# uSky Transport & Infrastructure Technology

# uSky **Philosophy**

**Transport is supposed to be a solution to a wide range of problems rather than a source of such**

**uSky Transport offers suspended transport technology for passenger and cargo mobility off the ground**

The fact that uSky vehicles move above the ground on a specially designed rail-string overpass ensures a number of advantages: optimized aerodynamics, increased speed, unprecedented safety, rational use of land and resources, and minimized environmental damage caused by transport. In addition, the cost of construction and operation is significantly lower compared to existing transport solutions.

# “uSky Technology: Optimal, Effective, and Safe

**Anatoli Unitsky**

Scientist and inventor, author of more than 200 scientific papers, 20 monographs, and over 150 inventions in the field of construction, transport, mechanical engineering, electronics, and chemical industry.

Creator of uSky and geocosmic transport systems, as well as a number of transport and infrastructure projects based on string technology.

Head of two UN projects (1998, 2002), member of the USSR Cosmonautics Federation.

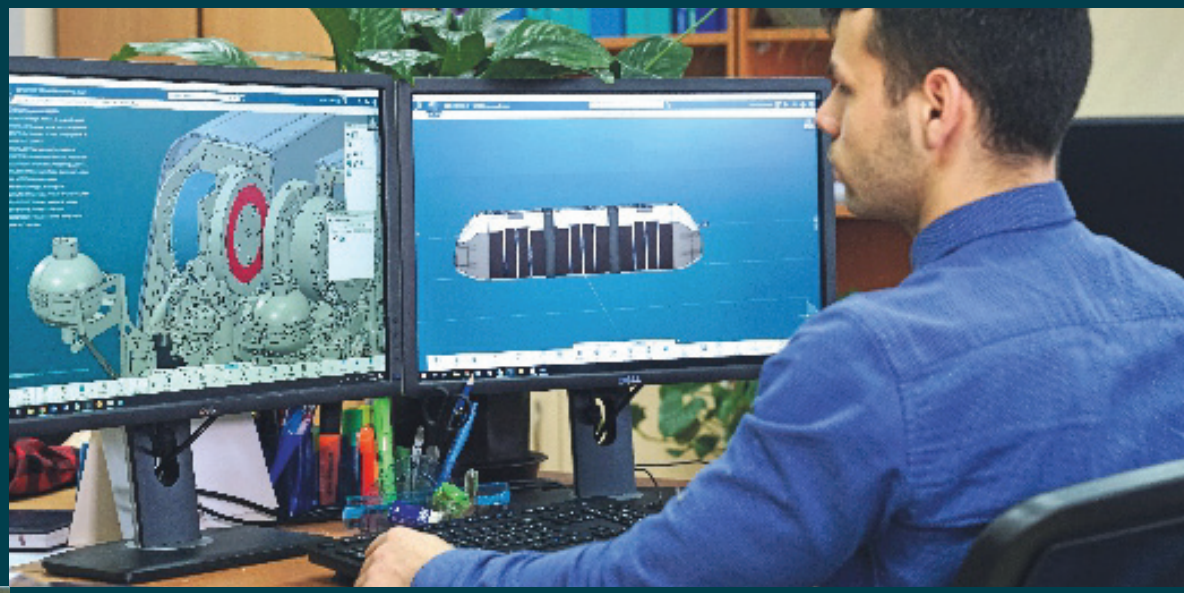
Founder of uST Group of Companies.
General Designer of Unitsky String Technologies Inc.

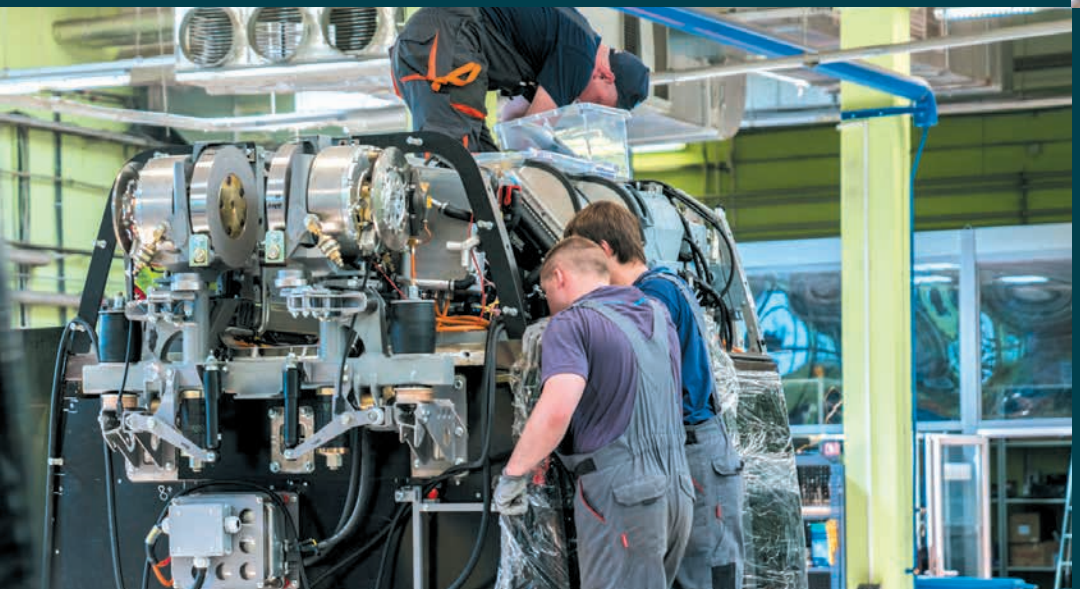
# uSky **Capabilities**

**Being a member of the group of companies with in-house firms covering the whole range of activities for implementation of uSky innovative technology, such as fully-equipped advanced engineering company, own manufacture facility with an extensive experience in production of transport vehicles, two certification and testing centers located in different climatic conditions and a separate unit responsible for certification and testing process, uSky is capable to implement a project of any complexity in accordance with client's wishes and the requirements of local conditions.**

