GREEN ROOFTOPS: NEW LEISURE SPACE

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The COVID-19 pandemic has made green public spaces in cities inaccessible. However, the demand for leisure in nature has not gone anywhere. Greening rooftops could allow us to organize new leisure space while improving the environmental situation, preventing road flooding and reducing the costs of maintaining urban infrastructure. Today, we can begin protecting the megapolis from the crises of the future: a lack of access to green public spaces due to COVID-19, streets flooding during heavy rainfall, the heat island effect, air and water pollution, a lack of green spaces in the city center.

Greening rooftops will allow the city to solve the problem of neighborhoods where there is a critical lack of green space, yet no space for new parks. Moscow's Central Administrative Okrug is the most obvious example: this area regularly experiences problems with street flooding, while dense construction, a large quantity of asphalt and a lack of green spaces leads to an increase in the heat island effect.

1. Why Are Green Rooftops Relevant for Moscow Today?

Green Rooftops Offer Protection Against Crises

The key concept of the current pandemic period is distance. WHO experts have implored people to observe physical distancing and limit visits to public spaces. A rooftop garden could become the ideal type of semi-public space that will help satisfy people's needs for leisure time in nature without violating necessary physical distancing measures. A rooftop garden can be separated into zones, each of which can be reserved for use at a specific time by residents of a single apartment. This will allow visitors to the garden to avoid interacting during their designated leisure time, reducing the number of potential social contacts. Neighbors can agree on usage times over social networks or using a special application.
Most importantly, a rooftop garden can already be organized through the joint efforts of a building resident's. The pandemic has shown that challenges for the city can be unpredictable and vary widely. In order to handle future crises, it is necessary to develop the city's sustainability. Green rooftops will help the city solve global problems by making it less vulnerable. The organization and development of green rooftops will allow cities to improve their environmental situation and the health of their residents, solve the increasingly pressing problem of urban flooding, and reduce the loads placed on grey infrastructure, thereby decreasing expenditure for its usage. In addition, the creation of new spaces for rent on urban roofs will open up new opportunities for small businesses,

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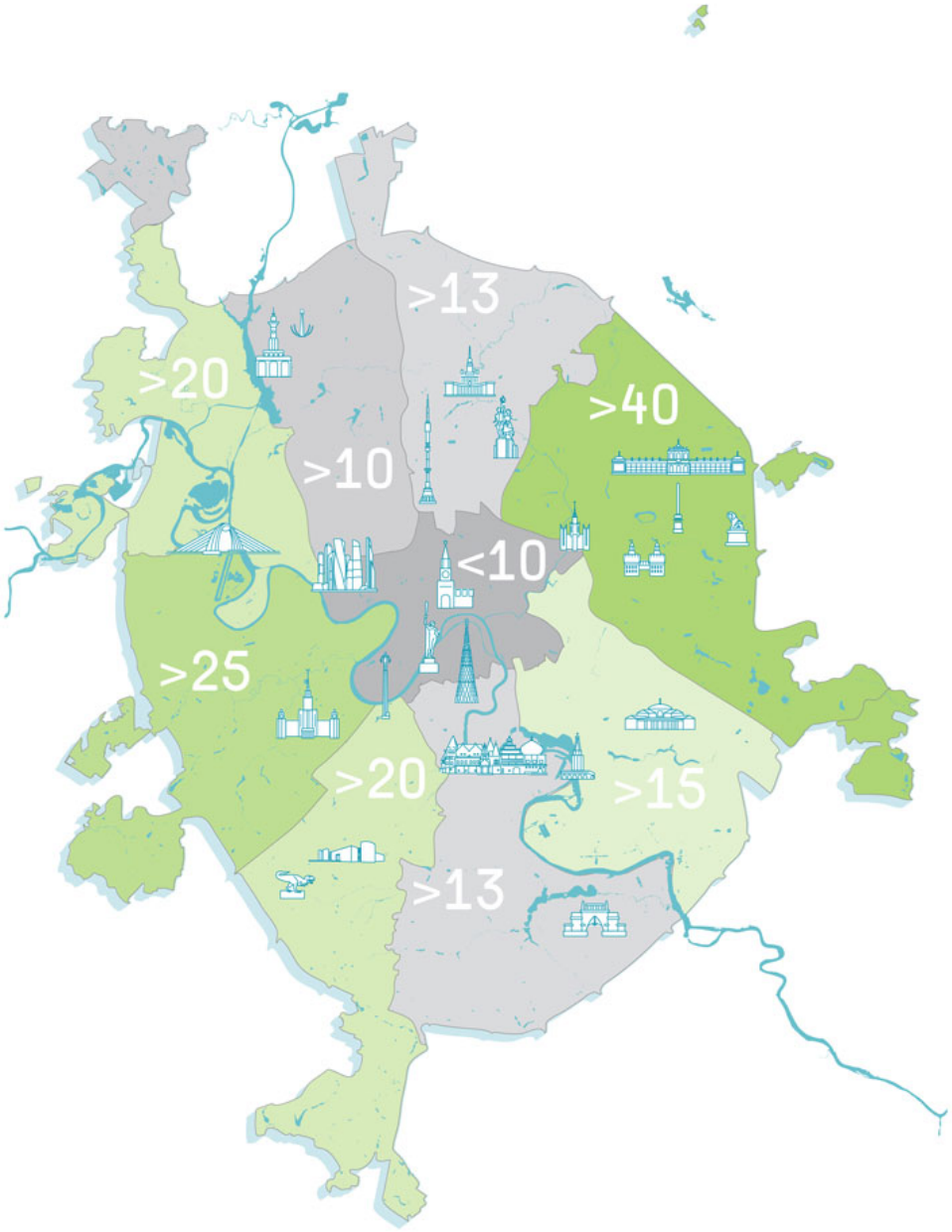
creating jobs and bringing the city additional income.



