

Use of underground space resources when updating urban development

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Abstract. On the basis of taking into account global trends and best practices, the task of integrated urban development of urban underground space with the integral use of its main resources and services (not only spatial, but also other: geoenergy, geomaterials, groundwater) is set. Through the prism of the implementation of this "Deep City" model, national peculiarities are investigated and the current situation regarding the effectiveness of the system and documents of standardization (technical regulation) in relation to such topical formats of urban renewal as a model of integrated development (renovation) of the territory is evaluated. The main Sets of rules (as well as their current draft versions of such documents) that establish or should establish appropriate requirements for the implementation of this segment of urban development activities are identified and analyzed. The analysis was carried out in conjunction with the relevant areas of improvement of legal regulation. The results of the analysis showed the presence of systemic standardization defects (primarily gaps) and identified their causes. On this basis, general proposals are given to eliminate the identified defects, as well as general and specific proposals for the development (revision) of standardization documents. Such recommendations can be useful to the developer, the state customer, the executor of the draft Code of Rules and National Standards, as well as a representative of the expert community.

1 Introduction

As a modern national model of urban renewal, it is necessary to consider the integrated development of the territory (IDT), which has gained its legitimacy by introducing amendments and additions to the Urban Planning Code (Chapter 10) [1]. To a certain extent, it has an inherited character, as if developing, but formally replacing the previous similar models provided for in [1] (development of built-up areas, integrated development and integrated development of territories). Due to the complexity and some duplication of algorithms, the lack of proper detail of legal regulation, support in terms of technical regulation (standardization) and proper further development, these models have proved ineffective in practice. It should be recognized that the IDT model also inherited a number of "diseases" of previous models. They are described in more detail, for example, in the author's article "Evaluation of the effectiveness of standardization of integrated

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development of the territory: urban aspect, which is being prepared in 2023 for issue in No. 3 of the journal "Bulletin of the NRU". In relation to the planning level, the main disadvantages of the model of renovation of residential areas of the city of Moscow were also shown [2]. It should be considered as a special case of the IDT model, which provides for a wider range of types of IDT, including the development of both residential and non-residential built-up areas, as well as spatial development of undeveloped territory. It is also fundamental that the IDT model concerns the renewal of inefficiently used territories not only in Moscow, but also in any other region of the Russian Federation.

The relevance of the KRS institute is confirmed, for example, by the composition of the Strategy for the Development of the construction industry, approved at the end of October 2022 by the Government of the Russian Federation (the use of KRT projects as a mechanism for settling emergency housing, etc.) [3]. In general, urban renewal, along with housing construction, are recognized as the most effective, key elements of the Strategy. At the same time, the Strategy highlights a number of problems and challenges associated with the inefficient use of land, energy and other resources, a shortage of land for development in central urban areas, and numerous restrictions on their use. In this regard, for example, such tasks as increasing the efficiency of the use of land intended for construction, practical application of the theory of a "pedestrian (compact) city", organization of the development of territorial schemes that ensure the efficient use of resources, ensuring environmental friendliness and energy efficiency of urban development are set as strategic tasks. Such tasks in a number of developed countries in Europe, North America and Southeast Asia are successfully solved by using the resources of underground space. However, for a number of reasons, Russia is significantly lagging behind in this regard (in general, due to the imperfection of state regulation) [4]). This circumstance allows us to assume (as a working hypothesis) that the mechanism of complex (integral) use of underground space resources during urban renewal requires systematic refinement. The purpose of the study, the results of which are reflected in this article, respectively, was to confirm this assumption with the designation of directions for increasing the integrated development of urban underground space (US) as an element of urban renewal (IDT, renovation). The object of the study was a model of complex (integral) use of US resources for the purposes of urban renewal (primarily residential) development. The subject of the study is the system of legal and technical regulation (standardization) that ensures the implementation of this model. The noted goal was realized by solving such tasks as analyzing regulatory practice, identifying its problems, and finding effective ways to remove regulatory barriers.

