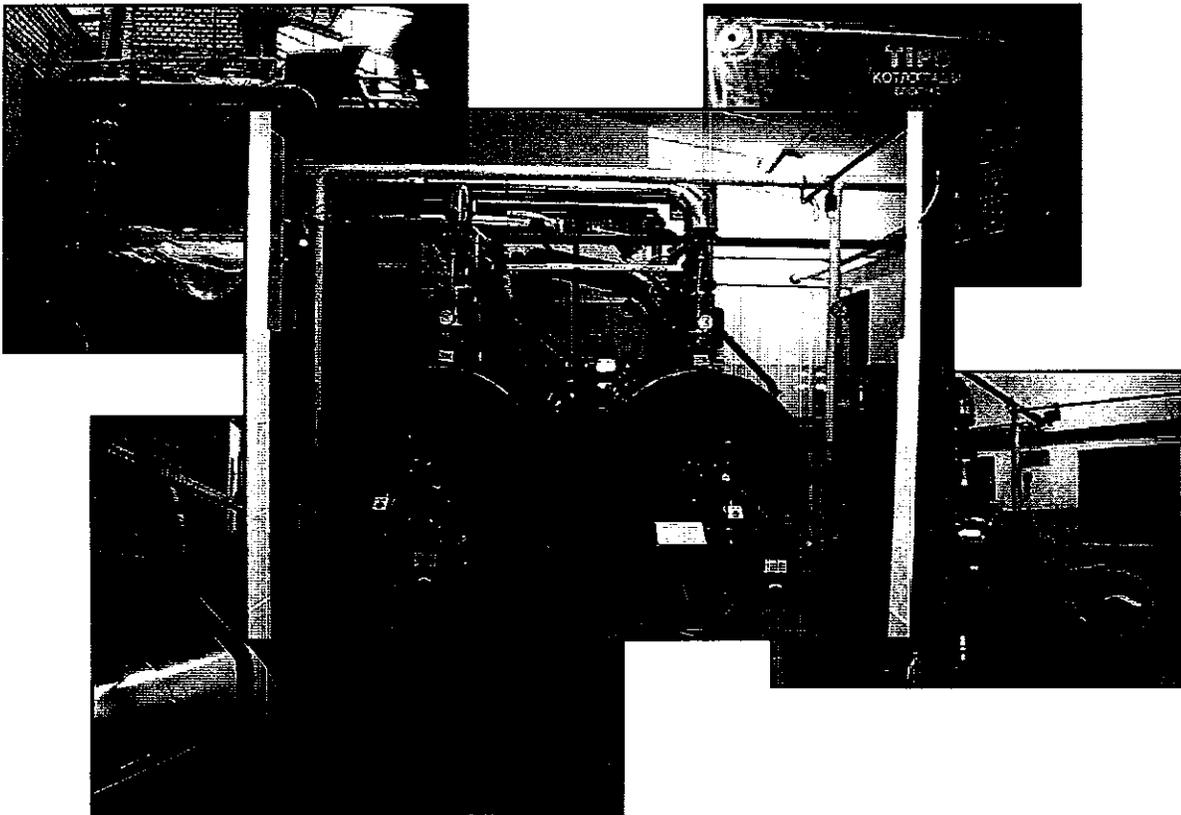


In Subotica, Nexant implemented Energy Conservation Measures in three municipal facilities: The Senior Citizens Center, the Town Hospital, and the District Heating Plant.

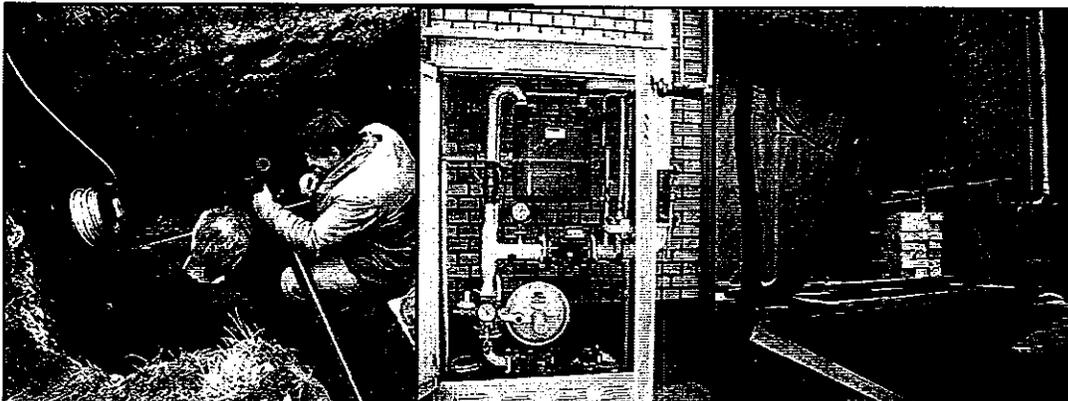
SENIOR CITIZENS CENTER



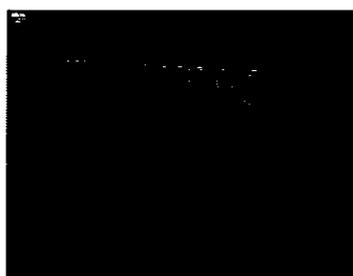
Heating System Upgrade - The center has been disconnected from the municipal District Heating Plant, and supplied with a new Central Heating System, consisting of two new 750 kW boilers, with dual fuel burners and automatic control station; this new heating system has been housed in a new boiler room. In addition, a 132 kW boiler has been supplied for sanitary water. Also, the existing steam boiler has been supplied with a new dual fuel burner.



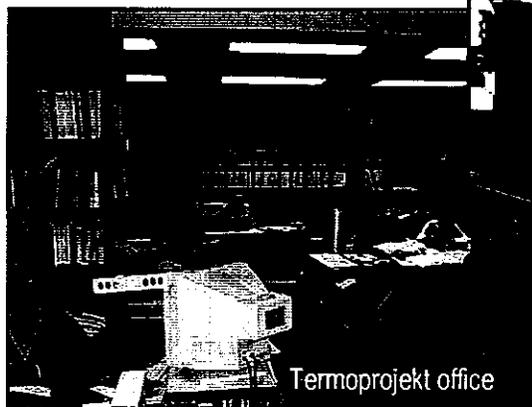
Connection to the municipal natural gas distribution network has also been supplied.



Thermostatic Control Valves have been installed on all radiators, and thermal shields have been installed between radiators and cold out-facing walls.



The work was subcontracted to TERMOPROJEKT d.o.o. of Subotica. The boilers were supplied by TIPO KOTLOGRADNJA of Belgrade



Termoprojekt office



TIPO Kotlogradnja facility

The combined savings achieved by these improvements are:

- | | |
|-------------------------|---|
| ▪ Annual energy saving: | 3,643,700 kWh/y (thermal)
138,317 kWh/y (electric) |
| ▪ Cost Saving (actual): | 89,900 \$/year |
| ▪ Investment Cost: | \$173,300 |
| ▪ Payback Period: | 2 years |

TOWN HOSPITAL



Condensate Return System and Steam Lines Upgrade - The badly worn-out equipment and material of the condensate return system of the hospital steam supply and domestic hot water supply system has been replaced. Also, the badly damaged steam line has been upgraded.



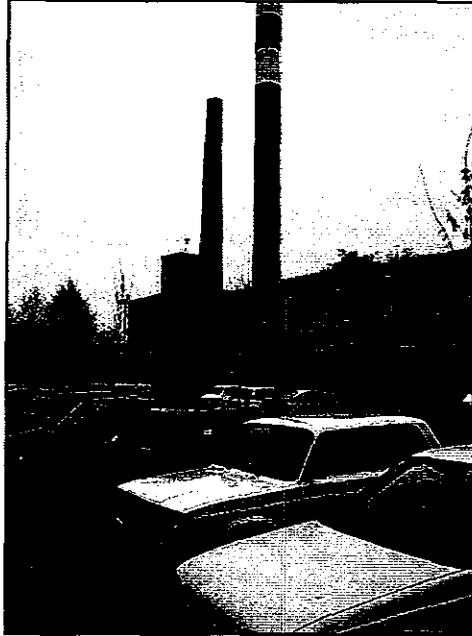


The work was subcontracted to TERMOPROJEKT d.o.o. of Subotica.

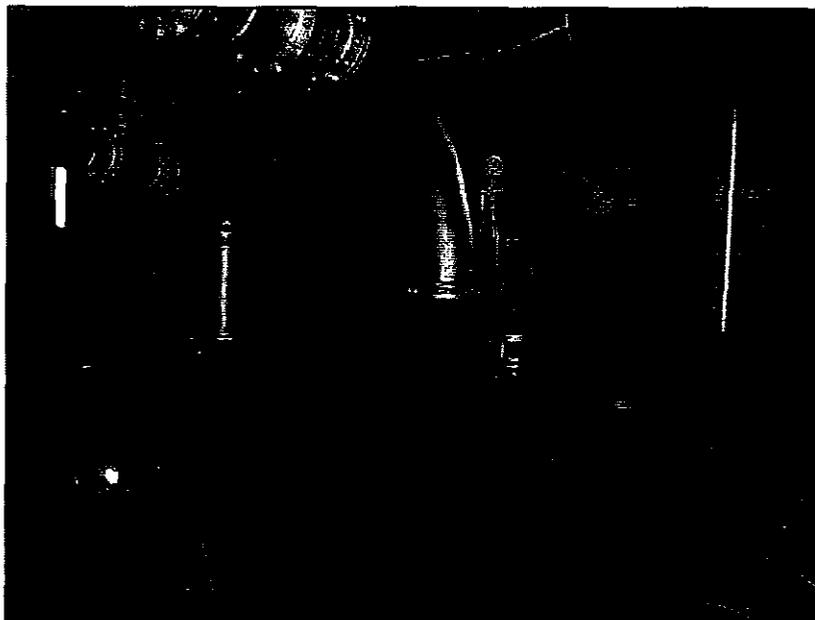
The combined savings achieved by these improvements are:

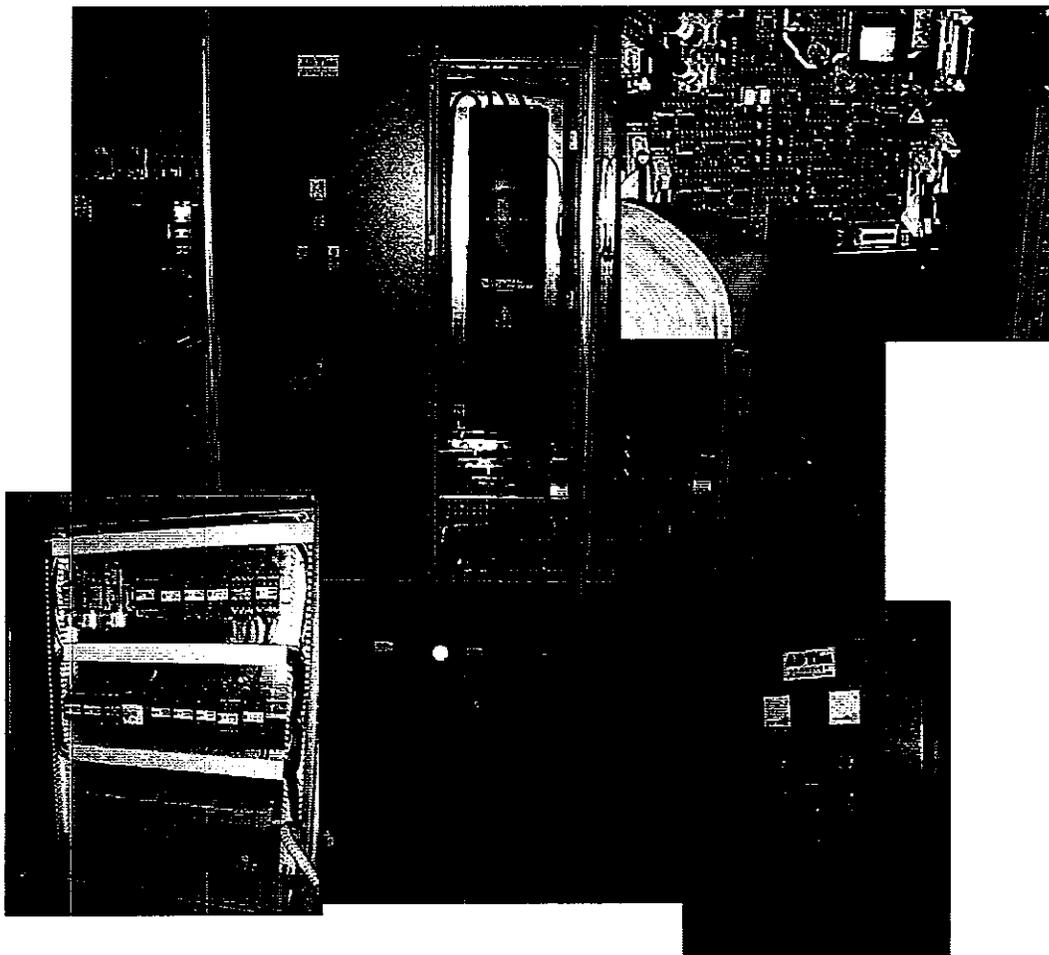
▪ Energy Saving:	354 tons/year (heavy oil)
▪ Cost Saving:	74,965 \$/y
▪ Investment Cost:	\$ 89,631
▪ Payback Period:	1.2 years

DISTRICT HEATING PLANT

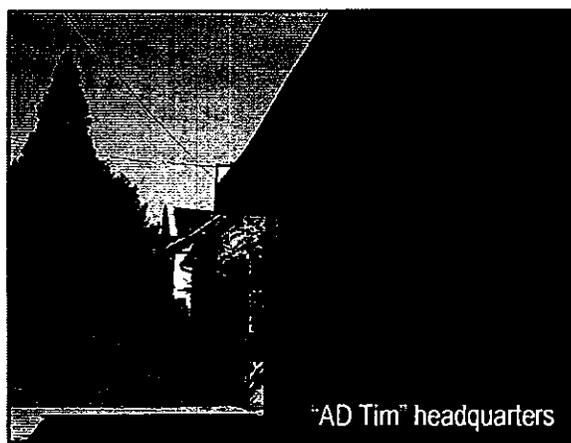


Variable Speed Drive - A Variable Speed Drive has been installed on the 315 kW main circulation pump of the Plant, which circulates water to the district heating customers. A flow control station modulates the flow of water by controlling, through the VSD, the speed of the main pump as a function of the outdoor temperature. In this mode of operation, the pump's power demand is greatly lowered.





The work was subcontracted to AD Tim d.o.o. of Subotica.

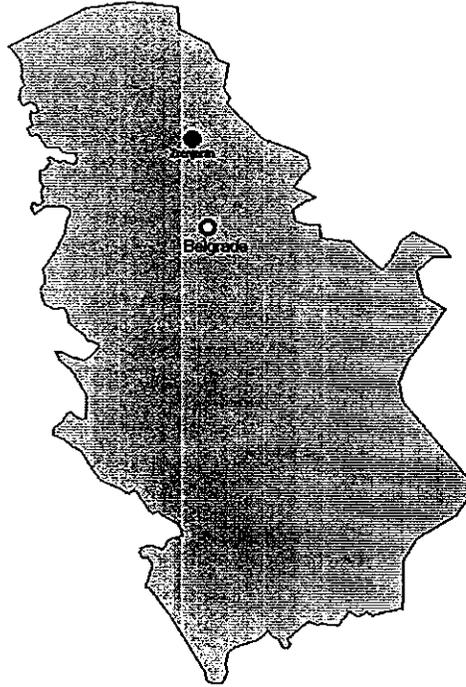


The savings achieved by this improvement are:

▪ Energy Saving:	295,000 kWh/y (electric)
▪ Cost Saving:	14,750 \$/year
▪ Investment Cost:	\$ 43,850
▪ Payback Period:	3 years

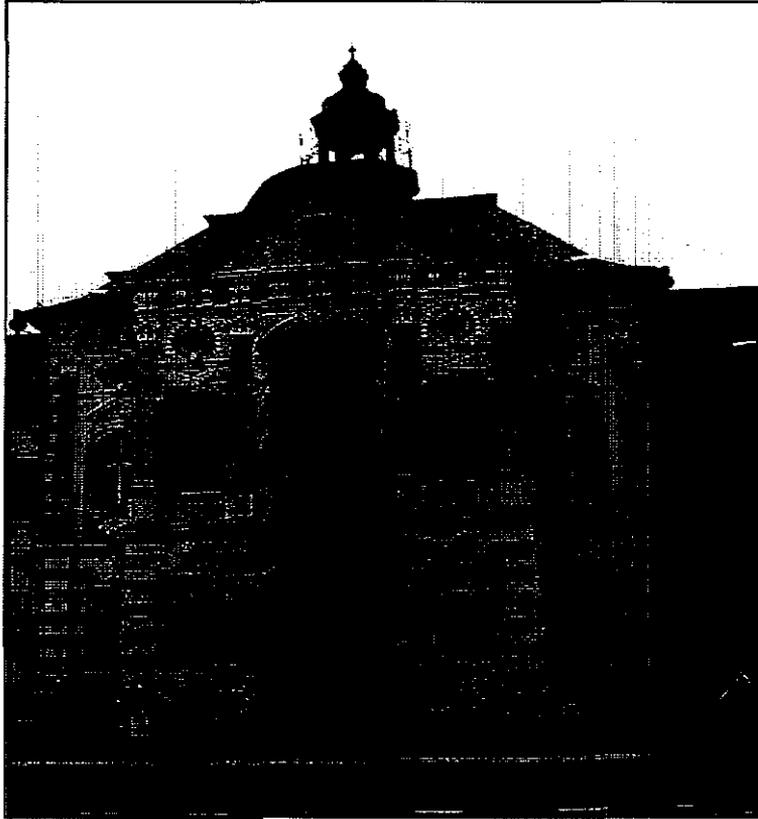
MUNICIPALITY OF ZRENJANIN

Zrenjanin is located approximately 85 Km north of Belgrade. It covers an area of 3 km², including 22 settlements, and has a total population of 144,000, 65% of which live in the city and the remaining in the rural surroundings. The area is considered one of the most heavily industrialized in Serbia. Textile is the largest industry accounting for 25% of the industrial output, Metal Industry accounts for 20%, and Chemical Industry accounts for 15%. The processing of agricultural products accounts for the biggest portion of the industrial output, approximately 32%.

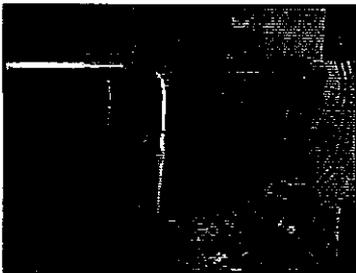


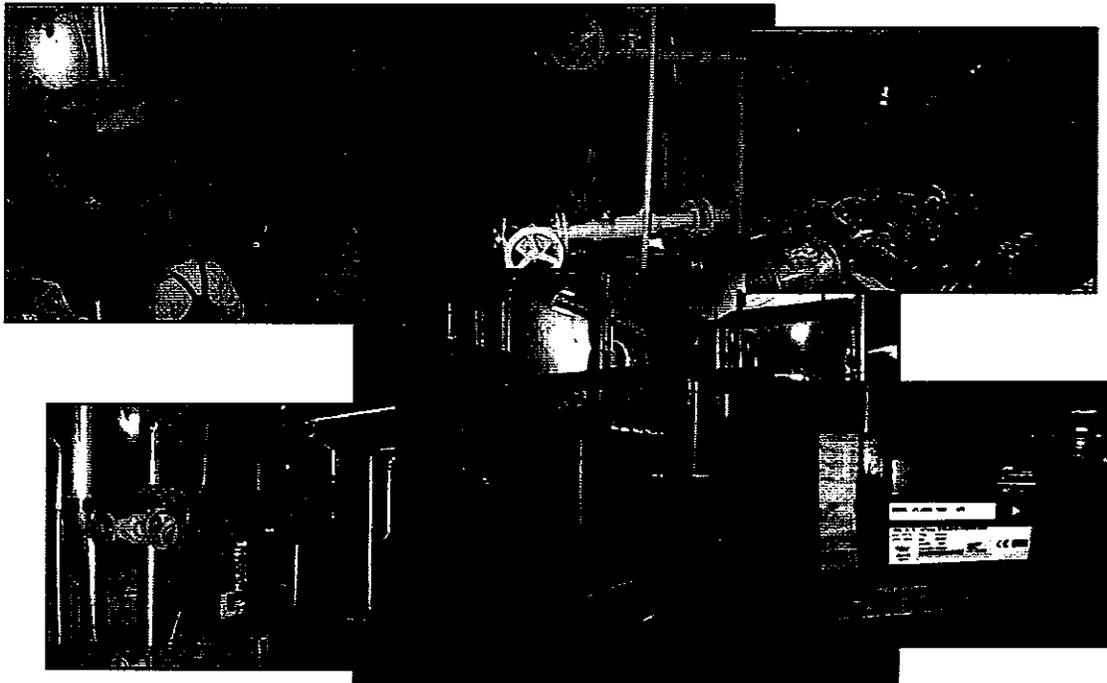
Nexant has implemented Energy Conservation Measures in Zrenjanin City Hall.

