Report on

Assessment of DSM Potential for Ivanovo, Perm and Novosibirsk Oblast

Prepared for

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

This report represents the work sponsored by the U S Agency for International Development (USAID), Bureau for Europe and New Independent States, Energy and Infrastructure Division USAID has been providing assistance to the government of the Russian Federation and as part of that has provided technical assistance to the energy sector in some regions The work reported herein was completed in the Ivanovo Oblast, Perm Oblast and the Novosibirsk Oblast as some of the tasks in the Energy Efficiency/Demand Side Management (DSM) Demonstration Project

The DSM Demonstration Project was begun in the fall of 1996 in the Ivanovo Oblast There were many objectives to the project One important objective was to demonstrate to industrial customers that investments in cost-effective energy efficiency projects would save them money and help to make them stronger The management and staff of AO Ivenergo were very active in the project as was the Ivanovo Regional Energy Commission

In making assessments of the DSM/energy efficiency potential for a utility, it should be understood that there are two categories of assessment results technical/economic potential and market potential The technical/economic potential is based upon the estimate of the actual savings that could be obtained if all of the cost-effective measure were installed, based solely upon engineering estimates of the equipment and processes The market potential is the savings that could logically be realized with an energy efficiency program This analysis incorporates other factors that influence the decision to move forward on energy efficiency projects, such as the overall economic condition of the enterprise

In the performance of the demonstration project, it was not possible to conduct a detailed assessment of the DSM potential for each participating oblasts However, a subjective assessment was made by the Project Manager with input from many others The assessment contained in this report is based upon data gathered from AO Ivenergo, AO Permenergo, AO Novosibirskenergo, the Regional Energy Commissions, industrial managers and other professionals in the participating oblasts A large market survey was not completed due to the necessity to complete a major project task that was planned to be done by an ESCO from the United States, thus causing resources to be re-directed to that effort

In the course of conducting the DSM pilot program with the industrial participants within the paraticipating oblasts, it became obvious that under the current economic conditions within the Russian Federation, it is nearly impossible for an industrial enterprise to obtain outside financing to implement energy efficiency projects (See report of Hagler Bailly Services under Delivery Order No 9, Deliverable under Section 5 (c)) At the time of this report the interest rates for commercial loans in Russia range from 70% to 100% This creates a very large impediment to energy efficiency projects that would otherwise be cost-effective and makes the assessment of DSM potential extremely difficult since most projects that could be implemented can not rely on outside financing

Except for very large government-owned projects which may qualify for funding from international organizations (i e EBRD, etc), only those projects which can be implemented using internal funding are possible until the economic conditions improve and interest rates fall to reasonable levels Many projects that are capable of being implemented are only the low-cost, or no-cost projects such as improvements in boiler operations

Although the present conditions for implementing energy efficiency projects are hampered by the economic conditions, there now exist the expertise within each of the participating oblast to perform technical energy audits to identify cost-effective measures An assessment of the potential should be performed by gathering energy usage data on the end-use, equipment, processes and operating characteristics for all of the customer sectors This should be done using a planned approach for data acquisition and analysis Data bases must be in place to store the acquired data and make it available for analysis

A Assessments

Under the current conditions in Russia, the technical potential for energy efficiency projects is far greater than the market potential Based upon the audits conducted at the industrial participants, an overall energy savings of 10-30% (both electric and thermal applications) could be expected from the implementation of energy efficiency projects These are projects that have a simple payback of less than two years and include both thermal and electric measures It has been reported by others that the district heating sector could result in an energy savings as high as 40-50%[1]

However, the market potential for energy efficiency projects is currently near 0% and is likely to remain so until the economic condition of the country/oblast improves Most industrial enterprises are barely able to remain open and do not even consider spending funds on energy efficiency projects

B Recommended Steps

When the economic condition improves to the point of moving forward on energy efficiency programs, an assessment of potential should be undertaken Before embarking on a large energy efficiency program, the participating oblasts should make an assessment of the potential for energy efficiency using the following plan

- Policy Framework to Promote Energy Efficiency - A Cooperative agreement reached with the Regional Administration, the Regional Energy Commission and AO Ivenergo
- Demand and Energy Forecast developed
- Data Acquisition
  - Develop and install a customer data base
  - Develop and implement customer data acquisition using market research methods, governmental data and data from the utilities