2 Materials and methods

Based on a review of available literature sources and normative technical documents (NTDs), as well as related regulatory legal acts (RLA), the situation in the field of integrated use of US resources for the purposes of urban renewal is assessed. On this basis, the barriers of the sphere of state regulation and negative trends are analyzed.

For these purposes, a selection of subject codes of rules (CR) has been carried out. According to the main ones, the assessment of completeness and compliance with the norms of federal legislation was carried out. Synthesizing the results of the analytical assessment, as well as taking into account the practice of the expert activity of the author, as part of the Subcommittee 9 "Urban Planning" of the Technical Committee 465 "Construction, and later as part of the Technical Committee 507 "Urban Planning" of the Agency "Rosstandart", relevant proposals for improving standardization and legal

regulation in the field of urban development are given. The study also applied elements of ontological engineering and classification (typology).

3 Results and discussion

The most important condition for the effective implementation of any economic activity is the unity of the professional terminology used. The considered sphere of legal and technical regulation of relations in the field of urban development of US in Russia is characterized by a significant degree of terminological disorder. The basic concepts in this area are not fixed in the relevant RLAs (in our opinion, this is the target format for acquiring the status of definitions). Holistically, they are not disclosed in the relevant NTDs. Thus, in CR 473, which claims to be the main subject of NTD in this area (see below), the basic concept of "underground space" in the text is replaced by the concept of "underground structure", which is unacceptable.

This situation can be partly explained by the multidimensional nature of urban development activities themselves, the imperfection of legislation on it and the weak structuring of basic terms and their definitions. To an even greater extent, this applies to the terminology of "underground urban planning". Taking into account the relevance of the issue, as well as starting from the basic principles of ontological engineering, we will try to reveal the key concepts in this field used in this study, bearing in mind their main interrelations.

Under the term "underground space" (US), it is advisable to understand a geometric three-dimensional space located below the planning mark of the earth. In the context of mining terminology, "underground space" can also be disclosed as part of the soil and subsoil of the earth, which is used or can be used for the purposes of territory development (underground part of the territory). Accordingly, the term "urban underground space" is considered as a spatial resource of soil and subsoil within the boundaries of the city.

At the same time, "territory" in urban planning can be understood as a three-dimensional geometric space of a specific jurisdiction, including, among other things, a part of the US and used for the purposes of its development.

The terms "underground building (structure)" or "underground part of a building (structure)" in the logic of CR 248 (see below) can be disclosed as a building (structure) or part of a building (structure) located below ground level (layout).

In a broad sense, the "development of underground space" is a two-pronged process of its "development" by creating underground buildings and structures (UBS) in it or their reconstruction According to new requirements [1] it should also include such stages of the life cycle as the operation of the UBS and their elimination, and in the light of the objectives of this study - the process of using other underground resources within the framework of urban planning activities (see below). Similar in content is the term "use of underground space", which refers to the process of extracting the useful properties of US (spatially basic, protective, geo-energetic and others) and the operation of the UBS, which also includes repurposing (changing the permitted use) of an underground object and its conservation.

In general, terminology in the field of urban planning requires its own ordering and additional alignment. This applies in particular to the aspect of urban renewal under consideration.

Taking as a basis the progressive model "Deep City" [5], the term "integrated urban development of underground space" will be understood below as urban development of the US that meets at least one of the following criteria of complexity (they are discussed in more detail in the context below):

1. Spatial complexity:

1.1. Simultaneous or sequential creation:

- underground and underground-ground complexes for various purposes, including several UBS (or underground parts of ground objects), physically connected to each other and/or with other ground buildings and structures (galleries, etc.);
- UBS (or underground parts of ground objects), autonomously placed above and under tunnels, as well as under by automobile and railway highways;

1.2. Creation of new integrated-attached type UBS.

2. Functional complexity:

2.1. Placement in one underground building or underground (underground-ground) complex of two or more parts of the building (complex) having different (at least double) functional purpose (combination of functions: transport, public, protective, industrial, recreational, etc.);

