Center for Energy Efficiency

ENERGY EFFICIENCY

Quarterly Bulletin

CENEf №18 January-March 1998

CONTENTS:

ENERGY EFFICIENCY POLICY NEWS

IMPLEMENTATION OF REGIONAL BUILDING ENERGY CODES IN RUSSIA: PROSPECTS FOR IMPORTS AND INDIGENOUS PRODUCTION OF ADVANCED TECHNOLOGIES

Yu.Matrosov, NIISF/CENEf, Russia
D.Goldstein, NRDC/IMT, USA
M.Chao, IMT, USA

1. Russian codes for energy efficiency in buildings

The federal Russian normative requirements for thermal performance of buildings have been established by the new edition of the federal SNiP II-3-79* (1995) "Thermal Engineering," in force since 1996. This document calls for two stages of implementation of new normative requirements for thermal performance, the first beginning in 1996 and the second in 2000. The year-2000 level corresponds to the requirements of such countries as Sweden and Canada. A good example of regional codes is the Moscow standards MGSN 2.01-94 "Energy Efficiency in Buildings," which came into force in the city of Moscow in 1994. Both code documents provide for a reduction of energy consumption of 20% in comparison with the level existing before the onset of the codes, with a subsequent additional reduction for energy efficiency from the year 2000 forth.

In Table 1 we present categories for residential buildings according to specific consumption of heat energy under the old and new normative requirements. One can see from the table, buildings built in compliance with the first stage of SNiP II-3-79* (1995) and the Moscow code MGSN 2.01-94 would already comply with the standards of Germany, and buildings built in compliance with the second stage of the federal code would provide for a reduction of energy consumption by another 18–20%.

Table 1. Classification of residential buildings of the Russian Federation according to their specific consumption of heat energy (calculated at the heat source) E_0, Wh/(m^2·°C.day)

Category of energy efficiency	Characterization of the building according to its energy-efficient features	Specific energy consumption E_0
I	Buildings in minimum compliance with the old SNiP II-3-79 (ed.1986)	150-100
II	Buildings in minimum compliance with the first stage (starting 1996) of the new SNiP II-3-79* (ed.1995) and the Moscow code MGSN 2.01-94 before Jan. 1, 2000	95-60
III	Buildings in minimum compliance with the second stage (starting Jan. 1, 2000) of the new SNiP II-3-79* (ed.1995) and MGSN 2.01-98	75-50
IV	Future energy-efficient buildings using new technologies	30-25

For example, a residential multifamily 17-story building from series P44/17 built in Moscow in compliance with the first stage of implementation of MGSN 2.01-94 and connected to a centralized system of heat supply will have a specific of heat energy E_0 = 61.5 Wh/(m^2. °C.day), and one built in compliance with the second stage of SNiP II-3-79* (1995) would have E_0 = 53.4 Wh/(m^2.°C.day).

The results of this research have been reflected in the draft of Moscow standards MGSN 2.01-98. In table 2 the required values for specific energy consumption (by the system of heat supply) are shown.

Table 2. Revised Moscow code (1998): required maximum specific consumption of heat energy (calculated at the heat source) E_0^{req}, Wh/(m^2·°C.day)

Building type	Number of stories			
	1 - 3	4 and more		
	Stage I	Stage II	Stage I	Stage II
Residential	100	80	75	60
Public	120	95	105	85

It is evident that the figures shown in Table 2 correspond to energy-efficiency categories II and III of Table 1.

2. The implementation of standards takes place with a lag period

The real transition to new building designs resulting from the entry into force of new codes and standards usually lags 2-3 years behind the time of adoption. To this point, the entry into force in 1996 of the new SNiP II-3-79* and accompanying design recommendations for code compliance for walls has led to implementation of new energy-efficient building envelopes within two years.

The transition of wall-panel prefabrication plants to production of three-layer wall panels instead of one-layer panels has been carried out in Buryatia, the Krasnodar and Krasnoyarsk Krays, and the oblasts of Voronezh, Kemerovo, Leningrad, Novosibirsk, Orlov, Belgorod, Tula, and Chelyabinsk. In all, at present, wall-panel plants from 57 of 98 regions of Russia have switched over to production of energy-efficient three-layer panels. (One should note that one-layer panels are able to satisfy the requirements of the new SNiP without being impractically thick.)

One must note that the transition of the Moscow construction industry, including joint production with foreign companies, has taken nearly three years. Now newly constructed buildings comply with category II of Table 1, and are achieving real energy savings.

