Government of the Republic of Uzbekistan

United Nations Development Programme

PILOTING ENERGY EFFICIENT AND RENEWABLE ENERGY SOLUTIONS

IN RURAL HEALTH CLINICS OF UZBEKISTAN

UNDP # 00059481 PROJECT

FINAL REPORT

Supervising and overseeing the piloting the Energy Efficient and Renewable Energy Solutions in four rural health clinics, monitoring of their operation and development of the Final Report, including recommendations on dissemination and replication of the optimal solutions in other rural health clinics or hospitals in Uzbekistan

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Currency Equivalents (as in October 2009)

1000 SUM	=	0,66	$	1000 SUM	=	0,45	EURO (€)
1 US$	=	1515	SUM	1 EURO (€)	=	2200	SUM

Weights and Measures (Metric and International Systems)

Cal : calorie
kcal : kilocalorie
Gcal : Gigacalorie (10^6 kcal); (1 MWh = 0.86 Gcal)
J : Joule
GJ : Gigajoule (10^9 Joule);(1 MWh = 3.6 GJ; 1 GJ = 0.0341 t.c.e.; 1 GJ = 0.0239 t.o.e.)
W : Watt
kW : kilowatt
Wh : watt-hour
kWh ; kilo watt-hour
nm^3 : normal cubic meter of natural gas (1,000 nm^3 = 9.46 Gcal = 11 MWh)
m^3 DH : cubic meter of District Heating water (1m^3 = 40.7 kWh = 35 Mcal)
MW_{el} : Megawatt electric (1,000 kilowatts)
MW_{th} : Megawatt thermal (0.86 Gcal/h)
t.c.e. : ton of coal equivalent (7*10^6 kcal or 29.302 MJ or 8.14 MWh)
t.o.e. : ton of oil equivalent (10^7 kcal= 10 Gcal or 41.860 MJ or 11.628 MWh)
V : Volt
kV : kilovolt
kVA ; kilo volt-ampere
m meter
km : kilometer
sq. m or m^2: square meter
s : second
h : hour(s)
yr : year(s)

Prefixes and multipliers

Prefix	**Symbol**	**Multiplier**	**Base 10 notation**
Tera	T	Trillion	10^{12}
Giga	G	Billion	10^9
Mega	M	Million	10^6
Kilo	k	Thousand	10^3

LIST OF ABBREVIATIONS:

ADB	Asian Development Bank
CDM	Clean Development Mechanism
CNG	Compressed natural gas
€	Euro: European Union currency
GHG	Green house gases
GJSC	Government Joint Stock Company
EE	Energy efficiency
HWS	Hot water supply
IRR	Internal rate of return
JICA	Japan International Cooperation Agency
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
PD	Presidential Decree
M&O	Maintenance and operation
NHC	National Holding Company
PSL	Power Saving Lamps
PV	Photovoltaic systems
R&D	Research and development
RE	Renewable energy
RES	Renewable energy sources
RHC	Rural health clinics
RUz	Republic of Uzbekistan
SHW	Solar heating water
SPE	Scientific and Production Enterprise
TACIS	Technical Assistance to Commonwealth of Independent Countries
TPP	Thermal power plant
UN	United Nations
UN FCCC	United Nations Framework Convention on Climate Change
UNDP	United Nations Development Program
UPS	Uninterruptible power supply
USD	United States dollar
UZS	Uzbek Sum (national currency)
VAT	Value Added Tax
WB	World Bank
WHO	World Health Organization

TABLE OF CONTENTS

List of tables:

INTRODUCTION, SCOPE and METHODOLOGY

At present, large-scale reforms are being executed in the public health sector of Uzbekistan. Establishment and development of the rural health clinics (RHC- primary health care) is the priority of the national policy.

The rural health clinics need reliable and uninterrupted supply of power and heat to provide up-to-standard medical services. Improving power and heat supply appears to be a key for Rural Health Clinics (RHC) being operational during working hours. This objective was defined by the Ministry of Healthcare of Uzbekistan within the framework of the 'Health-2' World Bank (WB) Project which is focused on helping poor families to improve their health by developing health care system, providing family members broad and good access to health care services as almost the entire population is living within two kilometers of a rural health clinic.

Within the framework of the UNDP's "Improving Power and Heat Supply Reliability in Health Rural Clinics of Uzbekistan" Project (2007), technical and economic assessment of options in order to equip the rural health clinics with Energy Efficient (EE) and Renewable Energy (RE) systems, notably the plants that transfer solar energy to electric and thermal power that can be integrated into existing conventional energy infrastructure to improve reliability of power and heat supply, has been implemented.

The options proposed have been adjusted to the relevant budget resources available in rural health clinics and to the budget for medical equipment. They have to ensure efficient use and saving of energy and fuel, to be coherent with budget available and to be replicable at a large scale.

The ongoing UNDP Project "Piloting Energy Efficient and Renewable Energy Solutions in Rural Health Clinics of Uzbekistan" have tested and demonstrate the EE and RE solutions in four representative rural health clinics (UMAROV, BAYMUKHAMEDOV, DJEYKHANABAD, and JUZIM-BOG) and have identified their feasibility and viability in order to recommend solutions to be replicated at a large scale in rural health clinics in different provinces of the country within the WB Health-3 project.

Considering that almost 90% of rural health clinics are connected to the grid, the first objective of the project was to identify how many hours (frequency and duration) the medical equipment is out of operation due to power failures. Second question was about energy efficiency: in order to limit the substitution to grid failures, it seems necessary to have an energy management approach and check on possible replacement of equipment intensively consuming power with more energy efficient equipment.

The second objective/condition was about heating and how to avoid limits of medical equipment operational due to lack of heating during winter season. As there is also lack of natural gas (mainly low pressure on the grid) there is lack of heating and hot water in the rural health clinic during winter season, therefore, the staff in rural health clinic is unable to work properly. Different solutions have been tested: insulation, replacement of doors and windows, thermal regulation, new gas burners, new gas boilers, solar thermal collectors.

After 4 seasons of monitoring results are now available and have confirmed but also invalidate some solutions, so it is now possible to recommend various solutions depending on specific conditions of the different RHCs: geographic/climatic, type of RHC, connected or not to power and gas grids, etc using the selected criteria defined during the feasibility study.

The national and international consultants have launched procurement of equipment and metering, supervised their installation and followed monitoring of pilots in four rural health clinics covering all seasons: collected data from November 2008 till October 2009. These data have been summarized in specific reports prepared by National Consultants (refer appendix).

In accordance with the terms of reference this final report includes a short analysis of monitoring results and lessons from this 12 months experience.

Then recommendations have been prepared from a technical point of view, for following actions in the four selected RHCs and for replication of the optimal solutions in other RHCs or hospitals in the country.

The last part of this report is more focused on financial and economic assessment of selected solutions for further dissemination.

EXECUTIVE SUMMARY

The solutions identified to improve power and energy efficiency and their reliability in the four selected rural health clinics confirm that problems can be solved with different technical equipment depending on each rural health clinic peculiarities and medical equipment already installed or to be installed during next three years.

In order to choose between the various solutions, reliable information was required: power cuts duration and frequency, lack of natural gas or low gas pressure duration periods and frequency. Unfortunately, such information was not available and depends on sources. Same difficulty about electricity and gas consumption: data collected from various sources were not coherent, and expenses for electricity and gas consumption do not correspond to real consumption. After 12 monitoring months, some of these questions do not find acceptable answers due to the uncertain representativity of the four selected RHCs (power cut off during 17 days in June for Umarov RHC!), to a lack of reliability of some meters and for some equipment such as UPS.

For ***power supply***, installation of batteries/accumulators and uninterruptible power supply (UPS) seemed the simplest and cheapest way, but according to the results, it may be preferable to install small photovoltaic (PV) systems which present the advantage of providing a good quality of power and autonomy for medical equipment during more than 8 months a year. In remote areas were maintenance could be difficult, it is also preferable to install photovoltaic (PV) systems. The diesel generator installed in Djeykhanabad presented good results and is convenient for rural hospitals linked with RHC. In order to find an answer to long period of power cuts off (longer than 2 days), it could be possible to buy a mobile diesel generator available at district or regional / province level.

Considering the ***power demand side***, the main action has to be undertaken concerning lighting: replacement of incandescent bulbs for low consumption energy efficient lamps. Due to comparison between RHCs, management of equipment can be improved, such as using centrifuge device after grouping several analyses (for one run of device) instead of using device per one analysis.

Heating demand and supply recommendations focused on energy saving (demand): installation of thermal regulation (temperature inside the buildings), improvement of insulation (ceiling, walls and floor, pipes), improvement (or replacement) of windows and doors (in order to increase their air-tightness), replacement with efficient gas burners or boilers, including thermal regulation.

Water demand seems limited for cold and hot water, so solutions tested were over-dimensioned and solar collectors does not correspond to the needs. If it is necessary to install something new, electrical water heaters seem the appropriate answer.

BACKGROUND

At present, large-scale reforms are being executed in the public health sector of Uzbekistan. Establishment and development of the rural health clinics (primary health care) is the priority of the national policy.

The strategy for the primary health care reforming is focused on improvement of quality and effectiveness of the medical service provided to the population, and is based on integration of modern medical technologies, preventive health care, training of general practitioners, strengthening of financing and management of primary health care.

For this improvement, the rural health clinics need reliable and uninterrupted supply of power and heat to provide up-to-standard medical services. Improving power and heat supply appears to be a key for Rural Health Clinics (RHC) being operational during working hours.

To carry out the reform, in 1998-2004 the Government with assistance of the World Bank implemented a pilot project (Health-1) in five provinces of the country: Fergana, Navoiy, Syrdarya, Khorezm and Karakalpakstan. The objective of the project was to examine and test how the primary health care system in rural areas can be reformed. The 'Health-1' project proposed and tested restructuring of the multi-stage health care system to the two-stage, by that reducing the maintenance costs of medical institutions. In addition, the project introduced a system where people get the first medical aid from a certified physician rather than from a medical attendant's assistant.

Positive results of the project persuaded the Ministry of Healthcare to develop a new 'Health-2' project. A grant from the Japanese Government funded the project preparation work. The Health-2 project aims to extend and deepen the scope of the primary health care reform across all regions of Uzbekistan. In line with the Agreement on Development Financing signed between Uzbekistan and International Development Association (IDA), Health-2 project was launched in 2004. This project will provide 2,200 rural health clinics with up-to-date medical equipment. Other components of the project will focus on making medical products more accessible, continuous medical education and improving quality of medical services. The project will also distribute best practices and lessons learn on financial and general management received from piloting during Health-1 project.

The Uzbek Government and international donor organizations have allocated substantial funds into rural health care infrastructure. However, the majority of rural health clinics have faced certain problems with power and heat supply during the recent years. The reasons are, in the first place, interrupted heating and hot water supply caused by problems with unstable natural gas and power supply to medical facilities (low gas pressure and frequent power failures), especially in winter season. Moreover, some problems with reliable cold water supply occur in summer season. These and other factors have made a negative impact on quality of medical services provided, medical equipment operation and capability of emergency medical aid.

Development and implementation of all possible options of uninterrupted and reliable power and heat supply to the rural health clinics, including integration of modern energy efficient and renewable energy systems (e.g. use of solar energy for electricity generating and water heating needs) into existing conventional energy infrastructure, provides the potential for more efficient and effective use of the medical equipment and more comfort conditions for physicians operation and patients treatment.

However, rural health clinics in Uzbekistan have some peculiarities. They are rather well equipped with various medical equipment such as emergency aid, laboratory equipment for medical tests, sterilizers, dental and physiotherapy equipment etc, which consume quite significant amount of energy. The average electric power required for this equipment operation is varying in the range of 7-13 kW, and average thermal power is in the range of 16-50 kW. Moreover, rural health clinics differ in premises size and facility design as some are located in the buildings built specifically for medical purposes, others in premises adapted for medical needs. They also range in scale (large regional health clinics and small rural posts). Rural health clinics are located in various climatic zones such as foothills, mountain areas, deserts, and valleys. They also differ in the water, power and heat supply infrastructure; most of rural health clinics are connected to the grid but heating is provided by boilers firing the natural gas coming from gas pipelines.

