Build Your Dreams

# BYD Rail Transit Solutions

## Elevate Your Commute, Elevate Your Life »


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Build Your Dreams

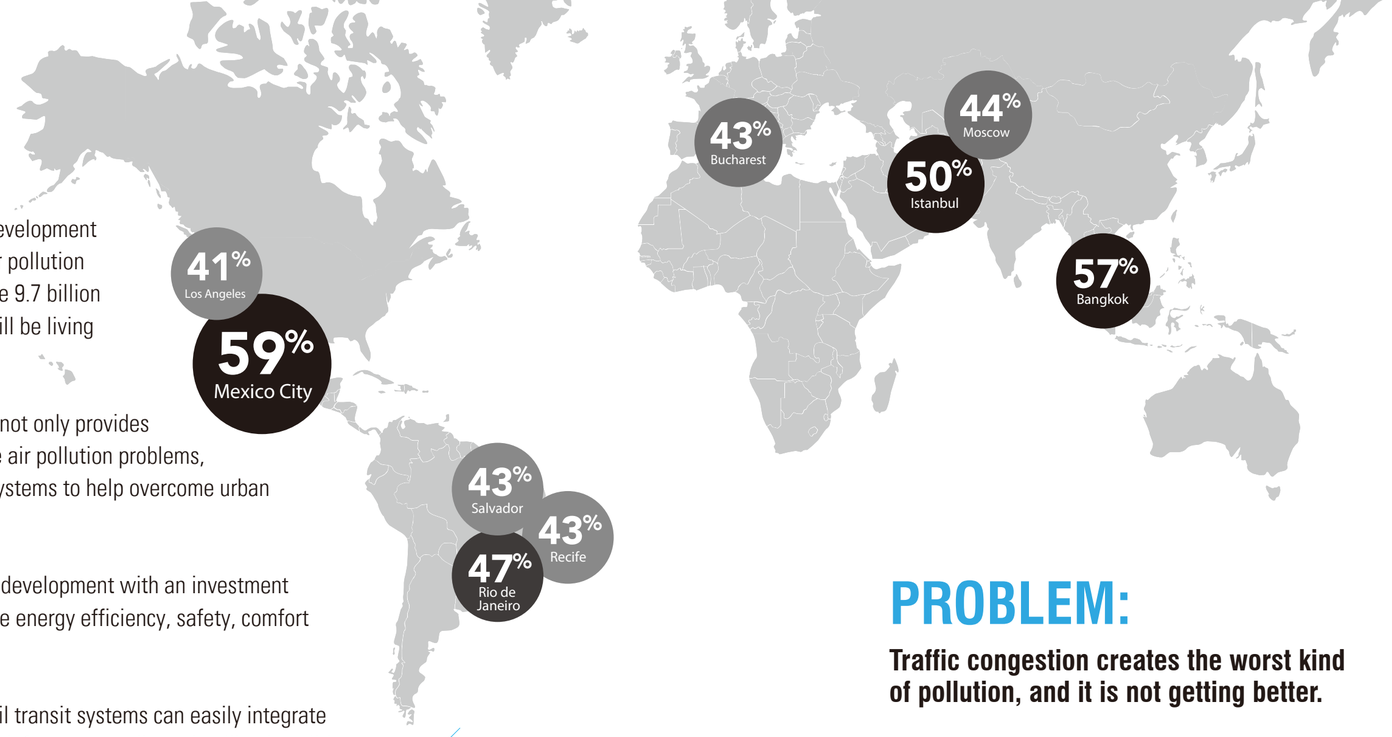
Along with economic prosperity, urban development also brings undesirable by-products, like air pollution and traffic congestion. By 2050 there will be 9.7 billion people in the world, of whom 70 percent will be living in cities. ①

As a pioneer in new energy solutions, BYD not only provides effective electrified transportation to tackle air pollution problems, it has also developed efficient rail transit systems to help overcome urban congestion and transit challenges.

The systems are the result of 7 years' R&D development with an investment of over 1.5 billion USD, designed to optimize energy efficiency, safety, comfort and intelligence.

Compared with typical rail projects, BYD rail transit systems can easily integrate into existing cityscapes without significant infrastructure disruption like demolition and construction costs.

① United Nations Population Division, World Population Prospects (2015 Ed.): https://esa.un.org/unpd/wpp/Publications/.