2.2. Creation of integrated pass-through engineering collectors ("utilidor");

2.3. Installation of green and other exploited types of roofs of underground and buried objects.

3. Resource (resource-ecological) complexity:

3.1. Use of extracted rocks for the purposes of territory development;

3.2. Economic use of underground water (water intakes, purification facilities, storage and collection of drinking water, etc.);

3.3. Use of thermal, electrical or any other energy produced within the framework of the creation and operation of the UBS, for example, by using heat pumps, etc. (geo-energetic type of resource complexity)

The criteria of complexity of visual, historical, cultural and other types, which are not considered in detail in the article, can also be highlighted. At the same time, in a broad sense and in an appropriate interpretation, the article "integrated urban development of US" is understood as a process aimed at the integral (joint) use of all the above-mentioned resources and services of US. It should be recognized that in this case, in order to consolidate the Russian version of terminology (as an option as part of a special national standard), it is necessary to conduct a special additional study of the issue with the involvement of linguists, philologists and other specialists, including ensuring harmonization with foreign regulatory systems in this area, see for example [6, 7].

In our opinion, such work should also be carried out to streamline the terminology of urban renewal, since the terms "integrated development of the territory", "renovation of residential territories", "reorganization of industrial territories" used in domestic practice, despite attempts to consolidate them in federal legislation, differ somewhat from those used in world practice ("redevelopment", "rehabilitation", "complex reconstruction of the existing development of residential neighborhoods", etc.), which may make it difficult to effectively relay the best world practices[8, 9].

The new model of the KRT, by virtue of the law [1], includes the development of both residential and non-residential built-up territory, as well as the spatial development of the "undeveloped" territory. Let's consider these situations in the aspect of the possibilities of using the resources of an urban US. It is obvious that in the case of the development of an "undeveloped" territory, as well as in the development of a built-up territory by the method of total demolition (such a model, for example, has been adopted for the renovation of residential areas in the city of Moscow), the possibilities of using the resources of the urban US are maximized and, above all, it concerns spatial resources. This is due to easier access for the creation of appropriate mine workings necessary for the implementation of underground construction, and not only in the physical context, but also in terms of

securing land and property relations (in the "undeveloped" territory, land plots are in state or municipal ownership, or state ownership of them is not delimited, including with capital construction objects located on them, provided that such real estate is not burdened with the rights of third parties). This possibility is objectively reduced in the case of the option of reconstruction of the development of the developed territory (the option is not considered in this article).

It should be taken into account that the main urban planning tool of the KRT is the layout of the territory, the preparation of documentation about which in the case under consideration according to [1] is mandatory. The use of individual elements of urban planning zoning as part of the PZP is fragmentary (the designation of the boundaries of the territory of the KRT, the limiting parameters of infrastructure security and accessibility).

The very institution of territory planning, including in the framework of ensuring the IDT, cannot be considered perfect [10]. The situation in the field of standardization in relation to the urban planning (planning) level remains even more problematic due to its multidimensional and social nature [1], as well as due to the absence or vagueness of the regulatory requirements of planning security. Taking into account these features implies a systematic reorganization of the structure of standardization documents with the expansion of their spectrum. A report on this subject with specific proposals with the participation of the author was prepared by Subcommittee 9 "Urban Planning" and sent in 2019 to the leadership of the Ministry of Construction of Russia, but so far these proposals have been ignored. In this regard, the practice of standardization of the planning level continues, only within the framework of construction (technical) rationing, as well as ignoring the normatively established requirement that standardization documents must comply with the norms of legislation. There is also no desire to fulfill the relevant scientific justifications.

In the conditions of this peculiarity, there is a shortage of scientific publications on this topic, and it is difficult to consider foreign studies as reference, since the emphasis in them is usually placed on the object level of construction rationing, and "planning" requirements are set by the RLA, municipal level. Therefore, such publications have not been identified with single exceptions in relation to the topic of standardization concerning the IDT framework. Moreover, they are absent in the part concerning the topic of integrated use of urban US resources in the KRT, which further emphasizes the novelty and relevance of the development.

