



METRO TUNNELLING

Underground Solutions Provider

CREG TBM

Make Tunnelling Safer,
Better and Faster

China:

China Railway Engineering Equipment Group Co., Ltd.
E-mail: info_intl@crectbm.com
Tel: +86 0371 6581 5987
Address: No.99, 6th Avenue National Economic & Technical Development Zone 450016 Zhengzhou, Henan Province People's Republic of China

Southeast Asia:

China Railway Engineering Equipment Group Co., Ltd.
Singapore Branch
E-mail: info_singapore@crectbm.com
Tel: +65 6747 8091
Address: 1004 Toa Payoh North, #06-15/16/17, Singapore 318995

Korea:

CREG Co., Ltd. South Korea Branch
E-mail: info_korea@crectbm.com
Tel: +82 010-2156-8662
Address: No.1521, Building B, Terra-tower, 651, Songpa-gu, Seoul, Republic of Korea

Europe & South & North Americans:

CREG TBM Germany GmbH
E-mail: info@creg-germany.com
Tel: +49 211 52288900
Address: CREG TBM Germany GmbH Willstätterstraße 15 40549 Düsseldorf Germany

Italy:

China Railway Engineering Equipment Group Co.Ltd Italy Branch
Email: creg.italy@legalmail.it
Address: Viale Giuseppe Mazzini 55, 00195 Roma

Oceania:

CREGA Australia Office
Email: info@crega.com.au
Tel: +612 9698 0018
Address: Unit 1, 118 Bourke Road Alexandria NSW 2015 Australia

Underground Solutions Provider

With the growth of urban populations and the acceleration of the urbanization process, the pressure on ground transportation is increasing, and the quality of the urban environment is gradually declining. As an efficient mode of public transportation, metro can transport a large number of passengers quickly and punctually, improve the transportation efficiency of urban traffic and relieve urban traffic congestion. Meanwhile, it can significantly reduce exhaust emissions, help improve the air quality of the city, and enhance the city's modernization level and international image.

As an equipment manufacturer that deeply understands construction and a comprehensive service provider that is highly proficient in manufacturing, China Railway Engineering Equipment Group Co., Ltd. adheres to a customer-centered concept and is committed to providing customers with all-round comprehensive solutions. With the help of tunnel boring machines of different diameters, it can make tunnel construction under diverse geological conditions safer, better and faster.

- 08** Melbourne's Suburban Rail Loop Project
- 10** Lot 2 of Grand Paris Express Line 16, France
- 12** Cross Island Line CR105 in Singapore
- 14** Shenzhen Metro Line 12 in southern China
- 16** Guangzhou Metro Line 3 Cross Passage in southern China

Cover photo:
Rail transit is an efficient way of public transportation and helps to relieve urban traffic congestion.

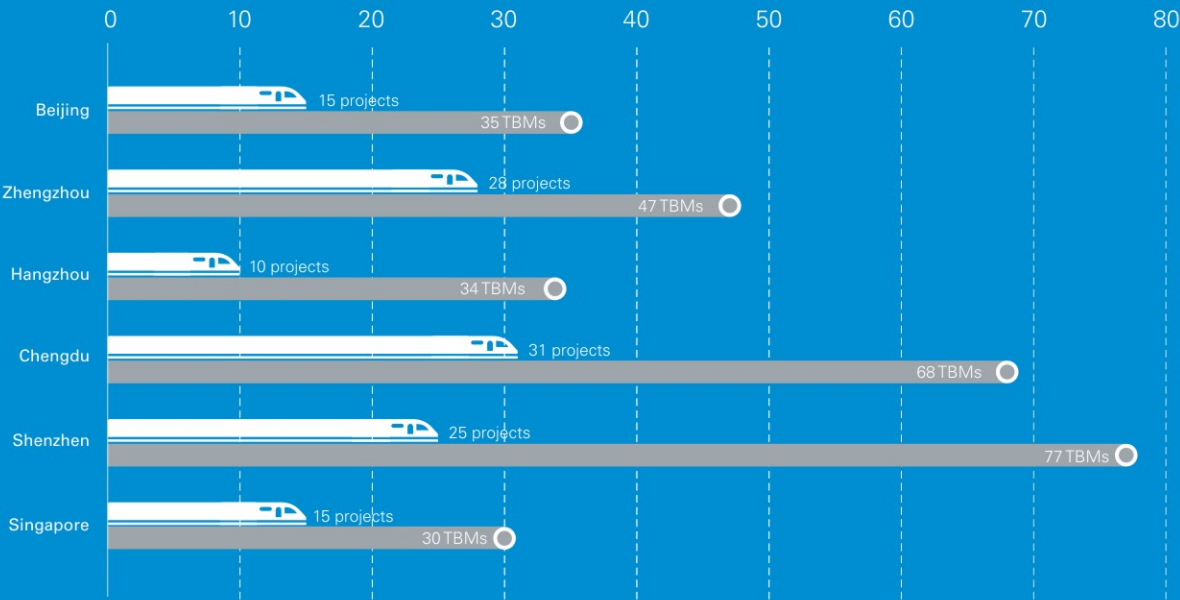
Metro tunnel in segmental lining for Incheon Metro

