Development, Review, and Implementation of Building Energy Codes in Russia: History, Process, and Stakeholder Roles

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ABSTRACT

This paper describes processes and stakeholder roles in the development and implementation of building energy codes in Russia. We begin with a historical overview of federal building codes in general, with a particular eye to the ways in which energy performance is regulated. We present a brief chronology of recent code innovations, which originated in the city code of Moscow and have since spread to other regions and to the federal level.

We then describe the process of federal-code development in Russia, enumerating stages and stakeholder roles. We also offer an overview of enforcement and implementation; codes have apparently effected significant market transformation for building envelope components, albeit at a pace that lags at least two to three years behind the actual onset of new code requirements.

Regional codes in Russia have proliferated widely across the country in recent years under a federal regulation allowing regional codes, as long as they do not contradict national code requirements. Thus regional codes have become a proving ground for various code innovations — most significantly, a shift from prescriptive, component-level regulation to whole-building performance requirements that recognize the influences not only of envelope thermal resistance, but also of building geometry, heating efficiency, controls, and other factors. We discuss the energy-saving implications of these innovative codes, as well as the process by which these codes come into being.

We conclude with a brief discussion of analogies and contrasts between Russian and American experiences in code development.

Introduction

Codes and standards for design and construction of buildings in Russia have evolved according to societal demands. Before the end of the 1980s, the closest attention was paid to the cost of construction — that is, the minimization of capital outlays — while operating costs were largely ignored, since fuel was cheap. The planned economy that prevailed at the time required that codes and standards address problems of public health and safety, as well as efficient use of construction materials.

The situation changed dramatically as a result of the country's shift to a market economy at the beginning of the 1990s and as a result of a significant rise in domestic fuel prices. People realized at this time that the country was profligately wasting its energy resources, to a major extent in the building sector, and that public outlays for the operating costs of heating buildings were relatively high. In this light, the federal parliament adopted legislative acts directed at energy conservation and energy efficiency. In addition, amendments to existing building codes were developed to reduce energy consumption, and ultimately, essentially new codes were developed regarding energy efficiency in buildings.

In the first section of this paper we present a short history of Russian building codes for thermal performance of buildings, in which we lay out the federal legislative framework on energy efficiency and the experience of development and implementation of the first regional codes for energy in buildings. We analyze the influence of these regional codes on the federal Russian code. We present the fundamental aspects of energy codes in Russia, the process for drafting them, reviewing and amending the drafts, as well as confirmation, implementation, and enforcement of codes. In the second section of the paper we present the trend toward implementation of codes at the regional level in Russia, the particularities of development of codes in regions, the procedure for adoption by regional administrations, and review and registration of regional codes by the federal Ministry of Construction (Gosstroi).

In the third section of the paper we describe a model regional building energy code that has been developed jointly by Russian and American specialists. We offer comparisons and analogies with the processes of development, discussion, adoption, implementation, and enforcement of codes in the United States.

Historical Perspective

Building codes in Russia (or "building norms and regulations," known commonly by their Russian initials as SNiPs) are legally binding documents for all entities, no matter what their legal structure or ownership form, public or private status, including individual citizens who carry out relevant work activities or seek to build their own buildings, as well as foreign entities and individuals active in building design and construction in Russia.

In Russia and the former Soviet Union, codes on the thermal properties of buildings (thermal-engineering codes) have existed since 1921 and since that time have undergone more than ten revisions, associated with change in the technical level of construction in the country. In the early codes, closest attention has been generally paid to public health and safety, as well as the efficient use of construction materials. Little regard was given to energy outlays during building operations, since fuel was cheap and centralized district heat supply for buildings, the most widespread heating mode nationwide, provided heat to buildings practically free of charge. In the former USSR, demand from the building sector for heating constituted almost one-third of overall energy consumption nationwide, or close to 250 million tonnes of coal equivalent per year.

Only in the 1979 code did requirements first appear for energy conservation (*Energy Build* 1990 & 1997). General requirements were established for the building, raising requirements for fenestration; also, requirements were introduced for calculation of the most economically advantageous thermal resistance levels for other envelope components.