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In the central administrative Okrug:
- The worst environmental situation out of all the city's districts. In general, the city has slightly more green plantings than the global standard, but in the Central Administrative Okrug, the figure is much lower
- This area is hottest of all in the summer. The difference between the city center and the suburbs can reach up to 10°C.
- Extremely dense construction, many rooftops, and no space to create new parks
- Critical transport infrastructure. Flooding of the Central Administrative Okrug, in particular, leads to multi-kilometer traffic jams and an overcrowded metro system.

Problems Solved by Green Rooftops

The Flooding Problem.
Due to global warming, the planet is experiencing the largest volume of precipitation of any period for which meteorological data has been collected. Like many other megapolises, Moscow is occasionally flooded by rainwater. If typical rainfall in our climate was previously lengthy and drizzly, near-tropical downpours have become almost a regularity due to the violation of the planet's delicate environmental balance. Such levels of precipitation cause mass transit accidents, ruin the lives of city residents and cause significant damage to the economy and environment. Rainwater gathers dust, trash and fuel residue from the streets, which goes on to find its way into rivers and groundwater.
The problem of removing excess water is solved by grey and green infrastructure. In its fight against heavy rain, Moscow is used to relying on grey infrastructure: storm drains, canals, sluices and other such tools. However, green infrastructure like rain gardens, parks and rivers are no less important. There are problems with these elements in Moscow, especially in the city center, which is subject to the heaviest flooding of all during heavy rainfall and where there is simply no space whatsoever for new plantings.
Green infrastructure naturally passes on and retains water without leaving it on the surface thanks to porous surfaces. In parks and in green spaces, this is achieved using soil, plus root structures that absorb moisture. There are special zones like rain gardens, which are capable of taking up water in even greater volumes compared to a regular green zone, especially if hydrophilic vegetation is planted. Porous surfaces also include gravel, paving stones with wide gaps filled with "screening" material, eco-pavement and selected other surface coverings. All of these allow water to easily filter through. There is also a third class of sites, called hybrids, such as green rooftops, which combine the advantages of both grey and green urban infrastructure.

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Moscow


Paris


New York

Lack of Green Spaces

Currently, the center of Moscow suffers from a critical lack of green spaces, as do certain other districts in the city. In the center of the capital, there are especially large quantities of asphalt and paving stones, dense construction and less green space than in other districts. Summer heat is felt more acutely here. In such conditions, we see the maximum possible effectiveness of green rooftops: city residents can have parks practically in their own homes. Of course, a green rooftop cannot replace a walk in a park, but it can serve as an excellent spot to relax, eat a leisurely breakfast or exercise outdoors within a five-minute walk from one's apartment door.

Environmental Problems

Greening rooftops is a strategy that helps reduce the "heat island" effect in major cities.
Causes of the "heat island" effect:
- Cities are a major source of greenhouse gases, which cause the greenhouse effect
- The continuous reduction of the percentage of urban land used as green spaces results in the disruption of natural processes of cooling and evaporation
- Large expanses of impermeable, heat-absorbing surfaces
- Dense, tall construction leads to a disruption of proper air convection

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- Cities produce and emit large amounts of heat into the atmosphere.