## Engineering Company

Today, longstanding developments by engineer and inventor Anatoli Unitsky provide a holistic high-tech transport system comprising the automated rolling stock and unique string tracks, as well as the infrastructure facilities and "green" power supply systems.





## Manufacture Facility

Special design and technology bureau with pilot production premises conducts the entire cycle of uSky rolling stock production.

uSky carries out end-to-end and full-fledged workflow comprising the pricing and quoting, design, construction and commissioning of the Transport and Infrastructure Technology, including training of specialists and after-sales service

## Test & Certification

uSky Transport features two test and certification centres in the UAE and in Europe enabling numerous checks, inspections and tests, which all uSky technology solutions are subject to.

The Certificate of Conformity issued by TUV SW STANDARDIZATION CERTIFICATIONS proves the safety of innovative uSky transport infrastructure solutions which include uPod, Srting-Rail Track Structure, Anchor Supports, Intermediate Supports, Service Station, Passenger Station.

## Construction of Commercial Projects

uSky Transport possesses all resources required to implement commercial projects anywhere in the world. This enables implementation of projects from design stage up to construction.

# **Passenger** Transport

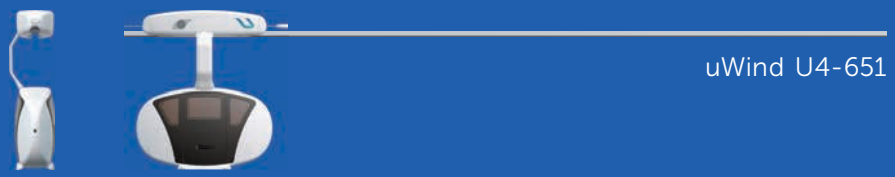
**uSky Transport is a unique infrastructure solution for cities and suburbs**

**The vehicles developed on the basis of the uSky technology are built using a principle of modular construction, that allows selecting the optimal rolling stock with minimal costs**

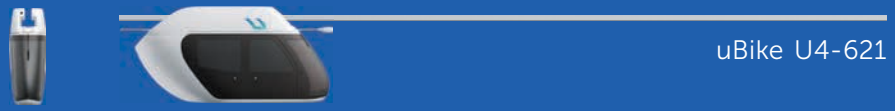
It is designed for city and intercity passenger transportation

It is harmoniously integrated into the existing infrastructure of any megacity

It is intended to solve traffic problems through the creation of the innovative elevated transport systems complemented with the high-rise buildings network



uWind U4-651



uBike U4-621

uCar U4-430

uCar U4-430-T3

uFlash U4-362

uBus U4-210

uBus U4-210-T2

uBus U4-210-T3

uBus U4-220

uBus U4-220-T2

uBus U4-220-T3

# uWind

## Monorail suspended light electric vehicle of small capacity

Due to its design providing maximum functionality, simplicity of use, low cost of production, and minimal power consumption, the uWind is one of the most affordable solutions for transportation links in sparsely populated and remote areas, as well as in regions of challenging terrain.

The optional design of the assemblies and components allows using this EV for passenger and cargo transportation.

| | | | |
|---|---|---|---|
| **Cruise speed** | | Up to 150 km/h | |
| **Maximum longitudinal slope of the track** | | Up to 15% (special version – up to 30%) | |
| **Single EV** | | **Couplings** | |
| Passenger capacity | 2 | Maximum number of uWinds in a coupling | 7 |
| Performance | Up to 720 pax/hour (roundtrip) | Performance | Up to 3,500 pax/hour (roundtrip) |
| Interval between the vehicles | 20 s | Interval between the couplings | 30 s |

# uBike

## Monorail suspended light passenger electric vehicle

It combines features of highly effective electric vehicle and sports  and entertaiment unit.

In addition to the on-board (and external) energy sources, it is equipped with a bicycle generator allowing uBike to be driven by the passengers' muscle power. In the future, it can be an alternative to a car, bike, and motorcycle.

| | | | |
|---|---|---|---|
| **Cruise speed** | | Up to 150 km/h | |
| **Maximum longitudinal slope of the track** | | Up to 15%<br>(special version – up to 30%) | |
| **Single EV** | | **Couplings** | |
| Passenger capacity | 2 | Maximum number of uBikes in a coupling | 7 |
| Performance | Up to 720–1,400 pax/hour (roundtrip) | Performance | Up to 3,500–6,300 pax/hour (roundtrip) |
| Interval between the vehicles | 20–25 s | Interval between the couplings | 30–40 s |

# uBus

## Passenger electric vehicle

It is designed for city and intercity transportation and has different versions (mounted or suspended, double-rail or quadrail). Its design and layout are determined by the specification and Customer's requirements.

uBus can be used as both single vehicle (like a car or a bus) and a train with different number and type of units.

