

Features of formation and realization of resource saving measures complex aimed to solve social, ecological and economic problems of the Russian construction industry

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Abstract

This article deals with the ecological aspects of the construction industry, the resource saving and ecological security management issues in construction, operation and maintenance of facilities. Rational natural resource management and resource saving measures may be considered the economic development goals of top priority. In order to effectively tackle the relevant issues, the authors suggest new approaches to forging the resource saving mechanism, including the creation of a national standard based on the international 'green' certification systems in line with the unique features of the Russian construction industry. This mechanism, relying on the world practical and academic experience and supported by the government by means of various incentives and benefits, is intended to become an efficient instrument in settling the environmental issues of the modern construction industry.

Keywords: resource saving measures, resource saving mechanism, sustainable development, ecological certification, environmental aspects

1. Introduction

The construction industry ranks among the main industries with the biggest impact on the environment. The process of construction, comprised of building a facility, producing and utilizing construction materials, operating and later demolishing the facility, affects the environment in all its entirety in a thoroughly negative way.

The construction industry features a great variety of requirements and rules, such as SNIPs (Russian Building Standards and Regulations), SPs (Russian Building Codes), GOST (Russian Interstate Standards) as well as other construction regulations. The first step of every construction project is assessing the facility cost, reviewing its safety, sustainability, life and functional characteristics. Only then are addressed the issues of ensuring environmental security, which afterwards results in inefficient natural resource management in the construction field and accumulation of environmental damage.

Nevertheless, slowly but steadily, the fact that the environment cannot resist the growing impact forever is gaining acknowledgment. The construction industry has a far-reaching impact on the ecosystem both directly and indirectly: the extraction and exhaustion of natural resources (raw materials, fuel, water, land resources), atmosphere pollution, condemnation of land for construction purposes, water pollution, affecting groundwater and natural landscapes, accumulation of waste, extirpation of animals and plants, decrease in biodiversity, deforestation, marsh drainage, interference into flora and fauna habitats, global warming, generation of municipal solid waste, degradation of population carrying capacity, increase of anthropogenic load on the area. (Astaf'eva, Potapova, 2015). All these factors account for greater focus of the society on the environmental aspects of human activity.

It is also important to underscore the complexity of the construction industry structure, which includes not only technology, production and organization aspects, but also the social ones

reflected in the relationship with the external and internal environment of the industry in question. Therefore, the development of a new approach to creating a resource saving mechanism requires due attention to all interrelations within the construction industry structure in terms of interaction both inside construction companies and between production process and social environment.

Russia is one of the countries with the biggest reserves of energy resources in the world, which has led to extensive utilization of natural resources and highly energy-intensive production. Irrational use of natural resources in its turn results in economic, ecological and social problems, the abundance of which may jeopardize the sustainable development of the country's economy. Thus, rational natural resource management and resource saving have become crucial goals of the economic development.

Given the present economic environment for the market economy development, the resource saving management is undergoing significant changes. They are connected with the economic pattern transformation, market environment, types of ownership changes and new economic relations. In industrialized foreign countries, resource saving, and above all energy saving, is one of the key aspects of enhancing economic efficiency. (Stelmah, 2010)

2. Methods and Materials

Therefore, we conclude that the existing resource saving mechanism has become obsolete and needs updating and improving. Abroad, for example, the most advanced method of increasing ecological compatibility in the construction industry is ecological certification by the so-called 'green' standards, with LEED (Leadership in Energy and Environmental Design, USA), BREEAM (BRE Environmental Assessment Methodology, UK) and DGNB (German Sustainable Building Council, Germany) being the most popular ones (Astaf'eva, Potapova, 2015). The international systems are rather complex and firmly grounded in the legislation, documents, standards and other regulatory documentation of the associated countries, which generates a lot of different problems with their implementation. In Russia, the legislation regulates the terms and means of production, improvement and reproduction for the sake of rational resource management (Olga Astaf'eva, 2013), but does not fully represent their application in terms of transition to resource saving industrial management principles in various sectors of the economy.

Certification systems lay foundation for promotion and realization of the state-of-the-art technologies, solutions, materials; for developing innovations and evaluating their effect. It is a standardized yet comprehensive approach to assessing various buildings. Construction in line with the voluntary certification system principles allows addressing several issues simultaneously: ensuring the safety, quality, comfort, sustainable and cost-effective facility.

