FIFA WORLD CUP
RUSSIA 2018

More sustainable stadium

2nd technical report (January to November 2016) on the implementation of environmental, energy- and resource-efficient design solutions for the stadiums of the 2018 FIFA World Cup Russia™

Content

This report was prepared in 2016 for the 2018 FIFA World Cup Local Organising Committee by a Russian public not-for-profit organisation in the field of sustainable construction, "The Russian Green Building Council" (RuGBC). The RuGBC is a member of the World Green Building Council (World GBC).

1. Introduction

Adherence to green building standards is an important aspect of sustainable development. Such standards regulate the ecological quality of buildings, and the stadiums of the 2018 FIFA World Cup™ are also covered by this good practice.

Green building makes the world better. Its standards are intended to achieve a higher level of comfort and safety and improve the economic performance of the buildings at the operational stage.

Green building standards are based on resource-efficient design and engineering, including special methods of efficiency calculation and the provision of high-quality equipment for the building heating and cooling systems, lighting, power and water supply. The standards also cover the environmental safety of building materials, certain social aspects and transport accessibility, as well as general environmental factors, e.g. amenity planting, air quality and level of comfort.

The report provides a general description of the technical aspects relating to the application of such practices for the construction/reconstruction of stadiums for the 2018 FIFA World Cup™.

2. List of terms and abbreviations

Environmentally friendly technologies and approaches used at the World Cup stadiums:

- **Ventilation units** in the balanced ventilation system with heat recuperation. The use of this technology saves heat in ventilation systems and reduces the power demand for the warm air supply. "Recuperation" means reusing heat in the ventilation systems.
- **Adsorption refrigerators and dry chillers/ multi-zone chilling units** are used for the generation and centralised supply of cold air via ventilation channels to fan coil units in the rooms. This is a resource-efficient and environmentally safe method of cooling air in the interiors of large buildings with forced mechanical ventilation.
- **LED-based lamps** are used for the indoor and outdoor non-sports lighting of stadiums. LED lamps represent the most energy-efficient and environmentally safe class of electric-powered lighting available on the global market of lighting equipment.
- **Heat distribution stations** represent a stadium heating technology that involves specific systems for the control, preparation and supply of heat received from external sources using an independent scheme.
- **The building management system** enables energy saving through the intelligent distribution of energy.
- **Water-efficient sanitary appliances:** Urinals and sinks are equipped with infrared pulse dosing water sensors and aerators. Toilet bowls have two flush options (six and three litres with one press of the relevant "flush" button).
- **Water-saving equipment:** Tanks are provided for the collection and storage of rainwater to be used to water the area surrounding the stadium.
- **Environmentally friendly materials:** Materials with special eco-labels to demonstrate their environmental performance.
- **Innovative environmental design approaches:** In the context of this report, this refers to the energy modelling of the buildings to estimate their energy performance and minimise energy consumption by introducing appropriate solutions at the design stage.
- **Biodiversity conservation approach:** Specific approaches are applied to minimise the loss of any flora and fauna at the construction sites and to preserve it as far as possible. This also refers to the appropriate remediation measures.
- **Transport accessibility:** In the context of stadium construction, this refers to the provision of elevators, special ramps for people with limited mobility and safe access routes for public transport, as well as the development of a public transport system in the vicinity of stadium.

3. Green-building and sustainable construction standards during preparations for the World Cup

In accordance with FIFA requirements, all of the World Cup stadiums have to be certified according to one of the internationally or nationally recognised green-building standards, which is in line with the Sustainability Strategy for the World Cup.

Certification of two existing stadiums under the BREEAM standard will be completed by April 2017.

Luzhniki Stadium in Moscow is expected to obtain final BREEAM certification with the "Pass" rating.

Spartak Stadium in Moscow is aiming to obtain final BREEAM certification with the "Good" rating.

A special Russian standard – "RUSO. The Football Stadiums" – has been developed for the purpose of assessing and certifying the World Cup Stadiums. It takes into account the requirements of internationally recognised standards and was developed by a consortium of scientific, engineering and building professionals headed by NP AVOK, with the support of the Russian Ministry of Natural Resources and the Russia 2018 Organising Committee.

The standard was officially registered in March 2016.

Since registration, there have been ongoing efforts to implement the standard as a certification tool for the World Cup Stadiums.

Saint Petersburg Stadium is going to be certified under the RUSO standard in May 2017.

The standard establishes the following:

- 12 mandatory criteria: 28 indicators
- 51 rating (supplementary) criteria: 121 indicators grouped in 12 categories
- Maximum score of 655 points
- Stadium certification threshold of 343 points
- A system with three ranks of certification

In accordance with the standard, the environmental sustainability of football stadiums is assessed by a set of provisional mandatory requirements and key criteria.

There are 12 mandatory criteria:

1. Prevention of environmental pollution during the construction phase of the project
2. Reduction of water used for irrigation of the adjacent area
3. Reduction of internal water consumption
4. Water consumption metering
5. Verification of compliance regarding putting the project facilities into operation
6. Minimum level of energy efficiency of the project
7. Energy consumption metering
8. Control measures to make sure that ozone-safe refrigerants are used
9. Efficient sanitation and waste disposal
10. Construction waste disposal
11. Minimum level of thermal/air comfort
12. Prohibition of tobacco smoking in the area surrounding the stadium

The key criteria are grouped under the following categories:

- Pre-design studies
- Comfort and quality of ambient environment
- Architectural and landscaping quality

- Comfort and ecological quality of interior environment
- Quality of sanitation and waste disposal
- Water conservation
- Power supply and energy efficiency
- Use of alternative and renewable energy
- Environmental considerations at the development, operation and decommissioning stages
- Economic performance
- Quality of design
- Quality of operation

Project design documents and operational property may be certified independently, however it is advisable to follow a sequential certification process from the design stage to putting into operation, in order to achieve a real improvement in environmental performance.

The “RUSO. The Football Stadiums Standard” will be an important part of the World Cup legacy for the national construction engineering sector in Russia.

In accordance with the official circular letter from the operator of “RUSO. The Football Stadiums”, certification of the following 2018 FIFA World Cup™ stadiums is planned in 2017:

- Saint-Petersburg Stadium
- Kazan Arena
- Ekaterinburg Arena
- Kaliningrad Stadium
- Rostov Arena
- Mordovia Arena
- Samara Arena
- Nizhny Novgorod Stadium

The following stadiums are planning to perform certifi cation either by "RUSO. The Football Stadiums" or BREEAM standards.

- Volgograd Arena
- Fisht Stadium

4. Resource-efficient approach and engineering solutions for the design and construction of the Stadiums

On the following pages, please find a review and summary of the environmental, energy- and resource-efficient design solutions and features for each of the official 2018 FIFA World Cup stadiums, as well as information on the environmentally friendly materials used in the renovation and construction of those sports facilities.

This information was collected for the 2018 FIFA World Cup Local Organising Committee by a Russian public not-for-profit organisation in the field of sustainable construction, “The Russian Green Building Council“ (RuGBC). The RuGBC is a member of the World Green Building Council (World GBC).

Luzhniki Stadium, Moscow

The construction and installation works at Luzhniki Stadium in Moscow had been completed as at November 2016.

The stadium is preparing for the final BREEAM certificate to be issued in March 2017 with the "Pass" rating.

This is Russia's largest open-air stadium, with a capacity of 81,000 for World Cup matches.

The stadium's energy and resource efficiency is ensured by the use of energy-efficient utility systems, environmentally friendly materials and an effective system to control the consumption of energy for heating, ventilation, electric lighting, chilling, pumping and other energy-intense operations within the stadium.