[1] Conversations with Vladimir N Nuzhdin, Ph D Head of Power Engineering University, Ivanovo

- Load Research Data acquisition (load shapes)

▸ Analyze the data and estimate the potential for energy efficiency measures
- Demand and energy reductions
- Cost reductions
- Segmentation of Results
  - by customer types
  - by cost-effectiveness (i e no-cost, low cost, etc)

I SITUATIONAL ANALYSIS

A. Background

Demand-side Management (DSM) and energy efficiency have long been used in the United States and other countries to reduce the growth of new energy resources, cut energy bills for consumers and reduce the environmental impacts of power production Following the energy crisis of the 1970's, much of the work was implemented by utilities, who were able to recover the cost through the rates charged for energy This has evolved to the stage where this work is now done primarily by Energy Service Companies (ESCOs) which offer a variety of services to their clients to provide lower-cost, reliable energy

In Russia, energy efficiency has only recently received some attention from politicians, engineers and others as a way to reduce the production costs of manufacturing operations and public utilities During the Soviet era, most of the manufacturing efforts were aimed at meeting the quotas from the central government planners Reducing costs through energy efficiency was not a priority, nor even considered by many plant managers

With the advent of a market economy and competitive pressures, Russian plant managers now find themselves faced with the need for controlling, and reducing, production costs However, the current economic crisis has forced these managers to concentrate their efforts into keeping the enterprise afloat There is little thought of spending money on energy efficiency projects, even those that are very cost-effective

B National Level

Since the post-Soviet era, the Russian government has passed several laws aimed at improving the efficienct use of energy They also passed laws concerning the auditing and measuring of energy usage

In early 1998, RAO-UES drafted and approved an energy efficiency program[2] for all of Russia They recognized that the energy intensity per unit of output for Russian products is 1 8 to 3 times greater than in developed Western countries and that the average industrial enterprise in Russia pays 18% of its production cost for energy, high intensity industries pay as much as 40-60% They have estimated that the total annual energy efficiency potential of the country is equal to 450 million tons of standard fuel In addition, they estimate that the emissions of harmful substances can be reduced by approximately 3 to 4 million tons per year

The program, which is being designed as of the date of this report, is for the years 1998-2005 and is expected to cost 55 3 trillion roubles[3] The energy savings is estimated at 168 trillion roubles and the average payback for the projects is 1 5 - 2 years The plan is for the

[2] from The Russian Economy is Making Transition to Energy Efficient Development by Nina Shimbireva

[3] Rouble amounts prior to the de-valuation in August-September 1998

government to make short-term (1-2 years) loans to qualifying enterprises for energy efficiency projects

According to the estimates, a savings of 20 trillion rubles per year will be saved by the year 2001 with the installation of metering and energy control systems This program is one of the first that is planned for implementation They believe that this will increase to approximately 33 trillion rubles by 2005

C Ivanovo Oblast

1 Economics

The Ivanovo Oblast is located about 250 kilometers east and north of Moscow, with the city of Ivanovo as the Regional Headquarters The Oblast has about 2 5 million people It has numerous types of industries, however, textile manufacturing is one of the most predominant The past several years has seen many of these large enterprises close, or reduce production significantly Much of this has been caused by the competitive market environment and the old inefficient industrial processes and equipment

2 Regulatory Climate

The Regional Energy Commission of the Ivanovo Oblast is very supportive of energy efficiency programs They have implemented a revolving energy efficiency fund to provide short-term loans for cost-effective energy efficiency projects within the oblast[4] This program is funded from a surcharge in the electricity tariffs and has already been used for several small energy efficiency measures at a few industrial facilities

During the USAID-sponsored energy efficiency demonstration project, the Chairman, commissioners and staff were actively involved They believe that energy efficiency programs are one way of helping the struggling economy by reducing the costs of the industrial enterprises They have pledged their support from the revolving fund for this effort

3 AO Ivenergo

According to the 1996 Annual Report of RAO-UES, AO Ivenergo owns 835 mW of electricity production capacity, which produced 2,030 million kWh in that year They purchased 2,062 6 million kWh from RAO-UES[5] at an average price of 143 46 Rbl/kWh plus an access fee of 17 6 Rbl/kWh RAO-UES controls 57% of the shares in the energo

AO Ivenergo also owns and operates some combined heat and power (CHP) facilities and produced 4,145 thousand Gcal of heat in 1996