In the Russian Federation as well as abroad, there exist various environmental certification systems; however, they are quite inferior to the foreign ones in terms of quality, comprehensiveness and employment.

Having analyzed various academic approaches to and studies on the 'green' construction, we come to the following conclusions:

- 'Green' construction and certification by environmental standards is a relevant and efficient tool to reduce the negative impact of the construction industry on the environment;
- 'Green' construction has crucial environmental, social and economic benefits;
- There is a variety of international and Russian certification systems with the international standards being superior to the Russian ones;
- Despite the popularity and acknowledgement of the standards, there persist certain hindrances to their implementation;
- The level of the 'green' construction development in Russia is much lower than the global one;

- It is essential to create national standards in line with the unique features of the Russian construction industry as well as the special characteristics of the national legislation and market.

An important role in construction belongs to office buildings, where an average person spends from 7 to 9 years over his/her life. There is a great variety of professions, but the vast majority of employees in developed countries tend to work in office buildings. Therefore, the office can be considered a sort of social environment. Ventilation, air-conditioning, heating, water and electricity supply, office equipment, transfer to the office, materials etc – not only the construction of an office building, but all the activities performed in the office have a far-reaching effect on the environment. Office buildings consume enormous amounts of resources both at the construction stage and during operation and maintenance. This makes strict regulations, environmental management, best practices and requirements that exceed public building codes particularly important. Modern buildings require a brand new level of construction implying environmentally efficiency and convenience.

One of the main goals of the 'green' standards is developing the type of environment that would be both user- and ecofriendly to the utmost. Apart from construction requirements, the standards also regulate further operation and maintenance of the facility.

The greening of offices makes it feasible not only to reduce negative impact on the environment, but also to improve working conditions and cut down expenses. A properly designed and set ventilation system, for example, allows sparing electrical energy, lowering the concentration of air pollutants and oxygenating the air. Hybrid ventilation and air-conditioning systems offer maximal natural ventilation and minimal heat losses due to heat recuperation. (Lukiashenko, Krivozertsev, Potapova, 2015)

3. Results

The principles and approaches, experience and best practices of the Russian and international environmental certification can become a solid basis for a unified universal resource saving mechanism. Its universality suggests the implementation of the same mechanism in buildings of different types regardless of their location and functional characteristics. The mechanism itself, due to a large amount of various optional criteria and requirements, can be adjusted in accordance with external and internal conditions. The sole limitation to the mechanism would be the climate, which however would only affect the efficiency and performance of the mechanism.

The main stages of developing a national 'green' standard are illustrated in the following flowchart (Figure 1).