What are the negative consequences of the heat island effect and why is it worth fighting them?
- The heat island effect lowers air quality and leads to the formation of smog. Power inputs toward indoor air conditioning and purification increase, as well as water usage for cooling and watering plants.
- Both the decrease in air quality and the increase in temperature cause and aggravate chronic illnesses among city residents. People with chronic illnesses, the aging, and young children are especially sensitive to increases in temperature.

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> *The "heat island" effect is a temperature increase in the city relative to surrounding natural territories. The temperature difference between these zones can reach up to 10–15˚C.*

Green rooftops help purify runoff water. In passing through the layers of a green rooftop, water is purified. It does not reach the sidewalk and asphalt, but goes straight into a storm drain instead, which means that it does not collect fuel, oil and other damaging substances from the streets. Such water is far easier to purify than water collected from the city streets. Rain barrels and reservoirs can also be installed on rooftops. They can be used for utilitarian purposes, such as watering plants and washing sidewalks and façades. A green rooftop doesn't merely help lower temperatures on the hottest days; it also absorbs some of the city's noise and carbon dioxide. The more space is dedicated to green rooftops, the more significant the effect will be.

Unsustainable Economy

Green rooftops help reduce usage costs in the city. They work as an additional layer of thermal insulation: those rooms located directly underneath them do not heat up as much during the summer and lose less heat during the winter. This allows buildings to reduce air conditioning costs during the summer and heating costs in the winter. Green rooftops also improve waterproofing on rooftops, which means that repair works are needed less frequently. Collecting water in rain barrels and using it for watering plants and other utilitarian purposes allows for further savings on water supply and drainage.

Farming can be an important element of the urban economy. As a result of "panic buying" during the COVID-19 pandemic, demand for food products exceeded the supply chain's standard capabilities. Store shelves stood empty. This situation sends out an important signal: in the future, it will be necessary to create more self-sufficient cities and neighborhoods that can provide their residents with produce and necessary goods themselves. The use of urban spaces to grow fruit, vegetables, legumes, poultry, small livestock and even fish can serve as one of the solutions. Urban farms and greenhouses can be organized on the rooftops of buildings – a colossal expanse of unused spaces in the world's cities – and provide urban residents with direct access to fresh produce, which will allow them to avoid panic buying during global crises. Urban farming can become a powerful economic stimulus for economies: it creates a new sector of the economy, which in turn brings new jobs for people who can take care of the plants. Farms can be used both by local residents for their personal needs as well as by businesses: restaurants can grow their own produce right on their own rooftops.

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2. How Are Green Rooftops Organized?

3 Types of Green Rooftops

There are three main types of green rooftops: extensive, semi-intensive and intensive. This typology is based on the depth of the rooftop's substratum. On extensive rooftops, the substratum is not very deep, and grasses or sedums can be planted here. Semi-intensive rooftops with a slightly deeper substratum are suitable for growing shrubbery. Finally, on intensive rooftops, shrubbery and even trees can be planted: the substrata of such rooftops are fairly deep.
Intensive greenery may not be suitable for all rooftops for a number of reasons: for example, a deep substratum would increase the weight of the green rooftop. However, any type of rooftop can be turned into a rain garden, one of the tools for collecting rainwater. The garden will hold even more moisture if hydrophilic plants are planted there, all while accumulating and purifying water. The deeper the substratum in which plants are planted, the more water can be retained.

What Happens to Green Rooftops in the Winter?

Cities like Stockholm, Oslo, Ottawa, Quebec and Edmonton are similar to Moscow in terms of climate and also experience cold winters. However, this does not stop local residents from actively working to green their rooftops. In order to let a green rooftop survive the winter and be ready for spring, it's enough to simply select plants that are suited to the local climate, focusing on hardy and undemanding cultivars. Extensive rooftops require the least care of all, while intensive rooftops demand the same kind of care as any garden. Like in urban parks, flowers and grasses can be planted seasonally.

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3. How Can You Make a Rooftop Garden?

Apartment owners in a residential building or the owner of a commercial building can try to green their rooftops independently. Such a rooftop can help to improve the environmental situation around the building, create a new leisure space for building residents, and increase the price or rent of apartments.