It is equipped with the climate control system, audio and video information system for passengers, etc. The cabin has special seats for persons with disabilities.

| | | | |
|---|---|---|---|
| **Cruise speed** | | Up to 150 km/h | |
| **Maximum longitudinal slope of the track** | | Up to 15%<br>(special version – up to 30%) | |
| **Single EV** | | **Couplings** | |
| Passenger capacity | 10–80 | Maximum number of uBuses in a rigid coupling | 3–7 |
| Performance | Up to 2,500–12,000 pax/hour (roundtrip) | Performance | Up to 12,500–35,000 pax/hour (roundtrip) |
| Interval between the vehicles | 30–50 s | Interval between the couplings | 40–50 s |

# uCar

## Double-rail suspended passenger electric vehicle

It is a stylish and comfortable vehicle intended to unclog the city streets.

It allows for a higher traffic flow compared to common massive and expensive train and planes.

| | | | |
|---|---|---|---|
| **Cruise speed** | | Up to 150 km/h | |
| **Maximum longitudinal slope of the track** | | Up to 15%<br>(special version – up to 30%) | |
| **Single EV** | | **Couplings** | |
| Passenger capacity | 6 | Maximum number of uCars in a rigid coupling | 7 |
| Performance | Up to 1,500 pax/hour (roundtrip) | Performance | Up to 7,000 pax/hour (roundtrip) |
| Interval between the vehicles | 30 s | Interval between the couplings | 43 s |

# uCar

## Tropical version

uCar (tropical version), as a modification of the earlier built uCar, underwent a number of improvements necessary for its operation in hot climate and upon increased humidity while providing the comfortable conditions for the passengers.

- Max. operating temperature: 50–60 °C.
- Temperature in the cabin: 20–23 °C.
- Duplication of all systems: independent drive of the vehicle axes, two cooling units, two climate control units, two energy accumulators, two types of charging (manual and automatic).
- More powerful electric motors.
- Updated braking system.
- Hydraulic suspension.
- Entrance/exit doors located on both sides of the cabin.
- Improved computer vision system.
- Vip-cabine equipped with four seats (two VIP-armchairs, two pull-down seats for the personnel), folding table, 32" screen, refrigerator, cup holders, more powerful acoustical system.
- Improved door operating gear.
- Insulated glazed units.

# uFlash

## Suspended passenger electric vehicle on steel wheels

## It is designed for intercity passenger and cargo transportation for the distances of up to 10,000 km

High-speed movement is provided by specially designed string-rail overpass, streamlined shape of the vehicle, and excellent aerodynamic properties.
The aerodynamic characteristics of uBus U4-362 are close to the theoretical limit: drag coefficient $C_x$ is equal to 0.06 (for reference: $C_x$ of Porche 997 is 0.28).

The vehicle is equipped with luggage compartments.

| | | | |
|---|---|---|---|
| **Cruise speed** | | Up to 500 km/h | |
| **Maximum longitudinal slope of the track** | | Up to 15% | |
| **Single EV** | | **Couplings** | |
| Passenger capacity | 6–46 | Maximum number of uFlashes in an electronic coupling | 18 high-speed uFlashes with a capacity of 46 passengers |
| | | Performance | Up to 50,000 pax/hour (roundtrip) |
| | | Interval between the couplings | Up to 120 s |

# **Cargo** Transport

### Transport system designed for cargo transportation for the distances of 500 km and more

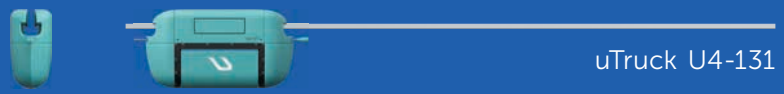
uSky cargo complexes provide wide opportunities for the Customers and are able to operate all year round under the various climatic conditions in remote and hard-to-reach areas, including high altitude, desert terrain, jungles, and continental shelves.

### Application of uSky cargo system:

- **transportation of loose cargo** (ore, coal, construction materials, overburden rock, etc.);
- **transportation of break-bulk cargo** (containers, woods, metal, etc.);
- **transportation of liquid cargo** (crude oil and refined products, liquefied natural gas, natural drinking water, etc.);
- **transportation of special cargo** (cryogenic fluid, radioactive materials, explosives, weapons, etc.).

uTrans U4-100

uCont U4-192-01



uTruck U4-131

uTruck U4-171

# uTruck

## Double-rail/quadrail suspended cargo vehicle

The model is distinguished by its audacious design solutions,outstanding visual novelty, and high functionality.

It is designed on the base of suspended urban passenger uBus and includes traction and cargo modules. Such a modular design allows using uTruck in almost all spheres of cargo transportation.

It is intended for transportation of bulk, liquid, hazardous, perishable, and break-bulk cargo. Loading and unloading of uTruck is carried out automatically.

The intelligent control system ensures the movement along the rail with minimal acceptable safe time interval while providing a high performance of the complex.