**Extra Travel Time Caused by Congestion**
Source: TomTom Traffic Index 2016
Most Congested Cities
Congestion Level (Extra Travel Time)

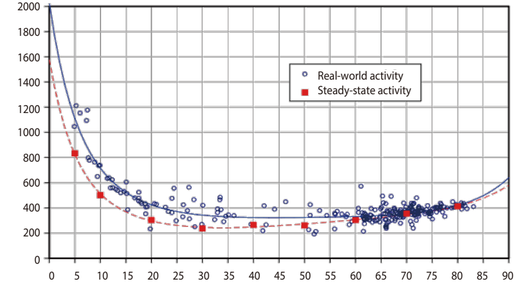
# PROBLEM:

## Traffic congestion creates the worst kind of pollution, and it is not getting better.

Historical data indicates that traffic congestion is up by 13% globally since 2008. Today, drivers in Mexico City for example spend 59% more time in traffic during the day, and up to 103% more time during peak periods. This means up to 219 wasted hours each year.

## High Energy Consumption & Pollution Emissions

Stop-and-go traffic produces significantly higher tailpipe emissions.




$CO_2$ emissions (grams/mile) as a function of average trip speed (mph)

## Substantial Financial Loss

Traffic congestion cost Americans $124 billion in direct and indirect losses in 2013, this number will rise to $186 billion in 2030." — FORBES (2014).

| Country | Secter | 2013 | 2020 | 2025 | 2030 | 2013-30% change |
|---|---|---|---|---|---|---|
| UK | Direct costs (value of fuel & time wasted) | 12,649 | 15,865 | 18,264 | 20,937 | 66 |
| | Indirect costs (increased cost of doing business) | 7,883 | 9,565 | 10,928 | 12,473 | 58 |
| | **Total** | **20,532** | **25,430** | **29,191** | **33,410** | **63** |
| France | Direct cost (value of fuel & time wasted) | 12,881 | 14,780 | 15,984 | 17,158 | 33 |
| | Indirect costs (increased cost of doing business) | 9,630 | 10,668 | 11,517 | 12,430 | 29 |
| | **Total** | **22,510** | **25,448** | **27,501** | **29,589** | **31** |
| Germany | Direct cost (value of fuel & time wasted) | 21,684 | 24,224 | 25,929 | 27,702 | 28 |
| | Indirect costs (increased cost of doing business) | 11,796 | 13,116 | 14,517 | 16,137 | 37 |
| | **Total** | **33,480** | **37,341** | **40,446** | **43,838** | **31** |
| USA | Direct cost (value of fuel & time wasted) | 78,519 | 97,099 | 109,550 | 120,695 | 54 |
| | Indirect costs (increased cost of doing business) | 45,639 | 54,157 | 60,151 | 65,526 | 44 |
| | **Total** | **124,158** | **151,257** | **169,701** | **186,221** | **50** |

Source: The Future Economic and Environmental Costs of Gridlock in 2030 Report for INRIX