How Do You Start?
Step 1: Transition the rooftop into serviceable status. For this, you need the permission of all of the owners and tenants of the building, after which you can send a request to Rosreester to change the status of the rooftop. Experience has shown that this is the most complicated step.
Step 2: Discuss what you would like to do with the rooftop with your neighbors and how much money you will need to invest in this shared task. It is important to choose the appropriate type of green rooftop, as well as planning out how you will fill the space and organize access to it. If there is a single owner of the building, they can make these decisions independently.
Step 3: Sign the minutes of the residents' meeting and submit the document to the Institute of Residential Planning (for example, the Moscow City Chamber of Notaries or the Moscow Scientific Research and Planning Institute of Typology and Experimental Planning), where a design will be

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prepared and approved at all the necessary levels of government.
Step 4: Make sure that the design corresponds to the technical and environmental demands of Construction Rules 17.13 330.2017, "Rooftops."
Step 5: Conduct a request for proposals and choose a contractor.
Step 6: Note the green rooftop on all necessary statements for the building and come to an agreement as to how its maintenance will be organized.

Current Solutions
In today's situation, where the majority of city residents are currently under quarantine, green rooftops have become especially relevant. What can you do if it will take some time to organize a full-fledged green rooftop, but you need an alternative leisure spot right now?
You can use container greening, like potted plants and wooden crates. You can grow both decorative plants and useful crops like herbs and vegetables in them. For furniture, you can use shipping pallets and movable garden furniture. To cover the rooftop, you can use rock chips, wood chips or decking. If there isn't much space on the rooftop, containers of plants can be stacked on top of each other, or you can create vertical greening. Grapes and other vine plants work well for this.
During the pandemic, it is important to organize the space to allow people to maintain social distancing. For this, you need to divide the space into functional zones with movable containers. If there are several entryways in the building, you need to create separate segments for each of them. That way, the number of users of a single segment will be limited.
It is important to provide for antiseptic treatments of all surfaces on the roof. The most important factor, however, is that residents must agree on the order in which they will use each zone. For this, they can use social networks, a special app or a dedicated site. In the future, this temporary solution may be augmented by an extensive rooftop that can go on to become a full-fledged rooftop park. In this case, wooden crates will rot and become overgrown with time, creating natural hills. Such a solution will turn out to be cheaper than intensive greening of the entire rooftop, while leaving the possibility for planting taller plants. Unlike a courtyard, the user community for green rooftops is limited to the residents of a single building or entryway, who have the right to use the space sequentially and thereby make it a safe place, even during a pandemic.

What can you do if your building's rooftop is not flat, but sloped – or too old to be greened?
One solution is to create similar green rooftops on nearby empty shopping centers, offices, universities, libraries and public garages. During the current quarantine period, they can be used according to the same principles as the rooftops of residential buildings. This means that only residents of nearby buildings can visit them after making an advance reservation and with strict

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limits on the number of people using the rooftop. In the future, these temporary rooftops can be turned into permanent ones.

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4. Worldwide Experience

Green rooftops have been successfully implemented in many cities around the world. These practices have mainly been incorporated into strategies of urban development, but there are also examples of state-level programs. For example, China has a large-scale state program to adapt cities for climate change, which includes green rooftops. The program began with 13 cities, including Beijing and Shanghai, and similar techniques are already being used in 30 cities around China.

Greening Strategies

The launch of such a project always depends on the interaction between city power structures and building owners: the former change urban planning standards and introduce incentives and subsidies for green infrastructure, while the latter invest in green rooftops and thereby increase the value of their real estate while getting new rentable spaces.

City administrations can speed the adoption of green rooftops in various ways. Here are the primary

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ones today:
- Recommendations and requirements to green all rooftops (Stuttgart, Germany) / rooftops with up to a 30-degree incline (Copenhagen, Denmark) / only flat rooftops on new construction (Basel, Switzerland).
- Subsidy and grant programs. In Stuttgart, up to 50% of expenses on erecting rooftop structures are compensated, and in London, there is a system of grants for private projects.
- Green index. In London, developers must enact a series of greening and rainwater drainage measures, each of which is evaluated. In order to receive permission to build, a barrier set on a district-by-district basis must be met. Similar indexes are in effect in Berlin, Hamburg, Malmo, Helsinki, Seattle, Washington and other cities.
- Changing the tariff policy. In Philadelphia, there is a flexible tariff structure for water drainage. This is a stimulus for those who drain the largest amounts of water to create green infrastructure elements in order to reduce their payments. In Munster, for example, the presence of a green rooftop gives building owners a discount on water drainage rates.
- A more systematic approach is used in London, where the overall green rooftop area was doubled over 10 years, from 71.5 ha to 151 ha. Both rooftops and walls are made green. The city conducted several large-scale studies in order to calculate the economic value of its natural resources, as well as assessing the impact of greening (and its absence) on the health of city residents and the urban economy. For example, it became apparent that each pound spent by the government on greening resulted in £27 worth of new business, services and amenities for city residents, while the very same residents save nearby £1 billion a year on healthcare thanks to improvements in the environmental status of the city.

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