Over
764

CREG TBMs of various types with diameter ranging from 3.07 to 12.66 meters have involved in construction of

more than
331

metro projects at home and abroad.



Metro tunnel construction

Leading technology and expertise worldwide guarantee the safety and efficiency of tunnel construction

Various CREG TBMs facilitate the construction of metro tunnels for urban transportation. In these projects, more than 3,000 kilometers of metro tunnel around the world have been constructed using the innovative tunnel boring technology of CREG. Based on solid professional knowledge and rich experience, CREG works closely with customers to develop tailor-made technical solutions to overcome all challenges and build robust tunnel structures while maximizing the safety of personnel and the urban environment as well as controlling budgets and schedules.

As the world's largest supplier of tunnel boring machines, CREG provides customers with products and services of the highest technological and quality standards, combined with fast and comprehensive service. CREG pays special attention to teamwork and works hand in hand with all parties involved throughout the project.

CREG has completed more than 1,200 projects around the world in the fields of metro, road, railway, utility, hydropower and mines. CREG's tunnel boring technology is adaptable to all types of tunnels, pipelines, shafts in varied geological conditions, with diameters ranging from 1 meter to 16 meters. Advanced technologies from CREG are used to build new infrastructure and help improve people's lives.

METRO TUNNELLING

Underground Solutions Provider

Earth Pressure Balance (EPB) TBM

Application Scenario:

- Metro tunnel

Shaft Boring Machine (SBM)

