ON THE ROAD TO ENERGY EFFICIENCY: EXPERIENCE AND FUTURE OUTLOOK

Researching energy efficiency practices among Russian companies

Russia Sustainable Energy Finance Program
International Finance Corporation
CONTENTS

MAIN CONCLUSIONS ...........................................................................................................4

1. INTRODUCTION ................................................................................................................7
   1.1. Economic preconditions for the research .................................................................7
   1.2. Research characteristics ..........................................................................................8
   1.3. Research relevance ..................................................................................................10

2. ENERGY EFFICIENCY POTENTIAL .............................................................................13

3. CURRENT ENERGY EFFICIENCY PRACTICES .............................................................18
   3.1. Strategy ....................................................................................................................18
   3.2. From small to large .................................................................................................20
   3.3. Industrial and regional trends in energy efficiency development ......................23

4. ORGANIZING ENERGY EFFICIENCY PROGRAMS .......................................................27
   4.1. Organizing energy efficiency efficiency programs: current practices ..............27
   4.2. The action plan ........................................................................................................28
   4.3. Tracking energy usage ...........................................................................................30

5. PROJECT FINANCING ....................................................................................................31
   5.1. Macroeconomic preconditions ...............................................................................31
   5.2. Investment potential for modernization ..................................................................31
   5.3. Estimating company demand for financing .........................................................33
   5.4. Expected payback periods .....................................................................................37
   5.5. Financing future energy efficiency projects .........................................................39

6. RESULTS AND RECOMMENDATIONS .........................................................................40
   6.1. Success factors for energy efficiency projects ......................................................40
   6.2. Consumption curves ...............................................................................................41

APPENDIX 1. Consumption curves by industry .................................................................43

APPENDIX 2. Overview of energy efficiency projects by industry .................................45

APPENDIX 3. Overview of energy efficiency projects by region ...................................47

APPENDIX 4. The volume of obsolete equipment by industry ........................................49
Main conclusions
On the road to energy efficiency: experience and future outlook

MAIN CONCLUSIONS

Russia ranks among the largest energy consumers in the world. Russian industrial companies use a much higher volume of energy for production than similar companies in other countries. This situation, combined with increased rates for electricity, gas and other resources, is generating much more interest in energy efficiency – 90% of the companies that were surveyed are already involved in projects in this area. However, companies are underestimating the opportunities and benefits of increased energy efficiency.

Company managers take an overly conservative view when it comes to assessing savings potential. Based on their estimates, they might be able to save just 8-10%, when in fact they could actually reduce energy resource consumption by 20-30%.

Due to a lack of cooperation between senior management and technical energy service personnel, promising projects that require considerable investment may be overlooked. Management teams are not always capable of correctly assessing the technical aspects or savings potential, while energy specialists often do not have a full understanding of a company’s development and financing strategy.

Managers primarily turn their attention to a company’s total energy expenses, rather than the share thereof in net costs, despite the fact that reducing the share of energy costs in total net production costs can give the company a competitive edge.

Company managers tend to underestimate the importance of a systemic approach to energy efficiency. Yet having a thorough and comprehensive energy efficiency program can help a company realize a greater number of projects and enjoy more success by using the most effective and cost-efficient routes.
Companies are not active enough when it comes to adopting proven energy efficiency measures. There is an entire set of measures commonly referred to as "good energy efficiency practices." However, these "good practices," such as insulation of buildings and installation of energy efficient lighting, are still not very popular in Russia.

Companies do not fully utilize efficient organizational means – such as motivating managers via results-based bonuses – to put energy efficiency programs into place.

Effective practices for tracking energy costs have certainly not developed everywhere. Most companies still do not keep records at a production zone level, and instead track the energy consumption of the company as a whole. This makes it more difficult to quickly analyze the energy consumption dynamics of a company’s highest-consumption manufacturing processes, or to evaluate the effects of introducing energy efficiency measures.

Nearly two-thirds of all enterprises claim that a lack of funds hinders them from carrying out projects in energy efficiency. However, only one out of every four companies sought outside financing, regardless of the fact that many banks and leasing companies already provide short- and long-term (3-5 years) financing, and 90% of the companies that sought external financing received it.

Since companies generally do not want to borrow funds, many valuable projects are left on the back burners. Furthermore, when a project is carried out, the long-term savings outweigh the costs of securing outside financing.

Company managers can achieve optimal results in energy efficiency if they take into account the following success factors:
The goal of this report is to generate interest among entrepreneurs in particular and the business community in general about the rational usage of energy resources, and to encourage investment in energy efficiency projects. This report contains useful information for entrepreneurs and managers, which we hope will help increase the success rate of programs aimed at increasing energy efficiency in the real sector.

This study was conducted in 2006 under the International Finance Corporation’s Russia Sustainable Energy Finance Program. This program is dedicated to becoming a catalyst for Russia’s energy efficiency market and encouraging the collaboration of companies, financial institutions and suppliers of equipment and services on this market. For more information, visit www.ifc.org/russia/energyefficiency.

### Key success factors for energy efficiency programs

<table>
<thead>
<tr>
<th>POTENTIAL &amp; STRATEGY</th>
<th>ORGANIZATION</th>
<th>FINANCING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Realistic estimate of energy efficiency potential</td>
<td>4. Have a comprehensive action plan for energy efficiency</td>
<td>7. Calculate the ROI</td>
</tr>
<tr>
<td>2. A development strategy will help determine energy demands</td>
<td>5. Appoint employees to supervise the project, award bonuses for project completion, get management involved, get technical and financial services involved</td>
<td>8. Recognize the benefits of securing outside financing</td>
</tr>
<tr>
<td>3. A step-by-step program: start with cost-efficient measures and gradually move to more capital-intensive measures</td>
<td>6. Keep detailed records of energy expenses at a departmental level or for the production divisions that have the highest levels of energy consumption</td>
<td>9. Announce the situation on the financial market, including the availability of long-term funds</td>
</tr>
</tbody>
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1. INTRODUCTION

1.1. ECONOMIC PRECONDITIONS FOR THE RESEARCH

Increasing efficient energy use is one of the top priorities for the Russian economy over the next 5-10 years for two reasons: first, high levels of energy consumption lower the competitiveness of Russian production on the domestic and foreign markets, and second, energy efficiency is one of the most important elements of ensuring the country’s energy security.

The Russian economy’s low level of energy efficiency is a major obstacle for economic growth. According to information from the International Energy Agency, Russia’s energy consumption per GDP is 11 times higher than that of Germany, 6 times higher than in Canada, and 4 times higher than in Poland.\(^1\) Closing this gap would mean both saving money for some companies and also increasing competitiveness among Russian manufacturers as a whole.

![Figure 1. COMPARING ENERGY CONSUMPTION PER GDP AND TOTAL ENERGY CONSUMPTION](image)

**Energy consumption per GDP in countries, kWh/$ (2002)**

- Ukraine: 24.3
- Russia: 23.3
- Kazakhstan: 6.2
- Poland: 3.9
- Canada: 3.6
- Brazil: 2.6
- US: 2.6

**Total energy consumption in the economy, TWh**

- Ukraine: 1,542
- Russia: 7,440
- Kazakhstan: 580
- Poland: 1,089
- Canada: 3,031
- Brazil: 2,247
- US: 26,526

**World**: 12,034

*Source: International Energy Agency, 2006*

Furthermore, over the past 5-6 years, energy prices have been rising steadily. In 1999-2005, average electricity rates for industrial consumers increased three times over. The Ministry for Economic Development and Trade has forecast that energy costs will continue to increase until 2009, when prices are expected to reach a level close to average European rates. Combined with today’s high energy consumption levels, energy expenses could deal a major blow to the competitive position of Russian manufacturers.

\(^1\) The International Energy Agency, 2005. These numbers were reported as GDP calculations in nominal terms. Energy consumption per GDP calculated at par with Russia’s purchasing power came to 3 times higher than in Germany and 1.8 times higher than in Canada.
1. Introduction
On the road to energy efficiency: experience and future outlook

Energy prices will continue to grow

Figure 2. GROWTH OF ELECTRICITY RATES FOR INDUSTRIAL CONSUMERS
RUR / kWh

Average European rates = RUR 1.7


1.2. RESEARCH CHARACTERISTICS

This report is based on a comprehensive study of industrial companies that was conducted in the summer of 2006. The research characteristics are listed in Figure 3.

In the study, the operations of 625 companies located in five of Russia’s federal districts and representing five different industrial sectors were analyzed. The survey was conducted in at least 6-8 cities in each federal district in order to ensure a sufficiently representative sample, allowing the assumption that the study’s results apply to the general situation in all of the industries that were examined during the survey.