Table 1 presents samples from the Register of Joint Ventures of those documents that are potentially the most significant for a particular variant of the IDT, and also reflects the results of their analysis in relation to the main directions of integrated urban development of the US.

Identification, decomposition and study of the NTD array concerning the noted complexity of the urban development of the US for the purposes of the IDT, ideally, it is advisable to carry out in the context of all levels of organization of urban development activities established [1]. Simplified further, the planning and local (object) level are considered. First, the joint ventures of Section 30 "Urban Planning" of the CR Registry are considered, <https://www.faufcc.ru/technical-regulation-in-construction/formulary-list> /, which by definition should be aimed at the IDT to the maximum extent. However, it turns out that this is far from the case and only some of them include separate requirements for the implementation of the IDT. These include, first of all, the basic planning CR 42, which contains numerous systemic shortcomings and, in our opinion, has exhausted the potential for its further development. In this regard, as an alternative, the decomposition of CR 42 is proposed, which can become the basis of a new structure and composition of the DS in the field of urban planning [11, 12].

The requirements, which are included in CR 42 in addition to the conditions of the IDT, related to the standards of urban planning design and the assumption of an increase in the density of residential and public-business buildings under the IDT. The requirements traditionally suffer from a lack of necessary justification, in particular, the lack of consideration of the urban planning potential of the US, in which the parameters of density, accessibility and provision of facilities could be adjusted to improve the quality of the urban environment.

The "key" residential development CR 476 for the KRT does not contain such requirements at all, therefore, in the spatial aspect (use of US resources), it is advisable to supplement its composition with a number of indicators for the implementation of the KRT (paragraph 7, part 4 of Article 42 [1]), which would take into account the urban development potential of the US.

Table 1. The results of the analysis of the main documents on standardization in terms of requirements for the integrated use of urban underground space

Name of the document ¹	Completeness of essential (special) requirements for the use of the main resources of the US *		The possibility of using the document for the purposes under consideration		Directions for improving the document
	Spatial	Geoenergetic	Planning level	Local level	
Section 30 "Urban Planning" of the CR Registry **					
CR 42	Insufficient***	Insufficient	Insufficient	Insufficient	Decomposition of CR, see in the text
CR 476	Insufficient (individual recommendations ² , references to CR 42)	Absent	Too	Too	Making changes and additions, see in the text
CR 475	Insufficient	Too	Absent	Absent	
CR 18	Too (references to CR 42)	Insufficient	Too	Insufficient, changes are being prepared	
CR 348	Too	Too	Too	Insufficient	
CR 19	Absent	Absent	Insufficient	Absent	
CR 450	Insufficient (references to CR 248, CR 52, CR 118****)	Too	Too	Insufficient	
CR 395	Insufficient	Too	Absent	Too	
CR 396	Too	Too	Too	Too	
CR 398	Too	Too	Too	Too	
CR 401	Too	Too	Too	Too	
Some other CRS relevant to the issue under study					

CR 473	Available	Insufficient	Insufficient	Insufficient	Monitoring of CR implementation with subsequent adjustment
CR 248	Insufficient	Too	Absent (by definition)	Too	Making changes and additions, see in the text
CR 120	Too	Absent	Absent	Too	
CR 118	Too	Insufficient	Absent (by definition)	Too	
CR 54	Absent	Absent	Too	Too	
CR 56	Too	Too	Absent	Too	
CR 113	Insufficient	Too	Too	Too	
CR 122	Absent	Too	Too	Too	
CR 160	Insufficient	Too	Too	Too	
CR 60?	Absent (by definition)	Insufficient	Too	Too	
CR 265	Available (by definition)	Insufficient	Insufficient	Too	

¹ Subject, area of rationing: CR 42 – urban planning, CR 476 – residential neighborhoods: CR 42 – urban planning, CR 476 – residential neighborhoods, CR 475 – parks, CR 18 - production facilities, CR 348 - industrial parks and industrial clusters, CR 19 - agricultural enterprises, CR 450 - agro-industrial clusters, CR 395 - transport hubs, CR 396 - streets and roads of settlements, CR 398 - embankments, CR 401 – high-rise buildings and complexes, 473 - underground buildings, structures and complexes, CR 248 – underground structures, CR 120 – subways, CR 118 - public buildings and structures, CR 54 - apartment residential buildings, CR 56 - industrial buildings, CR 88 -civil defense protective structures, CR 113 – parking lots, CR 122 - railway and road tunnels, CR 160 - multifunctional buildings and complexes, CR 160 - heating, ventilation and air conditioning, CR 265 - communication collectors.