Environmentally friendly materials are widely used at the stadium. These include:

- high-quality thermal insulation of walls
- water proofing
- energy-saving window systems
- translucent polymer roofing panels on the stands

The following technologies and solutions have been implemented at the stadium:

- **The recuperation of heat in ventilation systems** enables substantial savings through the reuse of waste heat to warm up air for interior premises. This approach enables savings to be made of up to 30% of energy used for warm air production.
- **Adsorption chillers for cooling** room air in the summer help to save up to 70% of electric energy compared to other equipment with a similar function.
- **LED-based lamps** in service and office rooms and corridors achieve savings of up to 90% of electric energy for lighting compared to incandescent lamps.
- **Heat distribution stations** enable the independent control of water heating for stadium facilities and thus save up to 25% of energy used to produce hot water.
- **Building management systems** control all utilities at the stadium to adjust capacities and resource distribution in line with actual demand, with a resultant reduction in the stadium's power consumption within a range of 20-70%, depending on the circumstances.

The stadium site features a unique biodiversity conservation approach. The reconstruction site is surrounded by a green square with well-maintained lawns and planted trees and shrubs. All valuable tree and shrub species within the fenced internal construction site have been preserved and protected by means of wooden shields to prevent potential damage by construction machinery. About 70 trees and shrubs which are located in the immediate construction area are thus being preserved.

Passive daytime lighting of the arena is used to minimise the consumption of electric power to illuminate the main arena in daylight hours.

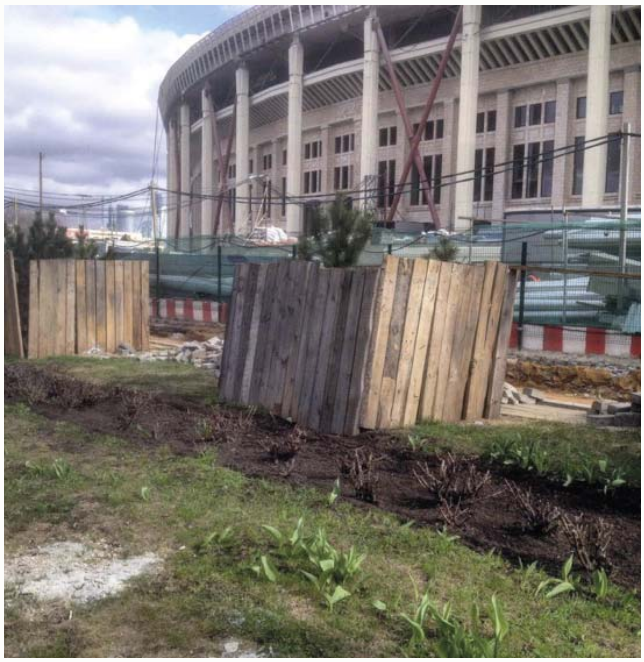
Passive natural ventilation using outdoor air from the arena bowl enables a substantial reduction in energy consumption for the ventilation of the interior space and spectator seats.

Water-efficient sanitary appliances with water dose control are provided throughout the stadium to save up to 60% of the water used for hygiene purposes in the large public spaces.

The well-managed construction site demonstrates good examples of practices encouraged by the environmental standards, including:
- tidy storage of equipment and building materials
- careful collection and timely removal of construction waste
- safe segregated storage of used luminescent lamps from the temporary site offices
- truck wheels are washed at the site exit
- dust suppression measures are deployed during the summer

Transport accessibility is supported by the developed public transport system. There are two stations with a range of metro lines and a total capacity of 50,000 passengers per hour located within 600m of the stadium.

Luzhniki Stadium

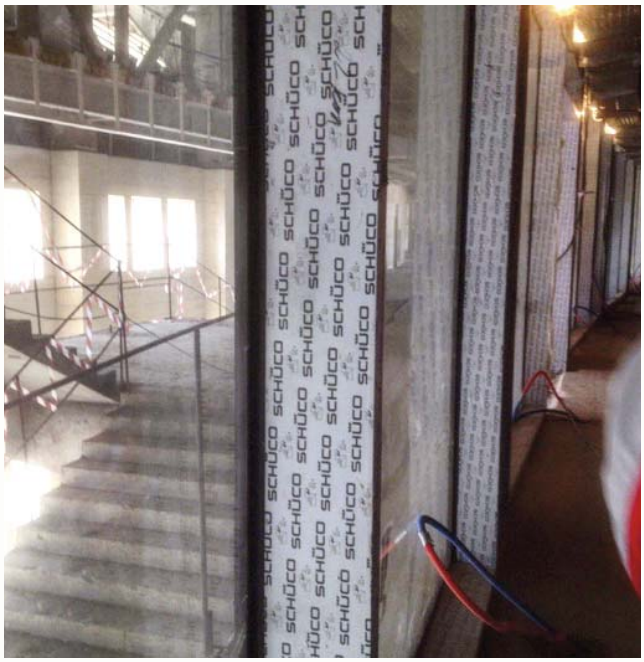


Protection of trees in the adjacent area. April 2016

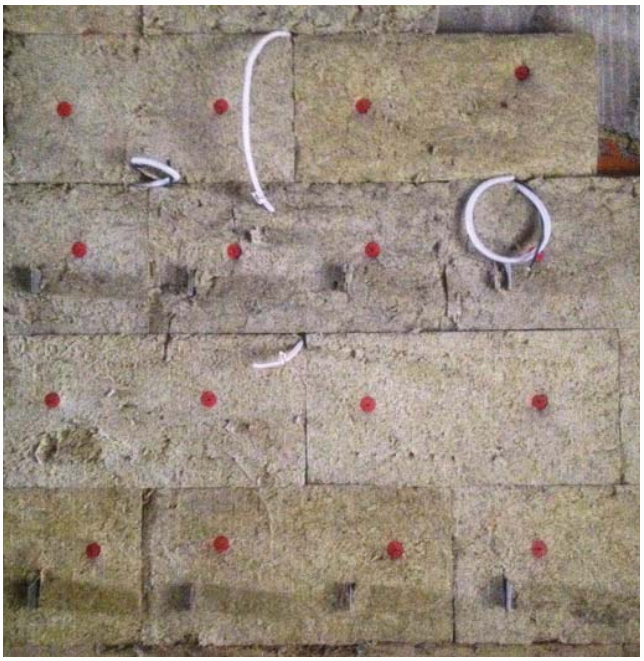
Used luminescent and mercury lamps are collected in a dedicated airtight container, and further protection of the broken lamps is provided by means of separate sealed tubes to prevent contamination by mercury fumes.

Luzhniki Stadium

Ceramic tiles on the historic outer envelope of Luzhniki Stadium are being restored and missing tiles replaced with new ones manufactured in the same way as the original items.