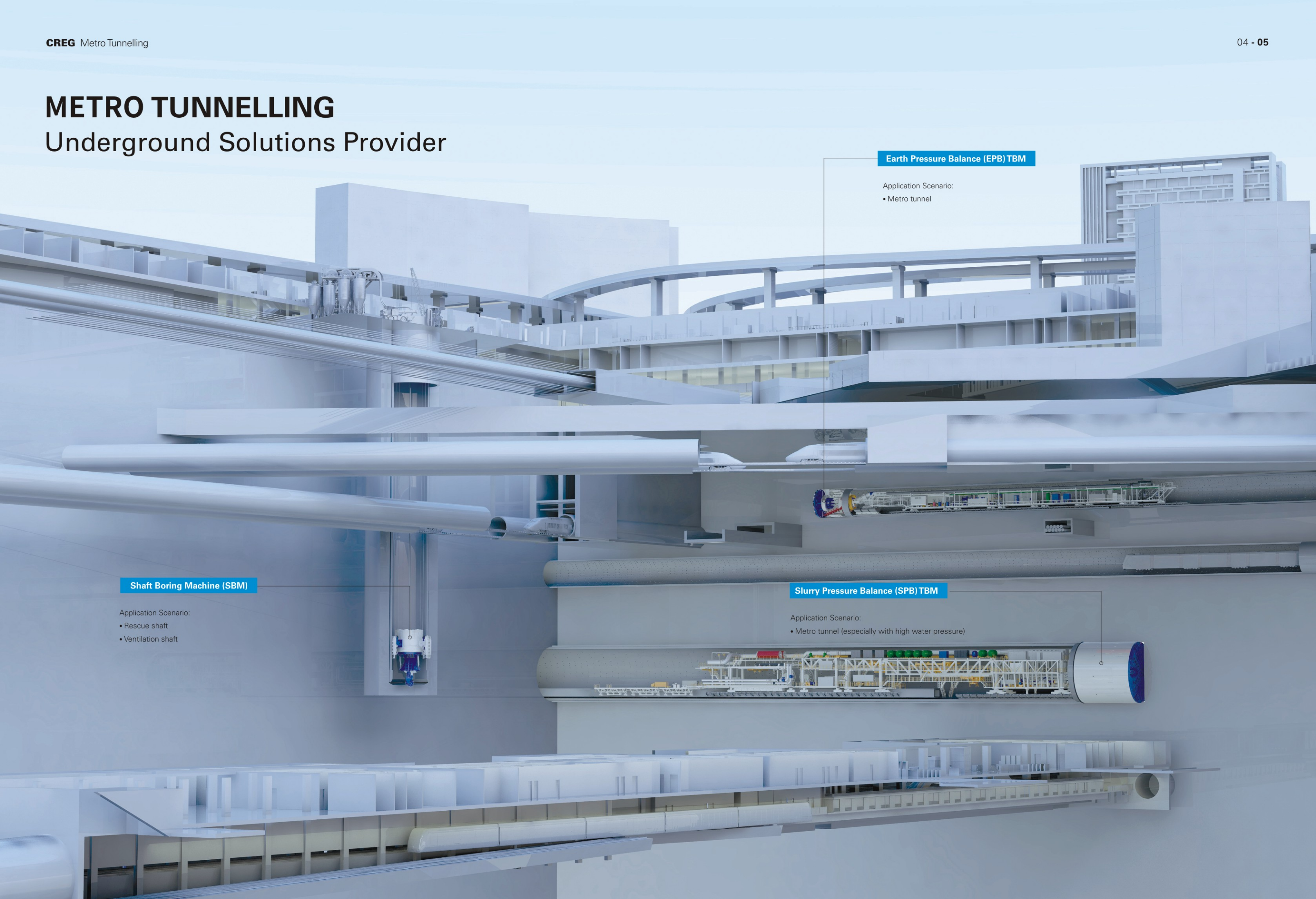
Application Scenario:

- Rescue shaft
- Ventilation shaft

Slurry Pressure Balance (SPB) TBM

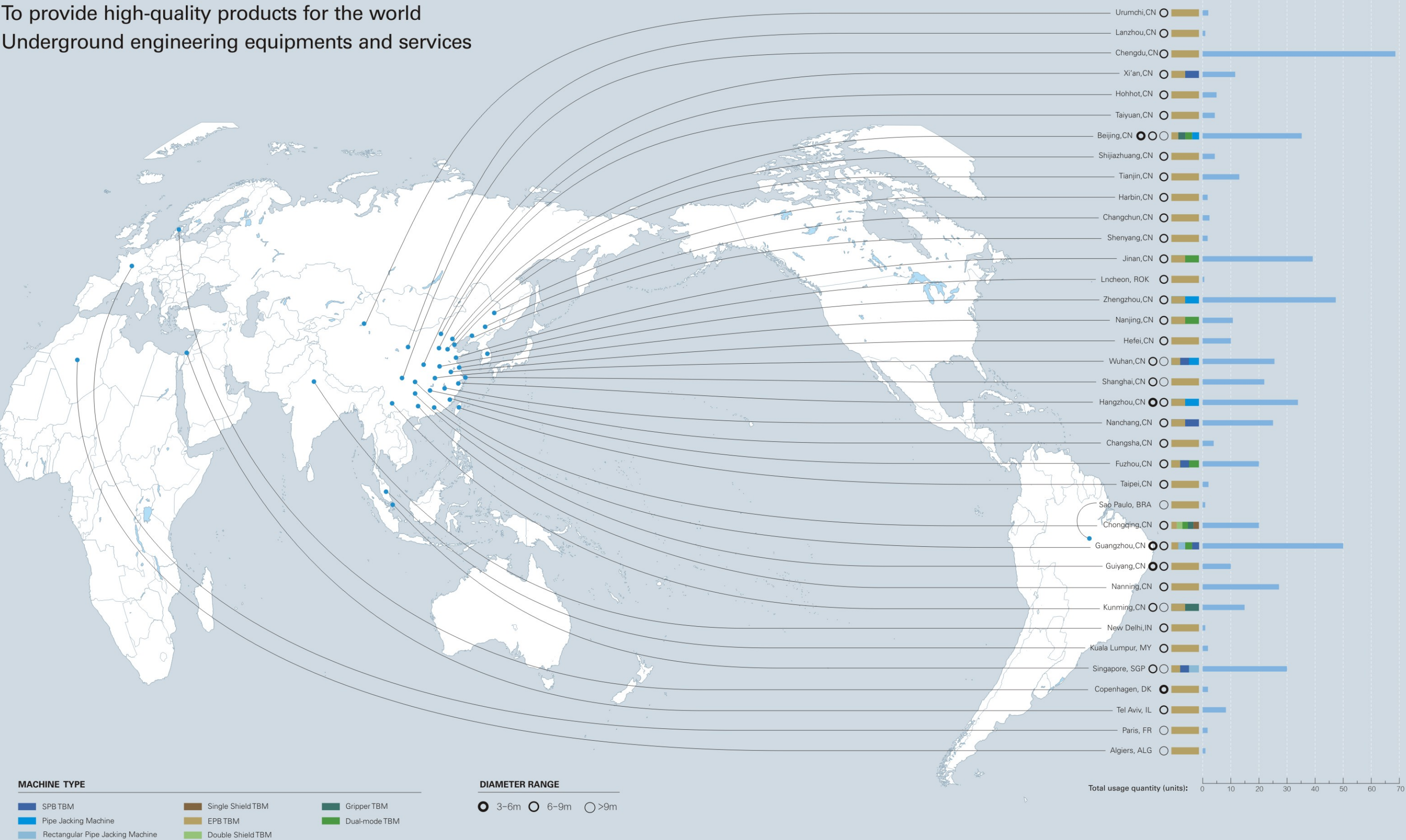
Application Scenario:

- Metro tunnel (especially with high water pressure)



GLOBAL VISION

To provide high-quality products for the world
Underground engineering equipments and services



Melbourne's Suburban Rail Loop Project

Effectively Alleviating Traffic Congestion in Melbourne

The Melbourne's Suburban Rail Loop project adopts an EPB TBM with an excavation diameter of 7.28m, an overall length of about 125m and a total weight of approximately 950t. The project includes four tunnelling sections with lengths of 6km, 6km, 3.5km and 3.5km, which are designed as twin bored tunnels. CREG 1564&1565 are responsible for the two 6km-long sections. The overburden ranges from 15m to 70m. Considering the shallow overburden, long distances, fractured strata, risk

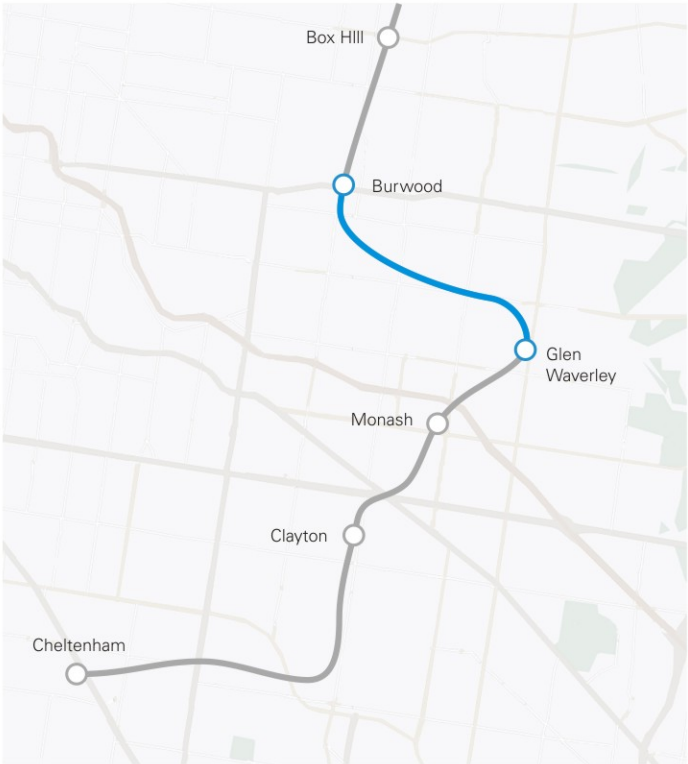
of cutter head clay clogging and the client's construction practices, the CREG design team completed a series of targeted optimizations. The TBM is equipped with advanced technologies such as cutter head telescopic flushing, semi-automatic segment erection, semi-automatic segment transport, green TBM and intelligent maintenance. The TBM design complies with Australian standards.