In this way, the conclusions made during this study can be taken as a more or less complete overview of the energy efficiency practices in the industries that were included. In addition, the trends that were identified may be considered typical for many industrial companies in other sectors.
The basic factors for 625 companies

The five industry sectors that we analyzed enjoy healthy competition, which creates opportunities for increasing economic efficiency. Similar economic conditions create a stimulus for rational spending in general and energy costs in particular. As a rule, the companies that we examined are successful under current economic conditions – nearly 60% had achieved sales growth both in monetary and unit output terms (see Figure 4). In general, average companies were surveyed: the annual revenue of 75% of all surveyed companies amounts to RUR 20-100 mln. Information about the practices of these companies in conducting and financing energy efficiency programs is of interest not only to similar companies, but to equipment suppliers, financial institutions and project developers.
Economically successful companies took part in the survey

Despite the fact that more and more attention is being devoted to ensuring energy security and energy efficiency in Russia today, there is not enough open-source information available about energy consumption or the current practices of Russian companies in energy efficiency. This study of energy saving practices and financing opportunities for projects in energy efficiency is the first of its kind in Russia.

Increasing energy efficiency became a major priority for other countries during the energy crisis of the 1970s, when rate hikes led to the need to rethink qualitatively energy efficiency policies in many industrial sectors.

This study is clearly very important today, as energy rates continue to climb and the energy capacity deficit continues to grow in Russia, as it will help expand market players’ knowledge of the possibilities of energy efficiency.

1.3. RESEARCH RELEVANCE

More and more Russian companies that have run into problems such as high costs or insufficient energy resources are now trying to streamline their energy consumption. The management teams of 85% of the companies that were surveyed believe that increasing energy efficiency is important for business development.

In 2005, the surveyed companies consumed a cumulative total of roughly 115 trillion kWh of energy. Their combined energy expenses came to an approximate annual total of RUR 5.6 bln. Almost 70% of all energy is consumed by companies in which management teams rate the importance of energy efficiency as high.

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2 The volumes of various energy resources have been included as total measured units using a scaling ratio.
85% of surveyed companies say improving energy efficiency is important.

Figure 5. THE RELEVANCE OF IMPROVING ENERGY EFFICIENCY

Is improving energy efficiency an important issue for your company’s development today?

- 53% yes
- 32% probably
- 11% probably not
- 4% no

Why?

- Energy costs are high: 58%
- Reducing energy costs as a percentage of total costs would increase competitiveness: 41%
- Reliable and uninterrupted energy supply: 26%
- Our equipment is very outdated and inefficient: 21%
- Energy consumption is on the rise and limits production growth: 18%
- It is difficult to increase energy limits: 14%

We compared the percentage of energy expenses in total net production costs and total energy costs in an attempt to identify which of these factors motivates managers to initiate energy efficiency programs to the greatest extent. The line in Figure 6 illustrates the average percentage of energy costs in total net costs, and the columns show the average total energy expenses. These figures are the averaged numbers of company responses to the question: “Is improving energy efficiency an important issue for your company’s development today?”

As seen in the chart, there are no major differences in the percentage of energy expenses in total net costs among those who believe that improving energy efficiency is important and those who do not. Total energy costs of companies that believe energy efficiency is a very important issue these days are almost 4 times greater than the total energy expenses of companies that are not interested in energy efficiency.

Consequently, we can see that managers are primarily concerned with their company’s total energy costs rather than the percentage of energy costs in the total cost structure, despite the fact that the share of costs is what determines a company’s competitive position when it comes to energy expenses.
What is more important: the percentage of net costs, or total expenses?

Is improving energy efficiency an important issue for your company’s development today?

This report is the first attempt to analyze the process of implementing energy efficiency programs that are already in place or being put in place at successful, mid-sized industrial companies. The report addresses the following issues: which energy efficiency measures are currently being taken, how companies approach the organization and financing of energy efficiency projects, and which factors are typical for the industries and regions included in the study.

Company managers will be able to find information about how companies similar to their own rate the energy efficiency potential for their production (Chapter 2) and about which development trends in energy efficiency exist in different industries and regions (Chapter 3). The report also includes information about the organizational and managerial methods that help implement energy efficiency measures (Chapter 4) and describes current practices in financing energy efficiency, in addition to revealing the opportunities and advantages of securing external financing for projects in energy efficiency (Chapter 5). Chapter 6 discusses the success factors on the road to energy efficiency, and contains descriptions of certain methods that managers may find helpful.
2. ENERGY EFFICIENCY POTENTIAL

It is clear that in order to launch a program aimed at increasing energy efficiency, upper management first needs to recognize the problem and understand the possible benefits of energy efficiency. As our study shows, energy consumption is an issue that is important to managers today. Many of them believe they have a solid understanding of their company’s energy costs, and even more managers believe that they know what they need to do in order to make their companies more energy efficient (Fig. 7).

Managers believe they are well informed as to energy costs and ways to reduce them

![Manager Awareness Chart]

It is especially important that many company managers both recognize the advantages of energy efficiency and have a good idea of the amount of potential savings. However, the overwhelming majority of companies surveyed gave conservative estimates when asked about savings potential: an average of 8-10% for different energy resources. According to international practice, in Great Britain for example, savings are much higher at approximately 20% for cooling, up to 30% for air compression and 20-40% for water expenses.

A more detailed review of the survey results on possible savings in electricity costs (Fig. 9) illustrates that nearly one-fourth of the managers we surveyed do not believe that the level of their electricity consumption can be reduced. Nearly 30% of respondents are confident that their electricity efficiency potential is just 1-5% of their company’s consumption. But experience shows that successfully implemented energy efficiency programs result in electricity savings of 5-6% from the introduction of cost-free organizational measures alone.
Companies underestimate potential savings

More than half believe that potential energy savings won’t exceed 5%

The following reasons stand behind Russian company managers’ conservative estimates of savings potential:

- **Insufficient experience implementing energy efficiency projects.** For large companies, the level of energy expenses can be a strategically important factor for ensuring competitiveness on both the foreign and domestic markets. The majority of these companies began working on comprehensive energy efficiency programs just three-four years ago. It would be logical to assume that mid-sized companies have even less experience in energy efficiency, both in terms of time and scope.
2. Energy efficiency potential

On the road to energy efficiency: experience and future outlook

- **Inefficient interaction between senior management and technical energy service specialists.** Increasing energy efficiency lies at the crossroads of general company development and energy supply. Technical specialists often do not take part in preparing a company’s strategic development plans, capital expense plans or other important measures that lay the foundation for economizing energy use. Today’s energy service managers primarily consider the measures that are in their zones of responsibility, which are first and foremost organizational issues related to energy supply for production and energy equipment repair – not energy efficiency. A chief energy expert’s zone of responsibility rarely includes providing economic grounds for energy efficiency programs. On the other hand, financial experts cannot competently assess which measures are required to increase energy efficiency, the volume of required investment or determine what the return will be on various measures. Often, this lack of coordination means that highly beneficial projects that require major investments end up outside the field of vision of energy service management and company management as a whole, which in turn lowers energy efficiency potential.

- **The absence of an energy service department or qualified personnel at many mid-sized companies.** Mid-sized companies often do not have the financial resources to invest in a separate, specialized energy service department, while functions such as energy consumption control and the implementation of energy efficiency projects are not delegated to senior engineering staff or production personnel. Only 47% of surveyed companies have a special staff unit or division responsible for the development and implementation of energy efficiency measures.

- **Limited access to information about international and national energy efficiency experience.**

International experience shows that actual achieved savings exceed expectations by 5-10% of total energy consumption. This level of savings is usually achieved after introducing a series of measures during the initial low-cost stage. As a rule, intensifying and expanding energy efficiency programs lead to even bigger results. The comparative macroeconomic figures shown for energy capacities in Figure 1 show that modern companies in other countries are more than twice as efficient in producing one production unit.
An initial estimate of possible energy savings can be calculated in different ways: with an internal or external energy audit, or based on a comparison of the level of energy consumption of companies with similar industry features. During our study, we gathered and analyzed data on the energy consumption of companies in different industries. This information helped us identify industry-specific factors that demonstrate the dependence of energy consumption on the production volumes in that industry. This report contains valuable information for making industry-based comparisons among the following five sectors for energy efficiency purposes: the bread industry (Fig. 10), the garment industry, furniture production, the milk and dairy industry, and meat processing (Appendix 1).