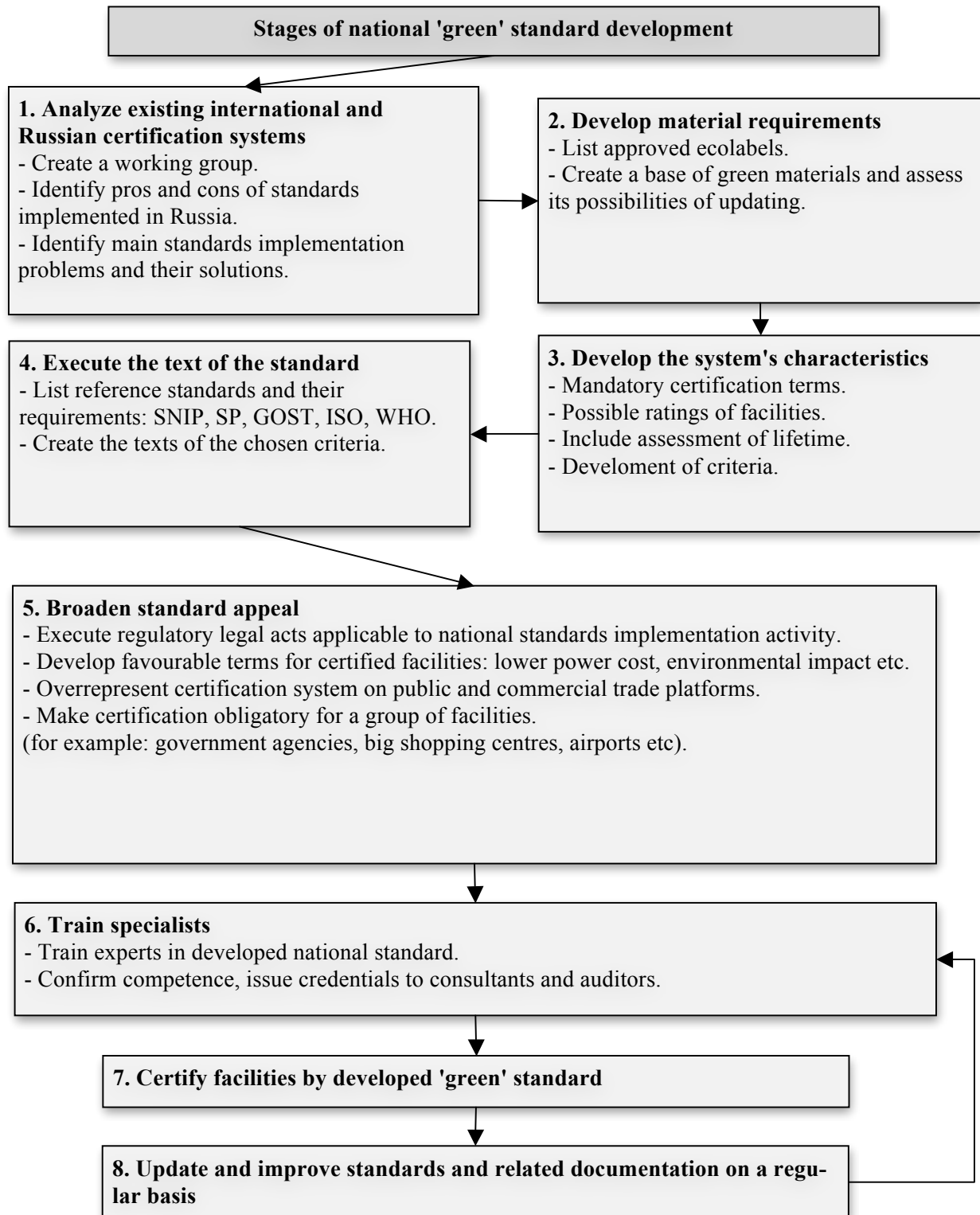


Figure 1 – Stages of national 'green' standard development (Made by authors)

Taking into consideration the study of the present 'green' construction standards and the Russian reality, the following two types of standards appear optimum:

Stage 1. Green building of a new facility. The standard regulates design, construction and operation of the facility.

Stage 2. Greening of an existing facility. The standard provides for greening an already built facility, i.e. applies only to the operation stage.

In line with the existing certification systems, 'green' office programmes, standards and other resources, it seems appropriate to divide the criteria of the new mechanism in the following units:

- A. *Construction;*
- B. *MEP engineering;*
- C. *Survey;*
- D. *Resource saving;*
- E. *Green purchases;*
- F. *Environmental awareness;*
- G. *Employee support.*

Each unit must contain obligatory requirements, the non-compliance with which results in denial of a certificate. The obligatory requirements ensure the environmental efficiency, safety, criticality, sustainability and energy efficiency of a facility. Stage 1 includes all the above-listed units; stage 2 includes all the units except for A and B.

Unobliging criteria add points depending on their relevance. The total amount of points determines the level (rating) of a facility, suitable for comparing two facilities, as the more requirements are met – the more goals are achieved and the higher the rating gets. At the same time, the breakdown of points and their amount are supposed to clearly represent the sustainability and environmental compatibility of a facility.

A positive aspect of the mechanism would consist in state support including various incentives, benefits and other preferences for facilities utilizing the mechanism. One example of such benefits could be reducing energy prices for the facilities, which cut down own energy consumption by 15%. Such crucial instruments for economic activity regulation as the investment, monetary, fiscal, price, legal and regulatory, administrative and managerial, strategic planning, information and stimulating ones, provide support to organizations, but also restrict and supervise them setting a line of development for their natural resources saving activities. Another beneficial factor for the development and promotion of this system would be its mandatory implementation at certain facilities, for example, in administrative districts or communities, in big schools or universities.

It is important to emphasize that this mechanism is in full compliance with the sustainable development agenda because it includes economic, environmental and social aspects. The environmental ones imply rational natural resources utilization, increased efficiency as well as energy and water consumption, transfer of waste for recycling.