Vital progress in the direction of energy efficiency in buildings was achieved in 1994-95. A new regional code for the city of Moscow, entitled "Energy Conservation in

Buildings," was developed in 1993 and passed in 1994 (City of Moscow 1994 & *Home Energy* 1996). In this code, for the first time in Russia, a complex approach was introduced in which requirements were established not only for the thermal performance of the building, but also for its heating, domestic hot water, heat supply, electricity, and water supply systems. Two stages of increasing stringency for thermal performance were introduced. The first stage, for example, doubled thermal-resistance requirements for walls.

Fundamental changes were introduced to the federal Russian code after these innovations in Moscow; these changes established requirements for thermal-performance of building envelope elements depending on the number of degree-days in the heating season. Following the Moscow model, the amended federal code established two stages for introducing new requirements, the first starting in 1995 and the second starting in 2000. The first stage doubled thermal resistance requirements for walls and the second stage, now in force, tripled the former requirements. The required levels for 2000 is approximately equivalent to the level of requirements in such countries as Sweden and Canada. These levels of thermal performance were established by means of calculations of the energy consumption of buildings during the heating season, but the methodology for the calculation for building energy consumption did not become a part of the federal code itself. Both codes (federal and regional) provided for a reduction of energy consumption in the first stage of 20 percent in comparison with the level that existed before the codes entered into force, with a further reduction of 20 percent with the onset of the second stage in 2000.

A fully developed energy code was developed in 1998 and adopted in early 1999 — again, in Moscow (City of Moscow 1999). For the first time in Russia, two alternative compliance methods were made available: the traditional prescriptive approach, and a new performance approach. This second method sets requirements for energy use in the building on the whole. In most cases, the key parameter for performance based compliance with the new federal and regional codes is specific energy consumption for heating over one heating season normalized per square meter of floor area and per degree-day. This parameter is calculated via a whole-building heat balance equation, which accounts for conductive and infiltrational heat losses, as well as internal and solar gains. (See Figure 1). Heat losses, in turn, are a function of the chosen building materials and geometry, as well as indoor and outdoor climate parameters. Comfort conditions for occupants of the building must also be satisfied. And finally, sanitary and health-related dimensions of thermal-engineering design lead to a requirement for the assurance against formation of condensate on internal surfaces of envelope elements.