[4] Conversations with Vladimir Y Dmitriev Chairman of the Ivanovo Regional Energy Commission

[5] Data from AO Ivenergo annual report

AO Ivenergo is supportive of energy efficiency programs, as shown by their active involvement in the USAID-sponsored energy efficiency demonstration project As part of this project, the management provided technical personnel for training in energy auditing and began the organization of a business unit to conduct energy audits at other customer facilities within the oblast

4 Energy Usage

In the course of the DSM demonstration project, the Project Manager visited numerous industrial facilities within the Ivanovo Oblast to select a few participants Table 1 shows the % of electrical energy supplied to each class of service in 1996 Most of the facilities are old with aging equipment It is not uncommon for an industrial facility to have boilers that are 40 to 60 years old, most without any modern controls Motors are old, inefficient and are not maintained on a regular basis The energy intensity to produce products is much higher than in other eastern European countries For example, in the beer brewery, the amount of energy to produce a liter of product is nearly twice that of breweries in Europe and the United States[6]

Table 1
AO Ivenergo Electric Energy Consumption in 1996

	Customer Class	% of Total kWh Consumption
1	Industry	37 6
2	Urban transport	0 7
3	Non-industrial consumers	4 6
4	Production sector of agriculture	16 4
5	Residential	5 9
6	Wholesale (re-sellers)	34 4
7	AO Energo Use	0 4
8	Total	100 0

In Ivanovo, the district heating system is old and run-down due to the lack of regular maintenance During the winter, leaks in the distribution system were obvious throughout the city However, the City Heat Nets and its experts have developed a detailed analysis and plan to improve the district heating system, restore some of the equipment and install new, improved equipment in some areas to increase the efficiency of the overall system They have not yet been able to acquire the necessary funding from local, national or international funding

[6] Statement of Anatolii Y Taltangov, General Director of Ivanovo Brewing Company

institutions

5 Industrial Energy Audit Results

One of the main thrusts of the energy efficiency demonstration project was to conduct energy audits at selected industrial enterprises within the Ivanovo Oblast Working with the management of AO Ivenergo and the REC, seven industrial enterprises were selected to participate Energy audits were conducted by Russian energy efficiency engineers from Moscow, with technical input from experts from the Ivanovo Energy Institute Personnel from AO Ivenergo were trained and participated in the on-site measurements and data collection at the industrial facilities

The participating industries included
- Textile factory
- Large machine shop
- Automobile parts manufacturer
- CHP
- District Heating system (part)
- Large bakery
- Brewery

The results of the energy audits provides information about the potential for energy efficiency within the Oblast However, there is one important caveat that make in difficult to expand the results to the entire oblast The industries in the study were considered some of the "best" industries, that is, they were not expected to collapse in the near future

As expected, much of the energy efficiency potential was found to be in thermal energy use followed by electric energy

D Perm Oblast

1 Economics

The Perm Oblast is located about 900 kilometers east and north of Moscow, with the city of Perm as the Regional Headquarters The Oblast has about 4 million people It has numerous types of industries, however, heavy machinery manufacturing is one of the most predominant The past several years has seen most of these large enterprises close, or reduce production significantly Much of this has been caused by the competitive market environment and the old inefficient industrial processes and equipment

2 Regulatory Climate

The Regional Energy Commission of the Perm Oblast is very supportive of energy efficiency programs The Commission is only beginning to function and does not have a paid staff

During the USAID-sponsored energy efficiency demonstration project, the Secretary of the commission was somewhat involved He believes that energy efficiency programs are one way of helping the struggling economy by reducing the costs of the industrial enterprises and other consumers

3 AO Permenergo

According to the 1996 Annual Report of RAO-UES, AO Permenergo owns 2,078 mW of electricity production capacity, which produced 10,853 million kWh in that year The fuel use was as follows 1) gas (90%), 2) heavy oil (5 9%), and, 3) coal (4 1%) RAO-UES controls 64% of the shares in the energo

AO Permenergo is supportive of energy efficiency programs, as shown by their active involvement in the USAID-sponsored energy efficiency demonstration project As part of this project, the management provided technical personnel for training in energy auditing