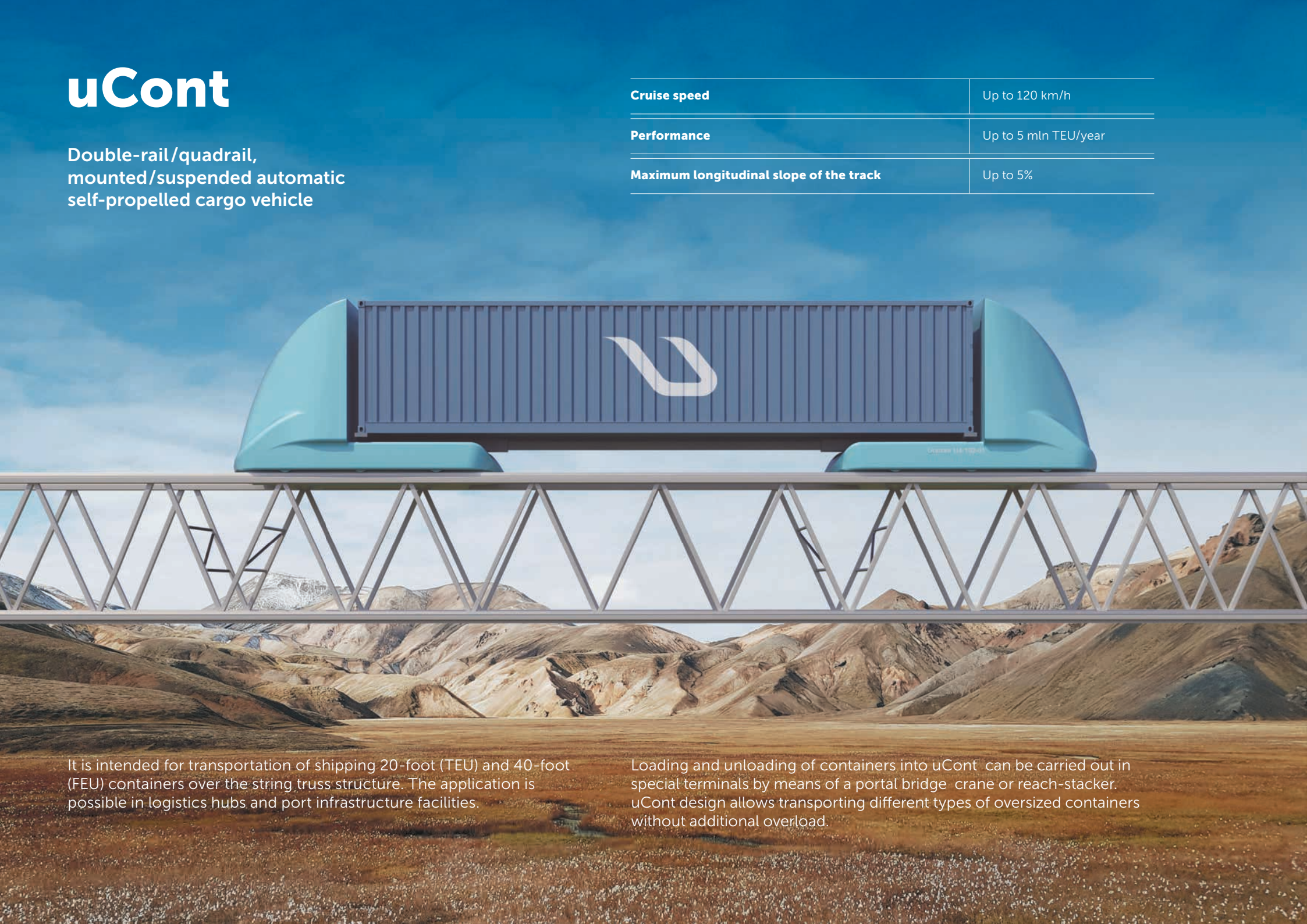
If required, uTruck can be combined with uTrans in order to expand its application.

| | |
|---|---|
| **Cruise speed** | Up to 150 km/h |
| **Performance** | Up to 100 mln tons/year |
| **Maximum longitudinal slope of the track** | Up to 15% (special version – up to 30%) |

# uCont

**Double-rail/quadrail, mounted/suspended automatic self-propelled cargo vehicle**

| | |
|---|---|
| **Cruise speed** | Up to 120 km/h |
| **Performance** | Up to 5 mln TEU/year |
| **Maximum longitudinal slope of the track** | Up to 5% |



It is intended for transportation of shipping 20-foot (TEU) and 40-foot (FEU) containers over the string truss structure. The application is possible in logistics hubs and port infrastructure facilities.

Loading and unloading of containers into uCont can be carried out in special terminals by means of a portal bridge crane or reach-stacker. uCont design allows transporting different types of oversized containers without additional overload.