² Placement of platforms (on roofs, underground garages or under separate buildings), as well as underground utilities.

* The results of the analysis of aspects of the use of geomaterials and groundwater are reflected below in the text

** The CR of section 30 concerning the improvement of the territory in the table are omitted as insufficiently substantive

***There are inconsistencies with RLA

**** CR248, CR 52, CR 118 contain a number of restrictions on the placement of underground facilities mainly related to the lack of daylight underground.

This aspect is clearly not sufficiently disclosed in the NTD on the design of industrial and agricultural facilities (CR 18 and CR 19, CR 53, etc.), which are already covered or in the future may be covered by the IDT mechanism (in terms of the territories of gardening by citizens,

<https://rspp.ru/events/news/komissiya-rspp-sformirovala-predlozheniya-po-sovershenstvovaniyu-zakonodatelstva-v-sfere-krt--6368cd92944df>). The issue is particularly acute with production areas used in cities so far extremely inefficiently, including due to ignoring the possible use of US. It is gratifying that the authors of the relevant NTDs in the course of

joint work in TC 507 "Urban Planning" began to realize this fact and agree to make changes and additions to the relevant regulatory requirements.

The spatial aspect of the complexity of the use of US resources is not taken into account in the considered subject JVs concerning the design of specific objects that may partially or completely fall into the zone of the IDT (CR 395, CR 396, CR 398, etc.). The insufficiency of its accounting, for example, in CR 120, CR 122, CR 113 does not allow for the effective (integral) use of US when laying tunnels. It is especially disappointing for the lack of substantive requirements for the design of facilities such as transport hubs, objectively aimed at the use of US. In the relevant sections of the projected Amendment No. 1 of CR 398, it is advisable, taking into account world practice and CR 473, to specify requirements for increasing the range of objects placed in the US (this proposal of the author of the article was partially accepted by reference to CR 473).

In our opinion, the functional restrictions on the placement of UBS included in CR 248, CR 52, CR 118 should (synchronously with the relevant sanitary standards) be revised and relaxed, taking into account the application of appropriate innovative technical (including the transmission of sunlight deep into [13]) solutions. Of course, this issue requires special research.

Of particular relevance in the current conditions are the issues of creating underground protective structures of civil defense, which can be located in the zones of the KRT, and in a peaceful period of time be used for a different purpose (respectively, they should be designed as dual-use objects). Taking into account the situation, the Ministry of Construction of the Russian Federation has now accepted the author's proposal to carry out special scientific research on the topic of optimizing the placement and typology of such objects.

As for CR 265, a number of shortcomings in the system of standardization of urban collector construction were previously identified and specially considered, the elimination of which will increase the share of combined laying of underground networks in integrated through-pass engineering collectors (in particular, the development of a special joint venture for urban conditions was proposed, which, of course, will be useful for the purposes of the KRT) [14].

To the maximum extent of the existing joint ventures, the aspect of the spatial resource of the underground part of the territory is reflected in Joint Venture 473 "Buildings, structures and complexes underground. Rules of urban planning", which was put into effect in the summer of 2020. It states, for example, that with a population of more than 1 million people in cities, it should provide for the integrated use of US, indicates the possible placement of "underground complexes", functionally both connected and unrelated, etc. However, all these and other correct requirements and recommendations cannot be applied due to the fact that they are not supported by legal norms in any way. In this regard, at the initiative of the author of the article, at the expense of the budget of the city of Moscow in 2001, a set of scientific studies was carried out to amend and supplement a number of federal laws, including codes [12]. An even more difficult current task is the practical implementation of the research results.