In the beginning of 1998 new all-Russian requirements for fenestration were confirmed, as presented in Table 3. These values apply to all fenestration (windows and skylights), including sashes and frames — that is, in the selection of fenestration, one must take the overall thermal resistance into account. During building design, the designer chooses an component according to data shown on its certificate.

Table 3. The required thermal resistance of fenestration, R

Building types	Degree-days	R_0^{req}, $m^2.^{\circ}C/W$	
		windows	skylights
Residential	2000	0.3	0.30
	6000	0.6	0.40
	8000	0.7	0.45
	12000	0.8	0.55
Public	2000	0.3	0.30
	6000	0.5	0.40
	12000	0.8	0.55

These new normative requirements open the way to contemporary energy-efficient fenestration.

For protection of the rights and interests of the Russian consumer of construction products against poor-quality items, of both domestic and foreign producers, the State Committee on Standards (Gosstandart) has introduced required certification for several types of construction materials with regard to their compliance with Russian standards and SNiPs. This means that without the relevant certificate, the sale of these items is prohibited in the Russian market.

At present in Russia, a large volume of testing and certification is being carried out for windows in vinyl and wooden frames, produced by Russian, joint-venture, and foreign firms. The rapidly growing demand for energy-efficient windows in Russia is making possible an accelerated transition of the Russian construction industry to the construction of energy-efficient buildings. Experience from certification of windows at the Research Institute for Building Physics indicates that there is a large quantity of quite airtight windows in the Russian market, with improved levels of thermal performance (overall thermal resistance from 0.45 to 0.7 $m^2.^{\circ}C/W$ and an air infiltration rate, taking into account the seam between the window and the wall opening, from 2 to 4 $kg/m^2.hr$, and an air infiltration rate via small openings in the window structure itself from 0.4 to 1.5 $kg/m^2.hr$ under ambient air pressure of 10 Pa.

3. Regional codes for energy efficiency in buildings

One of the main requirements of the Russian law "On Energy Efficiency" in the area of standards for buildings is the reduction of heat losses and curtailment of the use of heat-energy resources. This corresponds to the interests of the end-user to spend less on building operating costs and on the other hand, does not contradict the necessity of providing for comfort conditions for people therein. One should note that in the context of this all-Russian law, in connection with the growth of the role of regions, with decentralization, and with the development of self-governance, a need has emerged for the development of regional codes and standards for the energy-efficient consumption of heat.

Since 1995 the Natural Resources Defense Council (NRDC), the Research Institute for Building Physics, and the Center for Energy Efficiency have been carrying out a collaborative effort in the area of developing standards for the construction industry. The important significance of this collaboration consists in the fact that as is well known in foreign as well as Russian experience, codes are the best stimulus toward new construction goods and technologies. As a result of collaboration over the last three years under the support of the U. S. Environmental Protection Agency, the Russian-American group has developed a model regional building code ("Energy Efficiency in Buildings") for thermal performance of buildings, intended for regions of the Russian Federation. (For more details, see Bulletin No. 13, p. 5.)

At the foundation of the model code are performance requirements for buildings: specific energy consumption by the system of heat supply of the building during the heating season, taking into account the efficiency of the chosen heating system; provision of optimal comfort conditions in the building's occupied areas; and a mechanism for oversight over compliance with the standards not only during the design stage, but also in the construction and operation phases as well, and furthermore, in the estimation of costs in the real-estate market.

The oversight mechanism provides for the use of the so-called Energy Passport of the building (Bulletin No. 11, p. 6). At present a concrete manifestation of the Energy Passport has been confirmed by the Moscow government for use in design and construction practice for buildings in Moscow.Table 4 shows the suggested fixed-budget performance targets of the model regional code. (Note that the targets are considerably stricter than the equivalent norms for the amended Moscow code, and correspond generally to category III of Table 1.)

Table 4 Model regional code: required maximum specific consumption of heat energy (calculated at the heat source) E , Wh/(m . C.day)

Building types	Number of stories		
	1-3	4-5	6 and higher
Residential	75	55	55
Public	85	80	75

At present work has begun on the implementation of these regional standards in Moscow, and also in the Chelyabinsk, Rostov, Omsk, and Yaroslavl oblasts of Russia. The regions have become interested in the reduction of the subsidy portion of their local budgets and consequently, in regional standards that provide for more efficient energy use. Moscow is a good example of the execution of such work.