Within the framework of the UNDP's "Feasibility Study on Improving of Power and Heat Supply Reliability in Health Rural Clinics of Uzbekistan" Project 2007, technical and economic assessment of options have to be implemented in order to equip the rural health clinics with Energy Efficient (EE) and Renewable Energy (RE) systems, notably the plants that transfer solar energy to electric and thermal power that can be integrated into existing conventional energy infrastructure to improve reliability of power and heat supply has been implemented.

The options proposed have been adjusted to the relevant budget resources available in rural health clinics and to the budget for medical equipment. They have to ensure efficient use and saving of energy and fuel, to be coherent with budget available and to be replicable at a large scale.

Developing the options for reliable power and heat supply has take care that rural health clinics are equipped with a quite big number of medical equipment that requires substantial amount of electric power. It is also necessary to have enough power for lighting, communication, and in many cases for reliable cold water supply. Therefore, a combination of conventional and EE and RE systems has been considered. Thus, photovoltaic systems may be used for off-grid power supply for lighting and emergency equipment operation in case of power failure. Solar collectors can be used for autonomous hot water supply in summer season as well as for pre-heating of water for space heating needs in winter season to reduce natural gas consumption. Moreover, some local and foreign manufactures of PV and solar water heating systems licensed and certified according to national standards are available in Uzbekistan. These companies are able to meet the future demand in such equipment, and provide full cycle services such as installation, commissioning, operation and maintenance, and after-sale service. The options proposed have been adjusted to the relevant budget resources available in rural health clinics and to the budget for medical equipment. They have to ensure efficient use and saving of energy and fuel, to be coherent with budget available and to be replicable at a large scale.

The UNDP Project "Piloting Energy Efficient and Renewable Energy Solutions in Rural Health Clinics of Uzbekistan" has been testing and demonstrate the EE and RE solutions proposed for the four representative rural health clinics (UMAROV, BAYMUKHAMEDOV, DJEYKHANABAD, and JUZIM-BOG) and will prove their feasibility and viability with a sound justification to replicate these optimal solutions at a large scale in rural health clinics in different provinces of the country within the WB Health-2 project.

1. ANALYSIS OF MONITORING RESULTS 11/2008 – 09/2009:

To prepare the provisional recommendations, the International Consultant has been supported by several reports from National Consultants on monitoring:
- 4 seasonal reports about power supply and power consumption of 4 pilot RHCs ;
- 4 seasonal reports about heat and hot water supply and management, including solar water heating systems of 4 pilot RHCs ;
- 4 seasonal reports about economics.

- These reports are available in Russian and English and have not been enclosed to this report in order to focus on the main recommendations.

- Specific conclusions have been selected to explain recommendations:

1) **Power supply and power consumption:** (for more details refer to the reports of the National Consultants R. Golovizin , P. Pozichanyuk and E. Bikeyeva)

1.1) Power cut off:
-*Frequency:* The number of power cuts off depends on the season and on unpredictable events such as in Umarov RHC in June 2009. Based on monitoring data, as a result of emergency situation occurred in June, duration of power cut off from regular power network made up more than two weeks, and with consideration of total number of power cuts off for a whole summer period – more than three weeks.

Except this problem, the maximum number has been observed in winter and represents from 5 to 15 power cuts off per month, mainly during daytime. There were only once or twice a week during day time in November with exception for Djeykhanabad RHC, where there were also many cuts off during night time. This number was growing during winter season, 2 or 3 times a week, quite every day some weeks, during daytime (maximum 8 hours several times) and also during night time in Juzim-Bog and Djeykhanabad clinics.
For Djeykhanabad RHC, during winter it has been registered an average of 8 cuts off per month during daytime and 11 cuts off per month during night time. For Juzim-Bog clinic, the maximum number was registered in spring, but limited to 8 power cuts off per month (5+3).
Monitoring confirms the importance of power cuts off, but do not allow dimensioning alternative solutions due to scattered figures and unpredictable arrival (cases of cuts off). The information collected gives a better idea of alternative needs of power during cuts off periods.

-*Duration:* The average duration of power cuts off was less than 3 hours for Baymukhamedov and Umarov clinics and approximately 4 hours for Djeykhanabad and Juzim-Bog RHCs. But maximum duration during daytime can reach 7 or 8 hours. It happens several times in spring for Juzim-Bog RHC. For dimensioning, we propose to keep these figures: **average duration 4 hours, maximum 8 hours during daytime.**

1.2) Power/electricity consumed during regular period (without power cut off):
Data on power consumption varies from 1.1 to 7.7 kWh during daytime and from 0.85 to 6.4 kWh during night time. So the average consumption per day varies from 1.9 to 11.5 kWh. Some consumption must be identified in order to limit consumption especially during nights. Daily dispersal of power consumption is limited and less scattered for priority medical equipment: from 200 to 700 Wh per day.

10 months monitoring has confirmed low **electricity consumption with an average of 3 to 7 kWh per day** depending on season (and RHC). Maximum 7 kWh/day in winter reduced to 3 or 4 kWh in spring and summer for all needs, including energy consuming equipment.
It seems that part of power consumed is used for lighting and heating with electric radiators in winter which explain the difference. Considering the energy consuming equipment (autoclaves, distillers, etc), it may be possible to let them working during night times, wherever power cuts off are more frequent during daytimes than during night times.
Another reason of higher consumption in winter is lighting: pilot RHCs have been provided with **low consumption bulbs** (power saving fluorescent lamps-PSL)), but these were installed on a specific grid (backup power supply system) to be used during power cuts off, so there is no energy saving registered. Considering an average number of 18 energy saving light bulbs in each RHC (supplied by the Project) which consume from 5 to 6 kWh/day in winter, **the power saving potential is 800 to 1000 kwh per year for each RHC,** by replacement of filament lamps **with the energy saving ones** for lighting, potential economy will be: 45 000 Soums (30US$) for each RHC.

Based on the feasibility study, replacement of filament lamps and tube fluorescent lamps could become economically sound and rational. Even the cost of electricity in Uzbekistan is 5 times lower than in Europe, replacement of filament lamps with power saving fluorescent lamps (locally manufactured) is economically viable after 3,000 hours (2 years) and replacement of tube fluorescent lamps with power saving fluorescent lamps is viable after 6,000 hours (4 years).

1.3) Power produced by PV systems (Baymukhamedov and Juzim-Bog):
Monitoring did not allow identification of electricity produced by PV systems, but only the electricity produced during power cuts off. So in winter, less than 10 kWh/month have been used in Baymukhamedov RHC and 12 kWh/month in Juzim-Bog clinic compared to the potential of production (production output) from PV Systems of 30 kWh /month; in spring respectively 6 and 7 kWh/month compared to the potential of 50 kWh/month. The difference is even higher in summer: 1kWh/month in Baymukhamedov RHC and 2.3 kWh/month in Juzim-Bog RHC compared to a large potential: 60 to 90 kWh/month!

In Baymukhamedov RHC, the backup power supply system has been used as the source replacing /substituting the regular power network even without any cuts off. Staff of the clinic explains this regime of use of backup power supply system because its use for operation of EKG device is quite effective and "provides quality results of analysis". Such assertion needs to be confirmed and may represent ***a real opportunity to effectively use the electricity produced by PV systems all the year round without any consideration of power cuts off.***
It will be better for operating PV systems and considering annual production of 600kWh/year, the saved power will represent an economy of 30 000 Soums (20$) per year for each PV system installed.

Power produced by UPS in Umarov:
UPS works properly until the long power cuts off in June 2009. It should be noted that installed equipment as a whole, functioned in normal regime, which did not require additional costs for repair of devices. Except the faulty operation of accumulator batteries installed in Umarov RHC (registered in summer period). Thus, in Umarov clinic, which was in malfunction in June month ('grid power' was not supplied from 13.06 till 30.06.2009, i.e. during 17 days) and the backup power supply system was switched on (from 17.06.2009),

which uninterruptedly supplied the clinic with electric energy during 12 days. When energy was supplied back again through regular power network, and consequently, when accumulator batteries charging system was switched on to the charging mode, the latter was disabled, as it was not designed for charging of almost completely discharged accumulators. In this situation, the supplier company of backup power supply system made a decision on modernization (increasing its maximum capacity/load) of charging device and inclusion of the whole line of protective and blocking devices to its composition, which in future, during force-major circumstances, would not bring to malfunctioning of the system's separate component parts (abstract from the monitoring report of the national consultant Ms. E. Bikeyeva).

1.4) Power really consumed for RHC emergency equipment during power cuts off*:*

During the feasibility study, 5 medical equipment were considered with a priority 1 and were supposed to consume 2kWh/day + 1.5/4 kWh/day for the refrigerator. During the installation, only diagnostic equipment has been connected to a specific grid (connected to PV system or UPS) and it seems that electricity consumption was over dimensioned:

- Equipment for analysis: average consumption is from 100 to 300 Wh/working day, except in Juzim-Bog clinic (500 to 700 Wh/working day).
- EKG: average consumption is from 10 to 20 Wh/working day.
- Physiotherapy equipment: average consumption is from 100 to 400 Wh/working day.

So, for this priority equipment, the average consumption was from 350 to 800 Wh/working day. There is not a big difference in energy consumption for conducting analysis and diagnostic equipment in 4 pilot RHCs.

Adding a minimum energy consumption for lighting in the medical care services rooms (5 PSL, 20W used during 4 hours represent 400Wh/working day) will provide us approximate need in energy from 500 to 1000 Wh /working day, depending on the season.

1.5) Temperature regime in equipment storage rooms

Data analysis on temperature regime in equipment storage rooms shows that temperature was acceptable during winter, from 6°C to 20°C in Baymukhamedov and Umarov pilot clinics.

No data for Juzim-Bog RHC.

Negative temperature in the batteries storage room is dangerous for storage and capacities of accumulator batteries (risk of freezing of electrolyte and destruction of batteries).

For Djeykhanabad RHC, the lowest temperature registered in the rooms of the clinic was +8°C on the 10th of January and remained cold (12°C to 15°C) during the other days. Due to the risk of freezing of diesel fuel in diesel generator storage room, the place of the generator has been changed. There is a risk of freezing cooling liquid in the cooling system of diesel generator.

No real problem occurred during the other seasons.

1.6) Analysis of operation of diesel generator in Djeykhanabad:

During the winter period, the diesel generator worked during 19 hours, which represent consumption of 35 litres of diesel fuel. The generator automatically switches on when when the power is cut off from the grid. Considering the cost of this consumption, the chief of the clinic decided to limit the working time of the generator, so the clinic used it only when there was a real need for this and the fuel consumption decreased and was limited to 1 hour 50 minutes in summer, and fuel consumed equalled to 5,5 litres. It seems that there is no agreement with the hospital in order to provide power to it during power cuts off. So this installation is also over dimensioned.

Table 1.Conditional (conventional) map of technical level (competitive list proposed by NCs)

N of line	RHC title	Type of applied equipment	Conclusion on monitoring	Weak sides	Conclusion by objective data	Recommendations
1	**Umarov**	UPS	Equipment functioned in accordance with requirements specification (no comments)	During lengthy energy supply in regular power net, there are possibilities of failure of self-contained power supply system	The data presented are not fully reliable due to conducting monitoring of only part of the days and weeks	***Recommended for rescaling in places **with regular power infrastructure**, for improvement of reliability of treatment process
2	**Baymukhamedov**	PV System	Equipment functioned in accordance with requirements specification (no comments)	* In applied equipment there was no possibility of visual control of accumulated energy in accumulator batteries (to be noted during rescaling)	The data presented are not fully reliable due to conducting monitoring of only part of the days and weeks	*** Recommended for rescaling in places **with no regular power infrastructure**, for improvement of reliability of treatment process
3	**Juzim-Bog**	PV System	Equipment functioned in accordance with requirements specification (no comments)	* In applied equipment there was no possibility of visual control of accumulated energy in accumulator batteries (to be noted during rescaling)	The data presented are not fully reliable due to conducting monitoring of only part of the days and weeks	*** Recommended for rescaling in places **with no regular power infrastructure**, for improvement of reliability of treatment process
4	**Djeykhanabad**	Diesel Generator	Equipment functioned in accordance with requirements specification (no comments)	**it is necessary to sort out the issue of supply the diesel generator with fuel	The data presented are not fully reliable due to conducting monitoring of only part of the days and weeks	Recommended for rescaling in places **with no regular power infrastructure**, for improvement of reliability of treatment process **in large and multi-functional RHCs**

Source: NCs Petr Pozichanyuk and Roman Golovizin
*   Information of technical character
** Information of management character
*** Additionally, as a recommendation, there is a necessity of having mobile electric generator with capacity of 1-2 kWt (on petrol or diesel fuel) for a group of relatively closely located RHCs (price of the equipment is from 300– 500 Thousand Soums in prices of June 2009, Chinese production). This solution will maximally utilize the resource of accumulator batteries and improve reliability of medical treatment process, which depends on equipment operation.