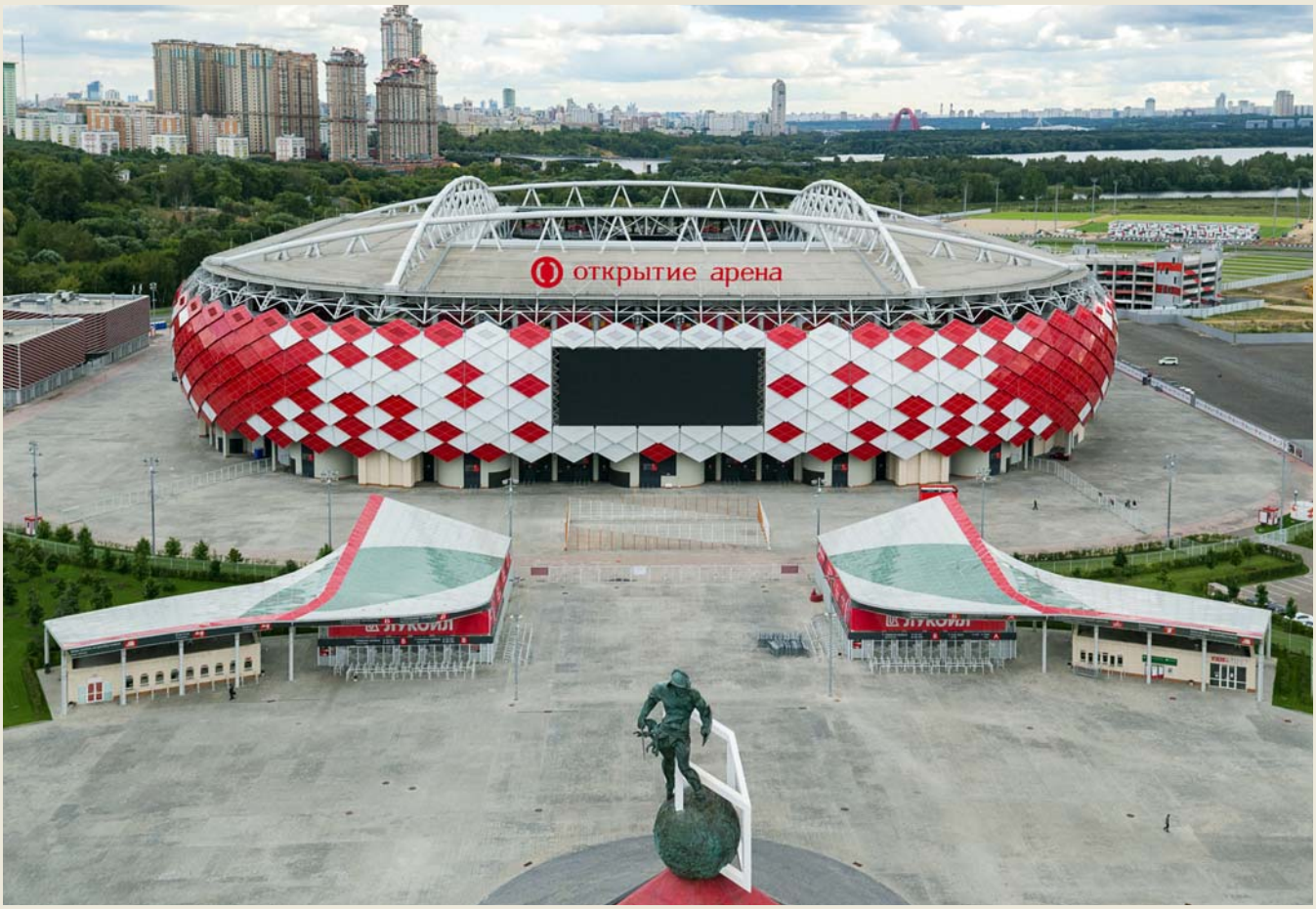
Window openings are filled with AGC glazing systems based on argon-filled double-pane units. The glazing units are fitted into Schüco aluminium profiles, which are considered to represent the best quality available on the market.



The thermal insulation of the walls is based on material manufactured by a specialised company in Russia.

Non-sports interior lighting systems throughout the stadium will use LED-based lighting devices from Russian manufacturer LIGHTING TECHNOLOGY. The picture shows a VIP sky box with architectural finishes and LED lighting.

Spartak Stadium, Moscow



Spartak Stadium in Moscow was commissioned in 2013.

The stadium is preparing for final certification under BREEAM In-Use with a “Good” rating certificate to be issued in March 2017.

Besides the quality of construction, the above standard is also intended to reward environmentally sound operational management practices.

The stadium energy and resource efficiency is ensured by the use of energy-efficient utility systems, environmentally friendly materials and an effective system to control the consumption of energy for heating, ventilation, electric lighting, chilling, pumping and other energy-intense operations within the stadium.

Environmentally friendly materials are widely used at the stadium. These include:

- high-quality thermal insulation of walls
- water proofing
- energy-saving window systems
- translucent polymer roofing panels on the stands

The following technologies and solutions have been implemented at the stadium:

- Recuperation of heat in ventilation systems enables substantial savings through the reuse of waste heat to warm up air for interior premises. This approach enables savings to be made of up to 30% of energy used for warm air production.
- Adsorption chillers for cooling room air in the summer help to save up to 70% of electric energy compared to other equipment with a similar function.
- LED-based lamps in service and office rooms and corridors achieve savings of up to 90% of electric energy for lighting compared to incandescent lamps.
- Heat distribution stations enable the independent control of water heating for stadium facilities and thus save up to 25% of energy used to produce hot water.
- Building management systems control all utilities at the stadium to adjust capacities and resource distribution in line with actual demand, with a resultant reduction in the stadium's power consumption within a range of 20-70%, depending on the circumstances.

The stadium features a unique building management system which effectively regulates distribution of power to various utility systems in order to save the essential resource.
Segregated collection of waste and environmental management practices are being implemented as part of the certification process under the environmental standard.
The stadium is located in a green square with well-maintained lawns and planted trees and shrubs. The entrance structure is complemented by a statue of the ancient warrior Spartacus.
Several land plots around the stadium will be developed into attractive residential quarters.

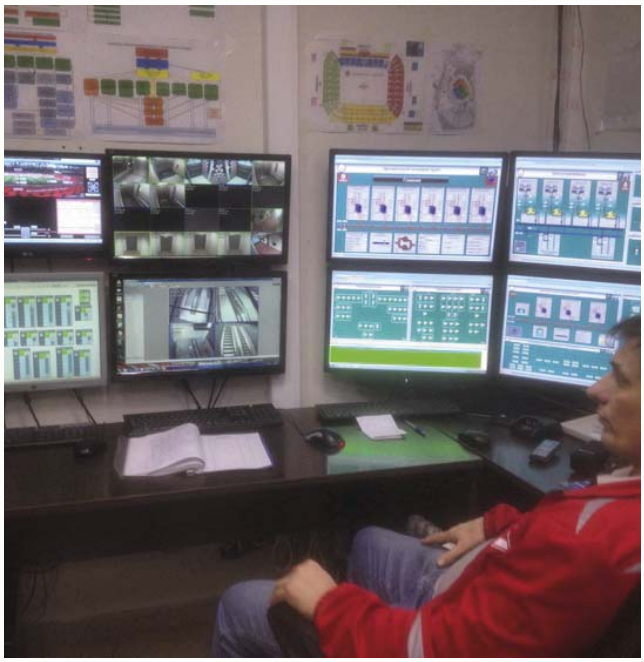
Passive daytime lighting of the arena is used to minimise the consumption of electric power to illuminate the main arena in daylight hours.

Passive natural ventilation using outdoor air from the arena bowl enables a substantial reduction in energy consumption for the ventilation of the interior space and spectator seats.

Water-efficient sanitary appliances with water dose control are provided throughout the stadium to save up to 60% of the water used for hygiene purposes in the large public spaces.

Transport accessibility is supported by a high-quality public transport system including one metro station within 600m of the stadium.

Spartak Stadium

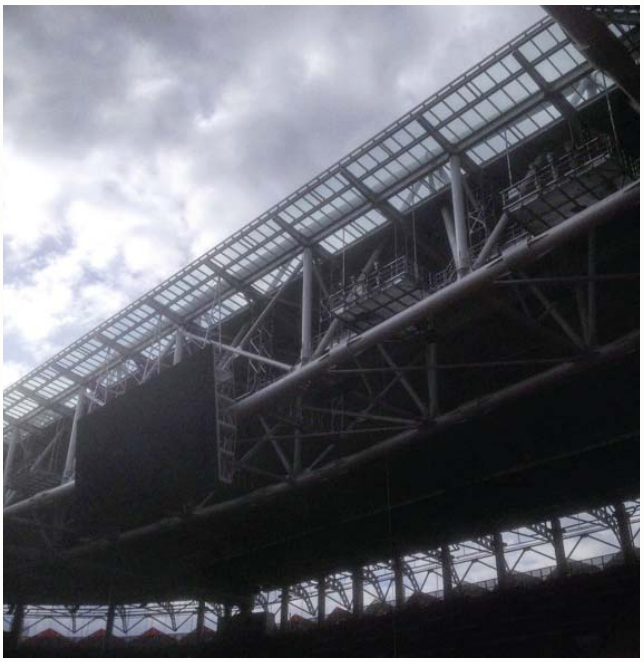


All building utility systems are continuously monitored in the central control room of the stadium, which also monitors dangerous geophysical processes and the structural stability of the building.