# uTrans

## Continuous cargo conveyor-type system

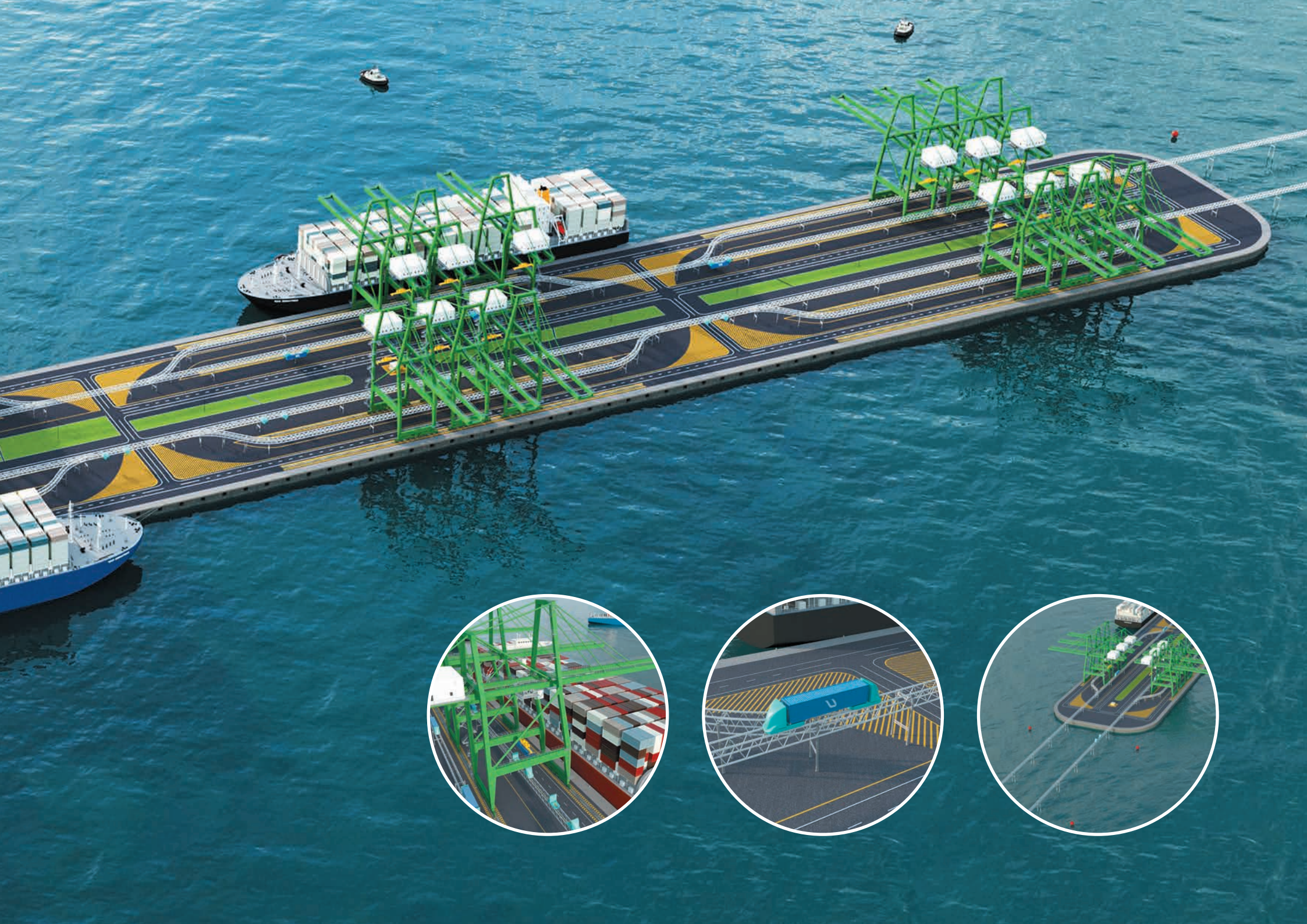
It is an optimal solution for the mining sites, loading-offloading terminals, and seaport terminals. It allows carrying out fast and affordable transportation of the significant volumes of bulk materials. The loading to the belt conveyor of uTrans is carried out from a special terminal, unloading – by tilting of the belt in vertical plane. It can operate twenty-four-hour all year round.

| | |
|---|---|
| **Cruise speed** | Up to 36 km/h |
| **Performance** | Up to 100 mln tons/year |
| **Maximum longitudinal slope of the track** | Up to 30%<br>(special version – up to 45%) |

# Sea Port

**Main advantages of using the uSky cargo transport system in the sea port:**

- Delivery of loose, liquid, and break-bulk cargo for the distances of 5–10 km and more offshore;
- Mooring of large vessels does not require the creation of quay walls, dredging, or shore reinforcement;
- It is possible to deliver goods to a sea port located at a depth of up to 25 m;
- The port infrastructure and uSky transport system together form a single logistics complex for cargo delivery;
- The transportation implies cargo delivery from a mining enterprise to a bulk carrier's hold without intermediate stocking.



# **Linear City:**
# In Unity with Nature

**uSky tracks contribute to the development of linear cities – cluster-type urban settlements harmoniously integrated into the environment**

uSky linear cities can be built in the mountains, in desert, and flooded territories, including areas with challenging terrain and on the sea shelf.

The construction of linear cities will not require cutting down forests, building motor roads and railways, or disturbing biogeocenosis within the construction area.