At present in Moscow, residents pay only 18% of the cost of heat energy, with the remaining 82% covered by the city budget. Now in Moscow 3.2 million square meters of overall (occupied) residential housing area is being built annually. Almost all these buildings are connected to the centralized system of heat supply. This implies an average growth of final energy consumption of 1.1 TWh annually (under design conditions). If Moscow had not gone over in 1994 to new standards, then the average growth of final energy consumption would have been 1.4 TWh. Thus, by the end of 1997 the energy-saving effect in

Moscow was 0.3 TWh or close to $3 million (US) — that is, Moscow has reduced the heating-subsidy portion of the budget by this amount.

4. Growing demand for new technologies

Despite real problems in the Russian economy, a significant growth in activity in the construction sector is being observed, particularly in construction of single-family residences. In 1997, nine square meters of residential buildings were built for every 22 square meters overall in Russia. The mobilization of activity by foreign and joint companies is also being observed, as they view the limitless potential of the growing Russian market.

As noted above, the new code requirements provide for savings of energy of 30% or more relative to the levels existing under prior codes. Achieving these savings is possible not only by means of the use of products now available in the Russian construction marketplace, making possible new energy-efficient building techniques, but also by means of the use of the newest Russian energy-efficient technologies, and also by the purchase on a mutually agreed basis of licenses and "know-how" with the creation of joint production facilities, which leads to the implementation of western energy-efficient technologies in the regions of Russia.

First of all this pertains to walls and roofs with the use of efficient light thermal-insulating materials. These goods are also promising for renovation of existing buildings. The use of energy-efficient windows provides for the required energy savings and comfort, and also for the use of solar energy in the cold period of the year or protection from insolation in the hot period of the year. Low-emissivity hard coatings and heat-mirror films for windows are very promising. Heat-reflecting films with a multi-layer coating may serve as an alternative. Also promising is the production of polymer-cement fixatives for the attachment and protection of exterior insulation for the exterior facade of buildings and frost-resistant fill materials. The reduction of the required air exchange rate in the occupied premises of the building and the necessary high level of airtightness of windows (caulking, weatherstripping) requires the taking of special measures for the provision of natural ventulation, which is new for the Russian market.

The increase in the efficiency of the systems of heat supply open the market to systems of decentralized heat supply, and in particular, highly efficient gas heaters, new heat-exchange apparatus and air-air heat pumps, and control devices. All these areas are still open niches in the Russian market for business.

There are many good examples while foreign companies are actively and persistently seizing the Russian market. Here we provide only a few examples.

The German firm KBE, which produces plastic frames for windows, has for the last two years created more than 150 joint and Russian enterprises for the production of window units in plastic frames in the majority of regions of Russia. This same firm is carrying out wide-ranging research on the adaptation of window units in keeping with the climate conditions of Russia, and in particular, for the provision of required air flow for the widespread Russian case of buildings with non-mechanical ventilation.

The Danish firm Rockwool can serve as another example, with regard to the production of mineral wool. This firm already has received certificates for its products and has created three affiliated joint companies for implementation in the Russian market, including the adaptation of design and technology. This firm also finances work for the definition of design characteristics of its goods in compliance with the new SNiP II-3-79*. This firm is engaged in active competition with other western firms, and in particular, the Finnish company Partec.

The Canadian firm DeGrand Corporation, together with Russian construction companies, is erecting so-called Canadian individual homes in Omsk. Research on the thermal-performance properties of such a home has shown that the design specific energy consumption of heat energy of the system of heat supply is equal to 53 Wh/m^2.°C.day. At the same time an analogous design of an individual home developed by the Omsk Civil Construction Design Institute in 1989 showed that the design specific energy consumption of heat energy of the system of heat supply is equal to 146 Wh/m^2.°C.day –that is, 2.7 times more. Analogous homes are being built in the Moscow oblast.

It is necessary to note that the hastily-considered transfer of foreign construction experience into Russian conditions, unfortunately, has led to insufficient consideration of the severe Russian conditions and to serious errors in design. Examples of widespread mistakes include

— the absence of breaks in thermal bridges in floors that run out to the balcony, leading to the increase in heat losses and the occurrence of dew point in zones adjacent to the floors, and finally to the formation of mold;

— insufficiently massive external walls, which do not provide for thermal stability of the occupied premises upon rapid changes in temperature conditions; incorrect designs of plate layers of building fasades, which lead to temperature problems and disruption of the humidity regime of walls;

— the placing of window units aligned flush with the outer surface of walls and the use of heat-transmitting window frames in combination with efficient sealed-glass units, which lowers the effect of the use of efficient glazing;

— incorrect placement of insulation and vapor-barrier layers;

— and the use in external thermal insulation materials made of polystyrene or other organic compounds, which is not permitted (with the exception of buildings with fewer than four stories) by Russian fire-safety regulations.