Bangkok， Thailand


Sao Paulo， Brazil
Zona Leste
Centro


Mumbai， India

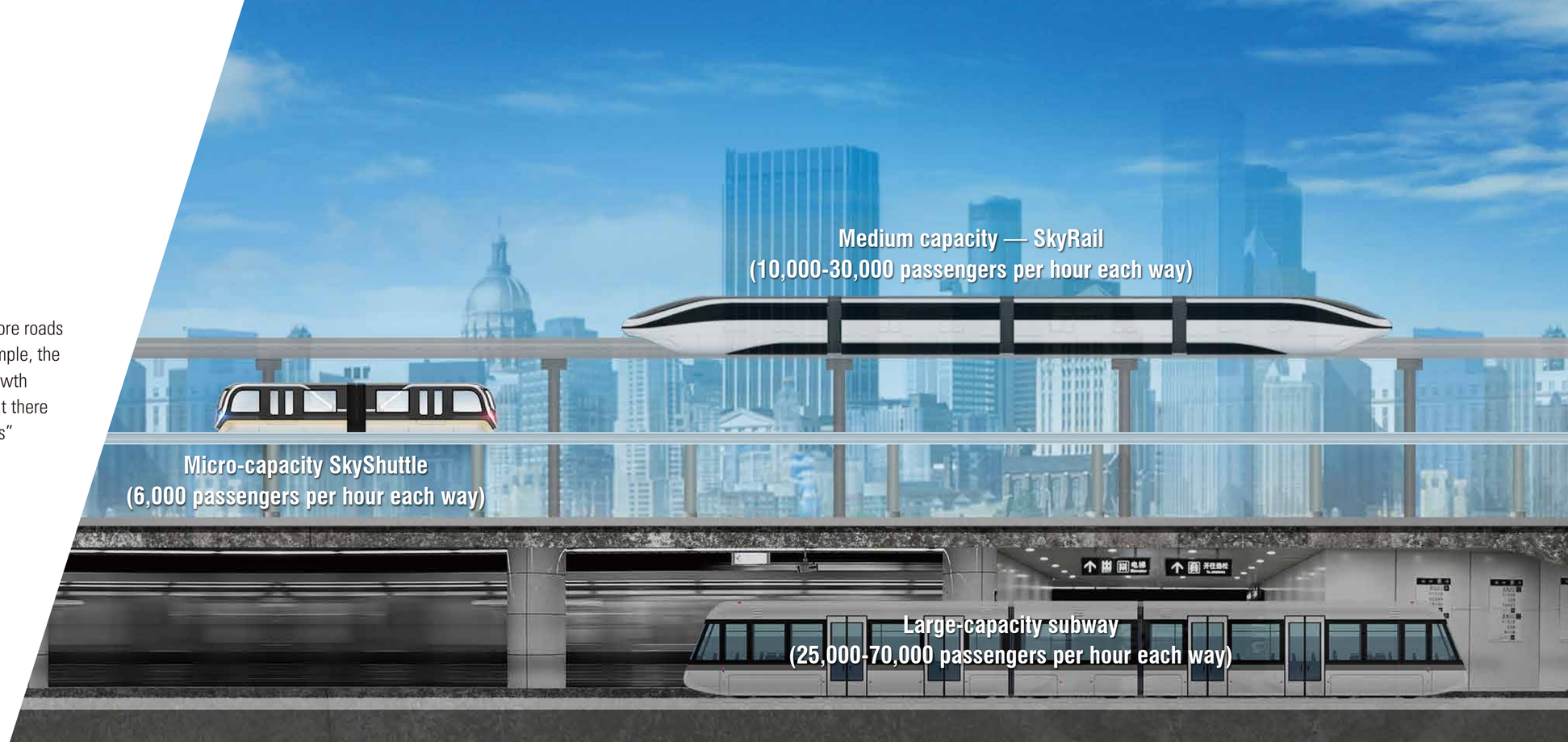

Cairo， Egypt


China

# BYD MULTI-LEVEL TRANSPORTATION SOLUTIONS

Cities have long been building more and more roads, but the more roads are built, the more traffic congestion there is. In China, for example, the growth rate of road space is only 2% per year, whereas the growth rate in the number of vehicles is 15%. Thus, it is imperative that there is a shift to a “city-on-rails” model instead of a “city-on-wheels” model if we are to find an effective solution for the traffic congestion conundrum.

As a complement to large cities’ subway systems, BYD rail transit solutions can effectively ease ground level traffic and provide a valuable addition to current transport networks with large, medium and micro-capacity transit modes. Entire urban transportation networks will be revitalized and run smoothly and efficiently.



# BYD RAIL TRANSIT HIGHLIGHTS

—— A Solution to Urban Congestion

# BYD MEDIUM CAPACITY RAILTRANSIT SYSTEM ——SKYRAIL

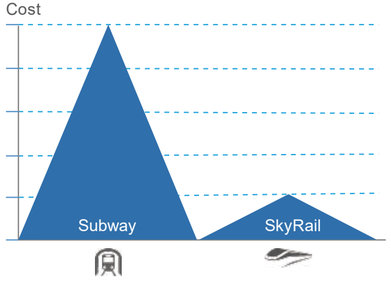
SkyRail is a medium capacity monorail system running on an elevated single track system that supports, stabilizes and guides the trains.

Equipped with high-efficiency backup power and the highest level of automated driving system, BYD SkyRail optimizes energy efficiency, safety, comfort and cost-effectiveness. Its sleek, modern design enhances the urban landscape.