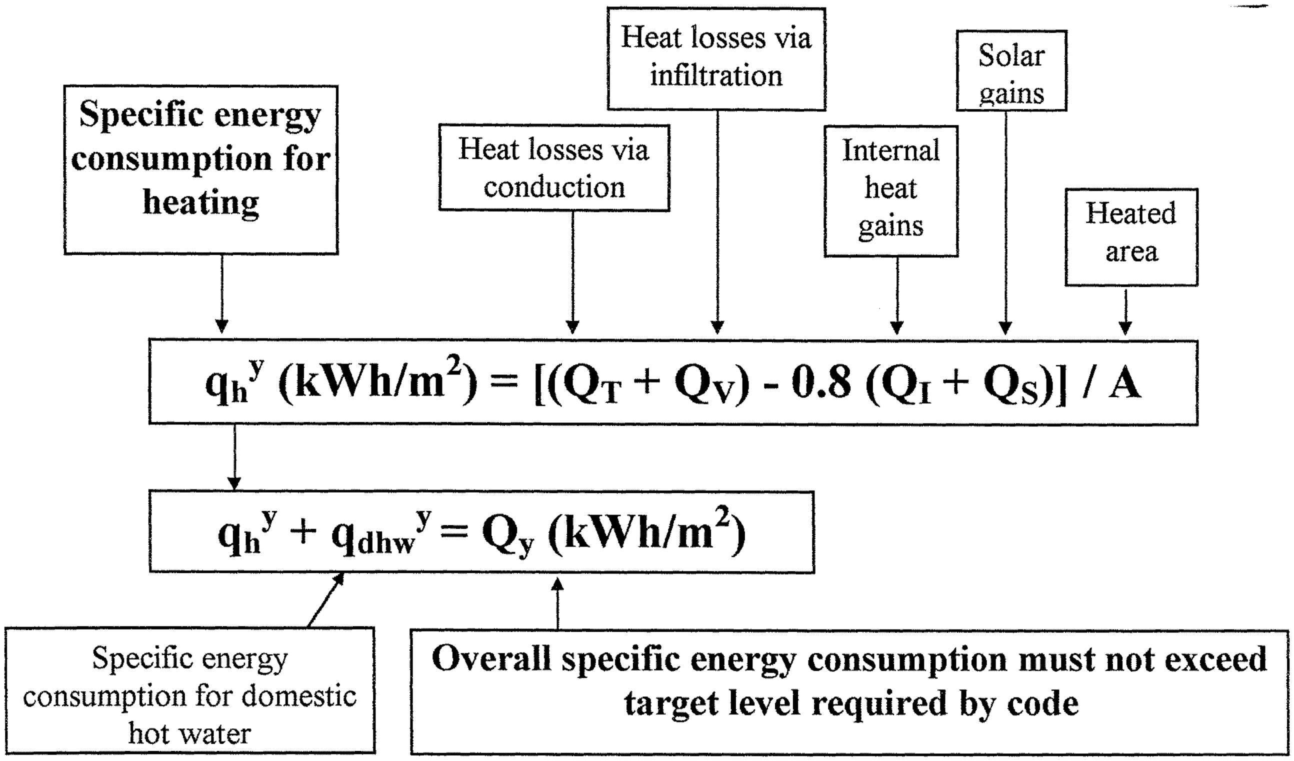

Figure 1. Whole-Building Heat Balance and Performance-Based Compliance in Russian Regional Codes

The development of regional codes for Moscow foreshadowed the development of a model energy code for Russian regions. This development was carried out between 1995 and 1997 through the collaboration of Russian and American agencies (the Research Institute for Building Physics, the Center for Energy Efficiency, Natural Resources Defense Council, Institute for Market Transformation, and others) under the financial support of the U.S. Environmental Protection Agency. Beginning in 1999, regions of Russia began en masse to adopt codes based on the model. Already such codes have been adopted and have entered into force in eight regions of Russia. (See map of Russia in Figure 2).

At present a final draft of a new federal code for thermal performance of buildings has been drafted and is being reviewed at the level of Gosstroi. This draft code, in terms of its basic ideology, is very similar to codes in the city of Moscow and the model regional code.