# Main
# Technological Elements

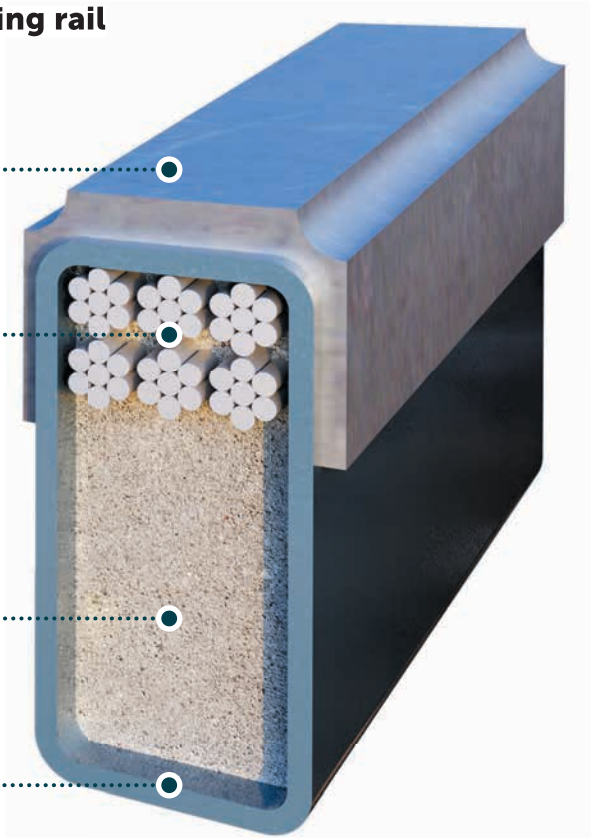
## The basis of uSky technology – an innovative string rail

String rail or rail-string is a conventional continuous (along the length) steel, reinforced concrete or steel-reinforced concrete beam or truss equipped with a rail head and additionally strenghened with pre-stressed (stretched) strings.

The string rail combines the characteristics of the flexible cable (at a long distance between anchored supports) and rigid beam (at a small beam span – under a wheel of rail and above the support).

A flat head of the rail and cylinder steel wheel ensure minimal energy consumption during the movement.

**Version of semi-rigid string rail**




Rolling resistance power of a wheel of uBus with weight of 5,000 kg at a speed of 450 km/h:

$P_{rr} = m \times g \times C_{rr} \times v = 5{,}000\ \text{kg} \times 9.81\ \text{m/s}^2 \times 0.0015 \times 125\ \text{m/s} \approx 9.2\ \text{kW}.$

For reference:
in the case of using pneumatic machine with $C_{rr} = 0.18$ (for $v = 450$ km/h)

$P_{rr} \approx 1{,}100\ \text{kW}.$

# Types of uSky rails

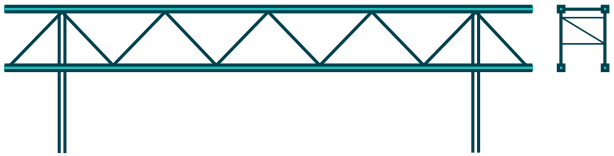
## and corresponding designs of track structure

### Rigid rail (truss)

Rigid continuous track structure

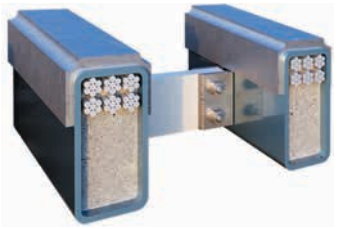
Top chord (variant)

Bottom chord (variant)

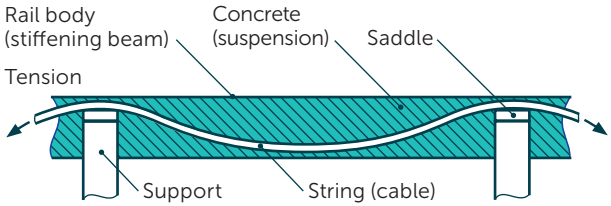


### Semi-rigid rail

Semi-rigid continuous track structure



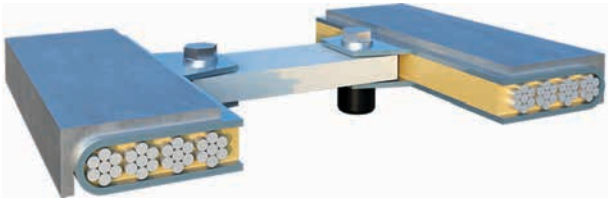
Track structure design follows the design of a suspension bridge, combining all its main elements.

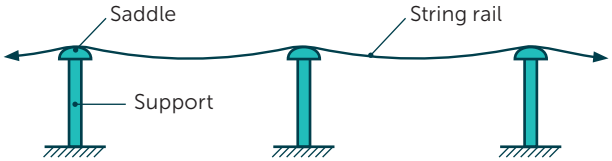



**Suspension bridge**


### Flexible rail

Flexible continuous track structure (variant)






**It is not an analogue to the cableway:**

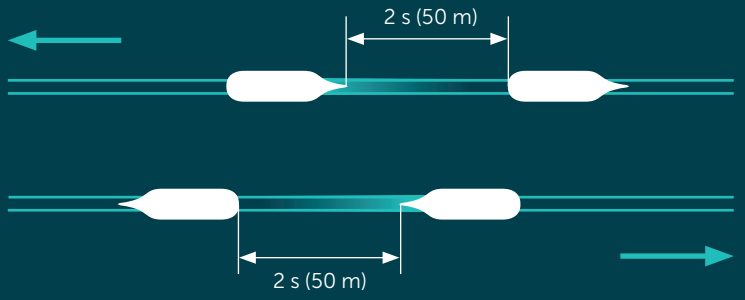
- Use of rail (lower rolling resistance);
- Lower energy consumption during the movement (by 3–5 times);
- Applicability of a gravity engine during the movement downward and gravity brake during the movement upward (reduction of energy consumption by another 3–5 times);
- Durability (5–7 times longer lifetime).