2) **Heat and hot water supply and management:** (for more details refer to the reports of the project national consultants Mr. A. Shaislamov and Ms. E. Bikeyeva).

2.1) Gas supply analysis: cuts off and low gas pressure; Coal supply

It appears from monitoring, that there was no real problem during this winter, may be due to the "warm" winter. There were just some problems in Juzim-Bog clinic in April which was quite after the heating season.

Gas supply has been stable and satisfactory during the monitoring period in Baymukhamedov (only one day gas cut off registered in December) and Umarov RHCs.

The situation was also stable during winter and March month in Juzim-Bog RHC, but there were a lot of problems in April and May: in April 2009, full gas cuts off were observed during 8 days and sudden gas pressure drops occurred during other 12 days. In May 2009, full gas cuts off have been observed during 13 days, and sudden gas pressure drops occurred during other 11 days. The stable gas supply was observed in May of 2009 during only 6 days! One can make conclusion from this, that the gas supply in Juzim-Bog RHC during spring season was extremely unstable and unsatisfactory.

Djeykhanabad clinic has two coal boilers. One can make conclusion from primary resource materials presented that, coal supplies in winter until March was stable and in sufficient quantity and interruptions with coal supply were not observed. On the contrary, the quality of coal was not good so the efficiency of coal boilers was limited and even with high coal consumption the temperature in the clinic's rooms was quite low: 15°C. 31st of March was the last day of heating season and operation of heating system. Provision of the clinic with coal, other materials as well as payment of salary to a 'boiler man' was stopped till the beginning of the next heating season.

2.2) Consumption of natural gas and coal by pilot RHCs:

The outside temperature was clement during this winter, so the consumption registered does not reflect the needs during a standard winter.

On the other hand, there is a problem of reliability of measures. How can we explain the difference of consumption during winter between Baymukhamedov RHC (3,670m3) with huge insulation and Umarov RHC (2,200m3) without a lot of saving measures? The outside temperature registered seems either not coherent due to close location of these two clinics. There might be some problems with reliability and registration of measures, because average daily consumption is quite the same: 32.6m3 and 32.3m3 accordingly.

Daily dispersal of gas consumption is also surprising: from 7 to 152 in Baymukhamedov RHC, 4 to 100 in Umarov clinic, but limited from 45 to 100 in Juzim-Bog clinic during the same climatic period!

Consumption of natural gas must be confirmed through the gas invoices.

For Juzim-Bog RHC, total consumption during three winter months was 5,225m3, which corresponds to an average daily consumption of 58m3. Such consumption seems important with regards to two previous ones, but the chief of the clinic told us that **the gas consumption decreased for 50% due to the new gas boiler!** Such information must be confirmed through gas payment invoices, but it shows that a simple replacement of a boiler with manual gas pressure regulation allows a large gas saving: about 4,000m3 for Juzim-Bog RHC, which represents 250,000 Soums (170US$).

For Djeykhanabad RHC, total consumption of coal during winter was 10.5 tons with an average daily consumption of 120 kg. For the heating season, total consumption of coal is estimated to 18 tons for a total cost of about 450,000 Soums.

2.3) Energy saving potential:

Considering the results in Baymukhamedov and Juzim-Bog clinics, the following parameters can be accepted as preliminary analysis and for replication:

- average annual consumption of natural gas makes up approximately approximately 2,000 to 5,000 m3 after replacement of gas burners or boilers;
- energetic efficiency of local boilers makes up 60-70% (20 to 30% energy saving);
- energy saving potential from automatic or manual gas pressure regulators can be estimated from 20 to 25%, especially during nights and non working days.
- economy through the ceiling, walls and windows insulation makes up 20-30%.

The comparative analysis prepared by Elvira Bikeyeva shows, that the pay-back period due to gas saving is less than 1 year for automatic gas pressure regulators, 7.1 year for thermal insulation and 9.9 year for new efficient boilers. It seems possible to reduce this last pay back period (from 5 to 6 years) for gas boilers by replacing only one boiler instead of two, like we have done, installing a new efficient boiler with a larger capacity 40 kW instead of 23 kW.

2.4) Water (hot and cold) consumption and assessment of temperature:

Cold water was a problem in Baymukhamedov and Umarov clinics where they have to store water in a small tank. The installation of tanks inside the boiler room prevented from freezing and is convenient. Staff has been used to save water, so they consume low quantity of cold (from 10 to 30 liters per day) and hot water. In Juzim-Bog RHC, which is connected to the water grid, they also have a low daily consumption of 100 liters per day. Djeykhanabad clinic, which is supplied by water from a mountain source, uses more, not only for medical purposes but also for gardening!

Hot water consumption is in the same range and clearly limited, solar collectors have been over dimensioned and are not very useful. I will not recommend their installation for dissemination. Indeed, consumption of hot water was in the range of 10 litres per day, except in Djeykhanabad clinic, where it uses 100 litres per day from the solar collector.
So, for dissemination and depending on the source of cold water, it could be possible to get hot water from electrical heaters with a capacity from 10 to 50 litres.

Main conclusions from monitoring:

The real period for monitoring was less than one year, from 1st November 2008 until end of September 2009. During this period some information is missing, some data are not coherent, some meters were not reliable or not at the best place (such as temperature of hot water in Baymukhamedov); some figures given by RHCs' staff were wrong; some tables prepared by NCs must be confirmed. Monitoring during another winter would be useful due to previous warm winter as well.

The **average duration of power cuts off** can be considered as 4 hours per day especially in winter, except in Karakalpakstan, where it happens more frequently in spring.

The **problem of quality of power** was not considered during this monitoring phase, but it could be necessary to check on voltage and frequency of power? What is the real role of stabilisers installed concerning quality of analysis and getting results from medical equipment?

Power consumed by priority medical equipment during power cuts off has been overestimated and it can be provided easily by the 3 systems tested, with exception for UPS, if the duration of power cuts off is more than 2 or 3 days.

Energy saving especially from lighting is preliminary to other action concerning power.

The relative softness of the last winter may explain small number of gas failures. Reliability of data collection from gas meters has also disturbed monitoring and comparison between RHCs consumption. **Gas boilers and burners replacement** have shown their efficiency with a capacity to work with lower pressure of gas than previous one.

Another source of energy saving is installation of regulators with a pay back period lower than one year. Insulation of buildings especially ceilings has to be realized when RHCs are refurbished, for the other one, the first and simple action is to ensure air tightness from windows through injection of silicon or equivalent in the interstice between walls and windows frame.

Monitoring has confirmed low consumption of water (cold or hot), except in Djeykhanabad clinic, where it is "free" (mountainous water). Installation of solar water heaters is over dimensioned and not really useful.

2- RECOMMENDATIONS TO IMPROVE RELIABILITY OF POWER AND HEAT SUPPLY

2.1) Power reliability and supply

Monitoring shows that there were a great number of power cuts off whatever was the RHC, from this information we must **identify a solution, which can provide electricity for priority medical equipment during 4 hours in winter.**
Such solution is consistent with UPS or Photovoltaic (PV) systems, but UPS has shown its limits during a long period of power cuts off. So if costs (investment and operating costs) are not so different, **I recommend installing PV system with a low capacity** (500W would be convenient with electricity consumption of priority medical equipment and security lighting).
Considering the investment cost of such system: approximately 7,500US$ including installation and training, it is obvious that such equipment cannot be installed in every RHC. So I recommend selecting some of them (one out of ten or more depending on the density of RHCs and population, giving priority to those which have to be refurbished) and install PV system during Health-3 project within 100 RHCs or more. The experience in Baymukhamedov RHC has shown that population accept to go in a more removed RHC for diagnostic and analysis if emergency during power cuts off.
For specific RHCs, located close to a rural hospital like in Djeykhanabad clinic, I recommend a diesel generator, cost of which will depend on the size of the hospital: investment costs about 8,000 to 10,000US$ + operating costs, diesel fuel (2 litres/hour) and spare parts, such as filters. But operating and maintenance (O&M) may be a problem for small RHCs; so we do not recommend a diesel or petrol generator for each RHC, especially in remote areas; another solution is proposed where no regular power infrastructure is reliable.
Considering petrol or diesel generator, operating and maintenance seems difficult for staff of RHCs, we (a national consultant confirmed by myself) recommend to **each MoH District to buy mobile (portable) generators operated by qualified personal that could be installed for few days in RHCs,** where power cuts off duration is more than 2 or 3 days. Every district could buy 2 or 3 generators (investment cost: 200 to 350 US$ per generator) and assumed a qualified service to RHCs which will request for. In order to assume transportation, operating (mainly fuel) and replacement of spare parts, every RHC requesting for such service will have to pay a lump sum per day or per working hour (2 to 5 US$ per working hour).

2.2) Optimization of power consumption

The average consumption varies from 3 to 7 kWh per day depending on RHC, with an important dispersion during day and night times, of which **lighting** represents more than one/third in winter period. Even it does not represent a huge consumption for the whole year, lighting is necessary and not efficient especially in winter, so I recommend replacement of incandescent bulbs with low consumption bulbs. Depending on the number of lamps (from 15 to 25 per RHC) investment cost will be from 100 to 200 US$ for each RHC and a pay back period of approximately 5 years, to be compared to a lifetime of more than 10 years.
A first action to be recommended is to save energy through **replacement of incandescent lamps with energy saving bulbs** (energy saving potential estimated to 800 to 1000kWh per year for each RHC).

Second action could be changing some practice of RHCs' staff in order to **optimize the usage of power especially for energy consuming equipment** (autoclaves, etc). Example: using centrifuge device after grouping several analysis instead of using it for each analysis.

If it is confirmed that power cuts off are less frequent during nights than during day time (except in Djeykhanabad RHC), it could be possible to organize/programme the usage of autoclave and other energy consuming equipment during nights. The cost of a programmed plug is 3 US$ and 2 or 3 for each RHC seems enough, so the investment cost could be less than 10 US$ per RHC.

For sterilization, it is possible to save energy by using a solar parabolic concentrator, which can provide 600°C or more, which is sufficient for destruction of bacterium. I recommend testing such solution, which will represent cost of raw material (including large parabolic TV receiver), realization and implementation in Uzbekistan. Estimated cost: 300 to 500 US$.

For priority medical equipment, daily dispersal of power consumption is limited: from 200 to 700 Wh per day. Indeed, priority medical equipment has been optimized and each RHC team has just to optimize the usage of them, especially during cuts off period in order to limit power consumption. These figures have been confirmed during 4 seasons, so we may agree with an **average daily consumption of 500 Wh**, which can easily be assumed by 3 new systems tested during this demonstration phase.

Concerning refrigerators, it seems that replacement is not necessary, indeed their efficiency is good enough and their inertial capacity is consistent with the average duration of power cuts off (except during long period of power cuts off as it happened in Umarov RHC in June).

2.3) Heating supply

Analysis of ***existing*** data showed that the gas supply in Baymukhamedov and Umarov RHCs was stable and satisfactory during past winter (2008-2009). Was it due to a “warm” winter? Only few low gas pressure cases with limited impact due to installation of new diffusion burners.
In Juzim-Bog RHC, gas cuts off were more frequent, extremely unstable and unsatisfactory, mainly in November and during the spring period, when the heating season was over. From this fact, it can be proposed to **add a liquid fuel burner which can replace gas burner, when gas cuts off occur during the heating season.** This recommendation concern Karakalpakstan Republic and Province(s), where power cuts off are more frequent.