Project Information	Project Characteristics
› Tunnelling length: 6,000 m › Geology: Sandstone & siltstone › Contractor: Bouygues & Webuild & GS JV	› Shallow overburden of 15m at the launch shaft › Partial fractured zone › Long distance › High abrasiveness

TBM Parameter
› TBM type: EPB TBM › TBM S/N: CREG 1564&1565 › Boring Dia.: 7.28 m › Main drive power: 4,015 kW › FAT date: October, 2025

Project Background

The Melbourne's Suburban Rail Loop project has a total length of 90km, divided into the East Line, North Line, Airport Line and West Line. The SRL-D lot includes four tunnelling sections, designed as twin bored tunnels. Upon completion, the project will effectively ease traffic congestion and connect residents of Victoria with major employment, medical, and educational hubs in Melbourne's eastern and southeastern areas. Travel time from Cheltenham to Box Hill will be reduced to just 22 minutes.



The SRL-D Lot Route



TBM Factory Acceptance Test

Lot 2 of Grand Paris Express Line 16, France

TBM comes back to France, the birthplace of TBM technology

The Line 16 of Grand Paris Express is one of the four new lines of the Grand Paris Express. Located in the Seine-Saint-Denis department, stretching from Saint-Denis Pleyel

to Noisy-Champs, it will connect the northern and eastern suburbs of Paris. It is 27.5 kilometers long and boasts 10 stations.

Project Information

- › Tunnelling length: 5,800 m and 5,300 m
- › Geology: Granular gypsum, silty clay, gypsum marl, limestone and sand.
- › Contractor: Webuild-NGE JV

TBM Parameter

- › TBM type: EPB TBM
- › TBM S/N: CREC 777/778
- › Boring Dia.: 9.86 m
- › Main drive power: 3,850 kW
- › FAT date: December, 2019
- › Best performance: 36 m per day

Project Characteristics

- › Overburden ranging from 8 to 52 m
- › Max. water pressure reaches 5 bar.

Project Background

As an important connection of the automatic super metro network in the Paris suburbs and a part of the development plan of the Paris metropolis, the project will ease the increasing passenger flow between the Paris suburbs and relieve the saturation of several radial rail transit lines.



Grand Paris Express Line 16 Lot 2 Route



CREG TBM "Mireille" broke through on Line 16 of Grand Paris Express

Cross Island Line CR105 in Singapore

Large diameter TBM with accessible cutterhead used in Singapore

The tunnelling length is 3,157 m with the minimum turning radius of 460 meters, the maximum overburden of 60 meters, and the maximum water and earth pressure on the axis of 5.25 bar. It travels through mixed ground with maximum uniaxial saturated compressive strength of 185

MPa. The tunnel passes beneath the runway of Changi Airport and thus requires strict settlement control. The TBM CREC 1108 supplied by CREG is the first large-diameter slurry TBM with accessible cutterhead in Singapore.

Project Information	Project Characteristics
› Tunnelling length: 3,157 m › Geology: Fluvial sand, fluvial clay, granite, mixed ground › Contractor: TAISEI - CSCEC JV	› Maximum uniaxial saturated compressive strength of rock reaches 185 MPa; › Strict settlement control as the TBM travels beneath airport runway.
TBM Parameter	Project Background
› TBM type: Slurry TBM › TBM S/N: CREC 1108 › Boring Dia.: 12.26 m › Main drive power: 4,200 kW › FAT date: May, 2023	As the first CRL in Singapore, the project has received extensive attention from local society and mainstream media outlets. It is the first tunnel project constructed by large diameter TBM in Singapore. It will serve the existing and future developments in the eastern, western and north-eastern corridors connecting major hubs including Jurong Lake District, Punggol Digital District and Changi region, and helps Singapore to realize the long-term vision of reducing car usage.



Cross Island Line CR105 Route



CREG's slurry collection system helps to create clean tunnel environment



CREG service team works closely with client during site assembly of TBM

Shenzhen Metro Line 12 in Southern China

Application of rectangular PJM on metro station construction in China

Shasan Station is the third station of Shenzhen Metro Line 12 Phase II project, located at the intersection of Ditang Road and Shajing Road in Bao'an District. It is an underground two-story station. The Tunnelling length of pipe jacking section is 70 meters and realizes "zero" clearance

tunnelling along the left and right lines to form the final metro station cross section. It passes under a cast-in-place concrete culvert of 11.5 m × 3.6 m. The tunnel overburden is 6.5 meters and is about 2 meters away from the culvert.