In this regard, it should be emphasized separately the recommendation of CR 473 on the creation of a single underground part throughout the block or micro-district during the renovation of residential areas and dwell on this in more detail.

The implementation of this radical model is very attractive, allowing us to solve a number of urban planning, engineering and environmental problems, as a result, significantly improve the quality of the urban environment to the level of the best world standards (the model "yard without cars, etc.). It is significant that the idea in 2020-21 was

supported at the level of the Moscow Government (meetings of the Joint Scientific and Technical Council on Urban Policy and Construction of the City of Moscow, as well as its sections "Urban Planning and underground Urbanism" and "Energy Efficient Construction") A decision was made on the experimental design and construction of an experimental quarter for the renovation of residential buildings in the city of Moscow with the integrated development of US and taking into account the maximum placement of parking spaces, necessary engineering infrastructure facilities and integration with the metro facilities of the renovation area "Maple Boulevard". However, the implementation of the decision has not taken place, which in our opinion is largely due to the noted and other defects of legal regulation (for example, the inarticularity of the model of the formation of a single or multi-contour land plot, the establishment of special easements, etc.), as well as standardization.

As for CR 473, it is advisable for the Ministry of Construction of Russia to monitor the implementation of its requirements and, on this basis, make appropriate changes, excluding requirements that are not provided with the necessary legal support.

In general, regarding the planning aspect of the problem, we can conclude that with the further development of the RLA and the NTD, it is necessary to focus on integrated solutions for the development of ground-underground space, given that the need for the construction of a UBS generally arises when the land resource of a specific territory is not enough to form a full-fledged land plot (placing all normalized elements on it).

During the analysis, other aspects of the complexity of the use of US resources in the city were also considered. It should be noted that the "Deep City" method is already partially implemented in Moscow. So, within the framework of the pilot project, the use of geo-energy resources was carried out (the transport hub of the metro station "Salarievo"). Rational logistics of the balance of volumes of extracted geo-materials is being implemented on the scale of the territory of New Moscow (projects of ski complexes), water supply in this territory is prioritized due to cleaner underground sources. However, of the above, perhaps only the aspect of the use of groundwater resources is more or less satisfactorily provided by the regulations. Without referring to the aspect of water extraction as a mineral, we note that in the relevant sections of the considered joint ventures (CR 450, etc.), usually in this part refer to special joint venture 31 concerning the design of outdoor networks and water supply facilities.

The situation is much more complicated with such new directions of using the potential of US, as geo-energetic (the use of heat pumps for UBS, etc.), the rational use of geo-materials extracted during the creation of UBS. They are not yet covered by proper technical regulation. As for the first of them, along with the need to make changes to CR 60, it seems appropriate to develop separate national standards. This issue also requires additional research, however, as well as the issue of expanding the logistics of the balance of the volumes of extracted geo-materials to the level of a large city (this requires amendments and additions to individual regulations concerning the organization of construction work, or the adoption of a special regulatory document).

Considering the NTD projects, it should be noted four JV projects, the declared scope of which directly concerns the IDT. These are joint venture projects with a common part of the name: "Urban planning. Integrated development of territories", concerning, respectively, the general provisions of the construction of models of the urban environment, low-rise, medium-rise and central models of the urban environment. Their preparation was additionally included in the Plan of the Ministry of Construction of the Russian Federation for the development (updating) of the joint venture for 2022 at the expense of extra-budgetary funds of the Fund HOUSE of the Russian Federation and was carried out

by the forces of JSC TSNIIpromzdani with the participation of the Fund HOUSE of the Russian Federation, etc., http://www.consultant.ru/document/cons_doc_LAW_390732/#dst100005 . A detailed analysis of these joint venture projects revealed a number of their systemic problems (its results are reflected in the author's article noted above, which is being prepared for publication).