The chart to the right illustrates an example that may help understand just how efficiently energy can be utilized by some companies compared with other companies in the same industry. The consumption curve demonstrates a line of dependency between the production volume and the volume of energy consumed. For example (Fig. 10), the consumption curve is: \( Y = 0.0019X + 0.3804 \), where \( Y \) is the amount of energy consumed and \( X \) is the production volume in tons. This dependency means that for 1 ton of production a company must consume 0.0019 mln kWh of energy, and expenses for purchasing 0.3804 mln kWh is a fixed sum for companies in this industry, i.e., it does not depend on the production volume. For Company A, which is shown as the red point on the chart, the volume of consumed energy equals 36 mln kWh. This consumption level is higher than the average industry consumption level by 20 mln kWh, since similar companies with similar production levels consume approximately 16 mln kWh. By positioning their company on a graph, managers can get a clearer picture of their competitiveness in terms of energy consumption and can formulate realistic expectations for energy efficiency programs.
Comparing the energy consumption of different companies with an industry curve does not provide a definitive estimate of savings potential. Over time, as energy efficiency programs are introduced in companies within an industry, that industry’s consumption curve will progressively move downward, reflecting the increased energy efficiency and its gradual alignment with global practices. This is why this method for estimating savings potential by industry consumption curves can only provide a picture of the short-term. In order to get a more complete picture of energy savings potential, one can apply both international experience and the experience of Russian companies that have been implementing energy efficiency projects over the past several years.

Based on the information provided above, one can draw the conclusion that the forecast figures for energy saving shown in Figure 8 are achievable, but understated: they reflect the general tendency of Russian companies to underestimate their energy cost reduction potential.
3. CURRENT ENERGY EFFICIENCY PRACTICES

3.1. STRATEGY

At first glance, the connection between energy efficiency and a company’s strategy may not be very clear. However, when developing a strategic plan, figures such as net costs, production volume and production capacity play a major role, as does the level of capital investment in upgrading production in the years to come. When plans to upgrade technological capacities and economize energy use are not aligned with the company strategy, it could result in major spending errors and the failure to meet all planned production volume targets. This potential risk may be successfully overcome if management puts a step-by-step plan into place to modernize production with respect to technology and energy. This plan must apply known parameters for production expenses and output (Fig. 11).

Figure 11. THE CONNECTION BETWEEN A COMPANY STRATEGY AND ENERGY CONSUMPTION PROJECTS

A development strategy will determine energy consumption

One very important factor when launching an energy efficiency program is preparing the best-possible plan for replacing outdated energy equipment, which was often installed more than 15 years ago (Fig. 12). Obsolete energy equipment, especially boilers, tend to have excessively large capacities that are simply not required by companies any longer. Outdated equipment can present a real obstacle to the development of modern production. As we will see further, the modernization of this equipment is the ultimate goal of a number of many large-scale projects, and the expenses of this modernization represent a considerable part of a company’s total expenses for energy efficiency projects.
Working with obsolete equipment, be it manufacturing equipment or energy equipment, does not require any major capital investment. However, it often results in breakages, and, consequently, delays the entire production process. Technical maintenance for this kind of equipment can be quite costly. Many believe that delaying investments for new equipment will save money in the long run, but that is not the case.

![Figure 12. OBSOLETE ENERGY EQUIPMENT](image)

Energy consumption costs amount to RUR 20 mln per year. Despite high production quality, excessive energy costs have a negative effect on the company’s competitiveness. According to the factory director:

«...the boiler we have now is meant to provide heating and hot water for a company producing 190 million square decimeters of leather each year. Today our company’s output is about 50 million dm2, which means we’re only using 25% of the capacity. Moreover, the boiler provides heat for a small district with a population of up to 10,000. In other words, today we have a very large boiler that we really don’t need at all, and we would like to figure out what volume of heating we do need so that we can install the kind of heating equipment that would literally pay for itself, not eat up our budget. Right now our gas costs have reached 50% of manufacturing costs.»

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**Inset 1. THE BURDEN OF EXCESS ENERGY CAPACITY**

The Bogorodsky Chrome Leathers Factory, located in the Nizhegorod region, is a typical Russian light industry enterprise. The factory was built in the 1970s and uses a good deal of equipment designed in an era when energy and fuel were provided to companies practically free of charge. But under today’s market economy conditions, inefficient energy consumption can be an obstacle for companies like Bogorodsky.

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There is a high percentage of obsolete equipment.
3. Current energy efficiency practices

On the road to energy efficiency: experience and future outlook

3.2. FROM SMALL TO LARGE

As a rule, companies begin to work on energy efficiency projects as part of a larger-scale project to modernize both manufacturing and energy equipment. The need to launch an energy efficiency program most often arises when company management recognizes the actual level of energy expenses while planning or calculating net production costs. It is then that management sets a goal to find low-cost and time-efficient energy saving methods. This is the first step. One good example of first-stage measures is the elimination of various types of energy leaks and introduction of other organizational measures to reduce heating and lighting usage at unused premises.

Inset 2. A COMPANY’S FIRST STEPS IN IMPLEMENTING AN ENERGY EFFICIENCY PROGRAM

The Zavolzhsky Motor Factory (ZMF) began to tackle energy efficiency in 2003, when factory experts developed and launched a comprehensive energy efficiency program that included measures to streamline the planning and metering systems and initiate other energy efficiency measures. The first step included a set of 170 measures, 150 of which were cost-free or organizational. These measures put things into order and instantly resulted in energy savings of 5-6%. First, the company improved the lighting system for departments and other premises – they began to clean the lights and glass sidings and changed the lighting fixtures in meeting rooms. Second, they made improvements to the heating system and introduced a new regular climate control regime. Furthermore, the company dedicated a great deal of attention to the performance of compressors. ZMF managed to set up the compressors based on an improved schedule and fixed air leaks. These measures cost very little, and resulted in considerable savings.

Source: The Industrial Information Bulletin, No.4/2006

In general, subsequent projects branch out into several different areas and the tasks at hand become more complex. The goals in the first stage are to achieve more flexible management and control of energy costs. The next step involves replacing power-hungry manufacturing equipment with more efficient equipment, which often requires considerable investments. The most significant effect in energy saving is often achieved when the modernization of key production equipment is accompanied by a calculation of required energy, and streamlining the company’s energy consumption in general.

During this study we discovered that nearly 90% of the companies that were surveyed are taking measures towards more efficient energy use. On average, one company is currently working on three energy efficiency projects, and more than half of the companies surveyed (53%) are working on two to four projects. One in every four companies is working on more than five projects.
Most energy efficiency projects that are currently being carried out by companies are low-cost: the average costs for these projects amount to RUR 2 mln, and only 8% of these projects involve expenses exceeding RUR 5 mln.

The most popular project today – the installation of metering devices – is currently being carried out by roughly half of the surveyed companies. This is a low-cost measure aimed at increasing the transparency of energy expenses. Many companies are working on projects to modernize production (Fig. 13). Roughly 45% of the companies surveyed are currently modernizing manufacturing equipment, and approximately 40% are upgrading their heating systems.

Total spending currently underway at approximately 550 companies for all of the energy efficiency projects shown exceeds RUR 3.5 bln, which amounts to nearly 60% of the total annual energy costs for these companies.

These estimates were obtained based on an analysis of the aforementioned projects carried out at the surveyed companies. However due to the specifics of certain companies and industries, a number of important projects that were either directly or indirectly linked to improving energy efficiency may not have been included in this study. It would be logical to assume that actual total expenses for energy efficiency projects among Russian companies are actually higher.

Figure 14 illustrates the level of expenses and the frequency of energy efficiency projects (shown in the color circles). The X axis represents the number of companies working on a project. The Y axis shows average company expenses per project in millions of rubles. The numbers in the
Measures to align companies with “best practices” are not popular enough

As Figure 14 shows, the most prevalent low-cost projects are aimed at installing metering devices (49% of all companies surveyed). The most expensive project, taken on by just 14% of all companies, involves automated metering and controls, while total expenses for these types of projects are more or less the same. Furthermore, putting in frequency controlled drives, a comparatively small project that shows results quickly, was carried out by just one in every five companies. Other measures such as insulating buildings and installing efficient lighting fixtures – which can be done at any factory – are carried out by relatively few companies.

These measures are often referred to as “best practices” in energy efficiency, and the effectiveness of these measures has been proven both in other countries and within Russia. However, average companies are currently not sufficiently active in introducing these kinds of energy efficiency measures.
3.3. INDUSTRY AND REGIONAL TRENDS IN THE DEVELOPMENT OF ENERGY EFFICIENCY

As we have mentioned above, a total of 625 companies representing five different industries and five federal districts took part in this survey. Based on an adequately representative sample of companies by industry and by region, we have attempted to identify the main industry and regional trends in the development of energy efficiency in Russia.