Project Information

- › Tunnelling length: 2×70 m
- › Geology: Muddy, silty clay, sandy clayey soil, fully weathered granite
- › Contractor: Sinohydro Bureau 11 Co., Ltd.

Project Characteristics

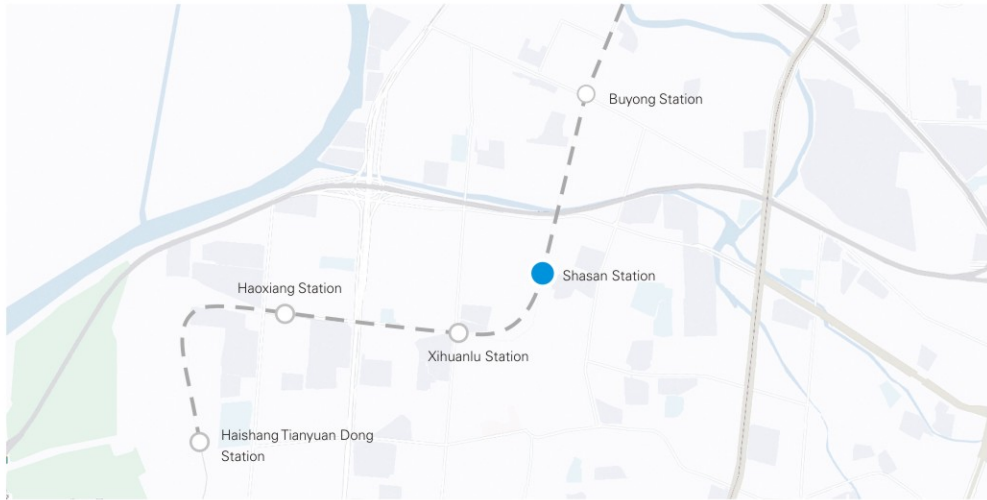
- › Super large cross section
- › Zero clearance
- › Fully weathered granite

Project Background

TBM Parameter

- › TBM type: EPB RPJM
- › TBM S/N: CREC 1179
- › Boring Section: 11.29 m×13.55 m
- › Main drive power: 2,370 kW
- › FAT date: January, 2023
- › Best performance:1 m per day

This project features shallow overburden, large cross-sections and zero clearance. the pipe jacking method has been introduced to metro station construction, which marks a major breakthrough in the technological innovation of pipe jacking machine, as well as a significant innovation in the application of new-type underground excavation technologies for metro stations.



Shenzhen Metro Line 12 Route



CREG TBM overcomes the challenge of ultra-small clearance excavation

Guangzhou Metro Line 3 Cross Passage in Southern China

Application of cross passage TBM in weathered granite strata

The tunnelling length of cross passage is 37.9 meters long with an overburden of 24.7 meters. It travels through moderately, fully and strongly weathered granite. In view of the challenges such as long distance and complex strata in this project, CREG has independently developed a TBM suitable for this project, based on our own experience and excellent technical know-how. The TBM integrates multiple functions such as launching inside the

tunnel, excavation, mucking, support, segment erection and receiving inside the tunnel. It boasts multiple technological innovation features: high maneuverability, high integration, double-cone stepped cutting profiling cutterhead technology, movable segment pre-stress support technology and low reinforcement environment launching and receiving technology.

Project Information

- › Tunnelling length: 37.9 m
- › Geology: Moderately, fully and strongly weathered granite
- › Contractor: Guangzhou Dunjian Construction Co., Ltd.