CITY HALL



Heating System Upgrade – An intermediary heat exchanger has been eliminated, connecting City Hall’s radiators directly to the District Heating Plant distribution system. An automatic control system has been supplied, to regulate the flow of hot water as a function of the outdoor ambient temperature and time-of-day operation. In addition, a metering device (calorimeter) has been installed to meter the amount of thermal energy supplied by the District Heating Plant.





Also, the existing radiators have been supplied with thermostatic control valves, and insulating shields installed between radiators and cold out-facing walls.



The heating system upgrade was subcontracted to SM INZENJERING of Zrenjanin.



“SM Inzenjering” design department

Windows Replacement – A total of 192 wood frame windows have been replaced with new wood frame, double glass panel windows of local manufacture. The Serbian Institute for the protection of Cultural Heritage has approved the style and the number of sections of each window.



The windows replacement was subcontracted to **DANILO BOSKOVIC** of Grdelica.



The combined savings achieved by these improvements are:

▪ Energy Savings:	443,300 kWh/y (thermal) 348,500 kWh/y (electric)
▪ Cost Saving:	24,700 \$/y
▪ Investment Cost:	\$ 89,350
▪ Payback Period:	3.6 years

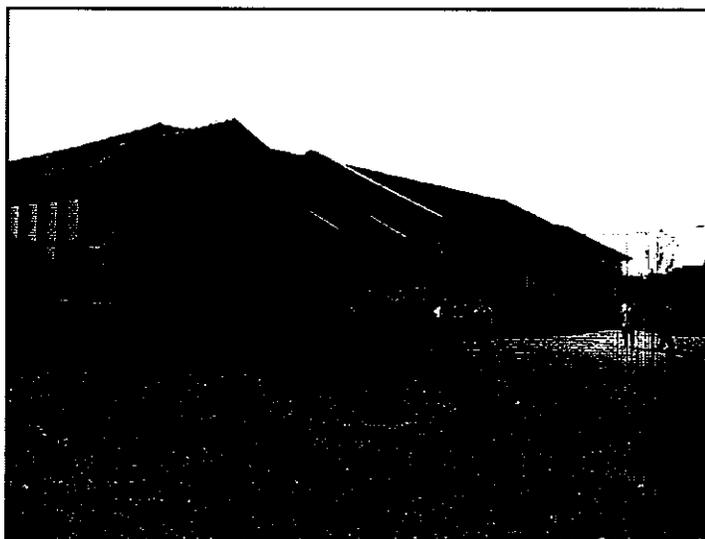
MUNICIPALITY OF KRAGUJEVAC

Kragujevac is situated approximately 144 km south of Belgrade, in a predominantly farming area, occupying an area of 835 km², with 57 settlements, and a population of 200,000. Early industrialization started in the first half of the 19th century, with the manufacturing of artillery field pieces. The city boasts many “first” in Serbia, including the first power station in 1884. Today is an important industrial centre, with approximately 1,160 private companies, including manufacture of passenger cars, commercial vehicles, sport and hunting arms and food processing.

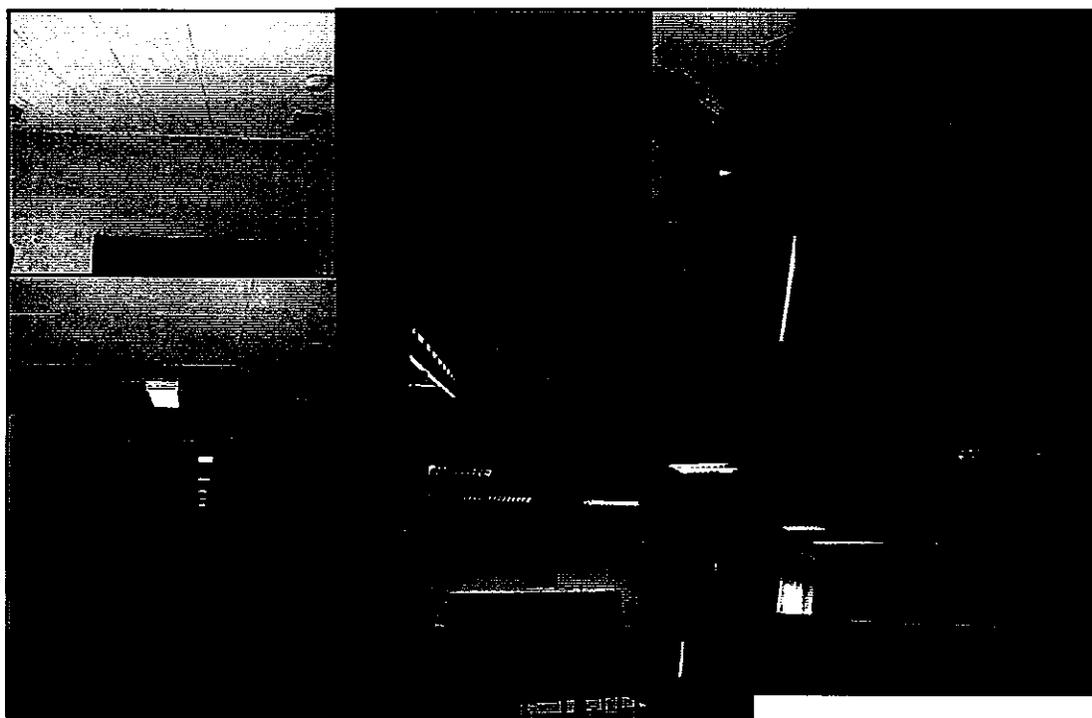


In Kragujevac, Nexant implemented Energy Conservation Measures in three municipal facilities: the Jovan Popovic Elementary School, the Natalija Nana Elementary School, and the Music School.

JOVAN POPOVIC SCHOOL



Lighting System upgrade – Replacement of the old incandescent light bulbs and fixtures with new high efficiency fluorescent tubes, complete with electro magnetic ballasts, and new fixtures.



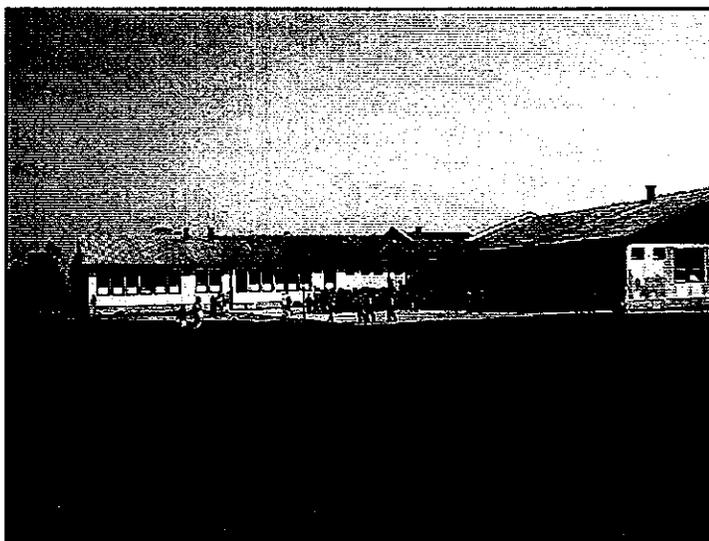
The upgrade work was subcontracted to EMPA d.o.o. of Aleksinac



The savings achieved by this improvement are:

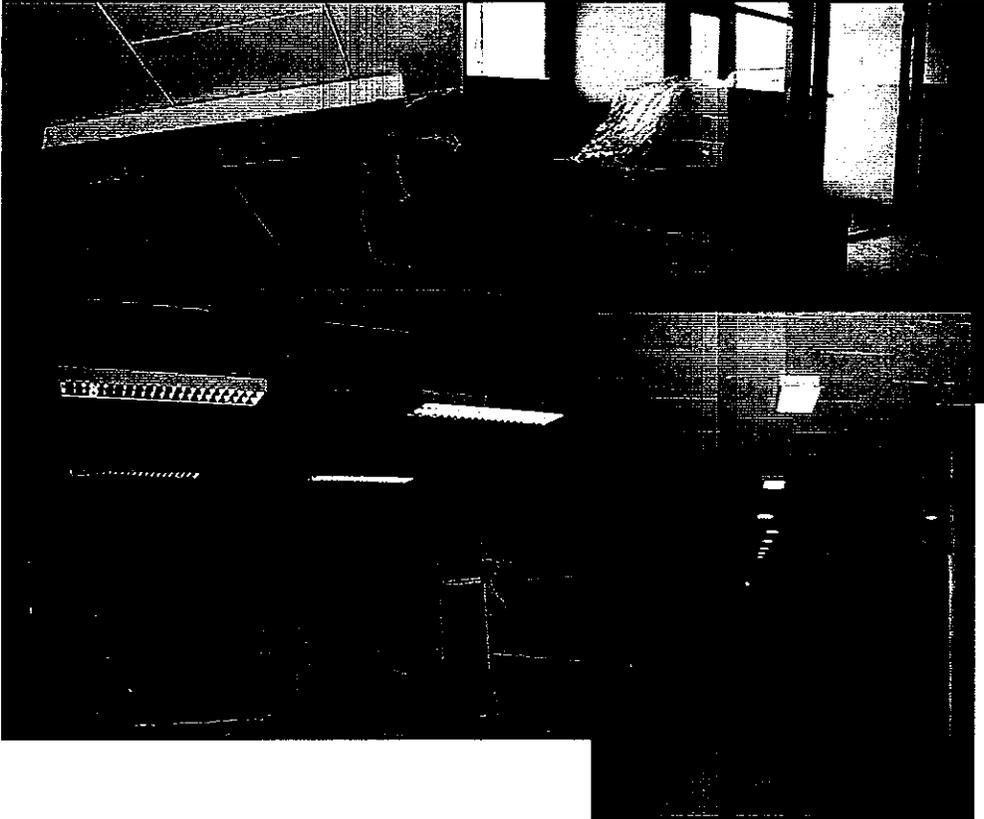
▪ Energy Savings:	31,000 kWh/y (electric)
▪ Cost Saving:	1,550 \$/y
▪ Investment Cost:	\$ 2,770
▪ Payback Period:	1.8 years

NATALIJA NANA SCHOOL

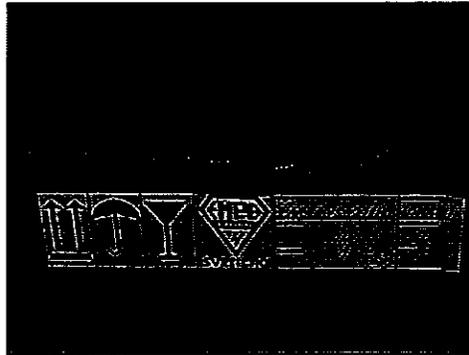


Lighting System upgrade - Replacement of the old incandescent light bulbs and fixtures with new high efficiency fluorescent tubes, complete with electro magnetic ballasts, and new fixtures.