5. The barriers in implementation of new technology

There exist a few other barriers which must be surmounted for western construction technologies and companies for success in the Russian market. We note a few of these barriers.

The first barrier is the system of Russian construction standards and codes, since any construction product and technology being implemented in the Russian market must satisfy the requirements of codes and standards.

Let us examine the example of thermal-insulation materials. Western firms that sell thermal insulation materials usually report the coefficients of heat transfer of their materials under dry conditions. Besides this, according to western standards this value is defined at a temperature of 10 °C, but according to Russian standards, at 25 °C. Russian standards require use of the so-called significant value of the coefficient of heat transfer, which is calculated at the average humidity of the material located in the assembly in which it will actually be used; this value is significantly higher than the value received under dry conditions. Therefore for the implementation of any thermal-insulation material it is necessary for a competent Russian organization to determine its coefficient of heat transfer.

The second barrier is the system of necessary certification of construction materials and goods. Wooden construction materials and standard-design buildings, wood-fiber panels, thermal and sound insulation, sealed glass units and windows in all types of frames, and locks all are subject to required certification.

With the case of the same thermal-insulation materials, it is necessary to receive three certificates for compliance with the requirements of Russian standards: thermal performance, hygienic, and fire safety. These certificates are granted by the certification organ in the State Committee on Construction (Gosstroy) of Russia; testing of material is carried out by certification laboratories accredited by the State Committee on Standards (Gosstandart), and in particular, the Research Institute for Building Physics.

The third barrier is the Russian climate conditions in which the building will operate. Some designs which find application in western conditions do not work sufficiently well in Russian conditions.

So it is, for example, with light low-inertia sandwich-type building envelopes, which consist of an efficient insulating layer enclosed in thin surfacing layers, which are not appropriate for severe climate conditions because of insufficient thermal inertia for cases of possible disruptions in heat supply or steep changes in the outdoor air temperature. Experience has shown that multi-layer building envelopes with a massive layer on the inhabited side and the insulating layer on the outside are more appropriate. In this case it is possible, as desired, to have another layer of protective surfacing made of brick or other surfacing material. The location of vapor barriers is also very important, so that condensate does not form on the inside of the building envelope.

The fourth barrier is Russian building designers with stubborn traditions of building design. Building envelopes have been designed over an extended period of time to be made of light concrete or solid brick. The basic insulating material used has been mineral wool that complies with fire-protection requirements. Plastic foam materials (such as polystyrene) are allowed only for buildings not more than three stories tall. Ventilation is from natural air flow. The system of heating is single-pipe hydronic. The heat-supply system is centralized and hydronic.

The fifth barrier is Russian contractors, who unfortunately are not accustomed to rigorous observance of the technological execution of the building design. Because of the low quality of construction at the construction site, building features often do not work as designed. As a consequence of this deficiency, it is essential to use designs whose main parts are produced at construction-industry enterprises — that is, it is necessary to use building components with a maximum degree of prefabrication.

For example, in exterior walls there is a ventilated air layer between the hard outer surface and the mineral-wool insulation. In assembly of the surfacing, because of the non-uniform surface of the mineral layers the air layer is closed off in places, which leads to the cutoff of air movement within it and the accumulation of moisture in the insulation layer. During rapid thaws frost forms on the outer surface, but beneath the surfacing layer one finds ice, which leads to the gradual destruction of the overall wall structure.

The sixth barrier is Russian building managers, who will operate the building. In Russian conditions the operation of the building is carried out by poorly qualified service personnel, in the absence of spare parts and replacement components such as sealed glass units and weatherstripping. Repair work is not conducted in a timely way. Cases of intentional vandalism are known to occur.

The seventh barrier is social, in that wide layers of the population still have not achieved those degrees of prosperity which would allow them to accede to the middle class capable of procuring real estate, which is very expensive for Russian conditions.

This is evident in the example of Moscow, which has had over the last few years swift paces of residential construction, up to 3.2 million square meters per year. However, in 1997 close to 1 million square meters of new construction built by means of municipal budget outlays or private investment have not yet been occupied as a result of the high cost of the apartments, in some cases exceeding $1000 per square meter.

There are the examples in the another regions of Russia at the same time where are the cost of the apartments don't exceed $500-600 per square meter. Although more acceptable cost of the multy family residential buildings shall not exceed $350 per square meter.

It is possible to lift this barrier by means of reduction of the cost of construction — that is, by satisfying code requirements by means of more efficient and less expensive methods. Therefore the question of lowering cost stands squarely side by side with the increasing of energy efficiency in buildings under construction.