For Djeykhanabad RHC, 2 coal boilers were not working efficiently due to the low calorific value/quality of coal. The hospital located next to the RHC has installed a locally made “rustic/robust” coal boiler, which seems more efficient and cheaper. There was another problem due to the heating network, so we cannot recommend replicating identical solution where there is no gas. Appropriate solution must be identified considering specific conditions.

Experiences during this demonstration phase show that if the main event is gas pressure decrease, it is possible to reduce the impact **by replacing injection gas burners (already installed in heating boilers in RHCs) with diffusion gas burners**.
“Indeed, two types of gas burners – diffusion and injection ones - are used for heating boilers. In diffusion burners, clean gas comes out from nozzles of burners and air-gas mixture is formed in the boiler’s furnace, which is then burned out. So the lowest limits of gas pressure by which diffusion burners may work sustainably makes up 50-80 Pa.
In injection burners, due to discharge created by gas, the discharge is formed in the burner, which contributes to injecting of the air into mixing cell of the burner. Thus, the air-gas mixture, ready for burning, comes out from nozzles of burners. The lowest limits of gas pressure, by which injection burners may work, should sustainably make up more than 150

Pa. Higher values of the lowest limit of gas pressure for injection burners are related to their operation principle, that air-gas mixture ready is formed inside the burner that is ready for burning. And by very low gas pressures, there might be effect of skip of fire inside the burner, which may bring to emergency situation" (Source report of NC Mr. A. Shaislamov).
Considering the information collected to date, it seems necessary to provide each RHC with a new diffusion and efficient gas burner(s), especially while refurbishing the RHCs, connected to gas network.
For other RHCs, not connected to gas supply network, installation of coal boilers is recommended taking into account the quality of coal, in order to optimize the consumption in the boiler.

2.4) Heating demand management

In order to reduce gas consumption and expenses, first action recommended is to **install thermal regulation and programming,** where it is possible. During the demonstration phase the regulation was manual, added to the change of burners, gas saving represents approximately 50% of past consumption! Investment cost for regulation is limited - from 50 to 100 US$ - so the payback period is less than 1 year.
In order to increase the inertial capacity of the RHC building and reduce the speed of decreasing inside temperature during gas cuts off or low pressure, it has been tested insulation of building in Baymukhamedov RHC. Insulation of ceiling, replacement of windows and doors, installation of a "tambour" entrance door unit, is quite expensive, and the pay back period is about 7 to 9 years. To date, several RHCs are using plastic sheets for reducing heat losses and air leakage from the RHC.
The first and simple action recommended is to **ensure air tightness of windows** through injection of silicon or equivalent in the interstice between walls and windows frame. For refurbishment, it is recommended to replace all windows and doors with efficient double glazing units. Specific attention must be given to the gynaecologist room where it is recommended to keep a temperature of 20°C.

Considering the large number of RHCs all around the country, it could be useful to train at the national level, the persons in charge of RHC maintenance, so that they can prepare/estimate thermal diagnosis of RHC when they are on site, and determine priority actions concerning insulation of the building, especially before refurbishment.

2.5) Cold and hot water supply and demand management

Consumption of cold water was very low during 10 months of monitoring period, so it does not seem necessary to organize a specific management for cold water; RHCs staff is aware of this. The installation of a new tank inside the building (like in Umarov RHC) is just necessary in order to avoid freezing during winter period.

Hot water consumption is limited and do not need a specific solution. Usage of hot water is limited to washing hands and boiling a water of tea (clinics use gas cooker for this purpose). Solar collectors tested in Baymukhamedov, Juzim-Bog or Djeykhanabad RHCs were over dimensioned.
Small electrical water heaters could be envisaged if it is possible to find from 10 to 50 litres capacity on Uzbek market. Estimated cost is from 100 to 150 US$, including installation on hot water network.

Table 2. Reliable power and heating supply and demand recommendations synthesis:

Target	Observations	Recommendations	Conditions	Estimated costs
Reliable power supply in selected RHCs.	Relatively high frequency (8 per month in winter) and duration (average 4 hours) of power cuts off.	Installation of PV systems (500W) in selected RHC to supply power in winter during power cuts off	Procurement: 100 systems or more, for best prices, ensure at national level basic spare parts, O&M in selected RHCs. Staff training. Installation of specific PV grid	Investment cost: 7500$/RHC + batteries replacement every 7 years (1000$) + O&M.
Reliability of medical analysis and diagnostics	Problems with quality of power and need for backup power supply which can provide quality results of analysis.	Connect priority medical equipment to the PV grid every day of the year, except in winter.	Confirm the voltage dispersal on the power grid, and the real improvement given by PV grid.	Budget saving: 20 to 30 US$ per year.
Emergency power supply from district level for priority medical equipment	an emergency power cut off for more than 2 or 3 days may happen (as in Umarov). During such period, it is necessary to provide RHC concerned with power	Alternative solution: mobile electric generators available at district level with capacity of 1-2 kWt (on petrol or diesel fuel) for a group of relatively closely located RHCs.	RHC will have to request and pay a lump sum per working hours. Availability of a qualified person in charge of these generators at District level.	Investment cost: 200-350 US$ per generator. Service cost: 2 to 5 US$ per working hours depending on distance.
Optimization of power consumption ; energy saving and RHCs power budget decreasing	Averagely 20 incandescent lamps are being used in each RHC and some equipment are not energy efficient or used inefficiently	Replacement of lamps with energy saving bulbs. Change the practice of RHCs' staff using energy consuming equipment. Test solar parabolic for sterilization.	Use new bulbs all year long (not only on PV grid like in pilot RHCs). Training, motivate RHCs' staff to energy saving.	Average investment 150 US$, saving 30 US$ each year. Limited cost for training. Test: 300 to 500 US$.
Reliable heat supply from gas where low gas pressure	Injection gas burners installed in RHCs need high pressure and are not operational at 50-80 Pa	Replacement of current burners with diffusion/efficient ones	Where there is low gas pressure, but not gas cuts off.	200 to 400US$ per burner including installation. Gas saving: 50 US$ per year.
Reliable heat supply where frequent gas cuts off occur heating period	Lack of gas does not allow RHCs maintain heating at acceptable level during heating season.	Buying a liquid fuel burner appropriate to replace gas burner during gas cuts off. Storage liquid fuel.	Technical staff of RHCs must be trained and able to change the burner by themselves.	200 US$ per burner + O&M including storage of liquid fuel (about 50 US$)

Reliable heating supply in RHCs with no gas supply.	Using coal boilers with condition of good quality of coal and efficient burners.	Installation of coal boilers adapted to coal quality. It could be locally made ones.	Taking into account local experiences and train RHC staff to use coal boiler.	500 to 1000 US$ depending on origin of coal boiler. O&M: 100 to 200 US$ per year
Heat demand management and saving	To date, main RHCs are heated days and nights even on Sundays	Installation of thermal regulation easily/manually managed by RHCs' technicians.	Finding regulator adapted to gas burners. Training of RHCs' technical staff.	Investment from 50 to 100 US$ with a pay back period less than 1 year.
Heat losses reduction: from doors, windows, ceiling and walls	Standard RHCs are not well insulated and heat is lost mainly from windows which are not tight	Ensure air tightness of windows through injection of silicon. Ceiling insulation, doors and windows replacement when refurbishing RHCs	Training of RHCs technicians for insulation actions. Provide a specific budget for insulation during refurbishment.	Investment for silicon tubes and plastic stripes: 20 to 50 US$ / RHC. Large investment for insulation 6,000 to 10,000$
Cold and hot water supply	Limited consumption and staff is aware of water saving. No real problems to date. Usage of hot water may change in the future?	For RHCs not connected to water grid, installation of new tank inside the building, if it is currently installed outside. Installation of small electrical water heaters (10 to 50 lt).	Confirm the awareness of RHCs' staff on water saving. Explain the best and useful usages of hot water.	Investment for tank: 800 to 1,500 US$. Small electric water heater: from 100 to 150 US$

3- COMPLEMENTARY COMMENTS.

Before further dissemination and replication of selected solutions, it seems possible to get more information and testing new technical solutions prior implementation of “Health-3” Project. Such extension is detailed within conclusions. So there is no chapter dedicated to dissemination and replication in other Rural Health Clinics.

As requested in the terms of reference, a lot of reports have been prepared by National Consultants and especially the last report from national expert on energy economics Mrs E. Bikeyeva. Refer to her last report for:

- Report on assessment the technical solution implemented and justifications on their financial viability prepared;
- Report on assessment the financial benefits received as a result of reduction in fuel and natural gas consumption prepared;
- Report on options how potential benefits can be reinvested into sustainable operations of the innovative energy equipment in rural clinics prepared;
- Report on justification why and how the implemented technical solutions meet the demands of rural clinics in uninterrupted and reliable supply of energy, based on the monitoring program results prepared;

Some personal complements and comments are added here:

3.1)Comments on potential for CO_2 emission reduction due to introduction of EE and RE equipment in rural health clinics and potential of CO_2 emission reduction after dissemination in other rural health clinics (3,000) located over the country developed;

Considering CO_2 emission factors used for the feasibility study, and results from monitoring, the main potential for CO_2 emission reduction comes from energy saving for heating (estimated potential 4,000m3 of gas per year = 45,000 kWh per year), and next one comes from substitution with photovoltaic system to generate electricity (600 kWh per year) and power saving using low consumption bulbs (900 kWh saved per year).

So the potential for CO_2 emission reduction for one RHC can be estimated as shown below:

Table 3. Annual potential of CO_2 emissions reduction in rural health clinics of type 2

#	Solution	Energy replaced (RES) or saved, in kWh	Reduction of CO_2 emissions, in kg of CO_2
1	New burners and regulation	45 000	15 300
2	Using PV systems	600	402
3	Lighting with PSL	900	603
	TOTAL potential:	46 500	16 300

If all RHCs are refurbished or equipped with new burners, PV systems and low consumption lamps, the **total potential of CO_2 emission reduction can be estimated to 50 000 tons.**

3.2) Socio – economic consequences of realization and dissemination of demonstration projects

The project success criteria are reduction of medical risks and improvement of quality of medical care services. Other factors are also not negligible such as:

- Influence for employment of population;

- Expansion of human services (non-manufacturing business), small business and development of social-production infrastructure. (For more details please refer to the report of Mrs. Bikeyeva.)

-Employment:

With an average of 15 persons working in each RHC, this means that to date, about 50 000 persons are working in RHCs all over Uzbekistan. The reliability of medical equipment is supposed to increase the number of patients in each of them and probably the creation of 1 or 2 job places in each RHC, which represent a potential of 6 000 working places mainly for women (about 90% of RHCs working staff).

-Development of small business:

Dissemination of demonstration projects will make positive influence not only for development of industrial potential of local producers of equipment at the national level, but also development of small business in the country. Introduction of energy saving technologies and devices on improvement of energy and heat supply reliability will inspire additional impulse for development of this branch not only in the Health sector.

-*Gender aspects:*

An important part of RHCs' activities are dedicated to women and children (gynecology and pediatrics). So RHCs are influencing improvement of health of women and children. Provision of uninterrupted work of medical equipment and a whole system of energy and heating supply of rural health clinics comes forth as one of the main factors of improvement of quality of rendered medical services, restraining a tendency of worsening of woman's health, cutting down the cases of maternal and infantile mortality, and as a result, reduction of regional differentiation by health status indicators. The proximity of RHCs is also important for girls' health (cases of anemia, absence of knowledge on contraception, low level of warning medical services or abortion). Improving the reliability of RHCs will also improve women and girls' health.

CONCLUSIONS

Alternative power supply during cuts off:

Optimal solution to provide 500 Wh per day seems to be PV system (with capacity of 500W), but as such system represent an important investment cost, it is recommended to install only one out of 10 or more RHCs.

To complete such solution and provide an alternative to other RHCs during long duration (lengthy) power cuts off, it is proposed to incite each district to buy and put mobile generators at disposal of requesting RHCs.