The upgrade work was subcontracted to EMPA d.o.o. of Aleksinac



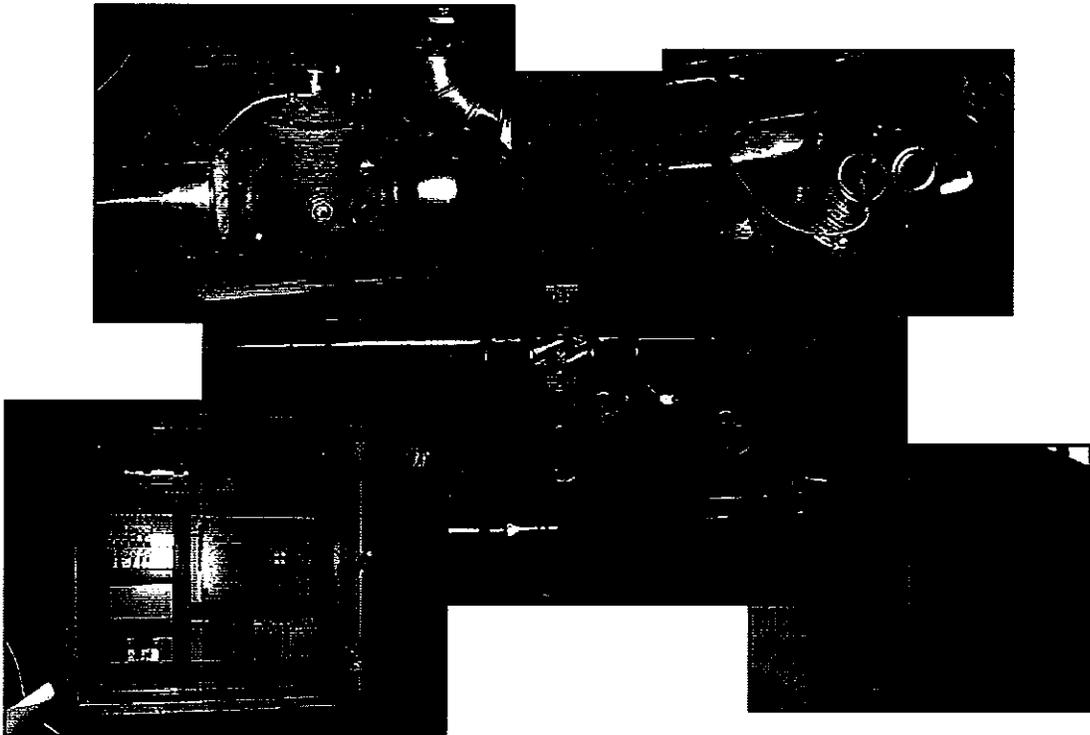
The savings achieved by this improvement are:

▪ Energy Savings:	12,400 kWh/y (electric)
▪ Cost Saving:	620 \$/y
▪ Investment Cost:	\$ 2,500
▪ Payback Period:	4 years

MUSIC SCHOOL



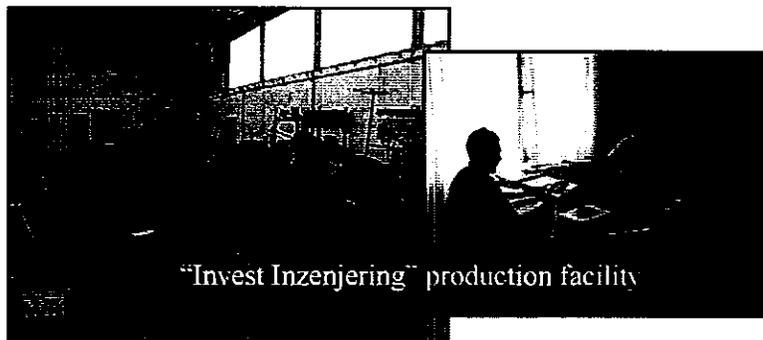
Heating System Control and Metering – Installation of an automatic system to control the supply of hot water from the District Heating Plant (DHP) as a function of the outside temperature. Installation of a device (calorimeter) to meter the amount of energy supplied by the DHP.



Installation of thermal insulation shields on all existing radiators facing cold surfaces (walls or windows exposed to the outdoor atmosphere), and installation of thermostatic control valves on all existing radiators.



The work was subcontracted to INVEST-INZENJERING of Krusevac.



“Invest Inzenjering” production facility

The combined savings achieved by these improvements are:

▪ Energy Savings:	608.000 kWh/y (thermal)
▪ Cost Saving:	21,900 \$/y
▪ Investment Cost:	\$ 10,800
▪ Payback Period:	0.5 years

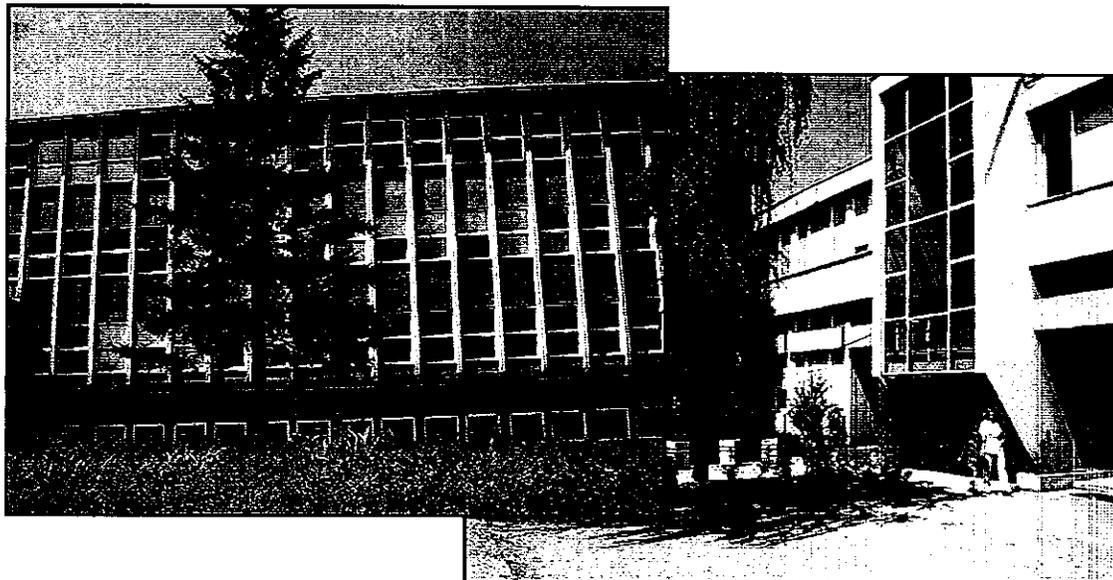
MUNICIPALITY OF KRUSEVAC

Kruševac is located 210 km Southeast of Belgrade. The town dates back to the Middle Ages and at one time was one of the cultural centres of Serbia. The town covers 854 km², with over 100 settlements. The majority of the land, approximately 57% of the total area, is rural and the rest is considered urban. Kruševac has a total population of 138,000 people, of which 29,000 are in working age. The most important industries are Chemical, Food (beverages), and Agriculture.



In Krusevac, Nexant has implemented Energy Conservation Measures three municipal facilities: The Health Centre for Children and Women, the Neven Nursery School, and the Street Lighting System.