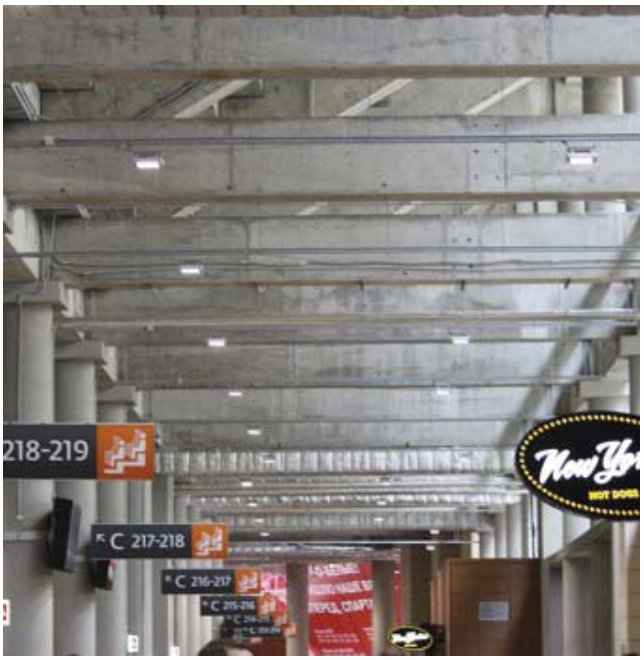
All building utilities including life-support systems are controlled by BMS TAC VISTA from the leading global supplier Schneider Electric (Sweden).

All main equipment for the heat distribution stations is supplied by the leading companies in the industry.

Spartak Stadium



The translucent roofing and canopies have been designed using modern energy-saving multiple-layer glass (triplex) in compliance with GOST R 51136-2008, formula 88.4 VSGESG, which consists of two 8mm layers of Planibel Clear tempered glass connected with four layers of PVB film. The translucent roof represents a glazing system with an aluminium posts and transoms system by Alutech ALT F50, where the posts are fixed on the main members of the roofing structure.



Both interior and outdoor non-sports lighting systems mainly rely on LED lamps – LED 32, LED 33, LED 24, LED 130, JAM 600, JAM 300 (Slovenia, Italy, USA, Germany).

Saint Petersburg Stadium, Saint Petersburg

Saint Petersburg Stadium which is scheduled to be commissioned in December 2016, is the most innovative and capacious roofed stadium in Russia.

The roofed stadium, with its sliding roof and retractable pit, is designed to accommodate 68,000 spectators at the World Cup and 84,000 spectators for subsequent concerts.

It is anticipated that the stadium will obtain final certification under the Russian standard "RUSO. THE FOOTBALL STADIUMS" in April 2017.

The stadium's energy and resource efficiency is ensured by the use of energy-efficient utility systems, environmentally-friendly materials and an effective system to control the consumption of energy for heating, ventilation, electric lighting, chilling, pumping and other energy-intense operations within the stadium.

Environmentally friendly materials are widely used at the stadium. These include:

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- **Adsorption chillers for cooling** room air in the summer help to save up to 70% of electric energy compared to other equipment with a similar function.
- **Heat distribution stations** enable independent control of water heating for stadium facilities and thus save up to 25% of energy used to produce hot water.
- **Building management systems** control all utilities at the stadium to adjust capacities and resource distribution in line with actual demand, with a resultant reduction in the stadium's power consumption within a range of 20-70%, depending on the circumstances.

178 unique engineering systems are embedded in the stadium design.
The sliding roof is covered by innovative lightweight **ETFE polymer which demonstrates the best environmental performance** in accordance with the special environmental quality standards for materials.
The roof and retractable pit are driven by unique custom-designed, energy-saving motors.
The stadium is fitted with **lifts for limited-mobility persons** that generate passive electricity on descent. The energy is accumulated in dedicated batteries, so up to 60% in energy savings can be achieved on the lift operation.
The unique robotic target-point fire suppression system at the stadium is a cutting-edge system for arenas designed to extinguish fire in specific areas and within the shortest time possible.
The stadium features a unique modern architectural design which is fused with the **entrance lobby structures from the old stadium**, which are subtly built into the modern building to preserve and maintain authentic structures for current use.
Environmental standards encourage **social aspects of development** such as legacy conservation activities.
The stadium is **surrounded by** a new urban cluster which is smoothly integrated into the environment of Krestovsky Island on the shore of the Gulf of Finland in the Baltic Sea. The landscape also includes well-maintained lawns and planted trees and shrubs. **Dozens of old trees** that are listed as landmarks **have been preserved**.
The new urban environment is represented by a hi-tech motorway – the Western High-Speed Diameter. Two new metro stations have been built in the vicinity of the stadium, as well as a pedestrian bridge, new sports palaces, various sporting complexes and new hotels. low mobility groups of people.

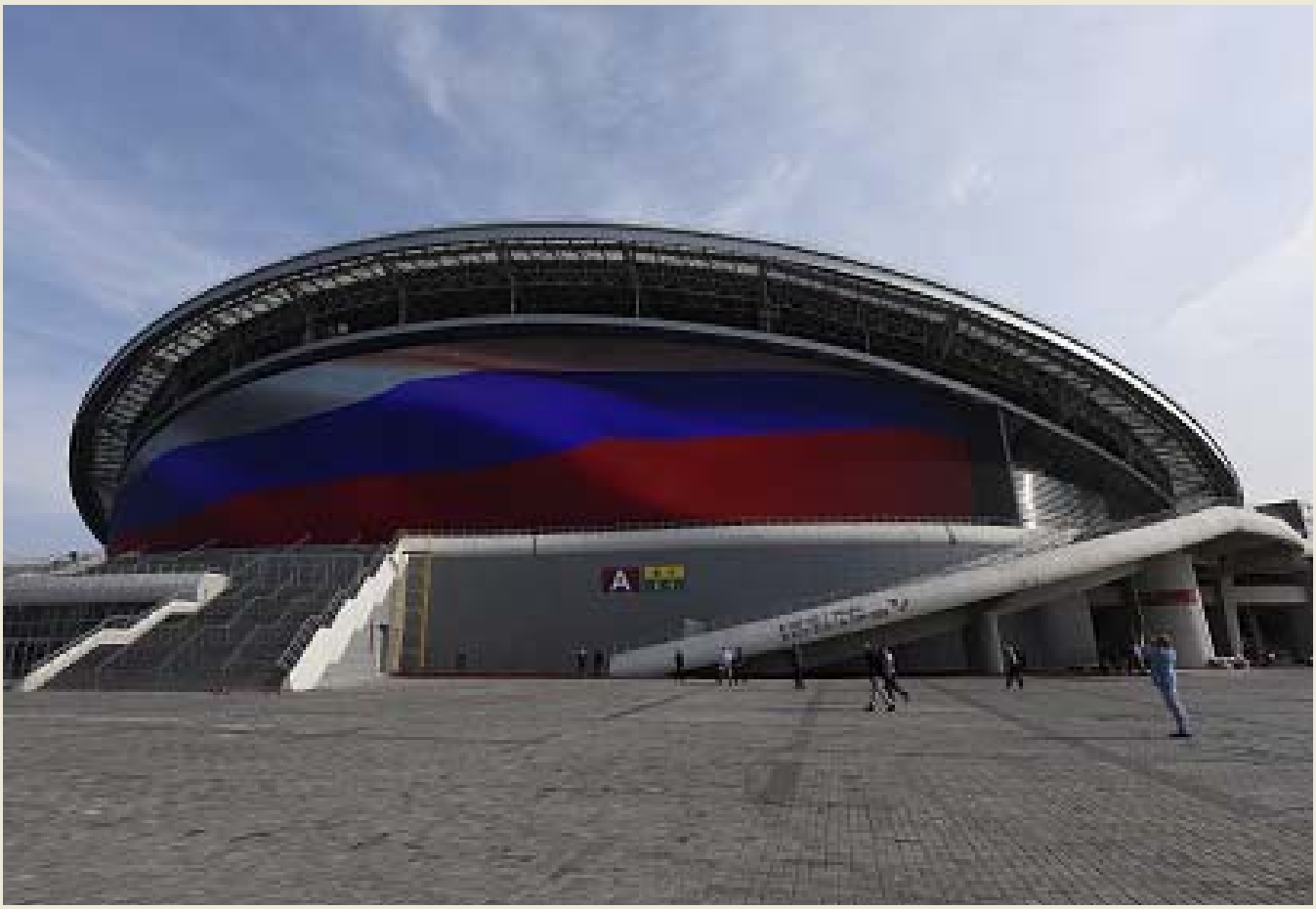
Passive daytime lighting of the arena is used to minimise the consumption of electric power to illuminate the main arena in daylight hours.