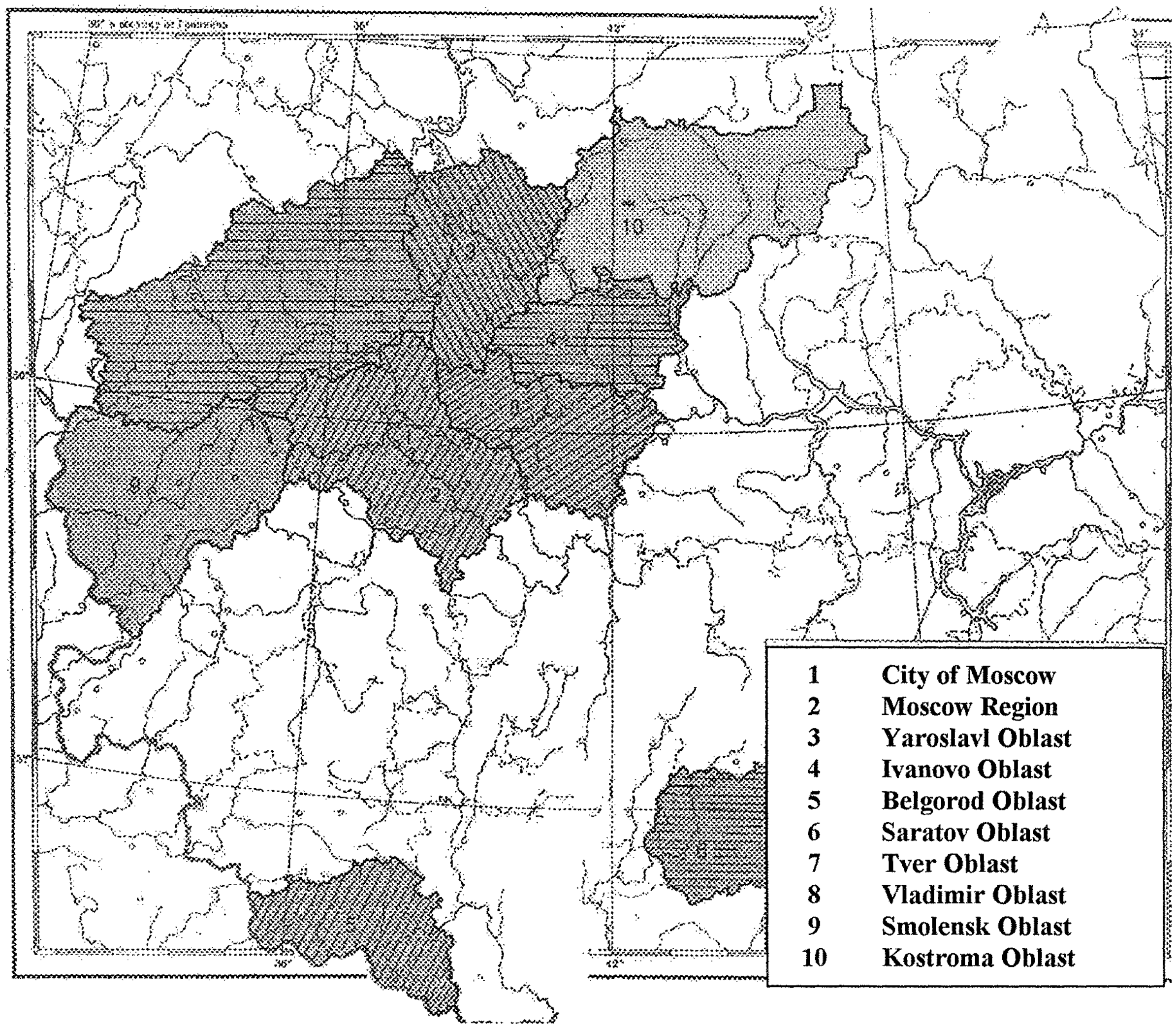

Figure 2. Regions of Russia that Have Adopted Energy Codes (as of April 2000)

The Process of Federal Code Development, Enforcement, and Implementation

Gosstroi has assigned responsibility for development of the various chapters of SNiP documents to advanced, highly specialized scientific research organizations. Thus, for example, the development of the SNiP for thermal performance of buildings has been run by the Research Institute for Building Physics, the top organization in this field.

The procedure for preparing drafts of code documents is laid out in the "guidance document" RDS 10-201. Most often, a lead agency (chief developer) comes out with an initiative to develop or revise a code, in the form of a written petition to Gosstroi. This lead agency also defines a group of participants in the proposed work — co-implementing organizations. A specialized department of Gosstroi responsible for technical codes reviews the proposal and upon approval reaches a formal agreement with the chief developer.

The development of codes proceeds in two stages — the first edition and the final edition. All editions are prepared by the lead agency and co-implementing organizations. The first edition is presented to Gosstroi and is distributed widely for review and comment to a geographically diverse set of design and research organizations of European central Russia, the northwest, the far east, the south, the Urals region, and Siberia. The final edition, developed in light of received comments, is presented to Gosstroi. Gosstroi directs the final edition to almost all republics and to the majority of regions of Russia for analysis and comment, and in certain cases, carries out a discussion of the draft code in its own scientific-technical council. Then Gosstroi, together with the lead agency, prepares an edition of the code to present for adoption and entry into force. At this stage, approval is sought from public health, fire safety, and legal agencies. Adoption and entry into force is carried out by a formal order of Gosstroi, after which the code is established as mandatory for implementation.