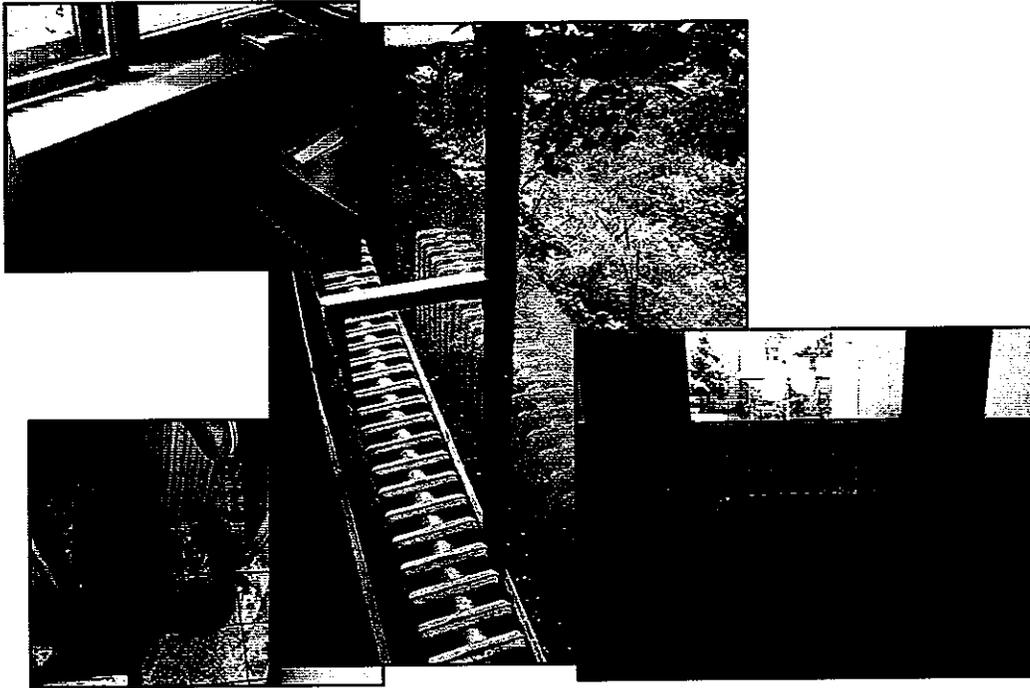
HEALTH CENTER FOR CHILDREN AND WOMEN



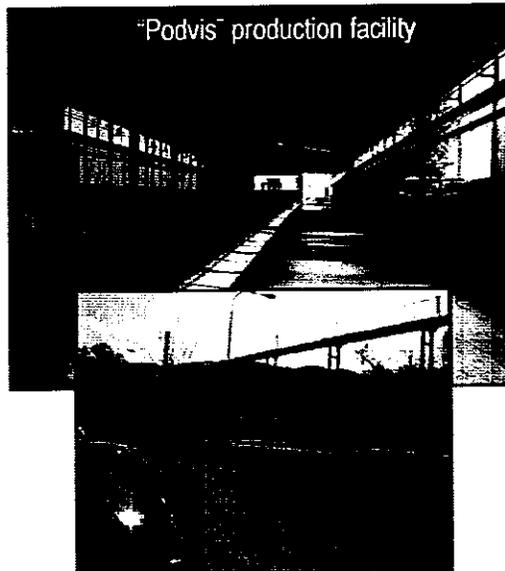
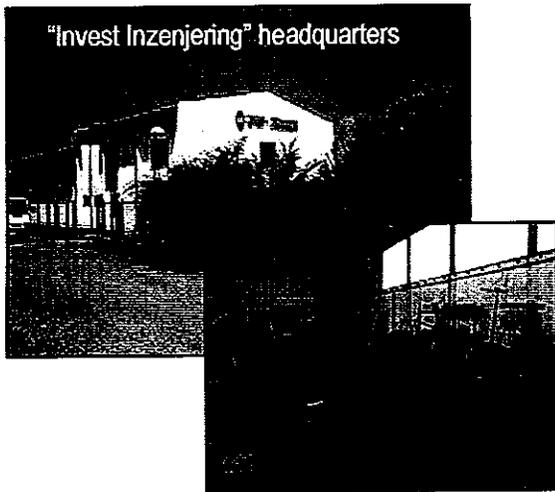
Heating System Upgrade - Two new boilers of local manufacture, related ancillary equipment and automatic controls had been installed to replace the two obsolete boilers in use at the Health Center.



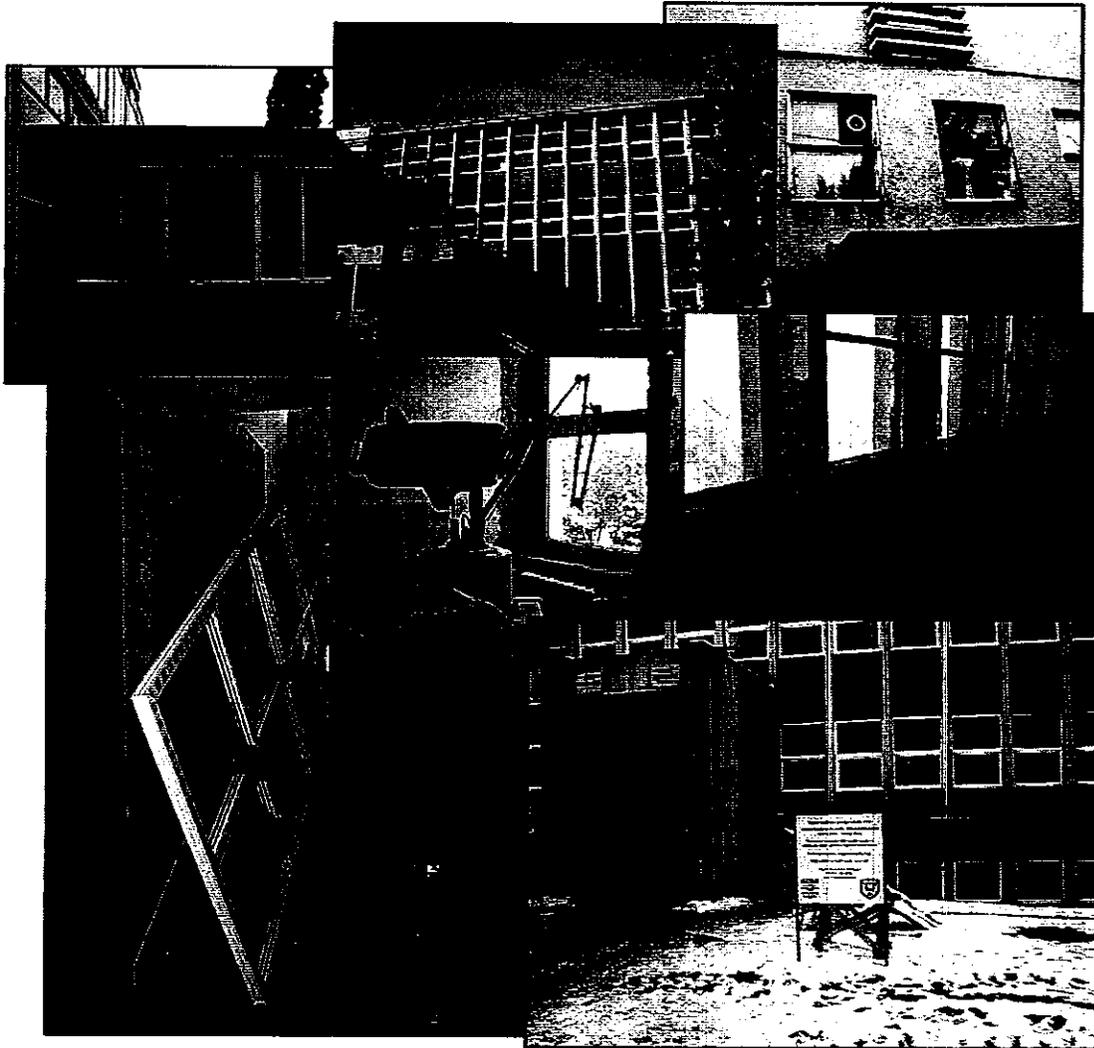
The upgrade includes also thermostatic control valves, and thermal shields installed on the existing radiators.



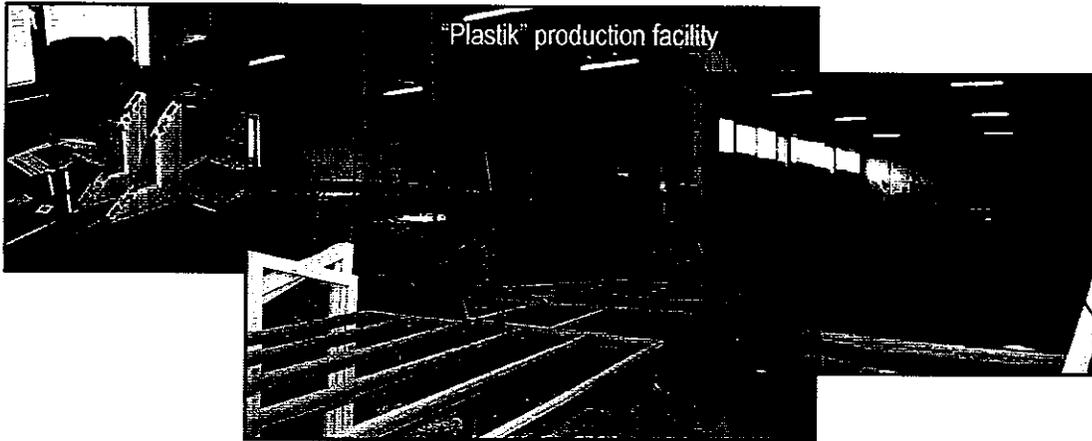
The Heating System Upgrade was subcontracted to INVEST-INZENJERING of Krusevac. The boilers were supplied by PODVIS of Knjazevac.



Window Replacement – All the old windows have been replaced with locally manufactured double pane windows with PVC frames.



The Window Replacement work was subcontracted to PLASTIK d.o.o. of Varvarin.



Also, all single pane glass panels, forming large portions of the building envelope, have been replaced with double pane glass panels mounted in the existing steel frames.



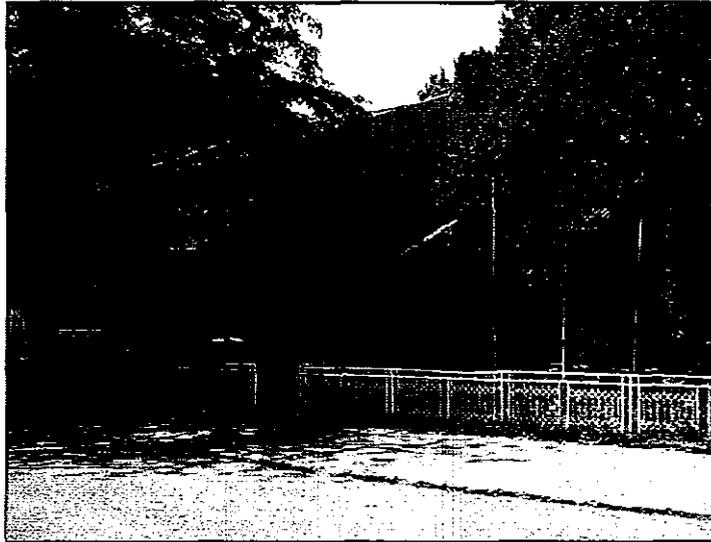
The glass panes replacement was subcontracted to SANS-GLASS of Krusevac.