Passive natural ventilation using outdoor air from the arena bowl enables a substantial reduction in energy consumption for the ventilation of the interior space and spectator seats.

Water-efficient sanitary appliances with water dose control are provided throughout the stadium to save up to 60% of the water used for hygiene purposes in the large public spaces.

Transport accessibility is supported by a high-quality public transport system. There is a tram line within 600m of the stadium. Electric trams are an environmentally friendly mode of transport.

Kazan Arena, Kazan



The Kazan Arena was commissioned in 2013 for the World Student Games, and subsequently reconstructed for the World Cup and recommissioned in 2016.

The stadium's energy and resource efficiency is ensured by the use of energy-efficient utility systems, environmentally friendly materials and an effective system to control the consumption of energy for heating, ventilation, electric lighting, chilling, pumping and other energy-intense operations within the stadium.

Environmentally friendly materials are widely used at the stadium. These include:

- high-quality thermal insulation of walls
- water proofing
- energy-saving window systems
- translucent polymer roofing panels on the stands

The following technologies and solutions have been implemented at the stadium:

- **The recuperation of heat in ventilation systems** enables substantial savings through the reuse of waste heat to warm-up air for interior premises. This approach enables savings to be made of up to 30% of energy used for warm air production.
- **Multi-zone chilling units for cooling** room air in the summer help to save up to 70% of electric energy compared to other equipment with a similar function.
- **Heat distribution stations** enable the independent control of water heating for stadium facilities and thus save up to 25% of energy used to produce hot water.
- **Building management systems** control all utilities at the stadium to adjust capacities and resource distribution in line with actual demand, with a resultant reduction in the stadium's power consumption within a range of 20-70%, depending on the circumstances.

Kazan has very well developed accessible facilities for low mobility groups of people.

Passive daytime lighting of the arena is used to minimise the consumption of electric power to illuminate the main arena in daylight hours.

Passive natural ventilation using outdoor air from the arena bowl enables a substantial reduction in energy consumption for the ventilation of the interior space and spectator seats.

Water-efficient sanitary appliances with water dose control are provided throughout the stadium to save up to 60% of the water used for hygiene purposes in the large public spaces.

Transport accessibility is supported by a high-quality public transport system. There is a tram line within 600m of the stadium. Electric trams are an environmentally friendly mode of transport.

Kazan Arena, Kazan

Ventilation units

Kazan Arena, Kazan

Screen view of the stadium control and monitoring system

Samara Arena, Samara

Construction of Samara Arena is in progress. As at November 2016, massive works were under way for the installation of in-situ concrete and metal structures.

The stadium is designed to achieve high energy and resource efficiency standards through the use of energy-efficient utility systems, environmentally friendly materials and an effective system to control the consumption of energy for heating, ventilation, electric lighting, chilling, pumping and other energy-intense operations within the stadium.

Environmentally friendly materials are widely used at the stadium. These include:

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The following technologies and solutions have been implemented at the stadium:

- **The recuperation of heat in ventilation systems** designed to achieve substantial savings through the reuse of waste heat to warm up air for interior premises. This approach enables savings to be made of up to 30% of energy used for warm air production.
- **Adsorption chillers for cooling** room air in the summer will help to save up to 70% of electric energy compared to other equipment with a similar function.
- **LED-based lamps** in service and office rooms and corridors will achieve savings of up to 90% of electric energy for lighting compared to incandescent lamps.
- **Heat distribution stations** to enable the independent control of water heating for stadium facilities and thus save up to 25% of energy used to produce hot water.
- **Building management systems** control all utilities at the stadium to adjust capacities and resource distribution in line with actual demand, with a resultant reduction in the stadium's power consumption within a range of 20-70%, depending on the circumstances.

Implementation of the stadium development project will also improve transport situation in the city. New roads will be provided and existing roads reconstructed as part of the transport accessibility programme. A total of 13 new roads will be built in Samara for the World Cup. The tram transport system will also be upgraded and developed. Trams are an environmentally friendly mode of transport.

Passive daytime lighting of the arena will be used to minimise the consumption of electric power to illuminate the main arena in daylight hours.

Passive natural ventilation using outdoor air from the arena bowl enables a substantial reduction in energy consumption for the ventilation of the interior space and spectator seats.

Water-efficient sanitary appliances with water dose control will be provided throughout the stadium to save up to 60% of the water used for hygiene purposes in the large public spaces.

The well-managed construction site demonstrates good examples of practices encouraged by the environmental standards, including:
- tidy storage of equipment and building materials
- careful collection and timely removal of construction waste
- safe segregated storage of used luminescent lamps from the temporary site offices
- truck wheels are washed at the site exit
- dust suppression measures are taken during the summer

Transport accessibility will be supported by a high-quality public transport system. Access roads will be provided for municipal buses, which will transport spectators and visitors to the stadium.

Mordovia Arena, Saransk

Installation of internal thermal insulation for walls and LED-based lighting fixtures

Construction of Mordovia Arena is in progress. Installation of equipment and metal structures was started in November 2016.

The stadium is designed to achieve high energy and resource efficiency standards through the use of energy-efficient utility systems, environmentally friendly materials and an effective system to control the consumption of energy for heating, ventilation, electric lighting, chilling, pumping and other energy-intense operations within the stadium.

Environmentally friendly materials are widely used at the stadium. These include:

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- **LED-based lamps** in service and office rooms and corridors will achieve savings of up to 90% of electric energy for lighting compared to incandescent lamps.
- **Heat distribution stations** to enable the independent control of water heating for stadium facilities and thus save up to 25% of energy used to produce hot water.
- **Building management systems** control all utilities at the stadium to adjust capacities and resource distribution in line with actual demand, with a resultant reduction in the stadium's power consumption within a range of 20-70%, depending on the circumstances.

The stadium site is located in a unique development area.
A huge urban cluster will be developed in the vicinity of the stadium, including landscaping and new residential quarters.
The site allocated for the development of the stadium was a waterlogged depression in the periphery of Saransk. The area has been ameliorated with imported soil, the river diverted and its banks raised. A landscaped embankment with convenient public paths is being built along the river. A fully new residential area will be developed around the dominating feature – Mordovia Arena – by 2018.

Passive daytime lighting of the arena will be used to minimise the consumption of electric power to illuminate the main arena in daylight hours.

Passive natural ventilation using outdoor air from the arena bowl enables a substantial reduction in energy consumption for the ventilation of the interior space and spectator seats.

Water-efficient sanitary appliances with water dose control will be provided throughout the stadium to save up to 60% of the water used for hygiene purposes in the large public spaces.

