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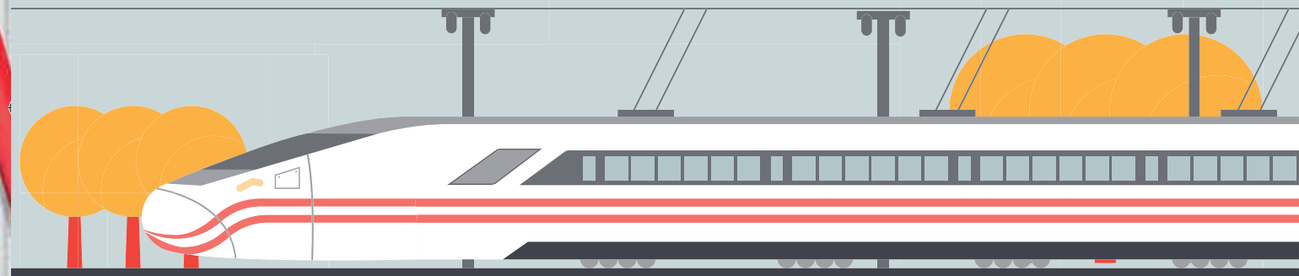
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ON TRACK

WITH THOUSANDS OF KILOMETRES OF LINES ALREADY IN OPERATION, EUROPE AND CHINA LEAD THE WAY IN THE GLOBAL RACE TO HIGH-SPEED RAIL

Words by **Samantha Whitaker** Illustration by **Adam Softley**



SPAIN // 2,056km in operation, 1,767km under construction

SPAIN IS LEADING THE WAY in Europe, with a total of 2,056km of high-speed lines in operation. The Alta Velocidad Española (AVE) is the second-longest network in the world after China and accounts for 35% of all European high-speed lines.

The acronym translates as 'bird' in Spanish, and the bullet trains fly along at speeds of up to 330kph (205mph), with a punctuality score of 98.8%. Unlike Spain's conventional 1,668mm wide-gauge tracks, the AVE features a standard European track width of 1,435mm, signalling the country's enthusiasm for European involvement.

In total, the network connects 21 cities and transports 11,500 passengers a day. The 471km Madrid to Seville line was the first to open in 1992, with the aim of helping develop the Andalusia region as a tourist destination. The popular 621km Madrid to Barcelona line opened in 2008, ferrying passengers between the capital and second city in less than three hours, and taking a huge volume of traffic away from the world's busiest air shuttle.

The delivery of high-speed rail in Spain is managed under a public private partnership, and there are currently 1,767km of lines under construction. At an estimated cost of €12.5bn (£10.4bn), the 940km Madrid to Levante line will be the country's most expensive high-speed rail project. Construction has also already begun on the Spanish side of the Madrid to Lisbon line, which will reduce travel time between the two capital cities to around three hours. Also, the LGV Perpignan to Figueres high-speed rail line, which opened in December 2010, linking Spain and France, is being extended to Barcelona.

Other high-speed projects in Spain include extensions to the Madrid to Valladolid and Madril to Seville lines, and the Basque Y line, which will link the three Basque capitals – Vitoria-Gasteiz, Bilbao and San Sebastián. There are also plans for an interconnecting tunnel between Madrid's Atocha and Chamartín stations, which will allow services a non-stop route between the northern and southern cities. Currently, the only option is for trains to bypass Madrid or for the driver to walk from one end of the train to the other, both of which impact on journey times. >>

CHINA // 6,299km in operation, 2,901km planned

CHINA'S FIRST high-speed line opened just before the August 2008 Olympics, delivering a 30-minute passenger service between Beijing and Tianjin. Around 69,000 people now use the service daily. The world's fastest line, from Wuhan to Guangzhou, opened in January 2011, with trains travelling 968km non-stop at an average speed of 313kph (195mph). China's two largest cities, Beijing and Shanghai, were connected in June 2011 with a 1,318km high-speed link capable of ferrying passengers in four hours 48 minutes – compared to around 10 hours on the previous railway.

With a population of just under 1.4bn, China has some of the world's most densely populated areas. The State Council's Mid and Long-Term Plan (MLTP) for railway development, adopted in 2004 and revised upwards in 2008, aims to increase the total rail network to 120,000km by 2015, including the construction of 16,000km of high-speed lines. China will then have more high-speed railway than the rest of the world put together.