In the joint venture projects, the importance of using US resources is leveled, especially in the complex context under consideration. Therefore, during the examination, the contractor and the developer were told that along with the formal mention of CR 473, it is advisable to take into account the specific urban development potential of the US by making appropriate requirements (as a reference option). In the context of the tasks assigned to the performer, this is essential (it provides an increase in the values of parameters that normalize the levels of compactness, environmental friendliness, etc.). Ideologically (see for example, the practice of underground urbanism in advanced countries and the requirements of CR 473) integrated and large-scale development of urban US is considered as an equivalent, and sometimes a priority urban planning direction, including quite socially, economically and environmentally recoupable (the practice of Montreal and other cities). Objective difficulties in this case (sanitary-hygienic, technical, geological, etc.) are successfully overcome by the use of appropriate new technical, construction and mining technologies, as well as by carrying out surveys and research. All this is beginning to find application in the Russian Federation and, of course, will develop further. Currently, according to our information, these four joint venture projects are being finalized based on expert comments.

Also considered are draft Amendments No. 1 to CR 19, CR 53, CR 475, CR 476, some of which objectively should relate to the model of the KTR at least in terms of the layout of the territory. Similarly, we recommended that the performers strengthen this aspect, including aiming at more active use of the potential of the US.

4 Conclusions

The fundamental principle and global trend is the desire for a more complete, integrated use of not only spatial, but also other resources and services of US (geo-energy, geo-materials, ground water). This principle, adopted within the framework of the "Deep City" model, is beginning to be implemented experimentally in the annexed territories of the city of Moscow, but replication of the experimental results has not yet been observed. At the same time, it seems that this systematic approach would be extremely useful in the areas covered by the model of IDT (renovation). In these territories, in particular, a "single underground space" could be created in advance within the blocks and other elements of the planning structure, and formations not only residential, but also of a different, primarily industrial nature.

As the analysis has shown, a significant barrier to the transformation of such best practices is the unsuitability of the standardization system and the associated system of legal support for the integral use of US. The vast majority of the considered subject NTDs contain gaps not only in terms of new aspects and directions of complexity (geo-energy, geo-resources), but even in terms of the traditional use of the subsoil as a space for the placement and creation of various underground and underground-aboveground complexes. Thus, the mechanism of complex (integral) use of underground space resources during urban renewal really requires systematic refinement.

In our opinion, a radical way out of a critical situation can be, first of all, a change in strategic views on the urban development of the US, recognition of it as an equivalent (in relation to the land) resource, and potentially even more attractive in terms of the prospects for using all the resources and services of the US in the course of urban development. Such a paradigm should be consolidated in the relevant sectoral strategic planning documents, and then reflected in the legal field. This will significantly facilitate the necessary transformation and correction of the standardization system due to its subordination to the legislation noted above.

The second prerequisite is the development of scientific groundwork to substantiate both the mechanism of the transformation itself and the adequate development of specific NTDs and related RLAs. It is obvious that the range of topics of scientific research on the problem of urban development of US in the framework of such a new system (integral) formulation is extremely diverse and extensive. Some of the directions are indicated above in the text (for example, the primary development of an ontology and the consolidation of an effective and complete thesaurus in the considered field of urban planning is important, it is also necessary to identify the features of the implementation of the IDT in historical territories using US resources, appropriate accounting and reflection in the NTD of such a legislative novelty as the introduction to [1] of the format of a single territorial planning document, as well as a similar account of the upcoming legislative novelties in the part of the

IDT

<https://www.minstroyrf.gov.ru/press/minstroy-rossii-podgotovil-izmeneniya-v-zakonoproekt-o-primenenii-mekhanizma-krt/> etc.). Due to the fact that the topic under consideration is objectively the most relevant in the city of Moscow, it is extremely advisable to restore the practice of a program-oriented approach to its solution (the corresponding City program adopted by the Moscow Government in 2008 was frozen, <https://www.mos.ru/authority/documents/doc/29263220/?ysclid=lg3h7fu09n450103617>). The topic is certainly relevant for the conditions of St. Petersburg, as well as other major cities of the country.

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