The social factors include better indoor climate and higher environmental awareness both with the present and future generations. Moreover, implementing such a mechanism in Russia would create new jobs for specialists, advance the environmental impact assessment and consulting, increase the energy efficiency and environmental compatibility of technologies and equipment.

Ensuring the well-being of employees, improving their labour efficiency, energy and water saving allows cutting down expenses, which accounts for economic benefits.

The resource saving mechanism helps to settle a broad range of issues:

1. Choose the optimum construction site;
2. Design an energy-efficient facility;
3. Arrange the most efficient water consumption possible;
4. Rationalize the utilization of all resources, consumable materials etc to the utmost;
5. Ensure maximum control and management of all the processes at the facility;

6. Choose and utilize green materials;
7. Create comfortable indoor climate;
8. Ensure comfort and safety;
9. Train and encourage employees to participate in environment-related events.

Modern advanced productive forces provide material basis for the rationalization of the resource consumption and saving routine, helping to save labour costs and expenses per each end product unit. The greater the amount and, most importantly, the higher the quality of the productive forces – the less material and other resources are required for an economic effect.

Most companies tend to take only administrative and technical measures, which allow saving certain types of resources but are not overall aimed at resource saving. Construction management, however, should be based on the relationship between the formal planning system and the current situational decisions within the general management framework.

The macrolevel requires focusing on such a development scenario, according to which resource saving principles of economy would result in economic growth while preserving the current level of consumption of various resources.

The construction industry has great potential for effective resource saving. In particular, it is feasible to save energy when building and operating a construction facility through electrical energy, fuel and water resources economy.

The recently increased necessity to involve resource-saving technologies in construction encourages building companies to be as efficient as possible at utilizing and allocating resources at every stage of construction – from the execution of design estimate documentation and all the way to the commissioning of a facility.

Resource saving requirements in the construction industry should be aimed at organizing the technology of construction, reducing the amount of production waste and saving energy resources.

The resource saving mechanism in question also helps to cut down financial investments in the execution of a construction project both at the allocation of funds and the approval of the design documentation including the system of the facility environmental certification, which allows choosing the best construction technologies.

A key aspect of developing the resource saving mechanism is creating a national standard based on the international 'green' certification systems in line with the unique features of the Russian construction industry reflected in the variety of criteria for the mechanism.

The evaluation table below can be used to evaluate the resource saving criteria (Table 1).

Table 1 – Evaluation table of criteria for the standard requirements (fragment);
(Made by authors)

Criteria	Score				Attained result (R_n) $R_n(1, \dots, n) \rightarrow \max$
	R_1	R_2	...	R_k	
Section N	«Section name»				$R_n(1, \dots, n) \rightarrow \max$
N_n	$N_n R_1$	$N_n R_2$		$N_n R_k$	$R_n(N_n)$
...
N_1	$N_1 R_1$	$N_1 R_2$		$N_1 R_k$	$R_n(N_1)$

Thus, the development of the standard requirements is determined by the evaluation of the criteria by the scoring scale, which made it possible to elaborate the following standard requirements (Table 2).

Table 2 – Standard requirements (fragment); (Made by authors)

№	Names of sections and criteria	Comments	Requirement	Obligatory requirement/ max score
Section A. Construction				
A1	Ban on asbestos	Usage of carcinogenic amphibole asbestos is prohibited in	Ban on usage of amphibole asbestos and asbestos-containing materials.	Obligatory requirement