# BYD SKYRAIL HIGHLIGHTS

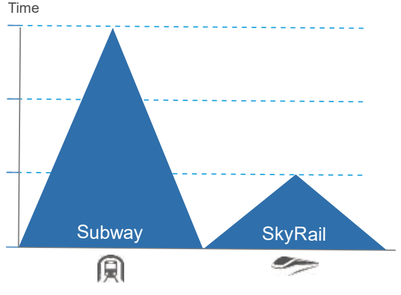
## Low Construction Cost

To build SkyRail is only one fifth the cost of a subway system, making it more profitable for operators with less tunneling, demolition and construction. For countries or cities who have concerns about the financial burden and high costs of building, operating and maintaining a subway system, SkyRail is an ideal choice.




## Short Construction Period

The prefabricated track beams of the SkyRail result in a construction schedule as short as 2 years, only one third of the time to build a subway.




## Easy City Integration

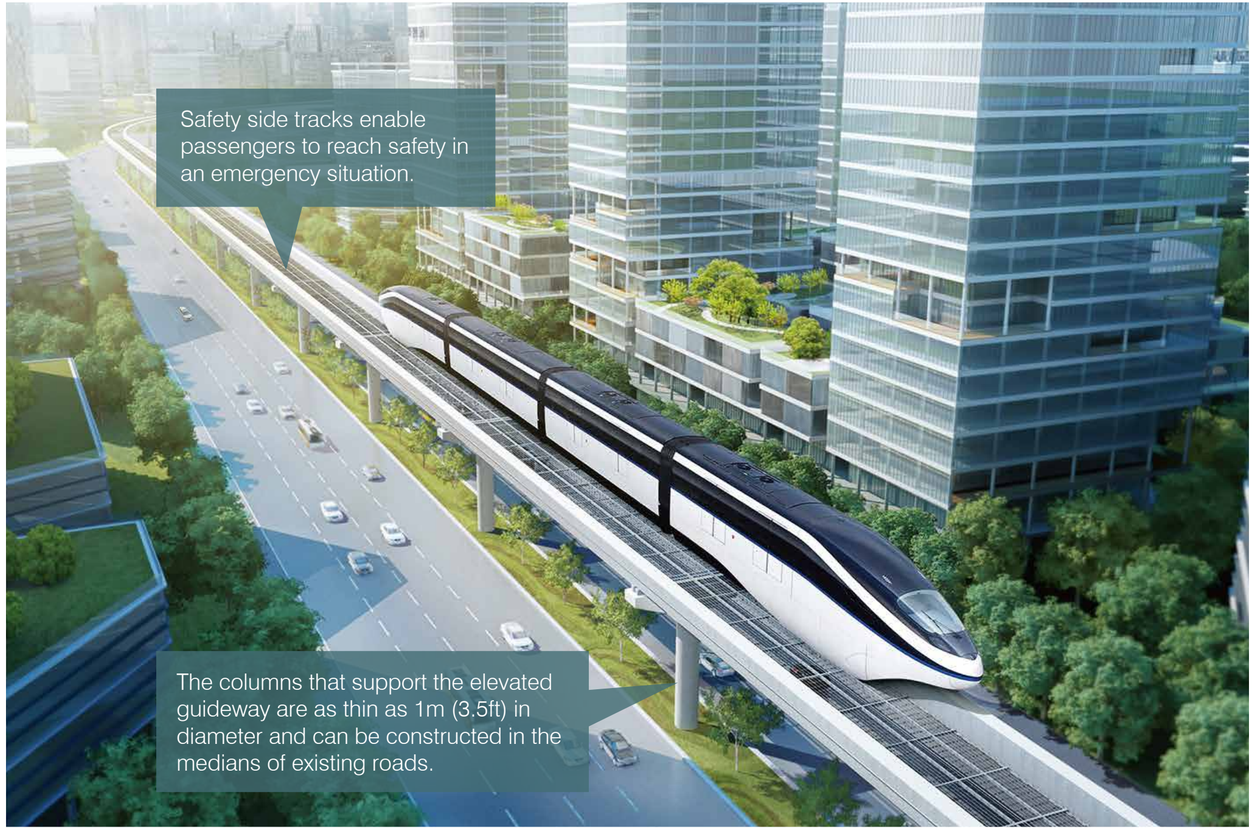
With over three times the gradeability compared to conventional rail systems and a significantly tighter turning radius, SkyRail seamlessly integrates into the existing cityscape. This avoids unnecessary demolition and reduces the complexity and cost of construction.