4 Energy Usage

The energy sales[7] to each customer class is in 1996 is shown in Table 2

Table 2
AO Permenergo Energy Sales in 1996

	Customer Class	% of Total Electric Energy Sales	% of Total Heat Sales
1	Industry	68 1	62 3
2	Transport	6 2	0 0
3	Residential	19 8	32 4
4	Agriculture	4 8	3 4
5	Others	1 1	1 9
6	Total	100 0	100 0

In the course of the DSM demonstration project, the Project Manager visited numerous industrial facilities within the Perm Oblast to select a few participants Most of the facilities are old with aging equipment It is not uncommon for an industrial facility to have boilers that are 40 to 60 years old, most without any modern controls Motors are old, inefficient and are not maintained on a regular basis

[7] AO Permenergo Annual Report

5 Industrial Energy Audit Results

One of the main thrusts of the energy efficiency demonstration project was to conduct energy audits at selected industrial enterprises within the Perm Oblast Working with the management of AO Permenergo and Permgosenergonadzor, six industrial enterprises were selected to participate Energy audits were conducted by Russian energy efficiency engineers from Moscow Personnel from AO Permenergo and Pergosenergonadzor were trained and participated in the on-site measurements and data collection at the industrial facilities

The participating industries included

- Milk factory
- Printing/publishing house
- Large Railway car manufacturing and Repair facility
- Concrete Panels Plant
- Large bakery
- Brewery

The results of the energy audits provides information about the potential for energy efficiency within the Oblast However, there is one important caveat that make in difficult to expand the results to the entire oblast The industries in the study were considered some of the "best" industries, that is, they were not expected to collapse in the near future

As expected, much of the energy efficiency potential was found to be in thermal energy use followed by electric energy

E Novosibirsk Oblast

1 Economics

The Novosibirsk Oblast is located about 1,500 kilometers east of Moscow, with the city of Novosibirsk as the Regional Headquarters The Oblast has about 4 5 million people It has numerous types of industries, however, the former defense industries are some of the most predominant The past several years has seen many of these large enterprises close, or reduce production significantly Much of this has been caused by the collapse of the military complex, the competitive market environment and the old inefficient industrial processes and equipment

2 Regulatory Climate

The Regional Energy Commission of the Novosibirsk Oblast is very supportive of energy efficiency programs The have been considering the implementation of a revolving energy efficiency fund to provide short-term loans for cost-effective energy efficiency projects within the oblast This program will be funded from a surcharge in the electricity tariffs

During the USAID-sponsored energy efficiency demonstration project, the Chairman, commissioners and staff were somewhat involved They believe that energy efficiency

programs are one way of helping the struggling economy by reducing the costs of the industrial enterprises and have pledged their support from the revolving fund for this effort

3 AO Novosibirskenergo

According to the 1996 Annual Report of RAO-UES, AO Novosibirskenergo owns 2,640 mW of electricity production capacity, which produced 9 871 million kWh in that year RAO-UES controls only 16% of the shares in the energo The utility provides both electric and thermal energy to its customers The total energy provided[8] is electric 60%, thermal 40%

AO Novosibirskenergo, and its marketing arm, Energosbyt, is supportive of energy efficiency programs, as shown by their active involvement in the USAID-sponsored energy efficiency demonstration project As part of this project, the management provided technical personnel for training in energy auditing

4 Energy Usage

In the course of the DSM demonstration project, the Project Manager visited numerous industrial facilities within the Novosibirsk Oblast to select a few participants Most of the facilities are old with aging equipment It is not uncommon for an industrial facility to have boilers that are 40 to 60 years old, most without any modern controls Most of the motors are old, inefficient and are not maintained on a regular basis

Table 3 provides the energy usage for each class of customer, as provided by the management of AO Novosibirskenergo

Table 3
Energy Sales by AO Novosibirskenergo in 1996

	Electric Energy		Thermal	
	Customer Class	% of Sales	Customer Class	% of Sales
1	State Enterprises	47	Industrial	30
2	Agriculture	11	Dwellings & Social/Cultural	62
3	Residential and small business	42	Social Purposes	8
4	Total	100		100

[8] Data sheet from AO Novosibirskenergo

5 Industrial Energy Audit Results

One of the main thrusts of the energy efficiency demonstration project was to conduct energy audits at selected industrial enterprises within the Novosibirsk Oblast Working with the management of Energosbyt, two industrial enterprises were selected to participate Energy audits were conducted by Russian energy efficiency engineers from Moscow Personnel from Energosbyt were trained and participated in the on-site measurements and data collection at the industrial facilities