The combined savings achieved by these improvements are:

▪ Energy Savings:	2,746,280 kWh/y (thermal) 187,350 kWh/y (electric)
▪ Cost Saving:	71,950 \$/y
▪ Investment Cost:	\$ 168,500
▪ Payback Period:	2.3 years

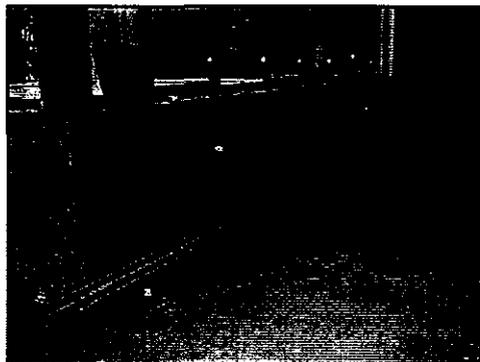
NEVEN NURSERY SCHOOL



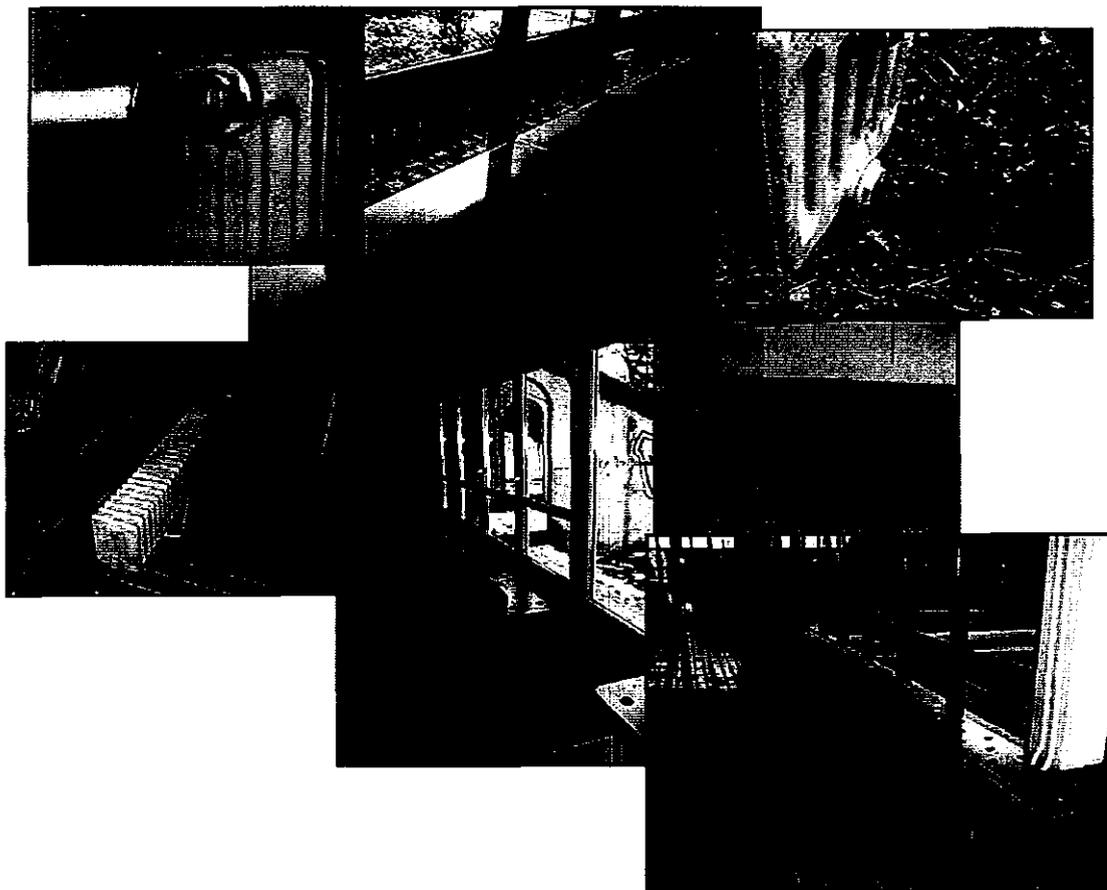
Heating System Upgrade – The old boilers have been replaced with two new boilers, of local manufacture, complete with related ancillary equipment and automatic controls. An additional small stand-by boiler, and a new hot water distribution system to the classrooms, lavatories, and kitchen, has been installed to satisfy hot water needs when the heating system is not in operation (in the summer).



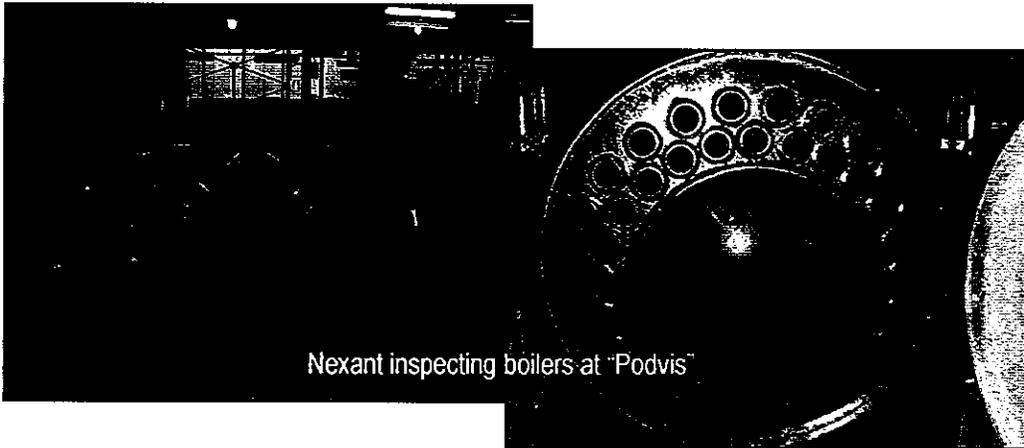
The new heating system is sized for the additional floor area of the newly added second floor, and the necessary distribution lines and radiators to the second floor have also been provided.



All radiators facing cold surfaces (walls or windows exposed to the outdoor atmosphere) have been provided with thermal insulators installed between radiator and cold surface. Thermal control valves have been installed on each radiator. The old radiator wooden enclosures have been replaced with new ones to allow proper heat circulation, in full compliance with the school's aesthetic requirements.



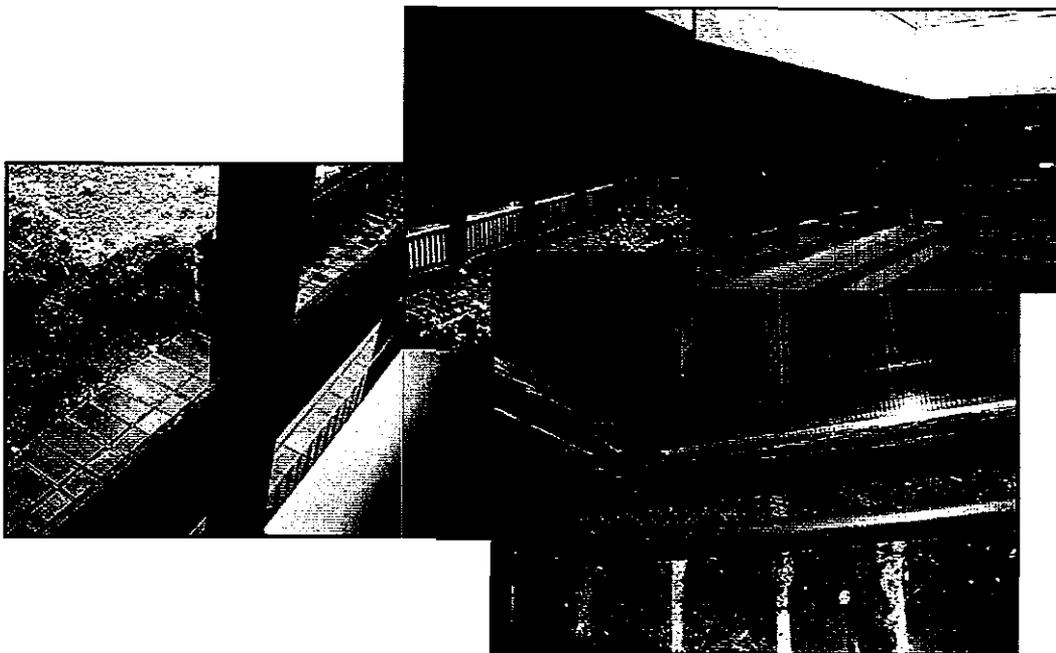
The Heating System upgrade was subcontracted to INVEST-INZENJERING of Krusevac. The boilers were supplied by PODVIS of Knjazevac.



Building Envelope Improvement - All the old windows exposed to the outside atmosphere have been replaced with locally manufactured double glass pane, PVC frame windows.

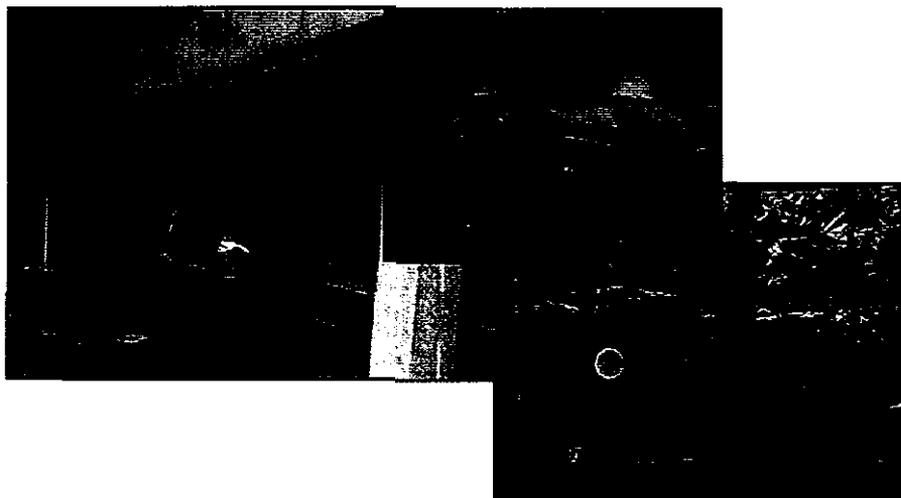


Also, all single pane glass panels, forming the two internal atriums have been replaced with double pane glass panels.



The window and glass panels replacement was subcontracted to PLASTIK d.o.o. of Vavarin.