Oversight over observance of the code in the design process resides with plan review agencies, and in the construction process, with "architectural-construction oversight" agencies. Moreover, agencies responsible for issuance of licenses for construction activity may revoke previously-issued licenses in cases of code violations.

The development of design guidance manuals, or "codes of practice," proceeds in a way analogous to that of codes themselves, though manuals are not sent to regions for approval.

One should note that the actual transition to new construction practices, technologies, and materials resulting from the introduction of new codes, usually lags two to three years behind the time of code adoption (Matrosov, Chao, & Goldstein 1998). One can state that at present, the entry into force of the 1995 version of the aforementioned national SNiP for thermal engineering and accompanying design guidance materials for energy-efficient walls compliant with new requirements made it possible to begin to implement new energy-efficient envelope elements within two years.

The transition of wall-panel prefabrication plants to the production of three-layer panels (with concrete layers sandwiching foam or fiber insulation) in place of one-layer concrete panels has already been carried out in the Buryat Republic, the Krasnodar and Krasnoyarsk Krays, and the Voronezh, Kemerovo, Leningrad, Novosibirsk, Orel, Belgorod, Tula, and Chelyabinsk Oblasts. In all, at present 57 of 89 regions of Russia have made the transition to production of three-layer panels for multistory buildings. One should note that the one-layer panels produced previously could not satisfy the requirements of the 1995 national thermal-engineering SNiP, without the creation of prohibitively thick walls.

Regional Codes: Principles, Process, and Regulatory Foundations

In Russia there are two types of building codes — federal SNiPs, which are mandatorily applied across the whole territory of Russia and a few other countries in the Commonwealth of Independent States, and regional codes, which apply to subject entities (regions) of the Russian Federation and whose purview is limited to the territories of those subject entities. Under this arrangement, regional codes must not contradict federal SNiPs — that is, regional code requirements must not be less stringent than all-Russian requirements.

Regional codes are a new endeavor. In the former Soviet Union, regional codes did not exist. The legal basis for the development of regional codes for subject entities of the Russian Federation is set forth in SNiP 10-01, entitled "The System of Codes in

Construction," which entered into force in 1995. In accordance with this document, executive authorities of the respective subject entities of the Russian Federation may adopt regional codes, subject to the subsequent registration of such codes with Gosstroi. During this registration process, the proposed regional code undergoes verification of its compliance with the mandatory requirements of federal code documents. Regional codes that do not comply with federal codes are not registered. The publication of registered codes is carried out by agencies of the respective subject entities of the Russian Federation.

Regional codes establish mandatory and recommended conditions for use within the boundaries of the given region, taking account of natural, climatic, and social particularities, national traditions, and the economic potential of the republics, krays, and oblasts of Russia.

The novelty of the approach in the creation of regional thermal-performance codes that provide for an energy-saving effect equivalent to the effect intended by federal codes, lies in the fact that under regional codes, designers make use of options that are not available under the federal thermal-engineering code.

Under this new principle, requirements are set forth not for the separate components that affect the heat balance of the building (walls, floors, ceilings, windows, et al.), but rather for the energy performance of the building on the whole. Energy performance is calculated as a function of envelope performance, building design and geometry, design and selection of heating and ventilation systems, additional heat gains, taking into account the efficiency of the heat supply system and climate parameters.

It is well understood that building design and geometry (including various arrangements for modular sections of standard building designs for multistory buildings) have a real effect on energy consumption. For examples, buildings with a broadened shape consume 15 to 18 percent less energy than buildings with a standard shape, and sectional layout of buildings in the P44 series (a widely-used standard design for high-rise residential buildings) with three to four sections of which two are corner sections, consume 25 to 30 percent more energy than a building made of four conventional, straight sections. A correct accounting of heat losses from infiltration creates the possibility of the use of engineering approaches, that reduce negative influence. Taking account of internal heat gains and solar radiation is possible where temperature-responsive control systems are used. Where temperature-responsive control systems are not in use, or where they are disabled, heat consumption is raised by 20 to 25 percent.