Industry Trends

We should first note that during the study, no major differences were found among the different industries in terms of the following factors:

- the relevance of energy efficiency
- the extent to which management is informed of energy saving possibilities
- estimated opportunities to improve energy consumption
- estimated savings potential
- ROI for energy efficiency programs

Figure 15 shows the differences between the industries in terms of the number of completed energy efficiency projects. All of the companies in metal processing, machine building and the meat and dairy industry are carrying out some kind of energy efficiency projects. In general, companies in the timber industry demonstrate a lower level of activity in energy efficiency (Fig. 15). Companies in the meat and dairy sector are working on 1.5 times more projects than companies in the timber industry.

Figure 15. THE NUMBER OF ENERGY EFFICIENCY PROJECTS BY INDUSTRY

<table>
<thead>
<tr>
<th>Industry</th>
<th>Number of Projects</th>
<th>% of Companies in the Industry Taking Part in a Project</th>
<th>Number of Projects Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat and dairy</td>
<td>485</td>
<td>94%</td>
<td></td>
</tr>
<tr>
<td>Bread and confectionary</td>
<td>454</td>
<td>93%</td>
<td></td>
</tr>
<tr>
<td>Metal processing and machine building</td>
<td>382</td>
<td>88%</td>
<td></td>
</tr>
<tr>
<td>Light industry</td>
<td>346</td>
<td>85%</td>
<td></td>
</tr>
<tr>
<td>Timber industry</td>
<td>312</td>
<td>83%</td>
<td></td>
</tr>
</tbody>
</table>
The metal processing industry is actively investing in energy efficiency

Appendix 2 includes charts that illustrate the costs of different kinds of energy efficiency projects and their prevalence in the given industries that were examined. They give a good idea of the differences between total project costs by industry and the types of projects that are most typical for each industry. The following features were noted:

- The modernization of manufacturing equipment and heating systems is widespread among all of the industries: roughly 50% to 75% of all energy saving costs are targeted at this project category.

- The prevalence of projects to modernize refrigeration equipment and compressor systems varies strongly from industry to industry. Refrigeration equipment is being upgraded proactively in the meat and dairy sector as well as in the bread and confectionary industry, while these types of projects are barely present in the other industries. Projects to upgrade compressor systems are the most prevalent in metal-processing and machine building as well as in meat and dairy.

- Light industry has the lowest total costs for energy efficiency projects. Furthermore, the percentage of projects with a budget over RUR 5 mln is just 3%.

In order to evaluate the differences among industries, we asked companies: what is the most important incentive to initiate energy efficiency projects? In the machine building and metal processing sector, this incentive turned out to be obsolete equipment. For the meat and dairy industry, the driving factor was the high level of energy costs – a typical company in this sector will easily spend 50% more than the average among all five industries.
In order to conduct a comparative analysis of project capital intensity, we compared the percentages of an industry’s energy costs in total combined energy costs and industry shares in energy efficiency investments (Fig. 17). It became clear that total energy costs for companies in the meat and dairy sector exceed the costs of most companies in metal processing and machine building. On the other hand, expenses for energy efficiency projects in the metal processing sector are comparable with total energy costs, likely due to the industry’s high capital intensity as well as the high volume of obsolete equipment among all five industries.

The percentage of companies in light industry and the bread and confectionary sector have considerably lower costs for energy saving than their percentages of total energy costs. This likely points to a lower interest in energy saving with comparatively lower total energy costs: companies in the bread and confectionary industry spend on average RUR 7 mln per year, while companies in light industry spend an annual average of RUR 5.8 mln.

**Regional trends**

In discussing the regional features of energy efficiency among Russian companies, companies in the Privolzhsk and Central districts have taken the lead in terms of the number of projects completed.

It was surprising to learn that activity in energy efficiency does not correlate with electricity rates and seems to be connected to other factors. One of these factors may be favorable regional policies in energy efficiency. The study did not involve a detailed analysis of regional policies in this area, although we should note that regional energy efficiency programs are actively being developed and implemented in many areas of the Privolzhsk and Urals federal districts.
The number of completed projects does not correlate to average energy rates

This more detailed review across different regions confirms our conclusion that rate hikes are not sufficient to push a company towards taking a more active stance when it comes to introducing energy efficiency measures. For example, in Krasnodar Krai, where rates are relatively high, the average number of projects per company is the lowest. In Nizhegorod region, the rates are much lower than average rates across all of Russia and yet many companies are actively involved in energy efficiency programs.

Increased rates are not enough

Figure 19. RATES AND THE AVERAGE NUMBER OF ENERGY EFFICIENCY PROJECTS PER COMPANY, BY INDUSTRY

<table>
<thead>
<tr>
<th>Electricity rates, kopecks per kWh</th>
<th>Nizhegorod region</th>
<th>Stavropol Krai</th>
<th>Samara region</th>
<th>Volgograd region</th>
<th>Chelyabinsk region</th>
<th>Sverdlovsk region</th>
<th>Novgorod region</th>
<th>Perm region</th>
<th>Leningrad region</th>
<th>St. Petersburg</th>
<th>Krasnodar Krai</th>
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<tbody>
<tr>
<td>118</td>
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Information about rates was obtained from Federal Rate Service Order No. 337-E/5 (August 2, 2005).
4. ORGANIZING ENERGY EFFICIENCY PROGRAMS

4.1. ORGANIZING ENERGY EFFICIENCY PROGRAMS: CURRENT PRACTICES

For an energy efficiency program to succeed, it is crucial that managers have the proper expectations about the size of investments and the effects of the program. It is also highly important to draw up a detailed plan of action. As described in Chapter 2 of this report, many Russian companies believe that lowering costs is one way to increase competitiveness. We were able to identify a number of key organizational factors without which companies would have a very difficult time achieving their goals to lower energy consumption.

Figure 20. IMPLEMENTING ENERGY EFFICIENCY PROJECTS: ORGANIZATIONAL FACTORS

Does the company have a plan to increase energy efficiency? If so, to what degree is this plan being implemented?

- 31% the plan has been prepared and is being implemented
- 54% there is no plan but other measures are being taken
- 14% there is no plan, or a plan is not being carried out
- don't know

The most popular methods used to implement energy efficiency plans and measures:

- There is an employee or a division responsible for preparing and implementing measures: 51%
- The company’s strategy or policy has a section on increasing energy efficiency: 22%
- There are fines for irrational energy use: 18%
- Bonuses are awarded for achieving savings: 16%

Using bonuses to motivate employees to save energy is highly undervalued. Bonuses are a very effective tool for implementing programs, as demonstrated by international experience and examples in Russian companies.
The experiences of companies that have successfully carried out energy efficiency programs show that having an employee or division responsible for energy efficiency is often not enough. The company also needs to involve senior management in the planning process and set goals for the energy efficiency program as well as investment provisions.

The data show that only half of the companies have determined a structure outlining the person responsible for designing and implementing energy efficiency measures. Energy efficiency plans are only carried out at 31% of the companies that were surveyed, and only 16% of companies apply incentives programs for those who contribute to achieving targeted savings.

The experiences of companies that have achieved successful results in energy efficiency show that their success was achieved via a step-by-step program, the appointment of employees responsible for carrying out the program with the participation of key divisions, and an incentives program for achieving energy saving targets.

Inset 3. THE KEYS TO SUCCESS: ORGANIZATION

«...In order to ensure the success of an energy efficiency project, it is important to set goals, secure management support, establish a control system for implementation and operation, and ensure a transparent incentives program for participating employees.

Any energy efficiency project should begin with organizing energy metering. Companies can achieve up to 5% in savings just by streamlining control in this area...»

Source: The Industrial Information Bulletin, No.4/2006

4.2. THE ACTION PLAN

Ensuring control over project deadlines and expenses presumes the existence of a well-developed energy efficiency program. As we have already mentioned in Chapter 3, many companies carry out several energy efficiency projects at once: two to four on average (only 24% of all surveyed companies were able to carry out more – Fig. 21).

A deeper analysis shows that the companies that have comprehensive energy efficiency programs are involved with over four energy efficiency projects. Meanwhile, the companies working on energy efficiency measures that are not reinforced in a clear-cut program are generally limited to two or three projects. The difference between project management opportunities become especially clear when it comes to more complex measures, such as modernizing manufacturing equipment, heating systems and compressors. Among the companies that are working on an energy efficiency program,
nearly one-half are currently upgrading manufacturing equipment, while the percentage of those working on modernization programs without a clear-cut program is noticeably lower (39%). Having a clear plan provides companies with the opportunity to carry out more projects that are in general more complex. This trend is illustrated in Figure 22.

Not many companies carry out more than five projects

Having a clear plan can help a company complete more projects

Furthermore, the average size of projects carried out by companies that have a comprehensive energy efficiency plan is considerably larger than those who do not have a plan. For example, expenses for upgrading heating systems for companies that are working in line with an action plan amount to RUR 3.8 mln, which is 56% higher than the average for all surveyed companies (RUR 2.5 mln). Projects that aim to optimize compressor systems
The practice of keeping records of costs by division is not prevalent.

show an even larger difference, at RUR 3.2 mln and RUR 1.8 mln, respectively. As a result, 31% of the companies that are working in line with an extensive energy efficiency plan represent nearly half (49%) of the total project costs.