## A Solution to Urban Congestion

The SkyRail's narrow track beams and support pillars minimize land use, allowing the SkyRail to be installed in congested areas and alongside existing highways.

## Safe Mode of Transit

- BYD proprietary technologies in electric motors, electronic controls, and batteries ensure the highest level of reliability. State-of-the-art power backup in each carriage keeps the monorail running, providing over 3 km (1.86 miles) of off-grid range in the event of a power outage.
- Flame-resistant materials are used to reduce the risk of onboard fires.
- SkyRail's larger train-to-rail-beam overlap ensures a higher level of stability. The independent elevated rail design eliminates opportunities for traffic collisions compared to Light Rail Vehicles and Trams operating on the same roads as passenger cars.
- Safety side tracks enable passengers to reach safety in an emergency situation.



## High Capacity Flexibility

- Multiple carriages can be connected to provide flexibility to adjust to a variety of transportation capacity needs.
- SkyRail has an adjustable passenger capacity with the ability to move 10,000-30,000 passengers per hour each way.

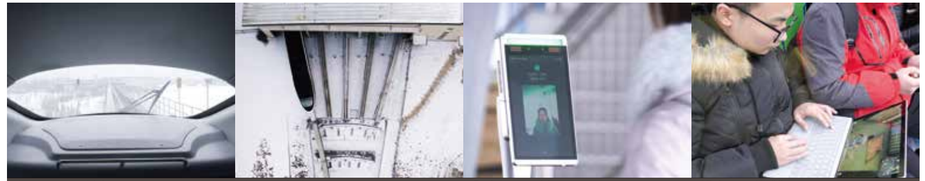
# OTHER BENEFITS

## Superior Energy Efficiency

- Regenerative braking further powers the BYD Iron-Phosphate batteries with around 30% improved efficiency.
- The high-torsion, all-aluminum body greatly reduces energy consumption and tyre wear.
- The BYD permanent magnet electric motor shaft drives the wheels directly, greatly increasing efficiency.

## Automated Driving Technology with 4.5G Super Broadband eLTE Technology

BYD SkyRail features the highest level automated driving system and 4.5G eLTE technology (optional) to offer remote control and seamless connectivity. It features multiple smart functions including automatic departure, autonomous wakeup, facial recognition turnstiles, automated tracking of passenger flow, and free high speed wi-fi service.



Autonomous driving | Automatic departure | Facial recognition | High speed Wifi

# BYD SKYRAIL PROJECTS

- Shenzhen BYD Headquarters:
4.4 km/2.7 mile track, 7 stations
- Strategic cooperation agreements with
China's biggest real estate developers - Vanke &
Country Garden
- Contracted with over 20 cities worldwide
including Shenzhen, Yinchuan, Guilin and Jining, China;
Iloilo, Philippines;  Alexandria, Egypt;
Casablanca, Morocco; and Phnom Penh, Cambodia;

# FLOWER EXPO PARK IN YINCHUAN

Built for the China Flower Expo Park, Yinchuan Line in northwest China is the first BYD commercial SkyRail line – 5.67 km (3.52 miles) long with 7 trains running through 8 stations.

Construction Time: 130 days completed on August 31, 2017.
Official Launch Date: September 1, 2017
Design Load Capacity: 5,000 passengers/hour/train

# Diversified Applications

- An effective complement to large cities' subway networks.
- The primary mode of public transit for small and medium-sized cities.
- Connections between suburban neighborhoods or main commuting lines linking large cities with surrounding townships.
- Exhibitions, conventions and scenic sightseeing routes.