The well-managed construction site demonstrates good examples of practices encouraged by the environmental standards, including:
- tidy storage of equipment and building materials
- careful collection and timely removal of construction waste
- safe segregated storage of used luminescent lamps from the temporary site offices
- truck wheels are washed at the site exit
- dust suppression measures are taken during the summer

Transport accessibility will be supported by a high-quality public transport system. Access roads will be provided for municipal buses, which will transport spectators and visitors to the stadium.

Nizhny Novgorod Stadium, Nizhny Novgorod

The construction of Nizhny Novgorod Stadium is in progress. As at November 2016, in-situ concreting works had been completed and the installation of metal structures started.

The stadium is designed to achieve high energy and resource efficiency standards through the use of energy-efficient utility systems, environmentally friendly materials and an effective system to control consumption of energy for heating, ventilation, electric lighting, chilling, pumping and other energy-intense operations within the stadium.

Environmentally friendly materials are widely used at the stadium. These include:

- high-quality thermal insulation of walls
- water proofing
- energy-saving window systems
- translucent polymer roofing panels on the stands

The following technologies and solutions have been implemented at the stadium:

- **Recuperation of heat in ventilation systems** designed to achieve substantial savings through the reuse of waste heat to warm up air for interior premises. This approach enables savings to be made of up to 30% of energy used for warm air production.
- **Adsorption chillers for cooling** room air in the summer will help to save up to 70% of electric energy compared to other equipment with a similar function.
- **LED-based lamps** in service and office rooms and corridors will achieve savings of up to 90% of electric energy for lighting compared to incandescent lamps.
- **Heat distribution stations** to enable the independent control of water heating for stadium facilities and thus save up to 25% of energy used to produce hot water.
- **Building management systems** control all utilities at the stadium to adjust capacities and resource distribution in line with actual demand, with a resultant reduction in the stadium's power consumption within a range of 20-70%, depending on the circumstances.

The stadium features a unique architectural design.
The architects designed the stadium shape to evoke the water and wind elements that characterise the Volga River. However, due to the limitations imposed by the close proximity to existing heritage sites, the sports facility has been designed with a restrained silhouette. The bowl will be screened by a semi-transparent wave-shaped facade consisting of trigonal pylons that form a circle. Tangential stairs will lead to a pedestrian gallery that will embrace the arena and impart a dynamic tone to the stadium building. In the evenings, the facade will be lit to make create an ethereal and artificial image.

Passive daytime lighting of the arena will be used to minimise the consumption of electric power to illuminate the main arena in daylight hours.

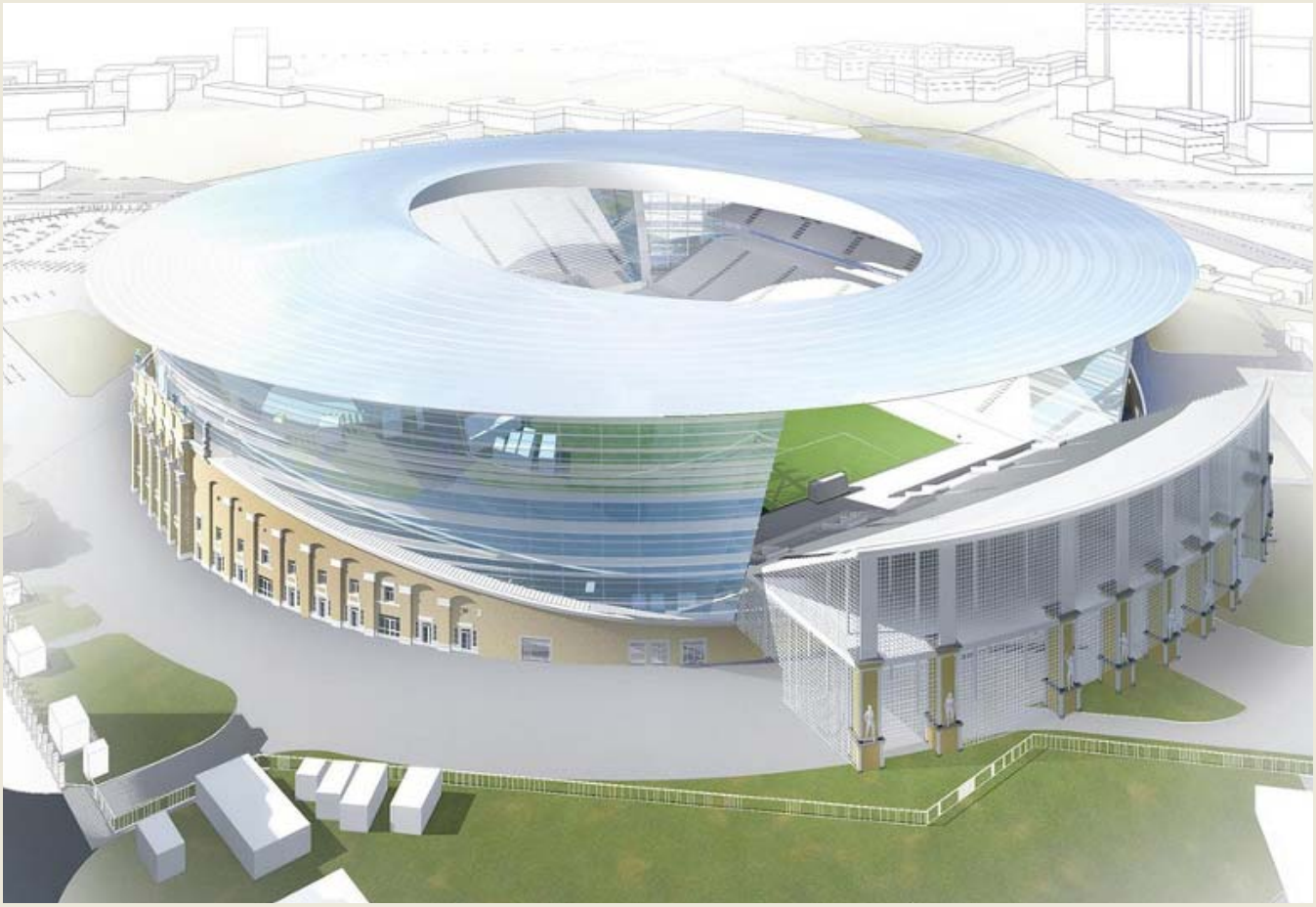
Passive natural ventilation using outdoor air from the arena bowl enables a substantial reduction in energy consumption for the ventilation of the interior space and spectator seats.

Water-efficient sanitary appliances with water dose control will be provided throughout the stadium to save up to 60% of the water used for hygiene purposes in the large public spaces.

The well managed construction site demonstrates good examples of practices encouraged by the environmental standards, including:
- tidy storage of equipment and building materials
- careful collection and timely removal of construction wastes
- safe segregated storage of used luminescent lamps from the temporary site offices
- truck wheels are washed at the site exit
- dust suppression measures are taken during the summer

Transport accessibility will be supported by a high-quality public transport system. Access roads will be provided for municipal buses, which will transport spectators and visitors to the stadium.

Ekaterinburg Arena, Ekaterinburg



In November 2016 the stadium is in the full stage of construction works. The stadium is designed to achieve high energy and resource efficiency standards through the use of energy-efficient utility systems, environmentally friendly materials and an effective system to control the consumption of energy for heating, ventilation, electric lighting, chilling, pumping and other energy-intense operations within the stadium.