For specific RHCs, not connected to the power grid, PV systems seem more appropriate (with capacity of 1000 to 2000W) associated to energy management and saving in the RHCs, especially during winter period and lighting demand.

Power consumption, demand side management:

Considering the *demand side*, the main action has to be undertaken concerning lighting: replacement of incandescent bulbs with low consumption energy efficient lamps.

Changing practice using energy consuming equipment may be another good opportunity for energy saving. Usage of parabolic solar heater for sterilization could also be tested.

Heating supply and saving:

Several solutions have been recommended depending on availability and reliability of gas supply: new efficient gas burners with regulation, liquid fuel burners adapted for replacement of gas burners, coal boilers.

On the *demand side*, priority must be given to thermal regulation and programming in order to reduce the inside temperature (and heat losses) during nights and non-working days. Thermal regulation and programming can be replicated in a large number of RHC for an investment cost less than 100 US$ and a payback period of one year.

Another energy saving potential is reduction of air leakage through windows, insulation of RHCs buildings and pipes, checking efficiency, controlling and regulating the temperature inside the buildings. Insulation can be envisaged for ceiling/roofs and/or windows (double glazing units), depending on the quality of existing materials. Training local staff in charge of RHCs maintenance on thermal diagnosis could be the first step in order to identify priorities.

<u>Global conclusion and recommendation concerning future and project extension</u>

In order to confirm which equipment may be replicated in RHCs by “Health 3” Project, I recommend taking advantage of delay to extend the demonstration phase in 2010 with a limited number of actions, which may confirm results of this first phase:

The monitoring period last only 10 months, due to “warm” winter and lack of reliability of some measures in 4 pilot RHCs (comparison of results between Umarov and Baymukhamedov RHCs is not available due to wrong timing in data collection by local staff), it could be a good opportunity to **extend the monitoring during next winter** in order to get information during at least 12 months and 2 winter seasons.

Some solutions tested during this demonstration phase do not convince with their effectiveness (solar collectors, PV systems, diesel generator are over dimensioned; UPS was not adapted to long cuts off periods), so it could be useful to **<u>test new solutions in one or two RHC(s) close to Tashkent</u>** (as Baymukhamedov and Umarov clinics):

- Small PV system (500W) used in winter, during power cuts off and rest of the year for priority medical equipment and lighting. Measurement of power saving.
- Petrol or diesel generator at disposal of RHCs during long period of power cuts off under responsibility of MoH Tashkent District. Test of feasibility and estimation of operating costs.
- Replacement of incandescent lamps with energy saving lamps and measurement of effective saving.
- Change of practice for management of energy consuming equipment, just training costs.
- Conception and testing a parabolic solar heater to reach 600°C for sterilization.
- Replacement of injection burners with diffusion burners: Confirmation of their utility even with gas low pressure.
- Buying a liquid fuel burner appropriate to replace gas burner during gas cuts off.
- Installation of thermal regulation manually managed and measurement of energy saving.
- Test of silicon (or equivalent) injection in the interstice between walls and windows frame and between windows sides for all windows of the selected RHCs.
- Installation of small electrical water heater (20 litres) if RHC is connected to water network.

Rough estimation budget for this extension:

- Referring to the synthesis table, investment cost and installation may represent: 10,000 US$
- (7,500 +300 +150 +400 +400 +250 +50 +50 +100 = 9,200$) + unexpected costs 800$.
- Procurement fees and installation to be checked by national consultants.
- Monitoring extension (using previous meters and loggers) data collection and analysis by national consultants;
- Training and checking RHC staff by national consultants and Chief of maintenance department in the Coordinating Unit of MoH.

Fees for Project Manager, National Consultants and International Consultant have to be added to investment cost:

- 6 months extension for Project Manager: = 6,500 US$
- 3x10 weeks for National Consultants: = 7,500 US$
- 2 weeks for International Consultant + travel and per diem: 6,000+2,000$ = 8,000 US$

So, rough estimation budget for 6 months extension is 10,000 + 22,000 + travel /facilities 4,000 + miscellaneous and unexpected costs (6%) 2,000 = **<u>38,000$.</u>**

ANNEXES

Annex 1. Terms of reference for International Consultant

Annex 2. Agendas of two missions to Uzbekistan

Annex 3. Project success criteria

Annex 4. Characteristics of RHCs and of the 4 selected ones.

ANNEX 1: Terms of Reference for International Consultant

Project Title:	Project of Government of Uzbekistan "Piloting Energy Efficient and Renewable Energy Solutions" supported by UNDP
Post Title:	International Consultant/Expert on Energy Efficiency and Renewable Energy Systems
Type of Assignment:	Supervising and overseeing the piloting the Energy Efficient and Renewable Energy Solutions in four rural health clinics, monitoring of the their operation, and development of a Final Report included recommendations on dissemination and replication of the optimal solutions in other rural health clinics or hospitals in Uzbekistan
Duty Stations:	Tashkent, Uzbekistan
Duration of Assignment:	17 calendar months (01.02.2008 – 30.06.2009-approx.), 30 working days
Contract Type:	SSA (full time for 30 w/d)

BACKGROUND/OVERVIEW:

At present, large-scale reforms are being executed in the public health sector of Uzbekistan. Establishment and development of the rural health clinics (primary health care) is the priority of the national policy.

The rural health clinics need reliable and uninterrupted supply of power and heat to provide up-to-standard medical services. Improving power and heat supply appears to be a key for Rural Health Clinics (RHC) being operational during working hours.

Within the framework of the UNDP's "Improving Power and Heat Supply Reliability in Health Rural Clinics of Uzbekistan" Project (2007), technical and economic assessment of options in order to equip the rural health clinics with Energy Efficient (EE) and Renewable Energy (RE) systems, notably the plants that transfer solar energy to electric and thermal power that can be integrated into existing conventional energy infrastructure to improve reliability of power and heat supply has been implemented.

The options proposed have been adjusted to the relevant budget resources available in rural health clinics and to the budget for medical equipment. They have to ensure efficient use and saving of energy and fuel, to be coherent with budget available and to be replicable at a large scale.

The UNDP Project "Piloting Energy Efficient and Renewable Energy Solutions in Rural Health Clinics of Uzbekistan" will test and demonstrate the EE and RE solutions proposed four representative rural health clinics (UMAROV, BAYMUKHAMEDOV, DJEYKHANABAD, and JUZIM-BOG) and will prove their feasibility and viability with a sound justification to replicate these optimal solutions at a large scale in rural health clinics in different provinces of the country within the WB Health-2 project.

OUTCOME OF THE ASSIGNMENT

The end result of assignment will be a Final Report on piloting the Energy Efficient and Renewable Energy Solutions in four rural health clinics that will include

- Testing and demonstration of Energy Efficient and Renewable Energy technological options selected for each of four rural health clinics;
- Monitoring of pilots in four rural health clinics covering all seasons.

<u>POST PROFILE</u>

The task of the International Consultant will be to ensure that essential steps in the process of piloting the Energy Efficient and Renewable Energy Solutions in four rural health clinics and preparation of the Final Report are undertaken.

To this end, the International Consultant will be responsible for mobilizing and leading national technical experts for planning and effectively undertaking the required surveys and preparatory field work, establishing dialogue and a working relationship with stakeholders (funding partners, national counterparts and local communities), and the timely delivery of the agreed documents.

Under the direct supervision of the Project Manager, overall guidance of UNDP's Head of Environment & Energy Unit and in close cooperation with Renewable Energy Adviser and group of National Consultants, the International Consultant/ Expert on Energy Efficiency and Renewable Energy Systems (acting in his/her individual capacity) will be tasked with the following duties and responsibilities:

Activity 1 – Equipping four rural health clinics with Energy Efficient and Renewable Energy equipment

***Task 1* Installation of metering equipment**

- To design metering installation in four rural health clinics;
- To supervise and oversee installation of electricity, natural gas, hot and cold water meters, temperature sensors, and power cuts recording equipment in each of four rural health clinics.

***Task 2* Carrying out the thermal diagnosis**

- To design thermal diagnosis for one rural health clinic (BAYMUKHAMEDOV);
- To assess results of thermal diagnosis conducted and provide with the follow-up recommendations.

***Task 3* Development of technical specifications and tender procurement of equipment**

- To supervise development of technical specification for EE and RE equipment proposed for each of four rural health clinics;
- To oversee the tender based procurement of the equipment specified.

***Task 4* Installation, adjustment, and commissioning the EE and RE equipment proposed for each of four rural health clinics**

- To oversee installation, adjustment, and integration of the EE and RE equipment into the conventional energy infrastructure of each of four rural health clinics based on the designs elaborated during the Feasibility Study phase;
- To oversee commissioning, operation and maintenance of the equipment and metering installed.

Activity 2 – Monitoring the pilot rural health clinics

***Task 1*. Design of Monitoring Program**

- To elaborate clear criteria on what would be considered as success of the pilot in collaboration with the Ministry of Health and the team of the World Bank that will serve as a basis for evaluation of the results of the demonstration project;
- To revise the initial baseline assessment made during the feasibility study phase using the metering installed and set up of new targets based on the project success criteria elaborated and approved;
- To consider potential risk and assumptions that might impact on the demonstration project implementation and success;
- To design a Monitoring Program to assess performance of the EE and RE equipment installed, and gain the practical experience, reliable data and information that will serve as a basis for elaboration of a Final Report.

***Task 2*. Conducting the Monitoring Program**

- To supervise and oversee collecting the relevant metering records related to equipment operation, power and heat consumption, duration and frequency of power cuts and natural gas pressure drops in four piloting rural health clinics;
- To analyze data and information collected;

- To estimate potential for CO_2 emission reduction due to utilization of EE and RE equipment installed in rural health clinics.

<u>Task 3</u>. Financial and economic assessment of technical solutions implemented

- To assess the technical solution implemented and justify their financial viability;
- To assess financial benefits received as a result of reduction in fuel and natural gas consumption;
- To explore options how potential benefits can be reinvested into sustainable operations of the innovative energy equipment in rural clinics.

<u>Activity 3 – Formulation of the Final Report</u>

<u>Task 1</u>. Analysis of monitoring results

- To elaborate profound and concise explanations that justify why and how the implemented technical solutions meet the demands of rural clinics in uninterrupted and reliable supply of energy, based on the monitoring program results.

<u>Task 2</u>. Development of recommendations

- To prepare recommendations on dissemination and replication of the optimal solutions in other rural health clinics or hospitals in the country.
- To elaborate a proposal on potential of CO_2 emission reduction after dissemination in other rural health clinics (3,000) located over the country.

<u>Task 3</u>. Preparation of Final Report

- To formulate the Final Report that will be a final output of the project included the analysis of monitoring results, financial and economic assessment of technical solutions implemented, and recommendation for their further dissemination and replication in other rural health clinics and hospitals to be undertaken by these stakeholders.

<u>OUTPUTS OF THE ASSIGNMENT</u>

- Report on design of metering installation prepared;
- Report on design of thermal diagnosis for BAYMUKHAMEDOV rural health clinic prepared;
- Report on assessment of thermal diagnosis results prepared;
- Technical specification for EE and RE equipment prepared;
- Tender based procurement of EE and RE equipment announced;
- EE and RE equipment installed, adjusted and integrated into the conventional energy infrastructure of each of four rural health clinics;
- EE and RE and metering equipment commissioned and operational;
- Criteria for evaluation of the demonstration project success clearly defined;
- Revised baseline determined and new targets set up;
- Revised Logframe matrix ;
- Report on design of Monitoring Program prepared;
- Report on analysis of the recorded data and collected information prepared;
- Report on potential for CO_2 emission reduction due to introduction of EE and RE equipment in rural health clinics;
- Report on assessment the technical solution implemented and justifications on their financial viability prepared;
- Report on assessment the financial benefits received as a result of reduction in fuel and natural gas consumption prepared;
- Report on options how potential benefits can be reinvested into sustainable operations of the innovative energy equipment in rural clinics prepared;

- Report on justification why and how the implemented technical solutions meet the demands of rural clinics in uninterrupted and reliable supply of energy, based on the monitoring program results prepared;
- Recommendations on dissemination and replication of the optimal solutions in other rural health clinics or hospitals in the country elaborated;
- Proposal on potential of CO_2 emission reduction after dissemination in other rural health clinics (3,000) located over the country developed;
- Final Report that will be a final output of the project formulated and submitted.