		production of construction materials; about 60 countries have completely or partly banned the usage of asbestos; over 95% of produced asbestos is exported to underdeveloped countries.		
A2	Sound level at construction site	Elevated sound level affects people and animals.	Day-night average sound level of a construction site must not exceed 70 dBA.	Obligatory requirement
A8	Using secondary materials	Using secondary resources helps to save the primary ones and reduce the amount of waste.	Use materials with a share of recycled or secondary materials. 10% of the total cost of all the materials in a project – 2 points, 20% – 3 points; 30% and more – 4 points.	4
Section B. Functionality				
B1	Compliance with environmental legislation requirements	Under no circumstances does voluntary certification relieve from the obligation to respect environmental norms, requirements and laws.	A facility must function in full compliance with the environmental legislation. All the necessary documents (for example, MPE, MPD, SPZ), waste deposits, registers, reports etc must be available. Any minor non-compliance must be closed within the period set by an auditor; major non-compliance entails denial of further certification.	Obligatory requirement
B8	Water saving. Wastewater	Restriction on and economy of water consumption allow saving not only water but also energy resources. A litre of water requires a lot of energy for its production, purification, transportation etc	Organize collection of wastewater and stormwater, which is later used for irrigation.	1
B10	Water saving. Faucets		Faucet water discharge must not exceed 6 l/min. If the right faucets are not available, water-saving aerators can be installed.	1
B11	Water saving. Water consumption monitoring		Installment of water meters, analysis of meter readings for positive dynamics	1
B12	Water saving. Showers		With showers available, water discharge must not exceed 10 l/min. With no showers available, a point is added automatically.	1
B13	Green construction materials	Ensuring environmental compatibility of used materials	Green materials must be a priority: Using materials with hygienic certificates, type I ecolabelling (for example, EcoMaterial, Vitality Leaf, The Blue Angel, Nordic Ecolabel, EMICODE, Eurofins etc). Wooden materials must have a FSC or PEFC certificate. 10% of the total cost of all the materials in a project – 1 point, 20% – 2 points, 30% and more – 3 points	B13 ???
B16	Innovations and best available technologies	Applying scientific progress, state-of-the-art technologies and solutions allows minimizing environmental impact most effectively	Encourage to apply best world practices, develop innovations. Assessed by experts.	2
Section C. Survey				
C1	Indoor climate	Providing comfortable indoor climate helps to rationalize resource consumption (for example, low temperature forces employees to turn on energy-inefficient heaters, while high	Indoors climate must have optimum temperature and humidity characteristics; it must be a comfortable working environment. - Air temperature in a workplace in the cold period of year must be from 22 to	Obligatory requirement

		temperature makes them use fans)	24° C, in the warm period of year – from 23 to 25° C. - Temperature difference at the floor and the head level of a sitting operator must not exceed 3° C. - Relative air humidity in a workplace must amount to 40 - 60 %. - Air velocity in a workplace must not exceed 0,1 m/s.	
C2	Air analysis	Providing a safe working environment to employees	Harmful substances concentration must not exceed 80% MAC for the following substances: 1. Carbon oxide, 2. Carbon dioxide, 3. Nitrogen dioxide, 4. Sulphur dioxide.	Obligatory requirement
C8	Visual comfort	Providing environmental and social safety as well as comfort and occupational disease risk reduction	Expert review: Assessment of visual characteristics, videoecology, glare prevention, light distribution, window size, workplace arrangement, choice of flowers, plants and office decoration, layout.	2
Section D. Resource saving				
	Waste for recycling. Paper	Producing paper from wood pulp affects the environment considerably – deforestation, ecosystem disbalance, water and energy consumption. Producing paper from paper waste reduces the negative impact, 1 ton of paper waste helps to preserve 20 trees	Collect paper waste for recycling. Paper bins must be available at every printer and within reach for all employees.	Obligatory requirement
Section E. Green purchases				
E2	Tableware	Using disposable tableware is inefficient.	Non-utilization of disposable tableware (plates, cups, cutlery). If non-utilization is infeasible, non-plastic biodegradable tableware (for example, made from corn or cane) must be preferred	Obligatory requirement
E6	Choosing green furniture	Reducing negative impact on the environment, looking after employees	Lack or negligible amount of harmful substances. Formaldehyde emission class E0/E1 (less than 8 mg/100 g dry matter).	3
Section F. Looking after employees				
F1	Smoking	Tobacco smell affects facility users negatively. Reducing passive smoking has a positive impact on facility users.	Smoking area must be located outside the facility OR If smoking areas are located indoors and the air vent is functioning properly – there must be no sensory detection of tobacco smell at any time within 1 metre from the area. Smoking areas must feature warning signs on health effects of smoking.	Obligatory requirement
F4	Corporate transportation	Apart from being convenient for employees, corporate transportation helps to reduce the amount of private cars in use on account of public transport	1 point – transfer from the nearest underground/other station to the office. 2 points – the Company owns an electric or hybrid vehicle for corporate purposes	2
Section G. Environmental awareness				
G1	Environmental Code of Employees'	Environmental Code of Employees' Conduct specifies and regulates all environmental	The document must be laid out, approved, publicly available, communicated to the Company senior	Obligatory requirement