## Specifications

| | Model | |
|---|---|---|
| Items | Mc (end car) | M (mid car) |
| Rated Voltage (V) | 750 | 750 |
| Car Length | 12 m (39.3 ft) | 12 m (39.3 ft) |
| Car Width | 3.15 m (10.3 ft) | 3.15 m (10.3 ft) |
| Width of Rail Beam | 0.7 m (2.3 ft) | 0.7 m (2.3 ft) |
| Wheelbase (centreline to centreline) | 9.12 m (30 ft) | 9.12 m (30 ft) |
| Seats per Carriage (passenger) | 16 | 18 |
| Full Load Capacity (passenger) (AW3)① | 190 | 204 |
| Curb Weight | 14,000 kg (30,865 lbs) | 14,000 kg (30,865 lbs) |
| Full Load | 30,000 kg (66,139 lbs) | 30,000 kg (66,139 lbs) |
| Design Top Speed | 85 km/h (53 mph) | 85 km/h (53 mph) |
| Operational Top Speed | 80 km/h (50 mph) | 80 km/h (50 mph) |
| Max. Gradeability | 10 % | 10 % |
| Min. Turning Radius | 45 m (148 ft) | 45 m (148 ft) |

Note: ① AW3: Stand Passengers 9 / ㎡ + All Seats

② All information based on the latest data at the time of printing. Final specs subject to change at production.

# BYD MEDIUM AND MICRO CAPACITY RAIL TRANSIT SYSTEM ——SKYSHUTTLE

Just like the human blood circulation system, cities not only need large and medium capacity transportation, but also effective micro-capacity transport to ensure unobstructed circulation within the whole transit network.

Incorporating design concepts from Italian, French, German and Chinese experts, the BYD SkyShuttle is a pure electric, rubber wheel tram running on an elevated track equipped with the highest level of automated driving system and optional 4.5G eLTE broadband technology.

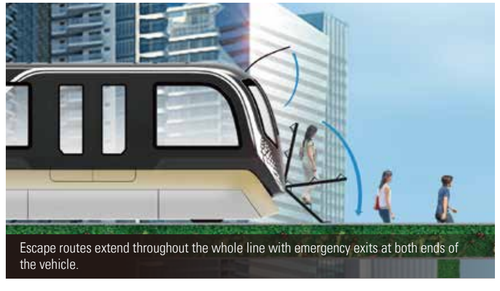
The SkyShuttle is an effective complement to large cities' subway and SkyRail networks, serving also as a primary mode of public transit for small & medium-sized cities.

# SAFE MODE OF TRANSIT

## Design

Excellent stability with tram wheels firmly locked onto the rail and capable of withstanding hurricanes up to category 12

The vehicle's interior is built with flame-resistant, composite materials, resulting in optimized acoustic and heat insulation.



Escape routes extend throughout the whole line with emergency exits at both ends of the vehicle.

The eLTE super broadband technology constantly monitors operations and provides immediate emergency assistance.

## Driving Control

**Four safety levels, guaranteeing the highest safety and integrity categories (SIL4)**


**SIL4: 10-9 ≤ THR ≤ 10-8, 0.001PPM~0.01PPM**

**SIL4: based on EN50128, EN50129**
**THR: Tolerable Hazard Rate**
**PPM: Parts per Million**

# COMPREHENSIVE INTELLIGENT SYSTEMS

## Fully Autonomous

Automatic monitoring, wakeup and stand-by modes, automatic track controls, screen door controls, video monitoring and communication systems, ensuring highly efficient operation.

## Facial Recognition

Facial recognition system at turnstiles, improving and simplifying the process of security checking; passenger behavior background analysis and big data backup storage further ensure system and public safety.

## Fast Departure

With the highest level of automated driving system, the SkyShuttle can depart within 1 minute intervals.

## Automatic Positioning

The automatic positioning system ensures driving safety and shortened departure intervals.

## High Speed Wi-fi Service

The carriage is equipped with high speed wireless broadband, serving rapid and stable wireless networks.

## Density of Passenger Flow

An intelligent monitoring system automatically adjusts departure frequency according to passenger flow, preventing energy waste and prioritizing passenger experience.

## Broadband + Real Time Communication

The control center carries out real-time communication with passengers via on-board video, and staff can also communicate by video with handheld devices.


# EASY CONSTRUCTION WITH SIMPLIFIED DESIGN

With full command of track drive, tram control, switch, track beam and other core technologies across the industry chain, BYD is able to build the whole SkyShuttle system on its own, including vehicles, tracks, stations and communication systems.

## SkyShuttle Systems

Pre-fabrication and assembly construction of stations, track beams, and pillars greatly reduce construction time. Complete systems can be open to public in under a year.