LIST OF DELIVERABLES AND TIME-LINE

Deliverable	***Deadline***
Deliverable 1: Report prepared on equipping four rural health clinics with Energy Efficient and Renewable Energy equipment	31 July 2008
Deliverable 2 : Monitoring Report prepared	15 September 2008
Deliverable 3 : Final Report formulated	15 June 2009

REPORTING:

The International Consultant must ensure timely preparation and submission of a comprehensive Final Report (i) assessment of monitoring data collected from four piloting rural health clinics; (ii) financial and economic assessment of technical solutions implemented to improve power and heat supply reliability in four rural health clinics selected; (iii) recommendations on dissemination and replication of the optimal solutions in other rural health clinics or hospitals in the country. All reports must be submitted in English to the UNDP CO in Uzbekistan and made in accordance with UNDP's requirements to reporting.

REQUIRED SKILLS, EXPERIENCE AND TECHNICAL CAPABILITY

- At least ten (10) years of working experience as a specialist in the field of energy, and EE and RE systems/applications;
- Academic qualification in energy, with specialization in power and heat supply. He/she must have knowledge of energy economics ;
- Practical experience in implementation and monitoring of pilot and demonstration projects related to utilization of EE and RE systems, working experience in developing countries and CIS countries is an asset;
- Practical experience in financial and economic analysis in accordance with requirements and based on criteria applied by the international financial institutions (World Bank)
- Good ability in partnering and networking;
- Proficiency in English, excellent drafting skills; preferably knowledge of written and spoken Russian and/or local language;
- Excellent interpersonal and cross-cultural communication skills;
- Previous experience of working in Uzbekistan will be an asset.

Approved by:

Mr. Anvar Nasritdinov, Head of E&E Unit __________________ __________________

Signature Date

ANNEX 2: Agenda of the two missions of I.C. in UZBEKISTAN

2.1. Agenda of the first mission of. Yves LAMBERT, International Consultant to Uzbekistan, 21 – 28 October 2008.

October 20th, 2008	Departure from home at 7:15 to Paris by train and at 14:10 by Air Baltic flight BT 742, via RIGA.	

Day 1. October 21, 2008, Tuesday

06:00 – 07:00	Arrival in Tashkent International Airport.	Tashkent International Airport
07:00 – 09:00	Rest in the Hotel.	Hotel "Poytakht".
09:15 – 10:30	Meeting with PM and national consultants (project progress, equipment installation status on project sites, eventual problems, unforeseen difficulties and solutions)	UNDP CO meeting room (2nd floor). YL, KU, 7 national experts.
11:00 – 12:00	Meeting with Mr. Shavkat Isametdinov, ENKOM – SOLAR Company Director	UNDP CO meeting room (2nd floor). YL, SI, KU.
12:00 – 14:00	Lunch break	Discussion YL-KU.
14:30 – 15:30	Meeting with Mr. Farrukh Khisamov, UNDP Procurement Unit assistant	UNDP CO meeting room (2nd floor). YL, FKh, KU.
16:00 – 17:00	Meeting with Mr. Anatoliy Khristich, FOTON Company Technical Director	UNDP CO meeting room (2nd floor). YL, KU.

Day 2. October 22, 2008, Wednesday

09:00 – 17:00 17:00 – 19:00	Travel to Djeykhanabad RHC by project car, commissioning / official hand over of EE and RE equipment installed. Meetings with the Head of RHC and persons in charge of equipment maintenance and monitoring in order to consider their knowledge and capacity to maintain and monitor the equipment installed. Work in the hotel	Tashkent region, Bostanlik district, Nanay regional center. YL, KU, 4 national experts. YL

Day 3. October 23, 2008, Thursday

09:15 – 14:15 14:30 – 18:00	Travel to Baymukhamedova RHC by project car, commissioning / official hand over of EE and RE equipment installed. Meetings with the Head of RHC and persons in charge of equipment maintenance and monitoring in order to consider their knowledge and capacity to maintain and monitor the equipment installed. Meeting with Mr. Bahadir Ergashev, NPC, Ministry of Health of Uzbekistan Work in the hotel	Tashkent region, Keles district. YL, KP, AN, KU, 7 national experts YL.

Day 4. October 24, 2008, Friday

09:15 – 15:20	Travel to Umarova RHC by project car, commissioning / official hand over of EE and RE equipment installed. Meetings with the Head of RHC and persons in charge of equipment maintenance and monitoring in order to consider	Tashkent region, Tashkent district, YL, KU, 4 national experts.

15:30 – 19:15	their knowledge and capacity to maintain and monitor the equipment installed. Work in the hotel	YL

Day 5. October 25, 2008, Saturday

09:00 – 10:30 + 13:00 – 17:00	Work in the hotel, preparation of the Report on equipping four RHCs with EE and RE equipment and devices.	Hotel “Poytakht”, Tashkent YL

Day 6. October 26, 2008, Sunday

09:00 – 18:00	Work in the hotel, preparation of the Report on equipping four RHCs with EE and RE equipment and devices.	Hotel “Poytakht”, Tashkent. YL

Day 7. October 27, 2008, Monday

09:30 – 10:00	Meeting with the Ms. Flora Salikhova, Human Development Expert	World Bank Country Office. YL, KU.
10:15 – 11:45	Meeting and discussion with the Project Manager	Project Manager office. YL, KU
12:00 – 13:00	Meeting with the Mr. Asomiddin Kamilov, Deputy Minister of Health and with Mr. Djamshid Maksumov and Ms. Roza Mukhamediyarova, “Health-2” Project, (confirmation of expectations from installation and concerning monitoring of equipment)	Ministry of Health of Uzbekistan. YL, BE, KU, ST.
13:00 – 14:00	Lunch break	Place TBC
14:30 – 15:00	Meeting with Ms. Yuka Sonoyama, JICA Assistant Resident Representative	Japan International Cooperation Agency Country Office. YL, KU.
15:30 – 16:00	Closure meeting with Mr. Anvar Nasritdinov, Head of EE Unit of UNDP CO	UNDP CO Meeting room (2nd floor) AN, YL, KU, SYu.
16:00 – 17:30	Closure meeting with PM, national experts in order to define the actions for the next months and confirm the monitoring plan.	UNDP CO Meeting room (2nd floor) YL, KU, 7 national experts.

03:55a.m. Tuesday, October 28, 2008.	Departure to Paris (via Riga) by Air Baltic flight BT 743. Arrival in Paris at 13:30 and at home at 19:00	Tashkent International Airport.

Abbreviations:

RHC – Rural Health Clinic
KP – Kyoko Postill, UNDP Deputy Resident Representative
AN – Anvar Nasritdinov, UNDP Head of Environment and Energy Unit
YL – Yves Lambert, International Consultant
RM -- Ravsham Muminov, Head of Tashkent Regional Administration of the Ministry of Health
BE – Bakhodir Engashev, National Project Coordinator, Ministry of Health
RG -- Rosa Galievna Mukhamediyarova, “Health-2” Project Coordinator, JBPR
KU – Kakhramon Usmanov, Project Manager
ST – Svetlana Tsoi, National Expert on relations with RHCs
FKh – Farrukh Khisamov, UNDP Procurement Assistant
SYu – Saida Yusupova, UNDP Environment and Energy Unit Assistant

2.2. AGENDA of the second mission of. Yves LAMBERT,
International Consultant to Uzbekistan, 6 to 13 October 2009

October 05th, 2009	Departure from Paris by Air Baltic flight BT 742	

Day 1. October 06, 2009, Tuesday

02:00	Arrival in Tashkent International Airport by Air Baltic flight BT 742 в 01:35 a.m.	Tashkent International Airport
03:00 – 09:00	Rest in the Hotel.	Hotel "Poytakht".
09:30 – 11:30	Meeting with PM and national consultants (project progress, monitoring process status on project sites, eventual problems, unforeseen difficulties and solutions)	UNDP CO meeting room YL, KU, 4 national experts.
11:30 – 12:30	Meeting with FOTON Company Technical Director	UNDP CO meeting room YL, AKh, KU.
12:45 – 13:45	Lunch break	Place TBC.
14:00 – 15:00	Meeting with UNDP Climate Change Specialist	UNDP CO meeting room YL, RB, KU.
15:20 – 16:10	Meeting with the National Project Coordinator, Ministry of Health of Uzbekistan	Tashkent city Department of the Ministry of Health. BE, YL, KU.
16:30 – 19 :00	Work in the hotel, final elaboration of the Report on monitoring of four RHCs with EE and RE equipment and devices.	Hotel "Poytakht", Tashkent.

Day 2. October 07, 2009, Wednesday

08:15 – 12:15	Travel to Baymukhamedov and Umarov RHCs by project car, conducting monitoring of EE and RE equipment installed. Meetings with the Heads of RHCs and persons in charge of equipment maintenance and monitoring.	Tashkent region, Keles district. YL, KU, 2 national experts.
14:15 – 19:00	Work in the hotel, final elaboration of the Report	

Day 3. October 08, 2009, Thursday

08:15 – 12:30	Travel to Djeykhanabad RHC by project car, conducting monitoring of EE and RE equipment installed. Meetings with the Head of RHC and persons in charge of equipment maintenance and monitoring.	Tashkent region, Bostanlik district, Nanay regional center. YL, KU,
14:00 – 18:30	Work in the hotel, final elaboration of the Report	

Day 4. October 09, 2009, Friday

05:45 – 22:30	Travel to Juzim-Bog RHC by air (HY1001 and 1008 return flight) conducting monitoring of EE and RE equipment installed. Meetings with the Head of RHC and persons in charge of equipment maintenance and monitoring.	Kegely District, Nukus, Republic of Karakalpakstan. YL, RB, KU.

Day 5. October 10, 2009, Saturday
Day 6. October 11, 2009, Sunday

09:00 – 18:00	Work in the hotel, preparation of the Final Report on monitoring of four RHCs with EE and RE equipment and devices.	Hotel "Poytakht", Tashkent.

Day 7. October 12, 2009, Monday

09:30 – 10:30	Meeting with the Director and Coordinator of "Health-2" Project, Joint Bureau of Project Realization (confirmation of expectations from demonstration project)	Office of JBPR. YL, KU, DjM, RM.
11:00 – 11:30	Meeting with the Representative of the World Bank	World Bank Country Office.

	mission in Uzbekistan (Health-3 Project)	YL, SH, KU.
12:00 – 13:00	Meeting with the Deputy Minister of Health of Uzbekistan	Ministry of Health of Uzbekistan. YL, AK, BE, KU.
13:00 – 14:00	Lunch break	Place TBC
14:30 – 15:00	Meeting with JICA Assistant Deputy Resident Representative	Japan International Cooperation Agency Country Office. YL, Sh.T, KU.
15:30 – 16:00	Closure meeting with the Deputy Resident Representative and Head of E&E Unit of UNDP CO	UNDP CO Meeting room (2nd floor) YL, KP, AA, RB, KU, MSh.
16:00 – 17:30	Closure meeting with PM, national experts of the project.	UNDP CO Meeting room (2nd floor) YL, RB, KU, 4 national experts.

October 13, 2009, Tuesday

Tuesday, October 13, 2009.	Departure to Paris by Air Baltic flight BT 743 at 02:35.	Tashkent International Airport.