4.3. TRACKING ENERGY USAGE

Another important tool for ensuring control and evaluating the effectiveness of energy efficiency measures is an energy metering system, which can help analyze consumption when and where it happens. Nearly half of all surveyed companies have already installed or are currently in the process of installing metering systems, and roughly 40% of companies are already using metering systems for consumption by department, which helps companies track achievements and develop an incentives program based on these results to both incentivize and penalize employees.

However, the effectiveness of metering has not yet been recognized everywhere. Currently, only 10% of companies use automated metering and control systems. Most companies still track only based on total company usage, which makes it more difficult to track energy consumption and determine which production units use the most energy. It also makes it more difficult to evaluate the true effects of newly implemented energy efficiency measures. As a result, the efforts and investments may have limited results.

An analysis of current energy efficiency practices has shown that Russian companies have begun to take certain steps towards establishing organizational energy efficiency tools. However, overall, there is still a great deal of room for improvement. A flexible energy metering and control system, a reward system for successful participants that have achieved targeted savings and other organizational incentives gradually create a more reliable foundation for supporting and developing energy efficiency programs.
5. PROJECT FINANCING

5.1. MACROECONOMIC PRECONDITIONS

The cornerstone in preparing an energy efficiency project is the presence of a company’s own financial means or the ability to secure outside financing for a program.

Over the past few years, the growth of the Russian economy and the development of financial markets have led to increased competition among banks on the lending market. Five years ago, it was very difficult for a company to secure outside financing quickly (a great deal of preparatory work was required, and credit procedures were very time consuming). Today, however, banks are trying to make the loan process as simple and speedy as possible, and a wide range of loans are now being offered. In addition to corporate lending, other types of long-term financing options are also growing.

5.2. INVESTMENT POTENTIAL FOR MODERNIZATION

At present the total energy efficiency project expenses of the companies we surveyed amount to nearly RUR 3.5-4 bln. Our study shows that managers expect these expenses to increase 15-20% over the next two-three years. As a result, the total volume of planned investments in upgrading energy and high-consumption manufacturing equipment in the mid-term amounts to RUR 4.5-5 bln. As noted above, the metal processing and machine building industry will be among the top spenders. The volume of financing in this industry makes up nearly 30-35% of the planned volume of financing for all five surveyed industries. Small and mid-sized projects of up to RUR 30 mln each will play a major role (over 30%) in company expenses for energy saving.
We will illustrate the growth trend in spending described above for projects aimed at updating obsolete energy equipment. When deciding what kind of equipment to select, companies must calculate the so-called total cost of ownership (see Inset 4) – that is, the parameter that sums up the one-time expenses for purchasing a piece of equipment as well as operational and maintenance expenses.

Inset 4. **TOTAL COST OF OBSOLETE EQUIPMENT**

The total cost of ownership is a financial indicator that is used to estimate direct and indirect costs related to the purchase, operation and maintenance of equipment. It includes the cost of installing the equipment and energy consumption, labor costs for personnel needed to run the equipment, the cost of premises required to house the equipment, as well as the losses related to potential breakdowns and repairs. The total cost of ownership is a calculation necessary for other types of financial analyses (ROI, IRR) that are used to assess the profitability of different potential investments.

But before beginning to calculate the total cost of ownership, managers should have an understanding of another cost indicator: the total cost of obsolescence. This number represents the costs related to the use of obsolete equipment. It includes the same components as total cost of ownership (energy expenses, labor expenses, losses due to breakdowns or repairs, etc.) and it also includes information about how operating obsolete equipment impacts the volume and quality of production, the percentage of defects and waste, work conditions and ecological fines.

More than 60% of the companies surveyed purchased energy equipment over the past two years. Of those, 80% calculated the equipment operating costs when selecting their new equipment. The managers of 57% of the companies that bought new equipment decided in favor of acquiring more expensive models. As the energy consumption of production continues to grow, the correct calculation of equipment operation expenses will also rise. This trend is illustrated in Figure 25.

An analysis of industry trends in energy efficiency shows that the meat and dairy industry takes the most deliberate approach to energy equipment operations expense: almost 70% of the companies that bought new equipment opted for more expensive models. Clearly this is because this industry has a higher level of energy consumption (50% higher than the average of the total sample). Companies in the metal processing and machine building industry as well as the bread and confectionary sector less often select more expensive equipment (50%).
What difficulties have you experienced in implementing energy efficiency projects?

- Insufficient funds
- Difficulties in securing financing for energy efficiency projects
- Lack of experience in developing these types of projects
- Need to obtain permits / consent from government bodies
- Difficulty in assessing the effects of the project
- Reducing the energy consumption limit
- Technical problems during implementation

Companies now consider equipment operating costs when selecting new equipment.

5.3. ESTIMATING COMPANY DEMAND FOR FINANCING

Our research shows that many industries do have an appetite for financing energy efficiency projects. More than 60% of companies believe that insufficient funds is the key obstacle hampering energy efficiency projects (Fig. 26). In the next two-three years, the companies that were surveyed plan to secure outside financing for nearly 40-50% of their total costs for energy efficiency projects.

Figure 25. CALCULATING EQUIPMENT OPERATIONS COSTS

If your company purchased energy equipment in 2004-2005, did you take equipment operating costs into account?

Figure 26. PROJECT DIFFICULTIES

Percentage of respondents

What difficulties have you experienced in implementing energy efficiency projects?

- Insufficient funds: 64%
- Difficulties in securing financing: 18%
- Lack of experience: 24%
- Need to obtain permits: 23%
- Difficulty in assessing effects: 16%
- Reducing the energy consumption limit: 13%
- Technical problems during implementation: 6%

Insufficient funds is a major obstacle.
However, companies avoid approaching banks and leasing companies for outside financing for energy efficiency projects despite the fact that ROI time frames for these projects now coincide with loan horizons. Only every fourth company has applied for outside financing, and nearly 90% of them were successfully granted loans (Fig. 27).

Most energy efficiency projects that are carried out today are low-budget with short-term returns. It is no surprise that companies prefer to finance these with their own capital. Furthermore, the small number of companies turning to banks may be related to the conservative estimated benefits from energy saving, lack of organizational experience in carrying out these kinds of projects, and inefficient support from a company’s technical services personnel and/or financial services.

On the other hand, financial institutions prefer to lend funds for projects that are meant to increase production capacities, not reducing expenses. Neither banks nor leasing companies have fully developed lending for energy efficiency projects as a separate banking product.

**Figure 27. APPLYING FOR AND RECEIVING LOANS**

<table>
<thead>
<tr>
<th>Did your company apply for a loan with a bank to finance an energy efficiency project in 2007?</th>
<th>Percentage of respondents</th>
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<tbody>
<tr>
<td>Yes</td>
<td>24%</td>
</tr>
<tr>
<td>No</td>
<td>76%</td>
</tr>
</tbody>
</table>

| Did your company receive outside financing for these purposes? |
|---|---|
| Yes | 11% |
| No | 89% |

Reasons against considering outside financing include high interest rates and sufficient funds (Fig. 28).
Financial leverage increases the return on a company’s invested capital.

Why didn’t your company apply for outside financing?

Nearly 30% of the total number of companies that did not apply for loans say they had sufficient funds. We cannot rule out that these 30% were only considering energy efficiency projects for which they had sufficient funds. It is curious that over one-third of those who did not apply for loans due to “sufficient funds” also mentioned problems related to insufficient financial resources for energy efficiency.

Considering the low percentage of applications for bank loans, it would be logical to assume that many companies simply do not understand the advantages of using financial leverage, which can help increase the profitability of a company’s own capital via external sources of financing. Figure 29 shows how this works. This hypothetical example was calculated based on fully realistic assumptions: an interest rate of 15% p.a. and a three-year horizon. As the example demonstrates, a company that utilizes external financing will see a growth in the return on internal capital.

Why don’t companies look into outside financing?

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Why don’t companies look into outside financing?

Why don’t companies look into outside financing?
There are, however, some limitations that apply when using financial leverage. When making a decision about a loan, companies must be confident that:

- the industry is developing
- sales and cash flow are stable
- ROA is positive
- the debt-to-equity (D/E) ratio is within the industry norm

Since so few companies apply for outside financing, many beneficial and promising projects to increase energy efficiency end up getting scrapped. Companies believe that external financing is too costly, yet they do not have sufficient funds of their own and ultimately decide against implementing a project. Meanwhile, a company’s total costs while maintaining the current volume of energy consumption end up being significantly higher in the long-term than if a project had been implemented with borrow funds.