There is strong growing interest in Russia in the implementation of new, inexpensive, and durable construction technologies, which insignificantly raise the overall cost of construction. Therefore the technologies that are competitive for implementation in the Russian market will be those that are cost-effective relative to existing western and domestic Russian technologies. This criterion applies first and foremost to systems of external insulation in buildings with the possibility of installation year-round; energy-efficient windows with regulated flow of outdoor air; thermally efficient window blinds; individual systems of heat supply with a high coefficient of performance; systems of microclimate regulation; simple systems of ventilation with mechanical air forcing; energy-efficient lighting; and other energy-efficient goods for buildings.

6. Stimulating for market transformation of progressive technologies

New normative requirements should immediately begin to transform markets toward the production and use of these types of cost-effective advanced building materials. It is true that in other cases, that new standards may force some existing enterprises to invest in expensive capital upgrades - for example, use of thicker forms for concrete wall panels. At present, such investments are a significant financial burden for many firms. In these cases, it may be desirable to implement market-transformation programs in conjunction with codes. Such programs may include equipment-conversion grants or privileged loans, whose initial funding could come from municipal budgets backed by international banks or agencies. Other initiatives may include "bulk procurement programs," in which municipal governments or major enterprises would order large quantities of efficient materials even before conversion of the manufacturing process. Bulk procurement has been successful in the United States and in Europe because it reduces the financial risk of conversion to greater efficiency.Components of such market transformation programs are

- studying the prospects for market of the efficient building materials, construction parts and technologies;
- developing the stimulus that are providing the implementation for a new building materials, construction parts and technologies including a source for budget,creating the industrial associations, developing a pilot and a demonstration projects, environmental protection and etc.

***

In conclusion one should note that the Russian market for energy-efficient construction technologies is practically boundless. Despite the present financial risk, many niches are already being occupied by western, Asian, and domestic Russian producers. The remaining open niches will also be filled soon, and for those who wait, this market will be irretrievably lost.

ON PREPARATION OF A DRAFT LAW OF THE CITY OF MOSCOW ON ENERGY CONSERVATION

T.Nirsha, Fuel and Energy Department of the Moscow Government

Last autumn the Fuel and Energy Department (FED) started a systematic work on a draft law of the city of Moscow on energy conservation. In the strict sense Moscow Government Ordnance No.971 of December 17, 1996 "On the Status of Energy Conservation Efforts" did not charge FED with a function to elaborate this law. However, life itself and real course of energy conservation efforts in the city showed that in the absence of such Law many correct provisions of the above Ordnance would "get stuck" in the legal muddle and lack of money.

Having started this work, FED found business partners both at the federal and regional levels. At the federal level the Ministry of Science and Technical Policy of the Russian Federation expressed readiness to share its experience in the elaboration of the Federal Law "On Energy Conservation" with the city of Moscow. The Moscow Government and Ministry of Science and Technical Policy adopted joint direction No.36-RP-6 of January 15, 1998 "On a Long-Term Program of Energy Conservation in the City of Moscow" whose priority task was to elaborate a Moscow draft law on energy conservation.

The Committee for Property and Economic Reforms of the Moscow Duma takes an active part in the elaboration of the draft law at the level of Moscow City.

Materials and proposals concerning the language of certain clauses and articles of the draft law are presented by Moscow Energy Conservation Agency, Moscow City Energy Inspectorate, Mayor Office, Department of Industry and Technical Policy, Department for Developing the Master Plan of Moscow City Reconstruction, Department of Housing and Utilities Economy, energy saving companies, Union of Domestic Manufacturers of Resources and Energy Saving Equipment and Systems (SPROS). In response to the information about elaboration of such a law draft the Moscow Center of Lawmaking took an initiative and promised to transform conceptual provisions of the document into legal rules.

We have failed so far to get the prefectural council involved in these efforts due to unclear delineation of responsibilities between the territorial and industry managerial bodies of the Moscow Government as regards the solution of energy conservation problem.

In compliance with the direction of the First Deputy of the Prime Minister of the Moscow Government Mr. B.V.Nikolsky the working group will submit the draft law for discussion at a meeting of the Energy Conservation Commission in February 1998. The Moscow Government is expected to submit formally a finalized draft law for consideration of the Moscow City Duma in April 1998.

What conceptual approaches are incorporated by the law-makers in this Law? First of all, this document is not a tribute to fashion. So to say if other regions adopt energy conservation laws, how can we let the capital lag behind in this issue? It is not the case, Moscow needs this Law to solve vitally important problems of the city.

First and foremost, it is needed to save financial