Abbreviations:

RHC – Rural Health Clinic
KP – Kyoko Postill, UNDP Deputy Resident Representative
AA – Abduvakkos Abdurahmanov, UNDP Head of Environment and Energy Unit
YL – Yves Lambert, International Consultant
RB – Rano Baykhanova, Climate Change Specialist, UNDP CO
BE – Bakhodir Engashev, National Project Coordinator, Ministry of Health
AK – Asamiddin Kamilov, Deputy Minister of Health
DjM – Djamshid Maksumov, Director of “Health-2” Project, JBPR
RM – Roza Mukhamediyarova, Coordinator of “Health-2” Project, JBPR
ShT – Shinji Totsuka, Assistant Deputy Resident Representative, JICA in Uzbekistan
SH – Susanna Harapetyan, Coordinator of Health-3 Project, WB in Uzbekistan
AKh – Anatoliy Khristich, Technical Director, Foton Company
AT – Akajon Tursunov, Technical Director, Enkom-Solar Company
EB – Elvira Bikeyeva, National Consultant on energy economics
KU – Kakhramon Usmanov, Project Manager
MSh – Makhmud Shaumarov, UNDP Environment and Energy Unit Programme Associate

ANNEX 3. Project Success Criteria
Classification of criteria for selection of solutions

Table 8.1 List of criteria and classification made by nine stakeholders

Criteria and explanation concerning criteria	Very important	Important	Medium	Not important	Not relevant
Avoid medical risks (if shortage of power or heating supply): wrong diagnosis and/or wrong treatment, infection, not proper sterilization	**8**		1		
Reduction of economical damage (drugs or vaccines losses, losses of working time, etc.)	**5**	3	1		
Reliability of equipment to ensure at least 95% of service required	**6**	1	1		
Lifetime of equipment: at least 5 years		**5**	2		1
Lifetime of equipment: 10 or 20 years		**6**	3		
Importance of cost compared with medical equipment costs*. (*considering the costs for medical equipment , comparison with costs for improving energy)*	3	3	2		
Replicable for dissemination to other RHC at a cheap price:(*some solutions are very specific to a RHC, some other could be more replicable at a large scale and reasonable cost)*	**4**	2	1		
Show room for long term dissemination: (*solutions innovative but often expensive, interesting and reliable for the future)*	1	**4**	1	1	
Participation to development of local production: (*preference for solutions which include local products better than imported)*	2	**3**	2		
Easy for operation and maintenance by local RHC staff	2	**7**			
Opportunity to reduce operational costs of RHC	1	**6**	1	1	
Energy saving and reduction of CO_2 emissions	1	1		1	

* A rough estimation of the cost of priority (1 & 2) medical equipment is 3000 US$

Criteria and explanation concerning criteria	Very important	Impor-tant	Medium	Not important	Not relevant
Avoid medical risks (if shortage of power or heating supply): wrong diagnosis and/or wrong treatment, infection, not proper sterilisation,	x				
Reduction of economical damage (drugs or vaccines losses, losses of working time, ….)		x			
Reliability of equipment to ensure at least 95 % of service required		x			
Life time of equipment: at least 5 years		x			
Life time of equipment: 10 or 20years			x		
Importance of cost compared with medical equipment costs.	x				
Replicable for dissemination to other RHC at a cheap price		x			
Show room for long term dissemination		x			
Participation to development of local production			x		
Easy for operation and maintenance by local RHC staff		x			
Opportunity to reduce operational costs of RHC			x		

Table 8.2 Classification of solutions regarding the different criteria

Criteria	Solutions
Avoid medical risks (if shortage of power or heating supply): wrong diagnosis and/or wrong treatment, infection, not proper sterilization	Power supply and heat supply whatever the solution is
Reduction of economical damage (drugs or vaccines losses, losses of working time, etc.)	Efficient refrigerator with a large autonomy plus power and heat supply.
Reliability of equipment to ensure at least 95% of service required	Selection of medical equipment with their own autonomy + a minimum of comfort in the RHC to provide services.
Lifetime of equipment: at least 5 years	Petrol generator, accumulators, power saving lamps
Lifetime of equipment: 10 or 20 years	PV systems, solar water heaters, new and efficient gas boilers, electrical water heaters
Importance of cost compared with medical equipment costs. (*considering the costs for medical equipment , comparison with costs for improving energy)*	Accumulators, PSL, automatic regulation of temperature.
Replicable for dissemination to other RHC at a cheap price:(*some solutions are very specific to a RHC, some other could be more replicable at a large scale and reasonable cost)*	Accumulators, PSL, automatic regulation of temperature
Show room for long term dissemination: (*solutions innovative but often expensive, interesting and reliable for the future)*	PV systems, solar water heaters, efficient gas boilers
Participation to development of local production: (*preference for solutions which include local products better than imported)*	PSL, PV panels, solar collectors, gas boilers, electricity meters.
Easy for operation and maintenance by local RHC staff	PSL, PV systems, solar water heaters, automatic regulation
Opportunity to reduce operational costs of RHC	PSL, automatic regulation, PV and solar panels if someone else pay for investment
Energy saving and reduction of CO_2 emissions	Efficient gas boilers, automatic regulation, PV systems (refer to Section 7.7.)

SUCCESS CRITERIA
for realization of the Demonstration Project "Piloting Energy Efficient and Renewable Energy Solutions in Rural Health Clinics (RHCs) of Uzbekistan".

Situation Analysis

1) Priority medical equipment and devices for rendering emergency medical care (such as EKG, laboratory analysis) do not work during the power supply cuts off from the power network
2) Power cuts off bring to spoilage of medical reagents (for example, general blood test etc.), as a result of frequent power supply cuts off, storage of analysis in required conditions (for instance, in refrigerators at corresponding temperature) is not ensured, which may bring to mistaken diagnosis and as a result of this – an incorrect treatment of patients;
3) Sterilizing devices do not work during power supply cuts off, which may bring to infection of medical instruments and materials; some medicines and vaccine are also kept in refrigerators, power supply cuts off also bring to loss of their quality because of not provision of proper conditions, which decreases/excludes their medical effectiveness.
4) Some medicines and vaccine are kept in refrigerators, power supply cuts off lead to their worthlessness because of not provision of proper conditions, which results in material losses, spent for their procurement, or additional costs occur for procurement of new medicines instead of worthless ones.
5) Some of the technical solutions and equipment on renewable energy (for example, solar photovoltaic systems) for improvement of reliability of power supply of RHCs are currently expensive (with long pay-back period) because of unequal tariffs for energy carriers (subsidized or noticeably smaller compared to the world prices for an energy)
6) Use of energy efficient, energy saving and renewable energy equipment of foreign production poses certain problems with after-sale warranty service, supply of spare parts, and at the same time, existing local production sometimes loses foreign models in quality and design of the equipment, although the equipment of local production is better adapted to local conditions and peculiarities (quality of power, water, gas supply, qualification level of personnel/workers)
7) Actual consumption of power and heating energy in RHC exceeds national and world standards, necessary heating and hot water supply is not provided, heavy heat losses from RHC building are still there, inefficient energy consumption leads to overcharge of natural gas, which negatively effects the environment and makes its contribution to the climate change.

2. Project related log frame:

#	Output	Baseline	Indicator	Target	Time frames
1	Energy (electric and thermal) is available in four pilot rural health clinics during power cuts off or problems with natural gas supply	As informed by RHCs staff, there are interruptions in power and heat supply due to unstable gas supply and power cuts off, especially in winter, that made medical and heating equipment not operational	1. The range of (a) electrical power/capacity (in kWt/h); (b) thermal power/capacity (in kWt/h.). 2. Temperature (degrees centigrade/ Celsius) inside refrigerator 3. Temperature (degrees centigrade/ Celsius) inside medical rooms	1. The range of (a) electrical power/capacity within 500Wt and 5 kWt/h. For daily production - from 2 kWt/h till 15 kWt/h, taking into account possibilities of autonomous operation during 6 hours and 2 days. (б) thermal capacity within 152 and 168 kWt/h 2. 4-8 ^{0}C registered inside the refrigerator 19 ^{0}C registered inside the medical rooms	Till August of 2008.
2	Designated staff-members in four RHCs are able to conduct O&M of energy reserving systems installed	RHCs staff provides O&M of conventional energy systems and is not familiar and not able to operate the EE and RE systems installed	Number of staff trained and certified (persons) in RHCs able to carry out O&M of the EE and RE systems installed	4 persons minimum (Per 1 trained staff from each RHC. Number of personnel trained may increase depending on quantity, type and complexity of maintenance of the equipment installed).	Till September of 2008.
3	Energy efficient, energy saving and renewable energy equipment procured locally and/or internationally is available in four RHCs	Conventional power and heat supply systems used fossil fuels are only available in RHC	1. Certificate of supplier for delivery of equipment and carrying out its O&M in Uzbekistan; 2. Guarantee period (years) for the equipment supplied	1. Selection of optimal supplier with possibility of carrying out local technical maintenance of EE, energy saving and RE equipment installed; 2. Warranty period – not less than 1 year depending on type of equipment.	Till 20 June 2008.
4	Energy consumption of RHC is not increased due to use of energy efficient, energy saving and renewable energy equipment	Actual consumption of power and heating energy in RHC exceeds national and world standards	% of energy consumption reduction	Energy consumption of RHC reduced due to application of EE and EE technical solutions piloted in each of four RHCs	Till 30 November 2008

3. <u>Outside of Project log frame: (Outcomes/Impacts)</u> – longer term changes that require energy and resources of multiple partners.

#	Output	Baseline	Indicator	Target	Means of verification and indicator measurement
1	Quality of RHC medical care services to population improved	When power cut off takes place in RHC, medical services to patients are not provided as medical equipment is not operational	No one registration of undelivered priority medical service during power cut off	Priority medical services provided during power cuts off due to use of power reservation systems	Log file of provided priority medical services to patients during power cuts off
2	Medical risks and economic damage associated with lack of power and heat supply are prevented	Power cuts off bring to spoilage of medical medical reagents; sterilizing devices and refrigerators where medicals and vaccine are kept do not work; poor working conditions for medical staff and lack of comfort for patients during unstable gas supply	1) No one registered mistaken diagnosis and incorrect treatment of patients; 2) Not even a single additional request for vaccine or additional costs from RHC budget for procurement of medicines because of their spoilage due to power supply cuts off; 3) Temperature (degrees centigrade/ Celsius) inside refrigerator 4) Temperature (degrees centigrade/ Celsius) inside medical rooms	Medical reagents, medicals and vaccine are in good conditions as refrigerators work and keep required temperature, and sterilizing devices are operational during power cuts off; heat and hot water supply are always available	1) Records on patients complaints and conclusions of medical inspection; 2) Official statements on medicals and vaccine spoilage explained by lack of power and purchase orders for new medicals and vaccine to replace the spoiled; 3) Log file with temperature records for refrigerators; 4) Temperature sensor recordings
3	RHC make savings from payment of electricity and gas supply charges	Actual consumption of power and heating energy in RHC exceeds national and world standards	1) % of energy consumption reduction 2) % of financial savings	Energy consumption of RHC reduced due to application of EE and EE technical solutions piloted in each of four RHCs	Comparative analysis of energy consumption and associated economic benefits

ANNEX 4. CHARACTERISTICS OF RHCs AND OF 4 SELECTED ONES

Table 1.1 General characteristics of selected rural health clinics

Type of characteristics	Umarov	Baymukhamedov	Djeykhanabad	Juzim-Bog
Location area	Tashkent province, Tashkent District	Tashkent province, Tashkent District	Tashkent province, Bostanlyk District	Republic of Karakalpakstan, Kegely District
Location description	Plain	Plain	Mountain terrain	Plain (Aral Region)
Number of persons in service	4,728	5,139	10,000	4,851
Type of RHC	2	2	3	3
Normative number of visits per day time shift (capacity of clinic)	50	50	50	50
Actual number of visits per day	25-30	25-30	35-40	20-30
Availability of in-patient (hospital) department	day care	day care	twenty-four hours	day care
Type of provided services	Therapy, obstetrics and gynecology pediatrics, inoculations, vaccination, blood examinations, physiotherapeutic procedures	Therapy, obstetrics and gynecology pediatrics, stomatology, inoculations, vaccination, blood examinations, physiotherapeutic procedures	Therapy, obstetrics and gynecology, pediatrics, inoculations, vaccination, blood examinations, physiotherapeutic procedures	Therapy, obstetrics and gynecology pediatrics, stomatology, inoculations, vaccination, blood examinations, physiotherapeutic procedures