One example of this situation is shown in Figure 30, where we look at the purchase of infrared gas equipment. Two scenarios are considered: (1) the project is not implemented and (2) the project is implemented. The figure shows the benefits for the company minus project-related costs, including interest. As it turns out, while management was considering applying for a loan, a great deal more funds were spent – more than the initial required investment. In the long-term, over 10 years (the service life of infrared gas heaters), the company would spend nearly twice as much money as a result of not making the investment than investing.

The development of energy efficiency projects will be directly related to whether or not Russian companies are able to resolve their issues with project financing effectively. Perceiving energy efficiency as part of a company’s economic life is a relatively new phenomenon and will continue to develop, especially with the appearance of more financing options. The key to overcoming the problems at this stage is getting management to recognize the advantages of financial leverage and become more proactive in applying for loans from banks and leasing companies.
Valuable projects may be bypassed

5.4. PAYBACK PERIODS

As we have already mentioned, measures to increase energy efficiency have different budgets and, correspondingly, different savings potential. When deciding which projects to include in an energy efficiency program, the management teams of just 45% of all surveyed companies consider return on investment time frames. Roughly 25% of companies sometimes analyze ROI, but not systematically. Almost one-third of companies surveyed did not examine ROI for their key projects. It is possible that this lack of prevalence of calculating the payback period may explain the low level of company activity in implementing energy efficiency projects.

It should be noted that projects that involve larger investments do not necessarily have a longer-term payback. For example, the simple payback period on projects to update process equipment averages 6 months. Process equipment modernization projects are carried out by 45% of the companies that were surveyed. Other, relatively more expensive projects, such as upgrading heating and compressor systems, also have a relatively short-term payback close to two years.
Figure 31 shows the simple payback for projects that have been completed and the desired payback for the companies that were surveyed. At present only 20% of the projects that were completed have a payback of more than two years, while roughly 40% of the companies believe that this is an acceptable ROI time frame. It would be logical to assume that in the future, companies will be more willing to consider energy efficiency projects with a longer payback than they are now, and that they will continue to work on larger, more costly projects.

Companies will invest in projects with longer-term ROI time frames

Readers should note that in international practice, payback periods for upgrading manufacturing equipment are much longer. This is first and foremost because of the high level of project predictability and calculability, experience in applying for loans and the accessibility of credit resources at lower interest rates and over longer periods of time. These economic conditions make it possible to take on longer-term energy efficiency projects with a high level of effectiveness.

The fact that Russian companies prefer shorter paybacks is fully understandable considering the current stage of the country’s economic development. Although bank lending is becoming more and more accessible, financial institutions have not yet developed sufficient confidence that companies will be able to ensure stable income over the course of three years or that they will be able to meet repayment conditions.
5.5. FINANCING FUTURE ENERGY EFFICIENCY PROJECTS

As stated earlier, the companies that took part in this survey currently spend more than RUR 3.5 bln on various projects aimed at increasing energy efficiency, which is roughly 60% of their total cumulative energy costs. In the next two-three years, these total expenses will amount to RUR 4.5-5 bln. Nearly 24% of the companies that were surveyed applied for a loan from a bank or leasing company in 2005.

Another no less important component for building effective project financing policies is the ratio between expected savings and the repayment term. Overall, management teams make rather ambitious plans when it comes to ROI time frames. This is determined by conditions in the country as well as the repayment terms for the kinds of loans that these companies might consider.

It is difficult to claim objectively that repayment conditions for loans that Russian companies receive for energy efficiency projects are very short-term. As we noted above, 7% of respondents say that short-term repayment is one of the reasons why they do not apply for outside financing. If we take a closer look at the companies that have secured loans for energy efficiency projects, we see that 20-25% of the loans have repayment terms of either three years or longer. A comparison of the ROI time frames for these projects and the loan repayment terms shows that the companies are trying to limit the ROI time frames themselves in order to accelerate loan repayment. Nearly 50% of the respondents who intend to take out a loan want to use the loan for a project that involves an ROI time frame that is longer than the loan repayment term. This demonstrates that companies are basically ready to take on potential financial risks related to difficulties in future operations, and sometimes do not decide to carry out valuable projects with longer-term ROI time frames since they do not fully understand external financing opportunities.

Managers may be advised to adopt a more flexible approach for taking advantage of today’s opportunities on the financial market. The better informed management is about the full range of external financing opportunities and their related advantages, the more successful and beneficial the energy efficiency projects they carry out will be.
6. RESULTS AND RECOMMENDATIONS

6.1. SUCCESS FACTORS FOR ENERGY EFFICIENCY PROJECTS

Based on the results of this study, international experience and the experience of successful Russian companies, we can name several key success factors for energy efficiency programs.

### Key success factors for energy efficiency programs

<table>
<thead>
<tr>
<th>Factor</th>
<th>Current situation for companies</th>
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</thead>
<tbody>
<tr>
<td><strong>WHAT TO DO?</strong></td>
<td></td>
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<tr>
<td>1. A realistic estimate of savings potential</td>
<td>Savings estimates are conservative</td>
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<tr>
<td>2. A development strategy determines energy needs</td>
<td>Energy saving measures are often not aligned with companies’ development strategies</td>
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<tr>
<td>3. A step-by-step program that moves from low-cost measures to more capital intensive phases</td>
<td>Most projects are low-cost with short ROI time frames</td>
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<tr>
<td><strong>HOW TO ORGANIZE IT?</strong></td>
<td></td>
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<tr>
<td>4. A comprehensive action plan for energy efficiency</td>
<td>Companies carry out different measures, but not comprehensive programs, which lowers the effectiveness and the scope of the projects</td>
</tr>
<tr>
<td>5. Employees in charge of energy efficiency, a bonus-based incentives program and management involvement</td>
<td>Not all companies have employees or divisions responsible for energy efficiency, and bonuses are awarded very rarely</td>
</tr>
<tr>
<td>6. Detailed metering of energy consumption at a departmental level</td>
<td>This factor is rarely seen, which deprives management of a tool to analyze and manage spending</td>
</tr>
<tr>
<td><strong>HOW TO FINANCE IT?</strong></td>
<td></td>
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<tr>
<td>7. A calculation of ROI</td>
<td>Companies calculate ROI less than 50% of the time</td>
</tr>
<tr>
<td>8. Recognition of the opportunities and benefits of securing external financing</td>
<td>Managers avoid loans, especially long-term loans, which leads to projects being postponed</td>
</tr>
<tr>
<td>9. Keeping informed of the situation on the financial market, including long-term investments</td>
<td>Awareness levels are low; only one-fourth of companies have applied for a loan</td>
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</table>

If a company’s management has already recognized the need to introduce an energy efficiency program, it needs to find the correct answers to the following questions before getting started: what exactly does the company need to do, how will it organize the process and how will it finance the projects? The answers to these questions will naturally be different for each specific situation, but trends and information outlined in this report will be helpful for most companies.
What exactly does the company need to do?

The first step is a realistic estimate of a company’s savings potential, which can be done either with an internal or external audit of energy consumption, as well as comparing the levels of energy consumption for production with peer companies using an industry consumption curve. Companies should also identify the required volume of energy with respect to the company’s general development strategy and plans for upgrading manufacturing equipment. This analysis will provide an opportunity to compile a list of possible measures to increase energy efficiency, both low-cost and capital intensive steps. The next step is to identify priorities and carry out the plan.

How will the company organize the process?

Efficient organization of energy efficiency programs requires a comprehensive plan with detailed control over the different parts of the plan. The lack of an action plan will have a negative effect on a company’s ability to achieve successful results in many different areas of energy saving. A transparent incentives system for employees who are involved in energy efficiency and proper recordkeeping practices for energy expenses are also fundamental elements of effective organization.

How will the company finance the projects?

Calculating the return on investment is an important element in initiating any project, especially if the project requires external financing. The practice of applying for loans for energy efficiency projects is not yet sufficiently widespread among Russian companies, although banks are now offering more and more opportunities in this area.

6.2. CONSUMPTION CURVES

As we already mentioned in Chapter 2, during this survey we were able to establish a tool for positioning the energy consumption of companies. This allows us to compare the energy efficiency of companies in one industry. We have gathered information about the production volumes, output and the energy consumption level required to support these production levels in various sub sectors. Intra-sector differentiation is needed because the specifics of production dictate certain requirements for the way in which energy is consumed and at what volumes it is consumed. Neglecting to consider these aspects may result in incorrect conclusions.
We have attempted to identify the mathematical patterns between production volumes and energy consumption and build consumption curves that will illustrate the dependency of the amount of energy consumed on a production volume within sub sectors. Knowledge of the energy consumption function in the respective sub sector may be useful to managers in order to understand and evaluate just how efficiently their companies are using energy. The curves in Appendix 1 are indicative of the situation, as in many cases the number of observations is insufficient or the $R^2$ indicator is too low. Companies are encouraged to work with their industry associations to gather, analyze and distribute more representative comparative data on the use of energy resources.