Environmentally friendly materials are widely used at the stadium. These include:

- high-quality thermal insulation of walls
- water proofing
- energy-saving window systems
- translucent polymer roofing panels on the stands

The following technologies and solutions have been implemented at the stadium:

- **Recuperation of heat in ventilation systems** designed to achieve substantial savings through the reuse of waste heat to warm up air for interior premises. This approach enables savings to be made of up to 30% of energy used for warm air production.
- **Adsorption chillers for cooling** room air in summer will help to save up to 70% of electric energy compared to other equipment with a similar function.
- **LED-based lamps** in service and office rooms and corridors will achieve savings of up to 90% of electric energy for lighting compared to incandescent lamps.
- **Heat distribution stations** to enable the independent control of water heating for stadium facilities and thus save up to 25% of energy used to produce hot water.
- **Building management systems** control all utilities at the stadium to adjust capacities and resource distribution in line with actual demand, with a resultant reduction of the stadium's power consumption within a range of 20-70%, depending on the circumstances.

The stadium features a unique architectural design.
The new stadium will be built on the base of the old stadium, and envelope walls of the old stadium will be integrated into the new structures. This complex project represents an amazing combination of classical design with the new high-tech attributes associated with World Cup arenas.

Passive daytime lighting of the arena will be used to minimise the consumption of electric power to illuminate the main arena in daylight hours.

Passive natural ventilation using outdoor air from the arena bowl enables a substantial reduction in energy consumption for the ventilation of the interior space and spectator seats.

Water-efficient sanitary appliances with water dose control will be provided throughout the stadium to save up to 60% of the water used for hygiene purposes in the large public spaces.

The well-managed construction site demonstrates good examples of practices encouraged by the environmental standards, including:
- tidy storage of equipment and building materials
- careful collection and timely removal of construction waste
- safe segregated storage of used luminescent lamps from the temporary site offices
- truck wheels are washed at the site exit
- dust suppression measures are taken during the summer

Transport accessibility will be supported by a high-quality public transport system. Access roads will be provided for municipal buses, which will transport spectators and visitors to the stadium.

Volgograd Arena, Volgograd

Construction of Volgograd Arena is in progress. As at November 2016, in-situ concreting works had been completed and the installation of metal structures started.

The stadium is designed to achieve high energy and resource efficiency standards through the use of energy-efficient utility systems, environmentally friendly materials and an effective system to control the consumption of energy for heating, ventilation, electric lighting, chilling, pumping and other energy-intense operations within the stadium.

Environmentally friendly materials are widely used at the stadium. These include:

- high-quality thermal insulation of walls
- water proofing
- energy-saving window systems
- translucent polymer roofing panels on the stands

The following technologies and solutions have been implemented at the stadium:

- **Recuperation of heat in ventilation systems** designed to achieve substantial savings through the reuse of waste heat to warm up air for interior premises. This approach enables savings to be made of up to 30% of energy used for warm air production.
- **Adsorption chillers for cooling** room air in the summer will help to save up to 70% of electric energy compared to other equipment with a similar function.
- **LED-based lamps** in service and office rooms and corridors will achieve savings of up to 90% of electric energy for lighting compared to incandescent lamps.
- **Heat distribution stations** to enable the independent control of water heating for stadium facilities and thus save up to 25% of energy used to produce hot water.
- **Building management systems** control all utilities at the stadium to adjust capacities and resource distribution in line with actual demand, with a resultant reduction in the stadium's power consumption within a range of 20-70%, depending on the circumstances.

The stadium design features a unique symbolic element.
The sports complex is located close to the Mamayev Kurgan and the main monument commemorating victory in what is known in Russia as the Great Patriotic War (1941-1945) – "The Motherland Calls". The other side of the stadium faces the right bank of the Volga River. The facade of the arena will recall the salute in celebration of the victory. The stadium will be a unique cutting-edge arena, with a canopy and natural turf pitch with a heating system.
The canopy comprises a super-light plastic polymer fabric membrane that will protect the stadium against the wind and rain, as well as scorching sun in the summer.
A new beautiful **embankment with a promenade** will be built on the bank of the Volga River near the stadium. The **forest park** area near the stadium will be preserved and by the time of the World Cup it will be converted into a well-maintained municipal park.

Passive daytime lighting of the arena will be used to minimise the consumption of electric power to illuminate the main arena in daylight hours.

Passive natural ventilation using outdoor air from the arena bowl enables a substantial reduction in energy consumption for the ventilation of the interior space and spectator seats.

Water-efficient sanitary appliances with water dose control will be provided throughout the stadium to save up to 60% of the water used for hygiene purposes in the large public spaces.

The well-managed construction site demonstrates good examples of practices encouraged by the environmental standards, including:
– tidy storage of equipment and building materials
– careful collection and timely removal of construction waste
– safe segregated storage of used luminescent lamps from the temporary site offices
– truck wheels are washed at the site exit
– dust suppression measures are taken during the summer

Transport accessibility will be supported by a high-quality public transport system. Access roads will be provided for municipal buses, which will transport spectators and visitors to the stadium.

Rostov Arena, Rostov-on-Don

Construction of the Rostov Arena Stadium is in progress. As at November 2016, in-situ concreting works had been completed and the installation of metal structures started.

The stadium is designed to achieve high energy and resource efficiency standards through the use of energy-efficient utility systems, environmentally friendly materials and an effective system to control the consumption of energy for heating, ventilation, electric lighting, chilling, pumping and other energy-intense operations within the stadium.

Environmentally friendly materials are widely used at the stadium. These include:

- high-quality thermal insulation of walls
- water proofing
- energy-saving window systems
- translucent polymer roofing panels on the stands

The following technologies and solutions have been implemented at the stadium:

- **Recuperation of heat in ventilation systems** designed to achieve substantial savings through the reuse of waste heat to warm up air for interior premises. This approach enables savings to be made of up to 30% of energy used for warm air production.
- **Adsorption chillers for cooling** room air in the summer will help to save up to 70% of electric energy compared to other equipment with a similar function.
- **LED-based lamps** in service and office rooms and corridors will achieve savings of up to 90% of electric energy for lighting compared to incandescent lamps.
- **Heat distribution stations** to enable the independent control of water heating for stadium facilities and thus save up to 25% of energy used to produce hot water.
- **Building management systems** control all utilities at the stadium to adjust capacities and resource distribution in line with actual demand, with a resultant reduction in the stadium's power consumption within a range of 20-70%, depending on the circumstances.

Unique water-saving solutions will be implemented at the stadium.
Rainwater will be collected in tanks to provide a backup storage capacity of 6,000 cubic metres for the watering of the area surrounding the stadium during the summer.
T**he area around the stadium** will be developed with new urban quarters with adequate amenities to be fully implemented by 2020. This development will be further supported by the construction of new motorways, bridges over the Don River and road junctions that will provide convenient access by road.
The unique forested belt along the bank of the Don River will be preserved.

Passive daytime lighting of the arena will be used to minimise the consumption of electric power to illuminate the main arena in daylight hours.

Passive natural ventilation using outdoor air from the arena bowl enables a substantial reduction in energy consumption for the ventilation of the interior space and spectator seats.

Water-efficient sanitary appliances with water dose control will be provided throughout the stadium to save up to 60% of the water used for hygiene purposes in the large public spaces.

Storm water storage tanks will be provided as a backup source of technical water for watering the area surrounding the stadium during the summer.

The well-managed construction site demonstrates good examples of practices encouraged by the environmental standards, including:
- tidy storage of equipment and building materials
- careful collection and timely removal of construction waste
- safe segregated storage of used luminescent lamps from the temporary site offices
- truck wheels are washed at the site exit
- dust suppression measures are taken during the summer

Transport accessibility will be supported by a high-quality public transport system. Access roads will be provided for municipal buses, which will transport spectators and visitors to the stadium.

Fisht Stadium, Sochi

Innovative translucent membrane of ETFE material

Construction of Fisht Stadium in the city of Sochi was completed in November 2016 and preparations are under way for putting the arena into operation by March 2017.

The stadium's energy and resource efficiency is ensured by the use of energy-efficient utility systems, environmentally friendly materials and an effective system to control the consumption of energy for heating, ventilation, electric lighting, chilling, pumping and other energy-intense operations within the stadium.