The participating industries included

- Furniture Factory
- Concrete materials factory

The results of the energy audits provides information about the potential for energy efficiency within the Oblast However, there is one important caveat that make in difficult to expand the results to the entire oblast The industries in the study were considered some of the "best" industries, that is, they were not expected to collapse in the near future

As expected, much of the energy efficiency potential was found to be in thermal energy use followed by electric energy use

II ILLUSTRATIVE DSM PROGRAM FOR PARTICIPATING OBLAST

The following section provides an illustrative example for the development of a DSM program in Russia It is not meant to be a detailed work plan, but provides some basic informational and policy requirements for a successful program

Based upon the data from the three participating AO Energos (see Tables 1,2 & 3), the primary focus should be on the industrial segment The industrial segment is where the largest energy use is and where the most opportunities for energy efficiency exists, except for the district heating systems

A Policy Framework to Promote Energy Efficiency

The promotion of energy efficiency requires the commitment and support of the Regional Administration, the Regional Energy Commission, the AO Energo and the financial community within each of the Oblasts

The DSM Demonstration program carried out under this USAID project provided the framework for developing and implementing a program for the participating oblast Valuable hands-on experience was gained by the local engineers and technicians from each AO Energo and some other local professionals In Ivanovo, the AO Energo has formed a business unit to begin conducting energy audits using the newly trained personnel and the equipment that was provided by USAID under the project The core of trained personnel is important to the continuation of the work in the Ivanovo Oblast

Additionally, the Regional Energy Commission in Ivanovo was heavily involved in the demonstration project and supports such a program Also, there are several other professionals within the Oblast who participated in the project and who could be used to provide the expertise to identify cost-effective energy efficiency projects at industrial enterprises within the Oblast

Each of the participating oblast could now begin to design and implement an energy efficiency program that would benefit the industrial enterprises and improve the economic condition of the entire oblast It is recommended that a small pilot program be implemented, using these personnel and under the direction of the AO Energo The purpose of the pilot would be to 1) increase the expertise in conducting energy audits and making recommendations for cost-effective energy efficiency measures, 2) gain experience in the organizational structure for performing the work, and 3) gain experience in working with the enterprises to implement the recommended measures

B Demand and Energy Forecast (kW and kWh)

Under the current economic condition in Russia, and in the participating oblasts, the forecast for energy use shows little or no growth for the foreseeable future The population is decreasing and industrial output, though growing, is becoming less energy intensive due to

several reasons These include

- Industries that are growing are using newer, and more efficient, equipment
- More efficient processes are being implemented
- Industries are providing less of the social services (i e housing, schools, stores, etc) that they have historically provided

In order to estimate the future potential for energy efficiency, it is necessary to develop a demand and energy forecast for the Oblast This forecast should be segmented by customer type and end-use technology, if possible

C Data Acquisition

The acquisition of accurate customer data is absolutely necessary in order to make estimates of the potential for energy efficiency projects This process should include the following steps

- *Customer Data Base* - Prior to the actual data acquisition it is necessary to develop a data base for the customer information, one in which the data for individual customers can be tabulated for the entire customer segment, or class The data bases must be computerized in order to accurately analyze the data contained therein Many software packages are available for this purpose Some of the information that such a data base should include are
  - Billing History (kwh, kw, Roubles)
  - Type of account (residential, commercial, industrial)
  - Premise information (i e location, etc)
  - Voltage delivery
  - Type of industry
  - Energy uses (i e processes, electric, thermal, other)

- *Customer Data Acquisition* - Using market research methods (customer surveys) and other methods to acquire data, information on energy usage must be acquired This data should be acquired from large industrial customers through on-site visits to the enterprises by representatives of the AO Energo This should be done by customer type, end use technology and processes

- *Load Research Data* - Load shape data is necessary to provide estimates of demand reductions, both at the customer level and the AO Energo level Metering should be acquired and a plan developed for acquiring load shape data on each major customer segment Statistical sampling methods should be employed to keep the costs to a minium level Figure No 1 is an example of the peak load reductions that may be possible with the implementation of a DSM program aimed at demand limiting This data should be acquired from large customers as well as the utility's system load