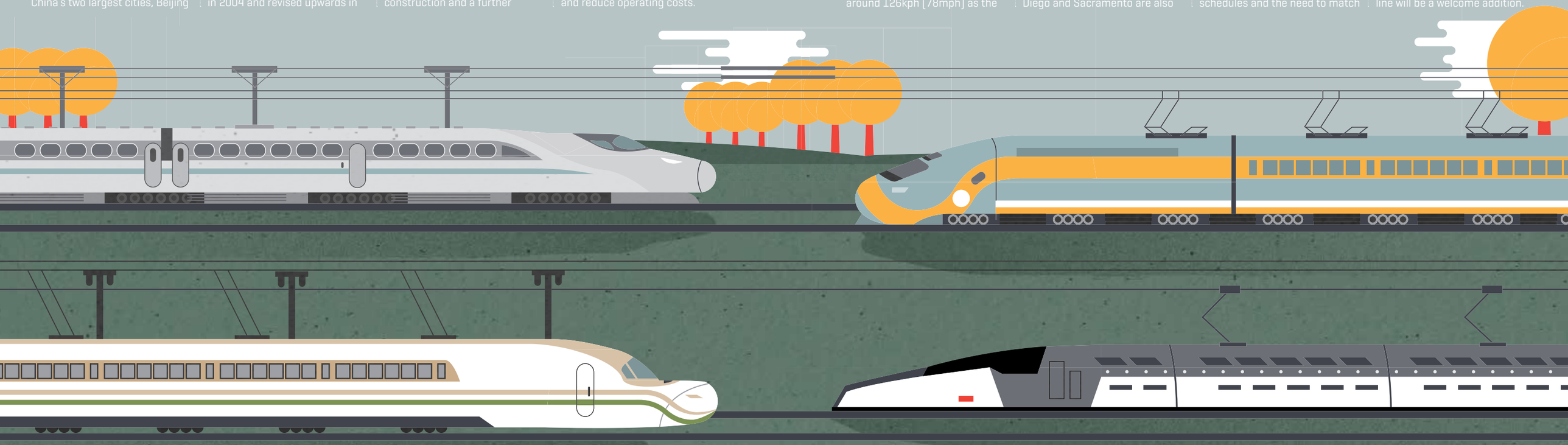
Total investment in high-speed rail to 2020 has been estimated at around US$300bn (£190bn). Currently, 4,339km of high-speed lines are under construction and a further 2,901km planned. However, a corruption scandal, and a fatal crash in July 2011 that killed 40 people, have led to increasing public anger and concerns about the safety of the network, casting a shadow over the development of railway projects. Trains on the Beijing to Shanghai line, for example, have been slowed from 380kph (236mph) to 300kph (186mph) to improve safety and reduce operating costs.

US // 362km in operation, 1,287km planned

THE US IS LAGGING BEHIND when it comes to high-speed rail. With only one 362km line currently in operation, it has looked on with envy at high-speed development elsewhere in the world. Opened in 2000, the Acela Express runs between Washington DC and Boston via New York City. Although the trains are capable of maximum speeds of 241kph (150mph), they only average around 126kph (78mph) as the track is shared with lower-speed passenger and freight services.

This year should see construction begin on the first phase of a 1,287km network in California, administered under the California High-Speed Rail Authority, which will connect the San Francisco Bay area with Los Angeles, reducing travel times to just two hours 40 minutes. From here, extensions to San Diego and Sacramento are also planned. Initially, the network was estimated to cost US$40bn (£25bn), with construction costs provided by the federal government and through P3 (public private partnership) funding. However, the authority has recently released a business plan estimating that the cost will be US$98.5bn (£62.4bn) – more than double the initial estimate – due to extended construction schedules and the need to match possible future inflation. Also, the 2008 estimate expected construction to be complete by 2020, but the revised plan has pushed this back to 2033.

The region is an earthquake zone and prone to dense fogs, making the already congested roads even more hazardous. And with California's population expected to grow from 35m to 48m by 2030, the high-speed line will be a welcome addition.



SAUDI ARABIA // 450km under construction

EXPECTED TO OPEN at the end of 2012, the 450km Haramain High Speed Rail Project (HHR) will link the Muslim holy cities of Medina and Mecca, cutting the journey time to around two hours. The US$1.8bn (£1.1bn) contract for phase one of the project, which began in 2009 led by the Al Rajhi Alliance, a consortium of China Railway Engineering and Saudi's Alstom Transport, includes civil works, such as construction of bridges, retaining walls, tunnels and embankments. Phase one also includes the US$38m (£24m) construction of five passenger stations in Mecca, King Abdul Aziz International Airport, Medina and two in Jeddah. Due to the fast-track construction schedule, designers Foster + Partners have adopted a modularised approach for the stations, with a high degree of prefabrication.

Phase two of HHR was awarded to Al Shoula, a Spanish-Saudi consortium, and involves the construction of railway tracks, signalling, operation and maintenance over the next 12 years, and the procurement of 35 high-speed electric trains capable of running at 360kph (223mph). The track will be designed to handle temperature fluctuations, which range from 0-50°C in the region.

Each year the city of Mecca attracts around 2.5m Hajj pilgrims and more than 2m Umrah performers during Ramadan and seasonal holidays. And with a resident population of 1.7m there is already heavy traffic, particularly on Fridays. The high-speed service will significantly relieve the pressure on the roads and drastically reduce energy consumption and pollution levels in Saudi Arabia.

AUSTRALIA // 1,600km proposed

NEARLY 10M PEOPLE live along Australia's east coast between Brisbane and Melbourne. In September 2010, Infrastructure Partnership Australia and Aecom launched a A$20m (£13.5m) study to identify possible land corridors that could support a high-speed railway network.

Phase one of the study found that the network would cost A$61-108bn (£41-73bn) and cover around 1,600km, passing through Brisbane, the Gold Coast, Newcastle, Sydney, the NSW Southern Highlands, Canberra, Albury-Wodonga, Tullamarine Airport and Melbourne. Trains would travel at up to 350kph (217mph), reducing journey times to just three hours between Sydney and Brisbane, and carry around 54m passengers a year by 2036, massively easing the pressure on the Sydney to Melbourne air corridor, which is currently the fifth busiest in the world. And with each full train of 450 passengers equivalent to taking 128 cars off the roads, levels of carbon pollution would be drastically reduced. A high-speed line linking Sydney and Canberra airports, which is part of the proposed network, would provide an effective and much-needed second airport for Sydney.

In response to the study, design practice HASSELL has developed a pioneering new concept for the Australian High Speed Vehicle. The proposed low-carbon, double-decker train looks very different to current designs, and inside would offer spacious, open-plan seating, with private berths for business meetings and luxury travel.

Phase two of the study, which will be far more detailed, has now commenced, and is scheduled for completion in late 2012.