	Conduct	aspects of activities in a facility	management and employees.	
G4	Sustainability Reporting (GRI)	Disclosure of information on the company's contribution to sustainable development draws public attention to this issue, engages employees and raises their environmental awareness	The Company must issue an annual sustainability report in line with the Global Reporting Initiative requirements (GRI)	2
G5	Green purchasing procedure	Green purchases include consumable materials, office equipment and any other units subject to environmental compatibility requirements. Regulating such a procedure can ensure environmental compatibility of purchases.	The document must be laid out, approved, publicly available, communicated to the Company senior management and employees. A competent specialist responsible for implementation and updating of the document must be assigned.	2

4. Conclusion

Implementation of 'green' standards in Russia has a number of problems, rooting mostly in the unique characteristics of the Russian market. It is essential to develop national standards based both on the most efficient approaches of the international systems and the Russian distinctive features. Such a mechanism could become an efficient resource saving instrument in the construction industry having the current international standards as its limitations.

The process of implementation of the 'green' construction national standard involves analyzing the market of green construction materials, developing regulatory and production documentation, adjusting the legislation, introducing a system of benefits for certified facilities.

This resource saving mechanism and its abovementioned requirements have already been tested in several projects, namely in Moscow offices. Due to the relevant measures, developed documentation and training of employees, energy consumption has been reduced by 8% and water consumption – by 13%. The offices have introduced waste sorting for waste paper, plastic, glass, batteries and accumulators. Over the first 6 months of 2015, more than 500 kg waste were collected and transferred for recycling.

The suggested national standard development scheme has the following advantages:

- Introducing benefits and an opportunity to cut down expenses make the system more appealing;
- The obligatory nature of its implementation for certain facilities allows the system to prevail over others as well as to increase the safety of important facilities;
- Developing a unified national standard accounts for its superior quality;
- The clear-cut system of evaluation criteria, the exposure and transparency of information exclude corruption;
- Training specialists will create jobs and broaden the scientific personnel base;
- Encouraging the market to increase production quality and reduce its environmental impact due to stricter requirements to materials.

In conclusion, developing a new resource saving mechanism relying on the international practical and academic experience as well as enjoying government support by means of various incentives and benefits, has the potential to solve not only environmental, but also social problems of the modern construction industry.

References

1. Astaf'eva O., Potapova I. Reducing the negative impact of construction on the environment through 'green standards' certification. Russian architecture and construction, N2, 2015.
2. Astaf'eva O., «Education management with anthropogenic activity», Ecological education and ecological culture of the population: materials of the II international scientific conference on February 25–26, 2014. – Prague : Vědecko vydavatelské centrum «Sociosféra-CZ». – p. 242, 2014.

3. Potapova I. Features of the Russian market of environmentally friendly building materials and their role in the formation mechanism of resource saving management in the construction industry. Online journal *Naukovedenie* 2015 Volume 7 N3 [Online resource]-M.: Naukovedenia, 2015-. Retrieved from: <http://naukovedenie.ru/PDF/28EVN315.pdf>, free access. – Title from screen. - Russian, English.
4. Astaf'eva O. Nature management law (textbook). M.: SUM, 2013.
5. Skladova E., Dimitrov V. XXVI International Research and Practice Conference 'Ecology. Production. Society. Person', article 'Environmental standardization and certification of biological areas in Russia'. 2014.
6. Stelmakh, N. Economy and resource saving management. s.l.: study guide for economics students. – BSEU Bobruisk branch, 2010 – p. 126.
7. Lukyashchenko K., Krivozertsev N., Potapova I. Green construction at a low ebb. Moscow: Green Buildings, issue N4, 2013.
8. Bayanduryan G., Lushnikov R. Resource saving regulation instruments: positive and negative aspects, Research and practice journal 'Service sector: innovations and quality', Issue N3, 2012. Retrieved from: http://journal.kfrgteu.ru/files/1/2011_3_3.pdf, free access. – Title from screen. - Russian.
9. Cherdakova, M. "Resource saving as government policy". Chuvash University Bulletin. 2013. N4.
10. Brodach M., Eames G. "Green building market situation in Russia". High-tech buildings. Online journal. ISSN 2311-9632. Winter 2013.