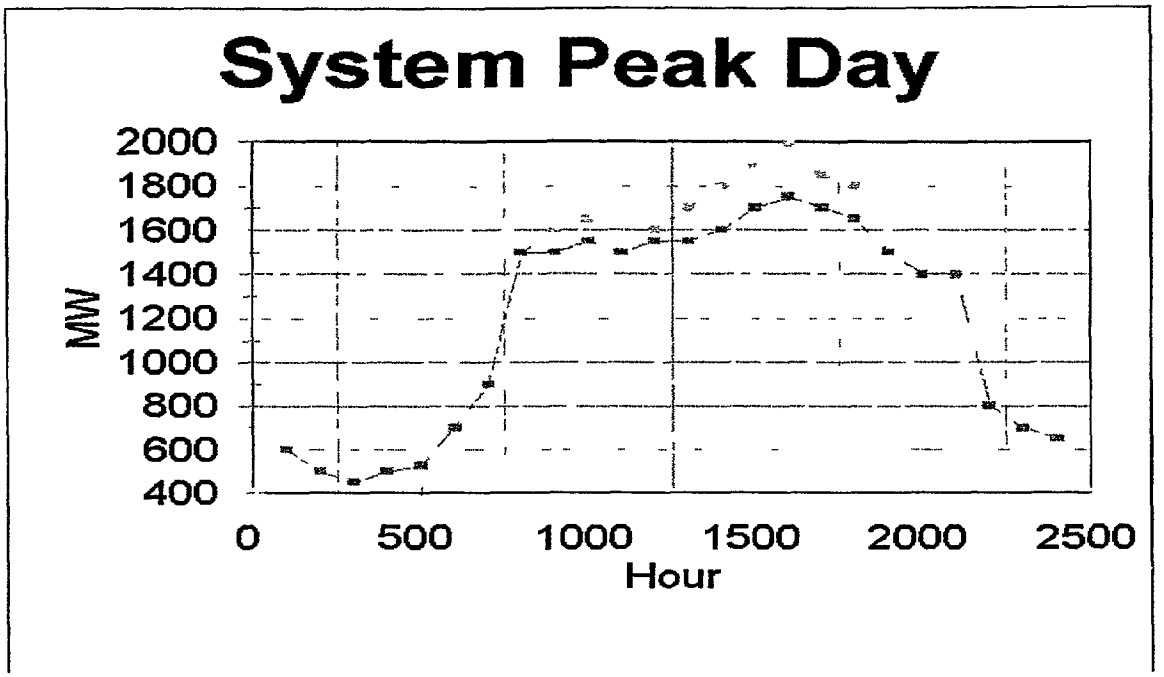

Figure 1

D Data Analysis and Estimate of Energy Efficiency Potential

Analyzing the data and using the results to estimate the energy efficiency potential is the next step Using the collective information from each customer class and end-use technology, the analyst can estimate the potential for

- Load Shape Modifications - An analysis of the possible load shape changes that may be possible from various types of DSM programs, some of which are rate-related (i e Time-of-use, Interruptible, etc) and which are aimed at reducing the utility's requirements to meet high peak daily, or seasonal, loads
- Demand and Energy Reductions - An analysis of the reductions in peak demand at both the utility level and the customer level An important analysis of the reductions in energy usage through energy efficiency improvements
- Cost Reductions
  - Reductions in purchased power and/or use of inefficient generators
  - Reductions in costs for customers

E Program Design and Implementation

The design of a DSM program should be prepared in a work plan that is approved by the highest levels of management and the Regional Administration and Regional Energy

Commission It should be a plan that is beneficial for the oblast and the energy consumers within the oblast

It is important that program design be focused in order to provide the maximum results The utility should segment the customer classes and end-uses

Segmentation of potential

- Customer classes - residential, commercial, industrial, government
- End-uses - motors, lighting, process heating, etc
- Cost-effectiveness - no-cost, low-cost, medium-cost, high-costs

The work plan should include staffing and equipment costs, and the costs of verifying the results in order to determine the cost-effectiveness of the plan The plan should include monitoring of the program in order to make modifications as it progresses The project work plans developed by Hagler Bailly for the demonstration projects at the three participating AO Energos provides a guideline for the work plans that can be written for future DSM/Energy Efficiency projects in Russia

As mentioned earlier, it is important to include all interested parties (Regional Administration and Regional Energy Commission) in the plan in order to gain their support and increase the chance of success