**Motion speed:**
from 100 to 600 km/h.
**Relative structural rigidity:**
1/1,000–1/10,000.
**Track structure curve radius:**
*r* = 5,000–50,000 m.

**Motion speed:**
from 50 to 250 km/h.
**Relative structural rigidity:**
1/500–1/2,000.
**Track structure curve radius:**
*r* = 500–5,000 m.

**Motion speed:**
from 30–60 (on support) to 120–150 km/h.
**Relative structural rigidity:**
1/100–1/500.
**Track structure curve radius:**
*r* = 100 (on support)–2,000 m.

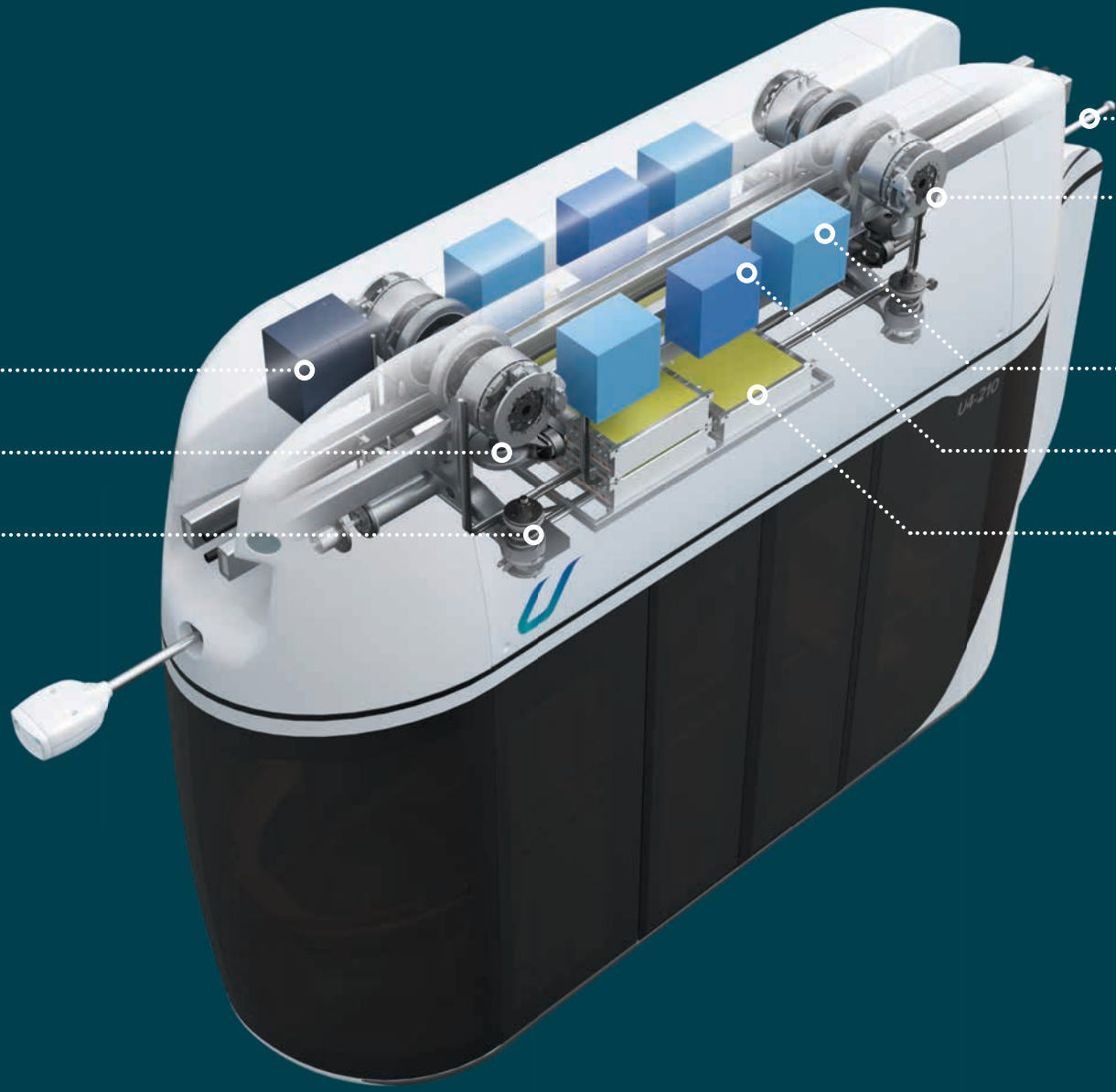
# **Transportation Capacity** of the Innovative uSky Transport System




A safe time interval between uSky Transport vehicles is 2 s (or 50 m), practically - 35 s (more than 500 m). Minimal safe interval between the transport vehicles of 2 s (50 m) is recommended by the American Automated People Movers (APM) Standards Committee.