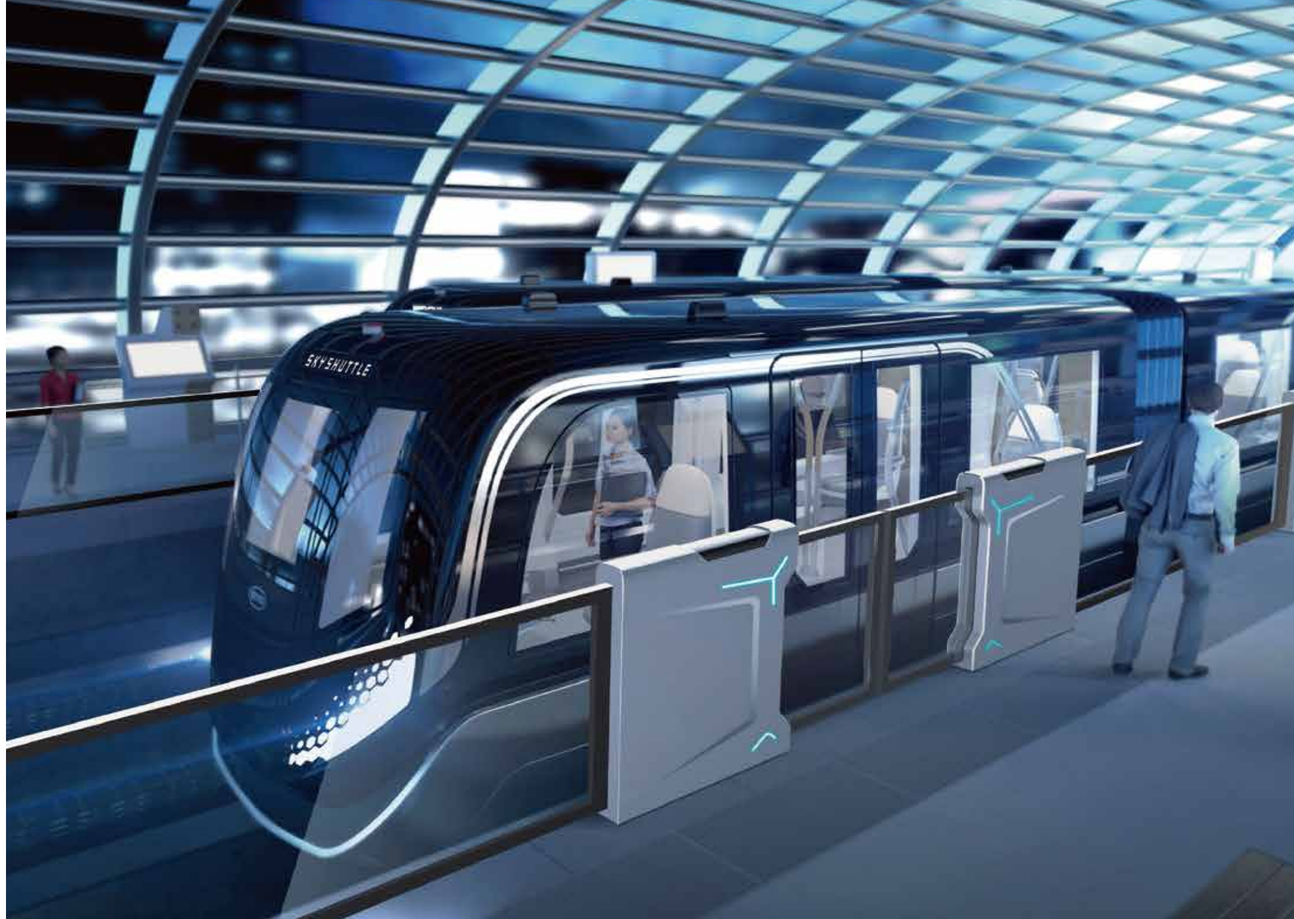
# Bus Station

- Stations are built following a simple, convenient and intelligent design concept.
- Suitable for any climate, the stations are well ventilated, quiet, with heat insulation and hurricane protection.
- Given their clean design, they require smaller engineering scale and lower land occupation.
- In order to be combined into a multi-layered transportation system, stations are seamlessly connected and integrated with the urban architecture.