Source: Abstracts of national consultants' reports

Table 1.2 Characteristics and representativity of selected rural health clinics

Characteristics of RHC	At national level	%	In three province with selected RHCs	%	In five rural health clinics selected	%
Total number of RHCs	3,080	100	645	100	5	100
Newly built	1,157	38	260	40	2	40
Reconstructed	1,923	62	385	60	3	60
Type 1	264	9	33	5	-	-
Type 2	1,531	50	209	32	2	40
Type 3	1,030	33	218	34	3	60
Type 4	255	8	186	29	-	-
Population	15,398,540	100	3,948,425	26	42,926	0.28

Heating gas	2,199	71	452	70	4	80
Heating coal	1,032	33	172	27	1	20
Heating electricity	347	11	48	7	-	-
Cold water connected	1,906	62	275	43	-	0
Cold water transported	1,155	38	370	57	5	100
Hot water boiler	1,180	38	223	36	1	20
Electricity (grid power)	2,674	87	645	100	5	100
Centralized sewage	60	2	29	4	-	-
Sewage locally treated	3,003	98	616	96	5	100
Telecommunication	1,645	53	293	45	4	80
Radio station	91	3	11	2	-	-
Car	228	7	37	6	-	-
% of RHC with medical equipment provided by “Health-2” project	N/A		N/A		35	

Source: Ministry of Healthcare

Table 3.5 Power consumption and expenses for utilities (power, natural gas and coal) in selected rural health clinics

Annual energy consumptions	**Name of RHC**				
	Umarov	**Baymukhamedov**	**Djeykhanabad** (Hospital+RHC)	**Pahtakor**	**Juzim-Bog**
Electricity consumption, kWh:					
2004	1,172	1,789	61,860	N/A	N/A
2005	978	1,889	143,960		
2006	1300	2,300	83,441		
Electricity expenses, 1,000 UZS:					***Tariff / kWh***
2004	31.9	48.6	1261.7	47.7	23.56
2005	31.2	57.2	4436.5	61.9	32.07
2006	(468*) 49.4	90.8	2956.9	(104*) 46.0	(91*) 36.21
Natural gas consumption, m^3:			***Coal in tons***		
2004	1,300	2,900	186.3	N/A	N/A
2005	1,105	3,300	158.5		
2006	1,200	2,500	249.4		
Natural gas expenses, 1,000 UZS:			***Coal in tons***		***Tariff / m^3***
2004	40.9	91.3	1,352.0	48.4	28.07
2005	45.7	135.0	1,130.4	360.6	38.66
2006	(572*) 49.7	103.5	2,176.6	(395*) 386.1	(524*) 40.85
Comparison with average expenditures of RHC in Fergana region (source is the Ministry of Healthcare)	RHC type 1	RHC type 2	RHC type 3	RHC type 4	

Electricity consumption, kWh: 2004 2005 2006	 6,726 7,539 7,886	 16,815 18,847 19,716	 20,178 22,617 23,659	 16,815 22,619 23,661
Electricity expenses, 1,000 UZS: 2004 2005 2006	 158.5 241.6 297.5	 396.3 604.0 744.8	 475.6 724.8 893.8	 396.4 725.1 893.9
Natural gas consumption, m³: 2004 2005 2006	 6,837 6,468 4,149	 17,093 16,172 10,373	 20,512 19,406 12,447	 17,094 19,409 12,449
Natural gas expenses, 1,000 UZS: 2004 2005 2006	 194.8 236.1 188.7	 487.2 590.3 471.9	 584.6 708.3 566.4	 487.2 708.4 566.5
Coal consumption, tons: 2004 2005 2006	 10.7 12.6 -	 26.9 31.5 32.0	 32.3 37.9 45.3	 27.1 38.0 62.7
Coal expenses, 1,000 UZS: 2004 2005 2006	 104.5 122.5 -	 261.4 306.4 316.1	 313.7 367.6 476.1	 261.6 367.8 626.4

Note: *** -** Data provided by the Ministry of Healthcare

1. Brief description of the rural health clinic (RHC).
2. Description of the building condition
    - 2.1 General conditions
    - 2.2 Architectural-construction characteristics of the building
    - 2.3 Heating system
    - 2.4 Hot water supply system (HWSS).
3. Energy consumption
4. Thermal diagnosis
    - 4.1. Thermal characteristics of the building
    - 4.2. Total heat losses through the building elements and heating supply system
5. Energy saving arrangements.

6. Technical-economic analysis.
7. Conclusion
7.1 Energy monitoring system
7.2. Proposals on energy monitoring

Example of report on energy investigation of heating and hot water supply systems as well as heat losses in «Baymukhamedova» RHC

1. Brief description of the Baymukhamedov RHC.

«Baymukhamedova» RHC is located in Tashkent region of Tashkent District. The general characteristic of the area - flat country.
Planned number of visits per day – 50. Actual number of visits per day – 25-30.
Total number of personnel – 18 persons.

2. Description of the building condition

2.1 General conditions

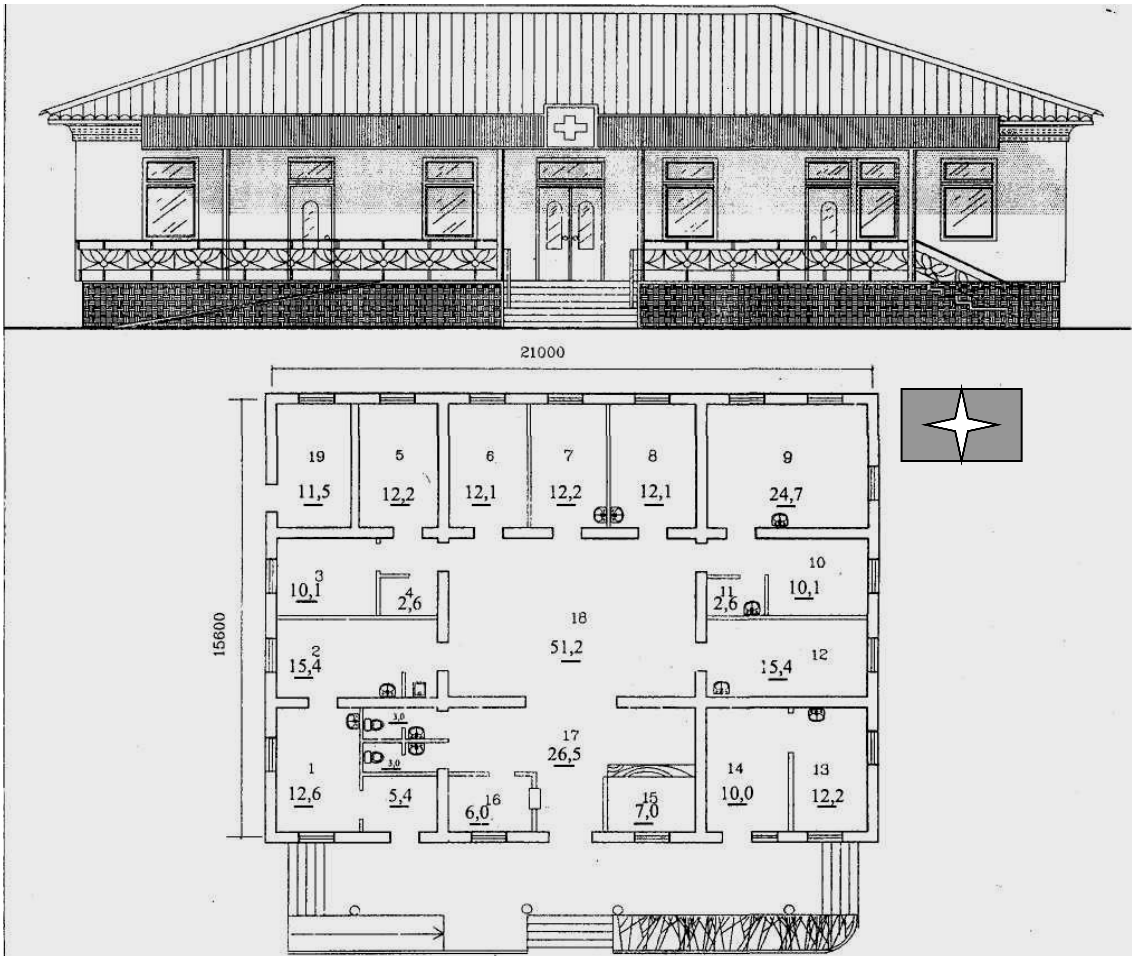
Heated area	292 m^2 .
Construction year:	2002
Microclimate in the building:	Required temperature in all rooms – 20 ^{0}C, on weekends and holidays – 14 ^{0}C. In winter period the problems occur with low temperature and draughts in consulting rooms because of incompactness of windows. In summer period the temperature in rooms is frequently above the line.
RHC cleaning order:	The floor in the building is washed twice daily.
Running and maintenance:	Operation and maintenance manual of heating supply system of the building is absent. There is the only staff member, who at the same time maintains the heating, water and power supply systems.
Energy metering device:	The gas meter is installed in boiler room.
Water supply:	Water supply – imported and supplied from storage tank with volume of 3 m^3.
Energy monitoring system:	Energy monitoring system in the building is absent.

2.2 Architectural-construction characteristics of the building

The RHC building is of square shape with the sides 2100 x 1560 mm and are aligned strictly by world sides (Picture 1). total number of rooms (without halls and corridors) – 16.

External walls:	External walls of the building of 400 mm thickness are made from baked brick and covered by plaster from cement of 10mm thickness from both sides, walls heat-transfer coefficient - 1.41 W/m² ^{0}C
Windows:	Window frames – wooden деревянные single glazing. Shading is absent. Windows heat-transfer coefficient - 6.67

	$W/m^2\ {}^0C$
Ceiling:	Overhead cover is from reinforced concrete slabs, haydite and adobe (cob) layer. Ceiling heat-transfer coefficient – 1.06 $W/m^{2\,0}C$
Floor	Floor cover is from reinforced concrete slabs, cement lining, linoleum. Ceiling heat-transfer coefficient – 2.48 $W/m^2\ {}^0C$
Roof:	roof timbers wooden, roof is covered by metal tiling.
Construction year:	2002
Visual damages:	No
External heat-release surfaces:	Surface of walls - 246.47 m² Surface of windows - 37.62 m² Ceiling area - 292 m² Floor area - 292 m² Rooms height in light - 2.9 m



Picture 1. Architectural – construction plan/scheme of the building of RHC «Baymukhamedova»

1. Midwife’s room. 2. Room for patients' examination. 3. Makeshift/temporary room for patients. 4. Inventory/household keeping room. 5. Makeshift/temporary room for patients. 6. Laboratory. 7. Sterilization room. 8. Medical/treatment – manipulative room. 9. Physiotherapy room. 10. Functional diagnostics. 11. Households room. 12. Consulting room. 13. Inoculations room. 14. Health visitor. 15. Registration office. 16. Pharmaceutical kiosk. 17. Entrance hall. 18. Hall. 19. Boiler room.

2.3 Heating system

Energy production:	The sources of energy supply are two self-made boilers installed in a separate room. The boilers work by nonvolatile scheme. Heat supply of the building is carried out without taking into account the operating running regime of the building. At night hours, as well as weekends and holidays, the automatic regulation of heat supply is absent.
Heating system:	Heating system – well-type (single-pipeline) radiator type, basement distribution. In boiler room the pipelines of heating system do not have thermal isolation. There is no leaking in the system, but, as expected, system is not balanced.
Automatic control:	Automatic control system and heating control system is absent

2.4 Hot water supply system (HWSS).

Thermal power production/output:	The source of hot water supply is one self-made hot-water boiler tank located in the boiler room. Hot-water boiler was switched off during the monitoring because of low gas pressure.
Hot water supply system:	HWSS – well-type (single-pipeline), blind (dead-end type) D_y=20 mm. Number of draw-off points – 7. HWSS pipelines in boiler room do not have thermal isolation. There is no leaking in the system.
Automatic control:	Automatic control system and heating control system is absent.

3. Power consumption

The region of the RHC location is gasified, however during the heating season/period the gas supply is extremely unstable. During the heating season of 2007-2008, because of low gas pressure, the power supply was maintained with the help of firewood (since the boilers design/construction allows burning firewood). During the energy research period and further monitoring process, the water temperature in feeding line of heating system was approx. 40 0C, because of low gas pressure.