This may be a useful tool for companies with similar lines of business. Only a simple calculation is needed: companies need to calculate the energy consumption of their companies and the total number of goods produced (in pieces or by tons) and then mark their location with the corresponding coordinates on the axes shown in the charts (Appendix 1, by industry).

If your company’s point on the chart is:

- lower than the industry curve: your company’s energy efficiency is higher than the industry average;
- higher than the industry curve: your company likely needs to take measures to improve energy efficiency;
- on the industry curve: this means that your company’s energy efficiency coincides with the industry average.
APPENDIX 1

CONSUMPTION CURVES BY INDUSTRY

The curves below are indicative of trends rather than representative as, in many cases, the number of observations was insufficient, or the R² indicator was too low. Companies are encouraged to work with their industry associations to gather, analyze and distribute more representative comparative data on the use of energy resources.

**Figure 1. THE FURNITURE INDUSTRY**

![Graph](image1.png)

\[ y = 0.077x + 1.753 \]

\[ R^2 = 0.6704 \]

**The furniture industry:**

*9 companies*

**Figure 2. LIGHT INDUSTRY**

![Graph](image2.png)

\[ y = 0.0413x - 0.5915 \]

\[ R^2 = 0.0566 \]

**Light industry**

*(garments): 9 companies*
Appendix 1
On the road to energy efficiency: experience and future outlook

The dairy sector: 16 companies

![Figure 3. THE DAIRY SECTOR](image1)

\[ y = 0.9158x + 17.914 \]
\[ R^2 = 0.1239 \]

The meat processing industry: 11 companies

![Figure 4. THE MEAT PROCESSING INDUSTRY](image2)

\[ y = 0.0016x + 0.3321 \]
\[ R^2 = 0.7872 \]
APPENDIX 2

AN OVERVIEW OF ENERGY EFFICIENCY PROJECTS BY INDUSTRY

Figure 1. THE WOOD PROCESSING INDUSTRY

Type of project:
- Upgrading heating systems
- Effective frequency controlled drives
- Installing automated systems of metering and managing energy use
- Upgrading manufacturing equipment
- Building insulation
- Installation of metering systems
- Upgrading heating systems
- Lighting
- Compressors

Most popular projects with high capital intensity

Least popular projects with low costs

The timber processing industry

Figure 2. LIGHT INDUSTRY

Type of project:
- Upgrading refrigeration equipment
- Building insulation
- Installation of metering systems
- Upgrading heating systems
- Effective frequency controlled drives
- Lighting
- Compressors
- Installing automated systems of metering and managing energy use

Light industry
The metal processing industry

**Figure 3. METAL PROCESSING AND MACHINE BUILDING**

<table>
<thead>
<tr>
<th>Type of project</th>
<th>Percentage of companies implementing these projects</th>
<th>Average project expenses (RUR, mln)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upgrading manufacturing equipment</td>
<td>17%</td>
<td>668</td>
</tr>
<tr>
<td>Upgrading refrigeration equipment</td>
<td>12%</td>
<td>233</td>
</tr>
<tr>
<td>Building insulation</td>
<td>11%</td>
<td>162</td>
</tr>
<tr>
<td>Installation of metering systems</td>
<td>5%</td>
<td>74</td>
</tr>
<tr>
<td>Upgrading heating systems</td>
<td>4%</td>
<td>20</td>
</tr>
<tr>
<td>Effective frequency controlled drives</td>
<td>3%</td>
<td>17</td>
</tr>
<tr>
<td>Lighting</td>
<td>3%</td>
<td>12</td>
</tr>
<tr>
<td>Compressors</td>
<td>2%</td>
<td>9</td>
</tr>
<tr>
<td>Installing automated systems of metering and managing energy use</td>
<td>2%</td>
<td>6</td>
</tr>
</tbody>
</table>

**Figure 4. THE MEAT AND DAIRY INDUSTRY**

<table>
<thead>
<tr>
<th>Type of project</th>
<th>Percentage of companies implementing these projects</th>
<th>Average project expenses (RUR, mln)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upgrading manufacturing equipment</td>
<td>26%</td>
<td>199</td>
</tr>
<tr>
<td>Upgrading refrigeration equipment</td>
<td>20%</td>
<td>360</td>
</tr>
<tr>
<td>Building insulation</td>
<td>19%</td>
<td>101</td>
</tr>
<tr>
<td>Installation of metering systems</td>
<td>17%</td>
<td>131</td>
</tr>
<tr>
<td>Upgrading heating systems</td>
<td>17%</td>
<td>40</td>
</tr>
<tr>
<td>Effective frequency controlled drives</td>
<td>12%</td>
<td>17</td>
</tr>
<tr>
<td>Lighting</td>
<td>12%</td>
<td>12</td>
</tr>
<tr>
<td>Compressors</td>
<td>10%</td>
<td>9</td>
</tr>
<tr>
<td>Installing automated systems of metering and managing energy use</td>
<td>9%</td>
<td>6</td>
</tr>
</tbody>
</table>

**Figure 5. THE BREAD AND CONFECTIONARY INDUSTRY**

<table>
<thead>
<tr>
<th>Type of project</th>
<th>Percentage of companies implementing these projects</th>
<th>Average project expenses (RUR, mln)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upgrading manufacturing equipment</td>
<td>31%</td>
<td>50</td>
</tr>
<tr>
<td>Upgrading refrigeration equipment</td>
<td>28%</td>
<td>230</td>
</tr>
<tr>
<td>Building insulation</td>
<td>28%</td>
<td>51</td>
</tr>
<tr>
<td>Installation of metering systems</td>
<td>17%</td>
<td>74</td>
</tr>
<tr>
<td>Upgrading heating systems</td>
<td>17%</td>
<td>20</td>
</tr>
<tr>
<td>Effective frequency controlled drives</td>
<td>12%</td>
<td>17</td>
</tr>
<tr>
<td>Lighting</td>
<td>12%</td>
<td>12</td>
</tr>
<tr>
<td>Compressors</td>
<td>10%</td>
<td>9</td>
</tr>
<tr>
<td>Installing automated systems of metering and managing energy use</td>
<td>9%</td>
<td>6</td>
</tr>
</tbody>
</table>
APPENDIX 3

AN OVERVIEW OF ENERGY EFFICIENCY PROJECTS BY REGION

Figure 1. THE CENTRAL REGION

The Central Region

- Compressors
- Lighting
- Effective frequency controlled drives
- Upgrading heating systems
- Installation of metering systems
- Building insulation
- Upgrading refrigeration equipment
- Upgrading manufacturing equipment
- Effective frequency controlled drives
- Lighting
- Compressors
- Installing automated systems of metering and managing energy use

Figure 2. THE NORTHWEST REGION

The Northwest Region

- Compressors
- Lighting
- Effective frequency controlled drives
- Upgrading heating systems
- Installation of metering systems
- Building insulation
- Upgrading refrigeration equipment
- Upgrading manufacturing equipment
- Effective frequency controlled drives
- Lighting
- Compressors
- Installing automated systems of metering and managing energy use
### The Southern Region

#### Figure 3. THE SOUTHERN REGION

- **Type of project:**
  - Upgrading manufacturing equipment
  - Upgrading refrigeration equipment
  - Building insulation
  - Installation of metering systems
  - Upgrading heating systems
  - Effective frequency controlled drives
  - Lighting
  - Compressors
  - Installing automated systems of metering and control of energy use

#### Most popular projects with high capital intensity
- Upgrading manufacturing equipment: 105
- Upgrading refrigeration equipment: 62
- Building insulation: 33
- Installation of metering systems: 20
- Upgrading heating systems: 15
- Effective frequency controlled drives: 15
- Lighting: 10
- Compressors: 8
- Installing automated systems of metering and control of energy use: 8

#### Least popular projects with low costs
- Total project expenses for all companies (RUR, mln): 66

#### Percentage of companies implementing these projects
- 0%
- 47%

### The Privolzhsk Region

#### Figure 4. THE PRIVOLZHSK REGION

- **Type of project:**
  - Upgrading manufacturing equipment
  - Upgrading refrigeration equipment
  - Building insulation
  - Installation of metering systems
  - Upgrading heating systems
  - Effective frequency controlled drives
  - Lighting
  - Compressors
  - Installing automated systems of metering and control of energy use