# Comparative Performance

| INDEX | MODERN TRAMS | BRT RAPID BUS | SKYSHUTTLE |
|---|---|---|---|
| Construction cost (100 million RMB/kilometer) | 1.2 - 1.8 | 0.6 - 1.2 | <1 |
| Construction timelines (year) | 1.5 - 2.5 | 2 | <1 |
| Single Capacity (10,000 passengers/hour) | 0.6 - 1 | 0.2 - 1.2 | about 0.6 |
| Average speed | 15 - 25 km/h ( 9 - 15 mph ) | 20 - 35 km/h ( 12 - 22 mph ) | 30 - 40 km/h ( 19 - 25 mph ) |
| Maximum gradeability | 6% | 12% | 12% |
| Minimum turning radius | 25 m ( 15 mile ) | 20 m ( 12 mile ) | 15 m ( 9 mile ) |
| Road occupancy | Running on ground, competes for road space | Running on ground, competes for road space | Running on viaducts on green belts, no road space occupancy |
| Layout mode | Mainly on ground | Mainly on ground | Mainly on elevated rails |
| Driving mode | Manned | Manned | Autonomous |
| Power supply system | Network power supply/Power storage supply | / | Power storage supply |
| Safety | Low | Higher | Highest |
| Traffic congestion | Increases congestion | Increases congestion | Reduces congestion |

Source: Standard for Classification of Urban Public Transportation CJJ/T 114-2007
Rail Transit Blue Book – China Rail Transit Industry Development Report (2017)



# EASY URBAN INTEGRATION

The SkyShuttle's unique design has reduced its turning radius to a minimum of 15 meters, enabling the tram to merge easily into communities.

Maximum gradeability reaches 12%, thus easily adapting to complex topographies.


- The track beams can be built to cross through buildings so that the compact SkyShuttle provides effective door-to-door, last mile transportation solutions.
- The vehicle's rubber tires make for a silent run, without disturbance to the surroundings.

# SUBSTANTIAL ECONOMIC BENEFITS

## Construction

Rails can be built on green belts, away from road areas. Construction periods are shortened and demolition work becomes unnecessary, significantly reducing construction costs.

## Operation

Labor costs are considerably reduced with technologies like automatic departure, autonomous wakeup, facial recognition turnstiles, automated passenger flow monitoring, and intelligent video supervision and maintenance.

## Travel Cost

SkyShuttle not only cuts transit time but also contributes to reducing household car ownership and alleviating parking problems.

## Environment

SkyShuttle diminishes the use and dependence on fossil fuels, as well as greenhouse gases and particulate emissions.

# ATTRACTIVE ADDITION TO CITY LANDSCAPE

Its holistic design by French, German and Chinese Experts with simple and smooth lines make for a stylish appearance and high-tech feel, providing panoramic views of the city.

Pioneering technologies conceal the sliding door system and air conditioner under the vehicle's floor, providing more unobstructed interior space.

## Diversified Applications

An effective complement to large-cities' subway, airport, highway or SkyRail networks

The primary mode of public transit for small and medium-sized cities

Exhibitions, conventions and scenic spots sightseeing routes

# BYD AT A GLANCE

- Over 220,000 employees and over 30 industrial parks worldwide
- Four core businesses: Electronics, new energy, automobile, and rail transit
- 2017 group revenue: over 16.7 billion USD
- Over 20 years' experience in battery R&D and manufacturing resulting in one of the world's largest power battery output capacity
- A pioneer in achieving a Zero-Emission Ecosystem: affordable solar power, reliable energy storage & electrified transportation
- Listed at #15 on the Forbes list of Companies Changing the World
- World's largest EV manufacturer in 2015, 2016 and 2017
- Global leader in solar and energy storage manufacturing

**over 30** industrial parks worldwide

**220,000** employees

2017 group revenue
**$16.7 billion**

## A PIONEER IN PROVIDING A NEW ENERGY ECOSYSTEM FROM POWER GENERATION TO STORAGE TO USAGE

### Battery Storage

Battery storage captures generated solar power and makes it available 24 hours/day, rain or shine.
Covering over 50% of the U.S. energy storage market for frequency regulation in 2015.

### Solar

BYD solar projects in almost 30 countries on 6 continents.

### Electrified Transportation

Largest passenger EV market share worldwide.
The first and only company in the world to provide 7+4 Full Market EV solutions.

# BUILD YOUR DREAMS