Additionally, thermal insulation has been installed on the internal surface of the slanted roof of the newly added second floor.



The combined savings achieved by these improvements are:

- | | |
|---------------------------|---|
| ▪ Energy Savings: | 598,200 kWh/y (thermal)
460,400 kWh/y (electric) |
| ▪ Cost Saving: | 36,650 \$/y |
| ▪ Investment Cost: | \$ 83,750 |
| ▪ Payback Period: | 2.3 years |

STREET LIGHTING



Part-time Delamping – Implementation of this measure is feasible only when the lighting system is three phase wired, and requires the installation of inexpensive radio-controlled, or timer switches. The required radio controlled relays have been installed, and now 50% of the upgraded street lighting system is being switched off after midnight. It has to be noted that after switch off, the level of light in the affected streets is still at an acceptable level, and poses no hazard to the limited volume of circulation at that time of the night.

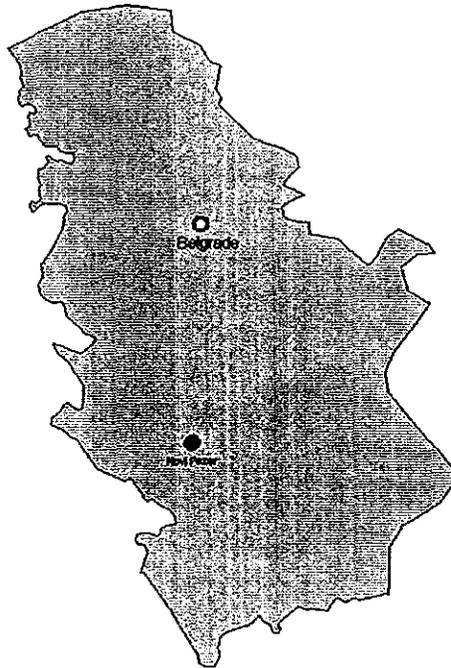


The savings achieved by this improvement are:

▪ Energy Savings:	467,100 kWh/y (electric)
▪ Cost Saving:	23,350 \$/y
▪ Investment Cost:	\$ 4,540
▪ Payback Period:	0.2 years

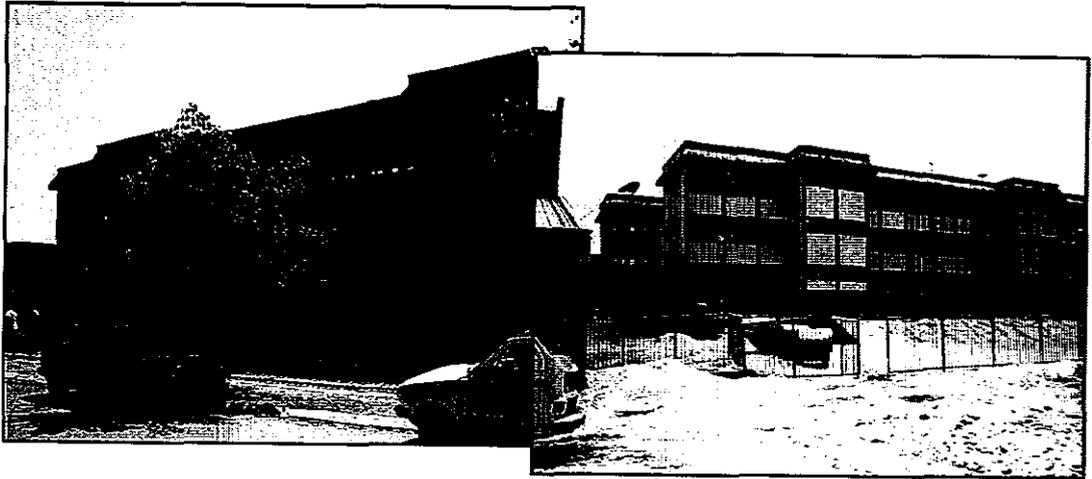
MUNICIPALITY OF NOVI PAZAR

Novi Pazar, an ancient town dating back to the Middle Ages, is located in southern Serbia, 315 km from Belgrade. The city covers an area of 742 km², 49% of which is agricultural, with 99 settlements. The population is approximately 85,000 people, with 70% living in the city and the rest in the rural surroundings. An important trade post in the Middle Ages (Novi Pazar means new bazaar), the city is now a thriving industrial centre, with textiles and food processing as its main activities. The Monastery of Sopocani (1263-1268), under UNESCO Protection, is located within the city's jurisdiction.

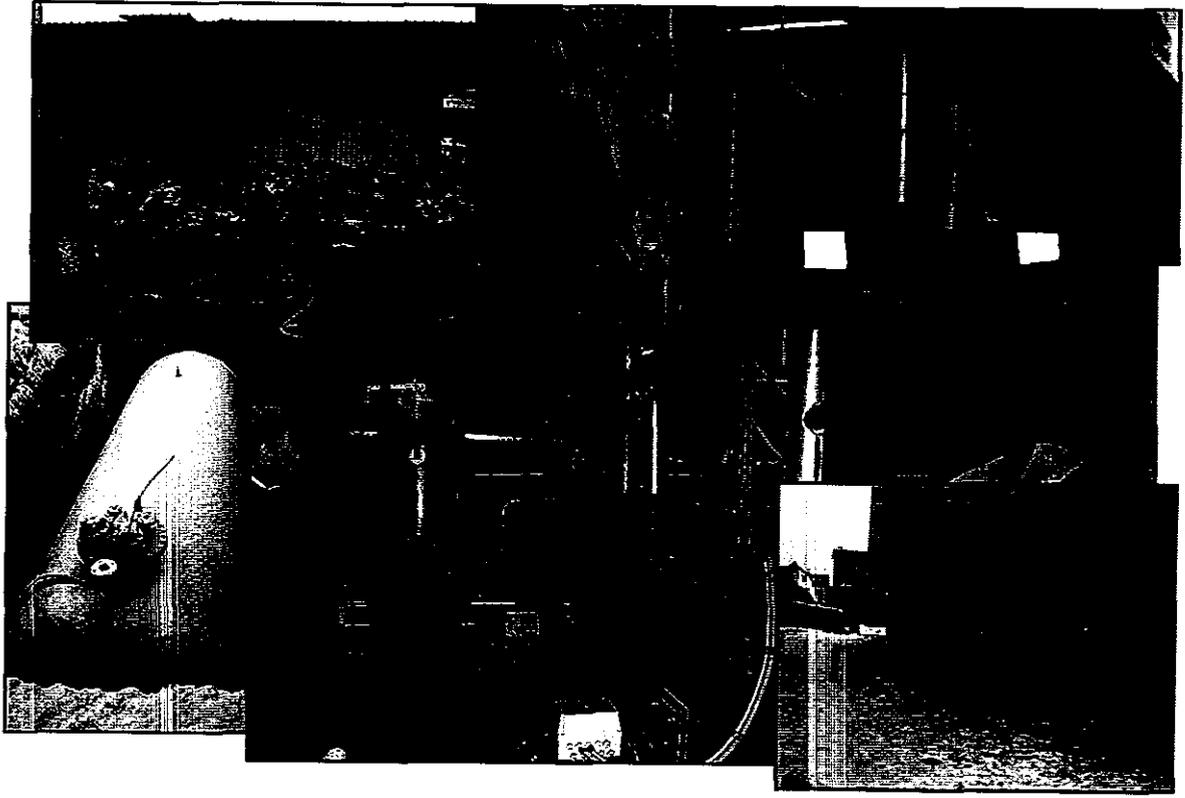


In Novi Pazar, Nexant implemented Energy Conservation Measures in two municipal facilities: the Vuk Karadzic Primary School, and the Stefan Nemanja Primary School

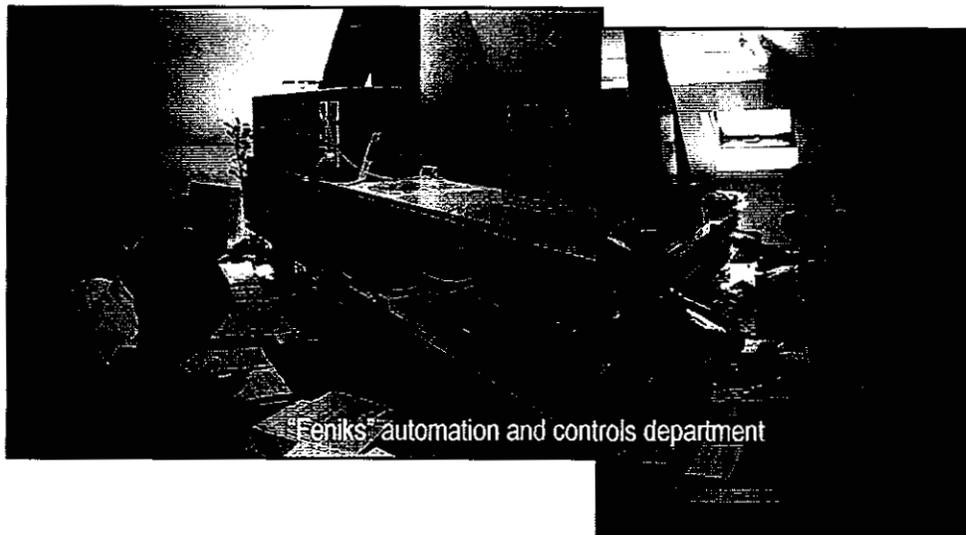
VUK KARADZIC PRIMARY SCHOOL



Heating System Upgrade – Two new light oil fired boilers of local manufacture, with related ancillary equipment and automatic control system have been installed to replace the two obsolete coal fired boilers in use at the School. Thermostatic control valves and thermal shields have been installed on the radiators already existing in the school.



The upgrade was subcontracted to INVEST-INZENJERING of Krusevac. The boilers were supplied by PODVIS of Knjazevac, and the automatic controls were supplied by FENIKS of Nis.