Another particularity of the proposed regional codes is the Energy Passport of the building, which is intended for use in quality control in design and subsequent construction and operation. The Energy Passport is a simple instrument in the development of the building design and in the verification of that design's compliance with the requirements of the regional code. Moreover, it provides potential building buyers and residents with concrete information on what they can expect regarding the energy performance of the building. More energy-efficient buildings may be given preference in comparison with less efficient ones that would lead to higher energy costs, which in turn are of course associated with non-compliance with the real energy-consumption implications of code requirements. Consequently, the Energy Passport is a fundamental document for economic incentives for energy efficiency (tax breaks, credits, subsidies, etc.) and informed assessments in the market for residential and commercial building space.

As stated above, the first case of development of a regional energy-efficiency code was carried out by the city of Moscow. The experience has turned out to be successful. The new—Moscow code from 1999, MGSN 2.01-99 "Energy Efficiency in Buildings," in combination with the 1994 Moscow code, provided for a 40 percent reduction in energy consumption for new and renovated buildings in Moscow, relative to consumption levels from before 1994. In 1998, the energy-saving effect in Moscow as a result of implementation of the new code stood at 0.3 TWh, or US $3 million; we project savings through 2000 at 1.8 TWh (or $18 million). (See Figure 3).

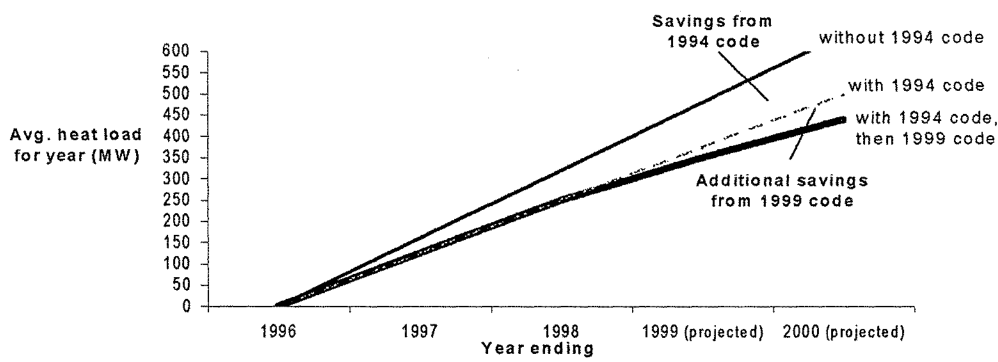

Figure 3. Projected Heat-Load Savings from the 1994 and 1999 Moscow Building Energy Codes

The Moscow experience led, as discussed above, to the development of a model code for use in Russia's regions. It also led to efforts to promote regional codes throughout Russia, by means of regional seminars, lectures, numerous publications, and also personal contacts with people responsible in the regions for construction. These contacts were made not only at the level of deputy governors and chief executives of regions, but also at the level of directors of regional design institutes and technical specialists. Thus the advantages of regional codes, as well as the procedure for code development, confirmation, and registration, all became clear to potential implementers . A great amount of work was also carried out in the clarification within Gosstroi of new methodologies, embodied in the regional codes, in order that there be no obstacles during the registration process.

After the receipt of approval from the administration of the region about the development of a regional code, a formal written agreement is reached and the first edition of the regional code is development. In the first draft of the regional code, climate data (degree days, solar radiation) are generated, the particularities of the regional construction industry and building-design community are taken into account, heat-supply systems are also considered, and the most widely-used building designs are checked for their compliance with proposed code requirements for specific energy consumption. Then the technical community of the region is familiarized with the first draft of the code through a face-to-face meeting with the authors of the code. Regional specialists develop additions, notes, and suggestions, which are then later taken into account in the development of the final draft. Some suggestions may be rejected, if they contradict the requirements of federal codes. The final edition is presented for the approval of regional enforcement agencies, after which it is presented to the governor or chief executive of the region for confirmation. The confirmed code is then sent to Gosstroi for registration. Prior experience with regional building energy codes has shown that Gosstroi registers them upon condition of consideration of its notes. After the receipt of an official confirmation, final preparation of the code for publication takes place, with due account of the notes of Gosstroi.