Maximum volume of passenger traffic will be 30,000 pax/hour (round trip) for the trains consisting of seven 25-seat uBuses.

# Chassis
## Layout



Emergency drawbar

In-wheel motor

Voltage converter

Motor inverter

Anti-derailment system

Cooling system radiator

Suspension springs

Accumulator battery

# **Intelligent Control System** of uSky Transport Complex

**Intelligent control systems (ICS) of uSky transport complex are a well-balanced combination of the known and proved effective technologies and advanced moderm methods related to neural networks, digital intelligence, big data, and blockchain**

The ICS covers all the aspects of the uSky transport complex operation. It collects data from all the uSky components and allow making the effective management desicions automatically without operator.

Implementation of the ICS will increase the efficiency of traffic control, reduce non-productive costs connected with cargo and passenger transportation, and accelerate development information technologies on the Earth.

### Intelligent control systems

- Traffic control system (higher level of control, adaptive system of route tasks)
- Interactive system for communication with a user
- Positioning system
- Machine vision (cameras,radars, sensors)
- OICS (onboard Intelligent control system)

### Onboard intelligent control system

- Onboard automated systems intended to manage the vehicle equipment and connect with the higher level control system (OICS)
- Traffic control system (automatic)
- Functional equipment control system (hydraulics and internal automated systems)
- Positioning system (inertial)
- Energy supply systems

### Safety and communication systems

- Internal vehicle network
- Inter-vehicle communication (V2V, C2C)
- Data exchange and communication with external objects of the complex (V2X, C2X)

# **Safety** of Transport System

**The technogenic character of the conventional transport causes environmental disorder:**

- open and ground water movements, natural habitat and migration ways of birds and animals are violated;
- many hectares of land are taken out from the beneficial use;
- noise, vibration, and electro-magnetic emission, air and hydrosphere contamination increase the disease incidence rate within the population;
- railway crashes and incidents on oil pipelines are accompanied by emission of chemical products in big volumes into the environment.

According to statistics, the crashes and accidents annually cause death of about 1.5 mln people, while even a greater number becomes disabled.

The construction and operation of expensive and material intensive conventional transport infrastructure require significant amounts of financial and natural resources.

## uSky is the safest transport system

The measures preventing uSky transport system from the accidents are described in details in operation manuals, as well as technical and project documentation. The design of rail-string overpass is conducted on the basis of the main principles of the structure reliability in accordance with ISO 2394 General principles  on reliability for structures, IDT.

- High resistance to vandalism and terrorist attacks.
- Location of the track structure above the ground enhances traffic safety by approx. 100 times.
- Positioning of uSky Transport & Infrastructure Technology above the ground with no crossroads eliminats the possibility of traffic accidents with ground transport, pedestrians, domestic and wild animals. The minimal distance between the vehicle bottom and ground surface is 4.5 m, as for the non-accessible roofs and tops of the buildings – 2.5 m, and automobile roads – 6.5 m.
- Anti-derailment system increases traffic safety by another 10 times.

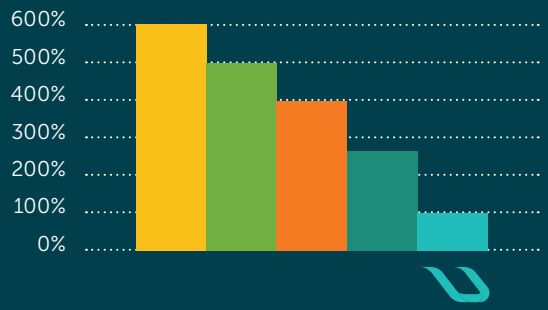
# uSky Compared
to existing analogues

Russian Academy of Sciences

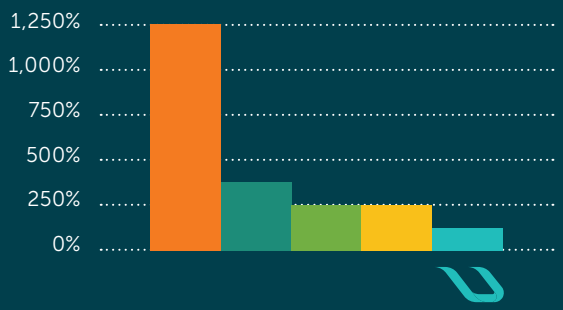
**As estimated by the Russian Academy of Sciences, the innovative uSky transport technology is the most cost-efficient, sustainable, and safe compared to all known and prospective transportation systems.**

- uSky Transport
- Railway transport
- Monorail
- Automobile transport
- Maglev

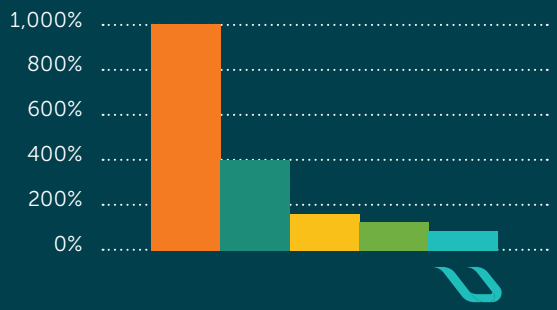
**Operating costs**




**Environmental pollution**




**Traffic accident rate**



uSky
Transport

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