Environmentally friendly materials are widely used at the stadium. These include:

- high-quality thermal insulation of walls
- water proofing
- energy-saving window systems
- translucent polymer roofing panels on the stands

The following technologies and solutions have been implemented at the stadium:

- **Recuperation of heat in ventilation systems** enables substantial savings through the reuse of waste heat to warm up air for interior premises. This approach enables savings to be made of up to 30% of energy used for warm air production.
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- **LED-based lamps** in service and office rooms and corridors achieve savings of up to 90% of electric energy for lighting compared to incandescent lamps.
- **Heat distribution stations** enable the independent control of water heating for stadium facilities and thus save up to 25% of energy used to produce hot water.
- **Building management systems** control all utilities at the stadium to adjust capacities and resource distribution in line with actual demand, with a resultant reduction of the stadium's power consumption within the range of 20-70%, depending on the circumstances.

The stadium features unique roofing canopies.
The canopies over the stands consist of two independent sections supported by boomerang-shaped arches with a span of some 280 metres, which are covered by a translucent membrane of ETFE film. This material is new to Russia and has an international eco-label of the highest grade.

Passive daytime lighting of the arena is used to minimise the consumption of electric power to illuminate the main arena in daylight hours.

Passive natural ventilation using outdoor air from the arena bowl enables a substantial reduction in energy consumption for the ventilation of the interior space and spectator seats.

Water-efficient sanitary appliances with water dose control are provided throughout the stadium to save up to 60% of the water used for hygiene purposes in the large public spaces.

The well-managed construction site demonstrates good examples of practices encouraged by the environmental standards, including:
- tidy storage of equipment and building materials
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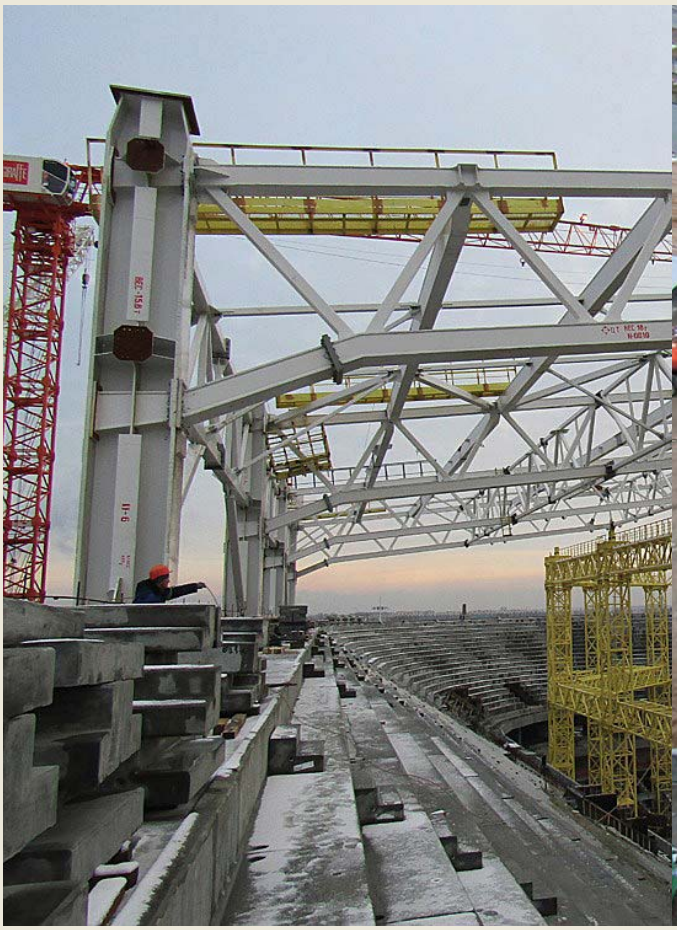
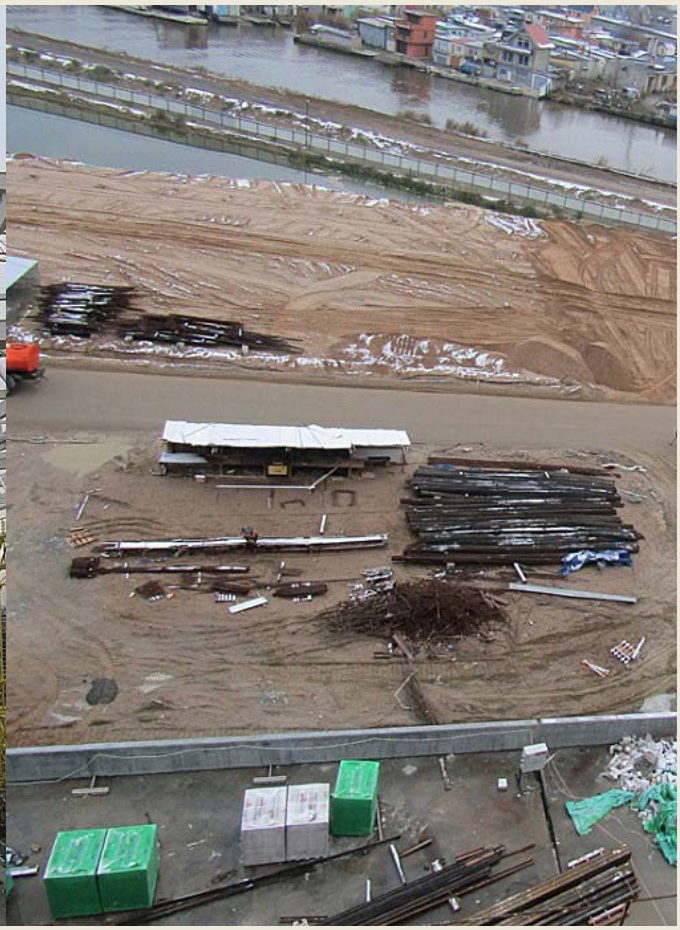
- truck wheels are washed at the site exit
- dust suppression measures are taken during the summer

Transport accessibility is supported by a high-quality public transport system. Bus stops for municipal transport are provided near the stadium. There is also a railway station within 600 metres of the arena.

Kaliningrad Stadium, Kaliningrad





Construction of Kaliningrad Stadium is in progress. As at November 2016, in-situ concreting works had been completed and the installation of metal structures started.

The stadium is designed to achieve high energy and resource efficiency standards through the use of energy-efficient utility systems, environmentally friendly materials and an effective system to control the consumption of energy for heating, ventilation, electric lighting, chilling, pumping and other energy-intense operations within the stadium.

Environmentally friendly materials are widely used at the stadium. These include:

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Transport accessibility will be supported by a high-quality public transport system. Access roads will be provided for municipal buses, which will transport spectators and visitors to the stadium.

5. Conclusions

The BREEAM green building standard is being implemented at the stadiums. Two completed stadiums will achieve BREEAM certification by March-April 2017.

Luzhniki Stadium in Moscow is expected to obtain a "Pass"-level BREEAM certificate.

Spartak Stadium in Moscow is expected to obtain a BREEAM-In-Use certificate with the "Good" rating.

The Russian standard "RUSO. THE FOOTBALL STADIUMS" has been adopted and its introduction commenced.

Saint Petersburg Stadium and Kazan Arena are preparing for final certification under the "RUSO. THE FOOTBALL STADIUMS" in April 2017.

All of the stadiums are designed to achieve high-energy and environmental performance standards and thus can aspire to certification under green building standards.

The stadiums' high-energy and resource efficiency is ensured through the use of energy-efficient utility systems, environmentally friendly materials and an effective system to control the consumption of energy for heating, ventilation, electric lighting, chilling, pumping and other energy-intense operations within the stadiums.

Conservation of biodiversity, well-managed construction sites, the use of environmentally friendly materials and the implementation of environmental management systems – all of these attributes are an integral part of the World Cup stadium projects.