After this stage, the process of implementation in the region begins. With this goal, technical training of the technical specialists of the region is carried out, the compliance software (Energy Passport calculation spreadsheet) is demonstrated, and concrete questions on code-compliant design are discussed.

Further, the leadership of the region often discusses suggestions for organization of a contest for the best demonstration project of an energy-efficient, code-compliant building or buildings, and the subsequent construction and energy-consumption monitoring of this building or buildings.

Thus, for example, the Ministry of Construction and Architecture of the Saratov Oblast, in collaboration with the Union of Builders of the oblast, as well as the Saratov chapter of the Russian Union of Architects, has announced a contest for the best basic design innovations (at the stage of the architectural design) for residential buildings for the Saratov Oblast, with high technical and economic performance indices and compliance with the regional code 23-305-99 SarO "Energy Efficiency in Residential and Public Buildings," with subsequent allotment of land for construction of a residential district through demolition of the more decrepit housing stock of the region.

At present NIISF and CENEf have reached agreements and have carried out the development of regional codes for 20 regions of the 89 republics, krays and oblasts from the West to the East and from the South to the North of Russia. As stated above, in eight of these regions, codes have already been adopted, all eight having received their required registration from Gosstroi and one region having had its registration denied. Regional codes have entered into force in the city of Moscow, and in the Belgorod, Ivanovo, Moscow, Tver, Saratov, Sakhalin, Yaroslavl and Vladimir oblasts. Work on regional codes is also proceeding in the Bashkortostan, Komi and Saha Republics, in the Krasnodar Kray, in Tomsk, Omsk, Chelyabinsk, Astrakhan, Smolensk, and Kostroma, as well as in the Khanty-Mansi Autonomous Region. (See map of Russia in Figure 4).