#### Most popular projects with high capital intensity
- Upgrading manufacturing equipment: 363
- Upgrading refrigeration equipment: 164
- Building insulation: 67
- Installation of metering systems: 26
- Upgrading heating systems: 26
- Effective frequency controlled drives: 17
- Lighting: 13
- Compressors: 12
- Installing automated systems of metering and control of energy use: 12

#### Least popular projects with low costs
- Total project expenses for all companies (RUR, mln): 35

#### Percentage of companies implementing these projects
- 0%
- 47%

### The Urals Region

#### Figure 5. THE URALS REGION

- **Type of project:**
  - Upgrading manufacturing equipment
  - Upgrading refrigeration equipment
  - Building insulation
  - Installation of metering systems
  - Upgrading heating systems
  - Effective frequency controlled drives
  - Lighting
  - Compressors
  - Installing automated systems of metering and control of energy use

#### Most popular projects with high capital intensity
- Upgrading manufacturing equipment: 191
- Upgrading refrigeration equipment: 177
- Building insulation: 83
- Installation of metering systems: 56
- Upgrading heating systems: 39
- Effective frequency controlled drives: 34
- Lighting: 15
- Compressors: 13
- Installing automated systems of metering and control of energy use: 13

#### Least popular projects with low costs
- Total project expenses for all companies (RUR, mln): 35

#### Percentage of companies implementing these projects
- 0%
- 47%
APPENDIX 4

THE VOLUME OF OBSOLETE EQUIPMENT BY INDUSTRY

Figure 1. THE TIMBER PROCESSING INDUSTRY

The percentage of companies operating energy equipment over 10 years old

- Boiler equipment: 44%
- Variable speed drives: 43%
- Compressors: 42%
- Ventilation systems: 40%
- Pumps: 40%
- Electrical drives / motors: 39%
- Heat exchangers: 32%

Years equipment in operation:
- From 11 to 15
- From 16 to 25
- Over 25

Figure 2. LIGHT INDUSTRY

The percentage of companies operating energy equipment over 10 years old

- Electrical drives / motors: 75%
- Boiler equipment: 73%
- Pumps: 72%
- Heat exchangers: 71%
- Compressors: 69%
- Ventilation systems: 69%
- Re-circulating water cooling systems: 68%

Years equipment in operation:
- From 11 to 15
- From 16 to 25
- Over 25
The volume of obsolete equipment in the metal processing and machine building sector

Figure 3. **THE METAL PROCESSING AND MACHINE BUILDING SECTOR**

The percentage of companies operating energy equipment over 10 years old

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Percentage of Companies Operating Over 10 Years Old</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventilation systems</td>
<td>68%</td>
</tr>
<tr>
<td>Boiler equipment</td>
<td>67%</td>
</tr>
<tr>
<td>Compressors</td>
<td>67%</td>
</tr>
<tr>
<td>Pumps</td>
<td>66%</td>
</tr>
<tr>
<td>Re-circulating water cooling systems</td>
<td>65%</td>
</tr>
<tr>
<td>Heat exchangers</td>
<td>65%</td>
</tr>
<tr>
<td>Electrical drives / motors</td>
<td>64%</td>
</tr>
<tr>
<td>Variable speed drives</td>
<td>63%</td>
</tr>
</tbody>
</table>

The percentage of respondents using equipment

- Ventilation systems: 50%
- Boiler equipment: 58%
- Compressors: 55%
- Pumps: 52%
- Re-circulating water cooling systems: 34%
- Heat exchangers: 43%
- Electrical drives / motors: 51%
- Variable speed drives: 26%

Years equipment in operation: from 11 to 15, from 16 to 25, over 25

The volume of obsolete equipment in the meat and dairy industry

Figure 4. **THE MEAT AND DAIRY INDUSTRY**

The percentage of companies operating energy equipment over 10 years old

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Percentage of Companies Operating Over 10 Years Old</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressors</td>
<td>52%</td>
</tr>
<tr>
<td>Heat exchangers</td>
<td>51%</td>
</tr>
<tr>
<td>Pumps</td>
<td>51%</td>
</tr>
<tr>
<td>Boiler equipment</td>
<td>50%</td>
</tr>
<tr>
<td>Refrigerators</td>
<td>50%</td>
</tr>
<tr>
<td>Electrical drives / motors</td>
<td>49%</td>
</tr>
<tr>
<td>Ventilation systems</td>
<td>47%</td>
</tr>
<tr>
<td>Re-circulating water cooling systems</td>
<td>42%</td>
</tr>
<tr>
<td>Variable speed drives</td>
<td>42%</td>
</tr>
</tbody>
</table>

The percentage of respondents using equipment

- Compressors: 70%
- Heat exchangers: 70%
- Pumps: 74%
- Boiler equipment: 83%
- Refrigerators: 77%
- Electrical drives / motors: 75%
- Ventilation systems: 76%
- Re-circulating water cooling systems: 53%
- Variable speed drives: 36%

Years equipment in operation: from 11 to 15, from 16 to 25, over 25

The volume of obsolete equipment in the bread and confectionary industry

Figure 5. **THE BREAD AND CONFECTIONARY INDUSTRY**

The percentage of companies operating energy equipment over 10 years old

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Percentage of Companies Operating Over 10 Years Old</th>
</tr>
</thead>
<tbody>
<tr>
<td>Re-circulating water cooling systems</td>
<td>67%</td>
</tr>
<tr>
<td>Compressors</td>
<td>63%</td>
</tr>
<tr>
<td>Variable speed drives</td>
<td>61%</td>
</tr>
<tr>
<td>Pumps</td>
<td>60%</td>
</tr>
<tr>
<td>Electrical drives / motors</td>
<td>59%</td>
</tr>
<tr>
<td>Heat exchangers</td>
<td>58%</td>
</tr>
<tr>
<td>Ventilation systems</td>
<td>58%</td>
</tr>
<tr>
<td>Boiler equipment</td>
<td>57%</td>
</tr>
<tr>
<td>Refrigerators</td>
<td>57%</td>
</tr>
</tbody>
</table>

The percentage of respondents using equipment

- Re-circulating water cooling systems: 34%
- Compressors: 66%
- Variable speed drives: 53%
- Pumps: 88%
- Electrical drives / motors: 90%
- Heat exchangers: 65%
- Ventilation systems: 89%
- Boiler equipment: 98%
- Refrigerators: 83%

Years equipment in operation: from 11 to 15, from 16 to 25, over 25
IFC’s Russia Sustainable Energy Finance Program

The International Finance Corporation (IFC) has accumulated vast experience in financing energy efficiency worldwide, including in Eastern Europe. The IFC has designed a special sustainable energy finance program for Russia as well. The program is meant to serve as a catalyst for the Russian energy efficiency market and encourage the active involvement of Russian companies, financial institutions and suppliers of equipment and services on this market. Under this program, the IFC will grant long-term (up to five-year) credit lines and partial guarantees to Russian banks and leasing companies which, in turn, will finance specific projects in energy efficiency. Our experts also provide technical, legal and financial consulting support for companies at all stages in project implementation.

The technical support program is financed by the Global Ecological Fund (GEF), the International Finance Corporation’s Fund for the Sustainable Development of Financial Markets, the Danish Environmental Protection Agency, the Finnish Ministries of Foreign Affairs and Industry and Trade, and the government of the Free State of Saxony.

Expert support includes:

- consulting for technical issues connected to identifying energy savings potential and an assessment of specific project risks;
- financial consulting, transaction structuring, financial project modeling aimed at estimating the economic efficiency of energy conservation, estimating financial risks, and providing assistance in preparing all required documents for loan applications with a bank or a leasing company;
- legal support: consulting regarding the legal structure of transactions and legislative requirements;
- informational support: provision of analytical information about different market segments, as well as about potential partners and equipment suppliers.

Projects that meet the following criteria are eligible for our program:

- the project is aimed at significantly increasing a company’s energy efficiency;
- the borrower or lessee is a privately owned company in which the government directly or indirectly holds interest of 49% or less (project financing in the municipal sector is a possibility if the bank or leasing company consents to take on the risks associated with financing a specific project);
- the ROI time frame does not exceed five years;
- the project involves installing equipment that has been tested and has been proven to be energy efficient. This applies to both Russian-made and imported equipment. All general industry equipment is eligible, such as manufacturing equipment that is specific to certain industries. Technologies for using renewable sources of energy and cogeneration will also be considered.

If your company is interested in increasing energy efficiency and has already selected an initial project in this area, you may receive project consultation. To start, you must prepare a description of the project, which should include the following information:

- a brief description of the company;
- an outline of the situation in the market specific to how it may affect the project’s outlook;
- the proposed technical solution(s);
- base financial aspects of the project (the size of the project, the required financing, expected savings and the ROI time frame).