TBM Parameter

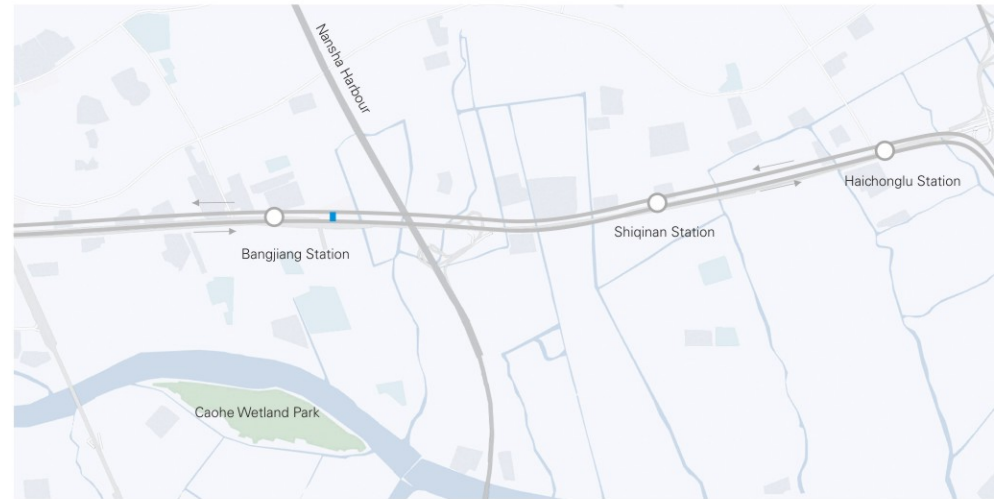
- › TBM type: Cross passage TBM
- › TBM S/N: CREC 1114
- › Boring Dia.: 3.28 m
- › Main drive power: 200 kW
- › FAT date: January, 2022
- › Best performance: 3.5 m per day

Project Characteristics

- › Long distance tunnelling
- › Complex strata

Project Background

TBM has been applied to cross passage construction in moderately weathered and weathered granite strata, breaking the common understanding that cross passage TBM can only be applied in soil strata. It has significantly enhanced the applicability of the cross passage TBM and provided solutions to the construction of cross passages.



Guangzhou Metro Line 3 Cross Passage Construction Site



CREG service team at job site



The pilot project enhances the applicability of cross passage TBM

Product portfolio for Metro tunnel

Tunneling technology suitable for various geological conditions and diameters

CREG is the only underground solutions provider that offers a comprehensive range of tunneling technologies suitable for various diameters and geological conditions. Furthermore, each CREG TBM or machine is specifically customised according to the geological, hydrological and other parameters of the project. Consequently, our products are recognized for their durability, reliability and performance, We are dedicated to providing exceptional customer service, and we constantly strive to exceed customer expectations.

Product Portfolio

16m

2m

EPB TBM

19m

2m

SPB TBM

16m

2.5m

Dual-mode TBM

15m

2m

Gripper TBM

15m

2.5m

Single Shield TBM

15m

2.5m

Double Shield TBM

5m - 15m (Full-face & Reaming)

Shaft Boring Machine

25m

7m

Vertical Shaft Sinking Machine

7m

5m

Reverse Shaft Machine

2650 mm (TBM)
2760 mm (Pipe jacking Machine)

Cross Passage Machine

1m x 1m - 14.82m x 9.446m (W x H)
1m x 1m - 11.29m x 13.55m (W x H)

Rectangular Pipe Jacking Machine

For more information of CREG, please refer to contacts at back cover.

CREG TBM breakthrough on Line 16 of Grand Paris Express



CREG headquarters

CREG

Underground Solutions Provider

China Railway Engineering Equipment Group Co., Ltd. (referred to as “CREG”) is a global underground solutions provider for a full spectrum of mechanized tunnelling technology and services. The company's headquarters is located in Zhengzhou, the capital city of Henan province. We bring together more than 4,500 employees including over 700 designers to design and manufacture TBMs and associated equipment. As the largest TBM supplier in the world, CREG boasts outstanding productivity,

performance, safety and geological adaptability, impressive R&D competence, a number of invention patents, as well as excellent after-sales service and support.

CREG has 16 production bases with an annual production of more than 300 TBMs. We have supplied TBMs ranging from ϕ 2m to ϕ 18m used in all kinds of ground conditions, including hard rock, soft soil and complex geology. Our products consist of Single/Double Shield Open-type TBM,

Gripper TBM, Earth Pressure Balance TBM, Rectangular TBM, Slurry TBM, Horseshoe-shaped EPB TBM, U-shaped Open-type TBM, Pipe Jacking Machine, Shaft Boring Machine, Reamer TBM and Inclined Shaft TBM. CREG is committed to every client as an efficient and reliable partner in the tunnel construction field. Until now, CREG has exported more than 140 TBMs to 34 countries and regions including Doha, Singapore, France, Italy, Australia, Lebanon, Poland, Denmark, South Korea and Austria etc.