The savings achieved by this improvement are:

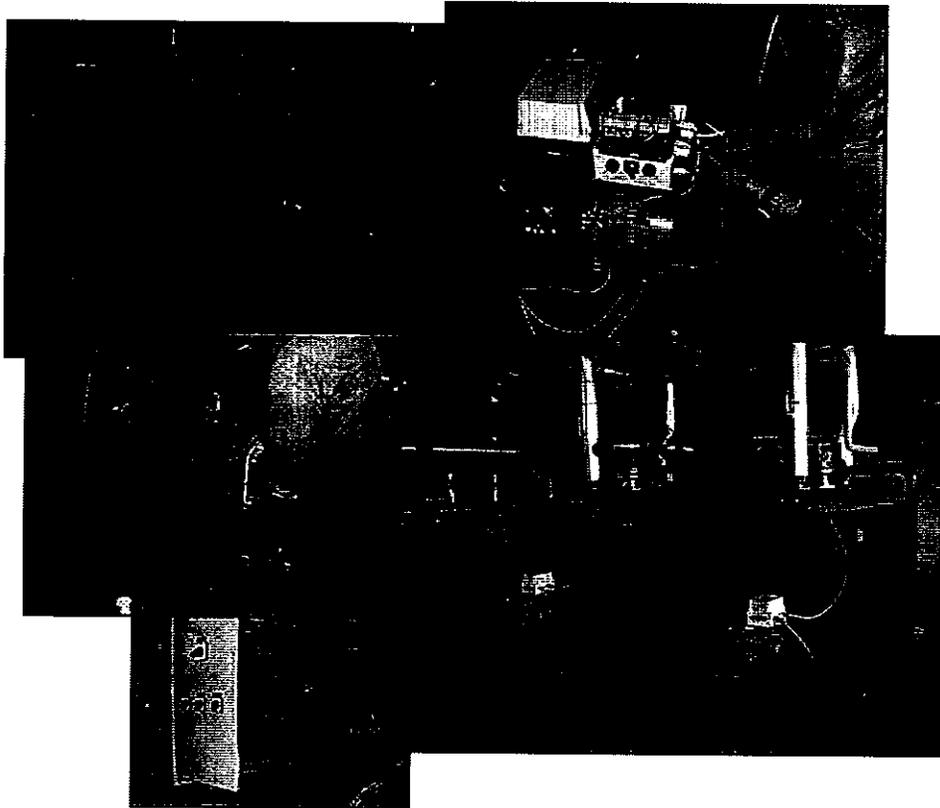
▪ Energy Savings:	7,582,650 kWh/y (thermal) 28,360 kWh/y (electric)
▪ Cost Saving:	41,000 \$/y
▪ Investment Cost:	\$ 51,650
▪ Payback Period:	1.3 years

STEFAN NEMANJA PRIMARY SCHOOL

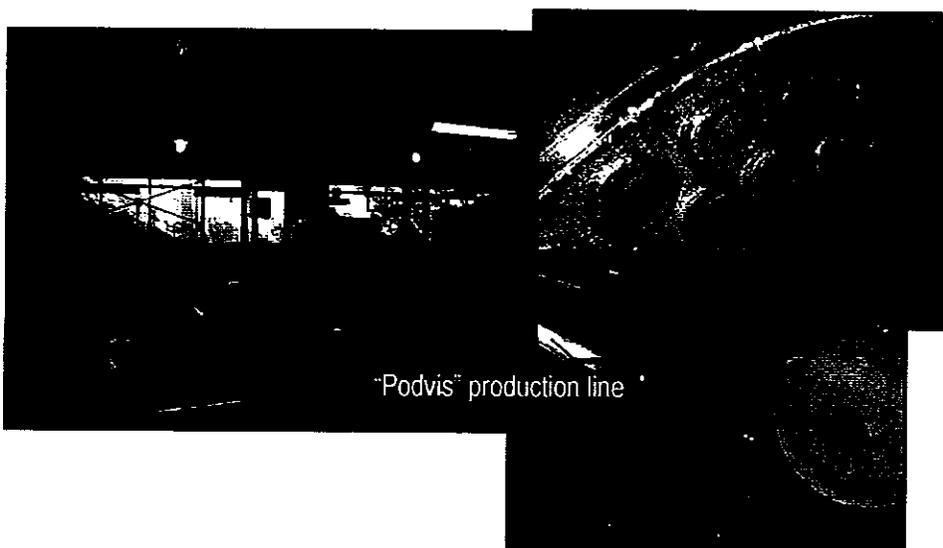


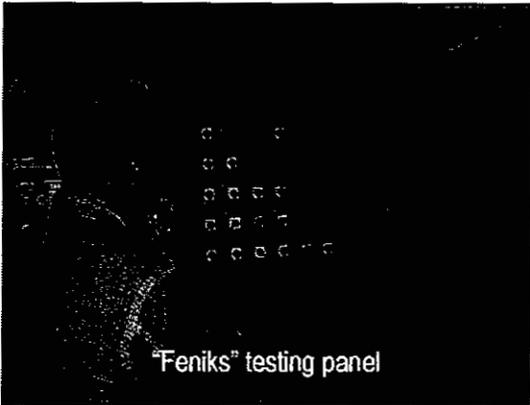
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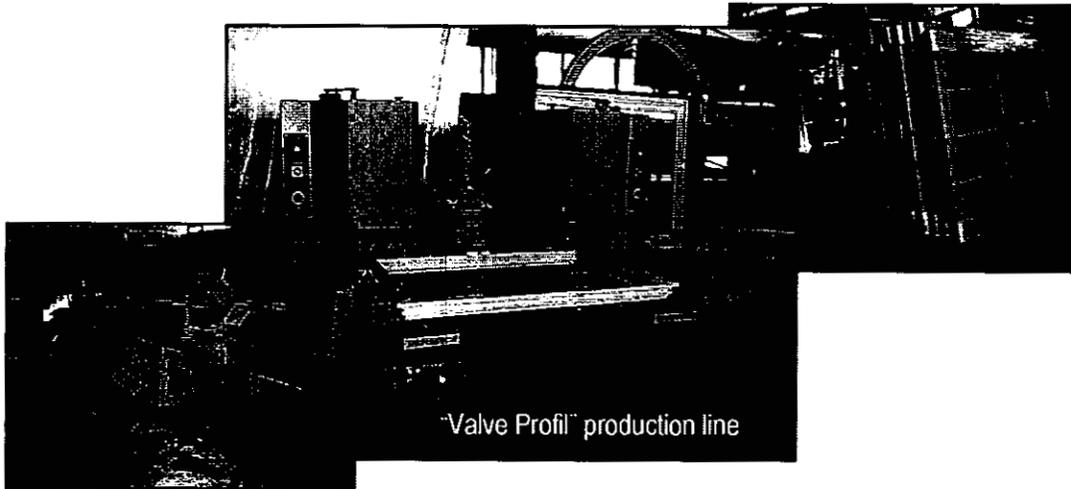




Windows Replacement – All the school's old windows have been replaced with new double glass pane, PVC frame windows of local manufacture.

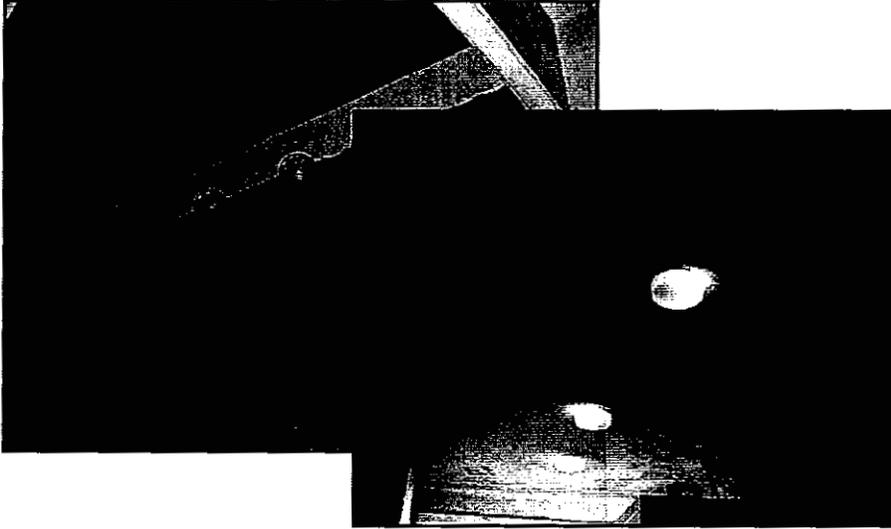


The windows replacement was subcontracted to VALVE PROFIL of Ratina, Kraljevo

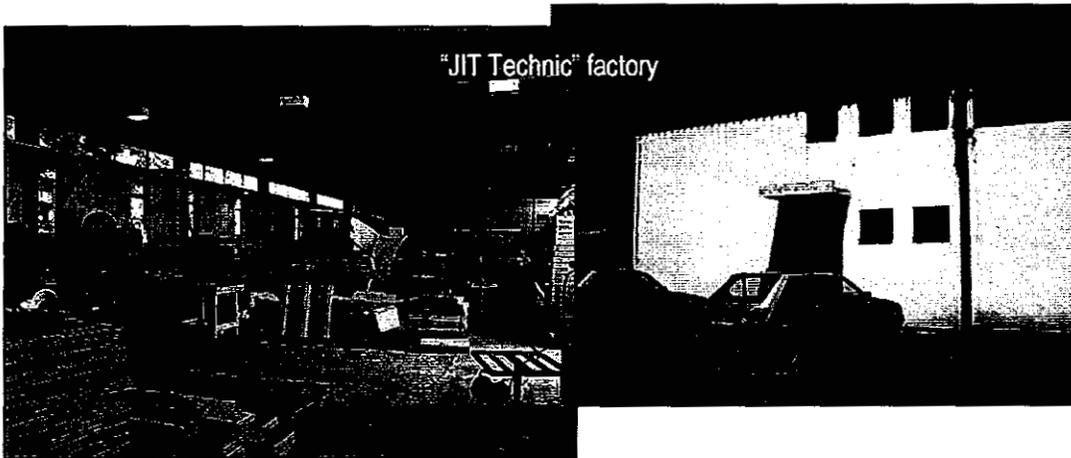


Light System Upgrade – All the incandescent light bulbs have been replaced with high efficiency fluorescent tubes.





The light system upgrade was subcontracted to JIT TECHIC of Sid.



The combined savings achieved by these improvements are:

▪ Energy Savings:	1,716,500 kWh/y (thermal) 32,500 kWh/y (electric)
▪ Cost Saving:	41,300 \$/y
▪ Investment Cost:	\$ 124,550
▪ Payback Period:	3 years