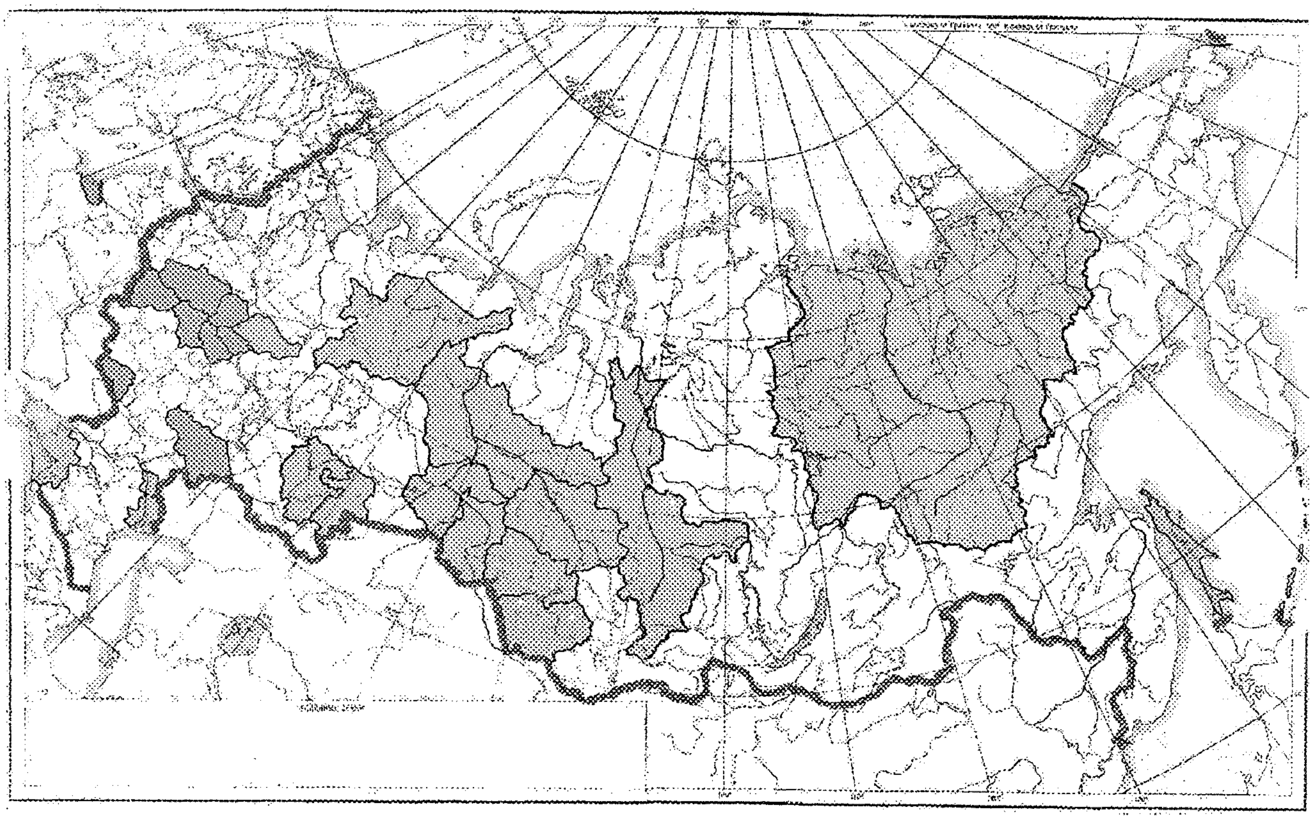

Figure 4. Regions of Russia with Energy Codes Presently Under Development (Shaded)

Analogies and Contrasts with Code Development in the United States

Given the differences in the economic and political histories of our nations, as well as the contrasts between our respective patterns of development in the construction sector, it is not surprising to see major divergences between American and Russian experiences in code development. Here we enumerate some of the most significant differences, and offer brief commentary on the reasons for them.

Russia has had a national building energy code since 1979, while attempts in the United States to create a national code fell flat in the 1970s, never to be revived since. One evident reason for this contrast lies with our respective political cultures. Despite major changes, Russia still lives with the legacy of decades of command-and-control policies and central authoritarian rule; the notion of a national code, centrally developed and enforced, still fits neatly in the conventional paradigm of Soviet and now Russian policymaking. In contrast, in the United States, ambitious federal policy efforts, especially those that seem to encroach on the purview of states, generate fierce controversy and resistance.

Another factor is the structure of the construction industry. In the former Soviet Union, construction, while reflective of some regional diversity, has tended to be remarkably uniform across the country in terms of technology and design; under these conditions, a national code actually makes a good deal of sense. In the United States, on the other hand, both residential and commercial buildings are much more diverse, and therefore less amenable to meaningful and implementable national standards.

Another difference between our countries lies with the degree and diversity of stakeholder representation in the code development process. In the United States, the committees that draft codes are populated by representatives of a broad range of stakeholder groups — government agencies, environmental groups, construction-industry associations, energy companies and energy-industry associations, national laboratories. In Russia, on the other hand, such committees are much more narrow, with participants from national laboratories, local design agencies, and official government departments, but generally not industry groups, environmental groups, or the general public. In Russia, codes may be viewed as technical documents with applications in policy; codes must be justified primarily on a technical basis among a select circle of officials and technical specialists.. In the United States, codes may be viewed as policy documents with technical content; codes must be justified primarily on a policy basis among the broad range of interested stakeholders. Notably, Russian energy codes are viewed as construction-industry policy to be duly handled by Gosstroi; American codes generally are viewed as instruments of energy and environmental policy, the field of the U.S. Department of Energy, the U.S. Environmental Protection Agency, and corresponding state agencies.

At the same time, Russian and American codes do have certain key features in common. In both countries, regions have used model codes, developed by nongovernmental agencies with outside support, as the basis for revision, adoption, and implementation of actual regulatory documents. Manuals and guidance documents are critical supplemental aids to implementation in both Russia and the United States. And in both countries, regions show varied degrees of willingness to pursue codes, with some showing no interest at all, while others appear regularly at the fore in adopting codes, setting standards for stringency, and developing innovations to ease compliance.

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