With our extensive research and practical experience, CREG offers a series of auxiliary mechanized tunnelling equipment and service packages. In addition to various types of TBMs, CREG also designs and manufactures Shaft Boring Machines, Cutters, Rolling Stock, Roadheaders, Three-boom Drill Jumbos, and Wet Shotcrete Machines etc. We provide a full range of tunnelling equipment and all-around solutions.

Overseas Business and R&D institutions

- CREG TBM Germany GmbH
- China Railway Engineering Equipment Group Co., Ltd. Singapore Branch
- CREG Co., Ltd. South Korea Branch
- CREG Co., Ltd. Italy Branch
- カレグ・テクノロジー日本株式会社

Full Range Services

CREG also provides high value-added customized services, including design, consultancy, tunnelling service, maintenance, remanufacturing, mechanical & electrical installation, technical service, spare parts, etc. CREG establishes remote support system for delivered TBMs to facilitate CREG rendering quick troubleshooting and real-time monitoring during tunnelling.



TBM disassembly
T311 Project in Singapore

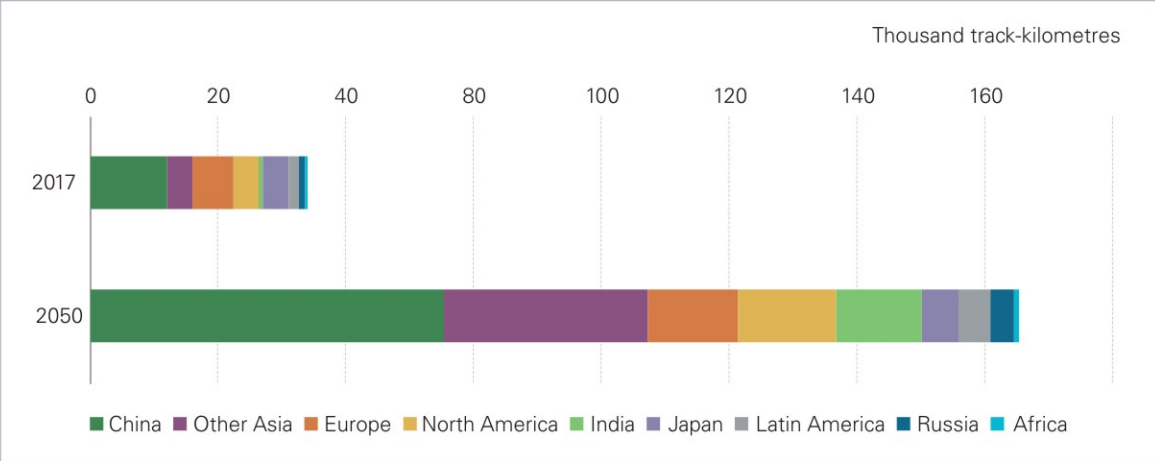


Trend

The metro rail network increases its length by 325% between 2017 and 2050, to reach over 150,000 kilometres (Figure 3.6). China adds the most track length in absolute terms between 2017 and 2050 (about 43,000 kilometres), although the growth rate is higher in India (reaching close to 13,000kilometres by 2050, up from roughly 1,000 kilometres in 2017). The balance of the global metro rail network shifts strongly towards Asia, where over two-thirds of all metro track-kilometres are to be found by 2050. Other regions where the length of metro systems is relatively low, including Africa, South America, North America and Russian Federation (“Russia”), more than triple or quadruple their metro network in the same

timeframe. Europe and Japan, which already have large metro network coverage in their main cities, add almost 8,000 kilometres and 1,700 kilometres of tracks, respectively, providing almost 240 billion additional passenger-kilometres of transport per year, compared to 2017. In all world regions, the rate of train activity growth is faster than the track build-out: in the High Rail Scenario, the capacity utilisation rate of the metro network is improved by 40% (in terms of train-kilometre/track-kilometre) by 2050, with shorter intervals between trains enabled by digitalisation.

Metro rail network build-out by region in the High Rail Scenario, 2017 and 2050



Source: IEA(2018).

