

TRAMWAYS BY SYSTRA: MOBILITY PROJECTS DRIVING CHANGE IN CITIES



PRESS KIT





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Since the first tramway line went into service in Nantes in 1985, tramway networks have spread throughout France - from Brest to Nice, from Montpellier to Lille, Bordeaux, Lyon and Paris, but also abroad. Trams have gradually reclaimed the heart of towns and cities. SYSTRA has played a key role in this boom and continues to innovate day after day to support the development of new networks in France and throughout the world.

« The revival of the tramway owes much to French engineering, with SYSTRA at the forefront. Indeed, our Group has made a major contribution to the construction of 24 of the 28 tramway networks in France. Today, this sustainable mobility solution is at the heart of the transformation of cities throughout the world. »

**Jean-Charles Vollery,
Chief Operation Officer, SYSTRA**



THE TRAMWAY – MEETING MOBILITY AND ECOLOGICAL CHALLENGES FOR AGGLOMERATIONS

The tramway is one of the only modes of transport that offers decision-makers and public authorities the solution to a complex challenge – how to offer a transport service that is rapid, high capacity, and reliable, operates long hours, is independent from road traffic flow and as carbon neutral as possible... all at a limited roll-out cost?

Win-win for all

Buses can operate in dedicated lanes, but only tramways can carry up to 250 passengers per tram vehicle, without load changes, morning to night, and transport 10,000 passengers per hour and in both directions.

Metro systems may boast high capacity, but the tramway is five times cheaper to build per kilometre. Furthermore, the construction project presents opportunities for city councils to make bold architectural moves to redesign the streets and public spaces, including completely redefining the areas bordering the routes on either side.

Faced with the growing popularity of soft transport modes, like the bicycle and electric scooter, the tramway offers greater accessibility for people with reduced mobility.

The tramway also meets a growing concern shared by our clients, city and territorial stakeholders, local inhabitants, and users – it ticks the low carbon emissions box.

« Choosing the tramway means opting for a rational mobility offer, proven to reduce polluting emissions in agglomerations while ensuring freedom of movement. At SYSTRA, our systemic vision is contributing towards defining and building tomorrow's cities and territories at a time when mobility, the environment, energy transition, and planning must be regarded as interdependent. »

Vincent Duguay,

Director, Urban Projects SYSTRA France

Environmental expertise for sustainable mobility

By taking on board the lifecycle of a mobility project from A to Z, SYSTRA fully understands all the complexities: right from the start we are involved in the preliminary planning, consulting, and concertation phases, up to independent certification and maintenance, and including studies, contractual support, overseeing implementation, and commissioning – for the infrastructure and systems (track, energy...), rolling stock, and environmental integration.

EXPERT VOICE

« At every step in a project, finding the most sustainable solutions possible is absolutely crucial: upstream, defining the optimal routes, then during implementation providing support, for instance, when choosing materials, irrigation measures for turfed surfaces and lastly, when the service is up and running, adapting the tram stops or building Park & Rides to better encourage modal shift. »

**Christelle Chichignoud,
Sustainable Development Director
SYSTRA**

For certain projects, clients expect SYSTRA to provide specific expertise on a wide range of environmental issues. These may concern the geographical features of the site(s) in question, the need to manage impacts like noise, or how to protect natural habitats...

In Île-de-France (Paris and its region) for instance, SYSTRA has brought its environmental skills and know-how into play for two tram-train (vehicle capable of running seamlessly between tram and standard heavy rail tracks) projects:

- For Line T12 (Massy-Evry), we did the preliminary studies for the future tram stabling workshop, taking into account the presence of broomrape, a protected plant species for which we have allocated a 3,000sq. metre park.
- For Line T13 (Saint-Cyr – Achères – Saint-Germain Grande Ceinture), we have worked with an ecologist during construction to preserve the parts of the national forest of Saint-Germain-en-Laye where the route runs.

TECH +

REDUCED WATER CONSUMPTION FOR GRASS TRACKS

SYSTRA explored different irrigation options to find the most ecological, sustainable, and appropriate water management system.

The solution was found in collaboration with Netafim, an Israeli specialist in agricultural water management. Instead of laying a continuous watertight slab, we designed an underground water distribution system that ensures controlled irrigation with the most accurate water volumes, combined with a ladder-like open-work slab.

A special grass was also chosen for its environmental qualities: it absorbs twice as much CO₂ as the existing grass, thus reducing pollution and improving air cooling. Since this grass is not tall it is also easier to maintain. In addition to the environmental benefits, the new watering solution and the grass selected enable savings in maintenance, thereby reducing operating and capital investment costs.

On 11 November 2020, at the Global Light Rail Awards in the U.K., SYSTRA won the 'Highly commended' prize for its innovative, tram track watering solution, installed on line T3 in Paris.



Reusing existing track: a key strength of the tram-train

Infrastructure is most sustainable when reused. The tram-train, by taking advantage of disused or rarely used rail tracks, really boosts services to the outskirts of cities and urban areas. In so doing it helps connect territories around agglomerations, as well as operating in the hearts of cities. Not to mention the potential cost savings for the project, especially with regard to land rights.

SYSTRA, a pioneer in new generation tramways, was the project manager for three of the most important lines commissioned in France, namely:

- The T4 in Île-de-France (Paris and its region), the first tram-train line in France, firstly between Bondy and Aulnay-sous-Bois, commissioned in 2006, followed by a new branch to Montfermeil, opened in 2020.
- The Nantes–Chateaubriant line, providing a mobility link in the Brittany countryside with 11 stations along a 69 km-long route.
- Ligne C in Bordeaux, with an extension to Blanquefort, the so-called 'Médoc tram-train', runs alongside the eponymous SNCF railway line.

In the Provence-Alpes-Côte d'Azur region of France we are working with the city of Aubagne as it prepares for a Val'Tram line, reusing the Valdonne rail freight track abandoned since 1987, to serve both urban and peri-urban areas in the hinterland of Marseille.

SYSTRA FIGURES IT OUT:

310

...people at SYSTRA are working daily on tramway projects in France. Today, the Group is the only player in the engineering market with a dedicated tramway team. These experts are largely based at our office in Lyon, which brings together all the skills and know-how for track studies and planning, implementation, and certification of rolling stock during commissioning. This centre of expertise in tramway engineering, the only one of its kind in France, also contributes to a great many projects all over the world.



SYSTRA'S EXPERTISE: DRIVING THE TRAMWAY REVIVAL IN FRANCE

For over 40 years, SYSTRA has played an active role in improving city centres. We have helped redefine the public spaces associated with tramway projects in most of France's major cities.

We were on the spot, right from the start, when Nantes decided to develop a modern tramway network for its agglomeration: in 1978, SYSTRA (then SOFRETU) advised the city council on the approach, then provided support during the project right up to commissioning of the first line in early 1985. Furthermore, we continued assisting SEMITAN (Société d'Economie Mixte des Transports en Commun de l'Agglomération Nantaise), which has since built one of the longest tramway networks in France – three lines reaching over 44km.

In nearly 50 years, almost every agglomeration in France with over 150,000 inhabitants has adopted a tramway. To date, the market remains particularly active:

« We won half the tramway tenders launched in 2021 for high-stake assignments – in terms of integration, the environmental and energy transition – together with many co-contracting partners. A lot of cities are still debating whether to introduce the tram or extend their existing tramway networks: this is indeed the case for Annecy, for which we have already done a study, as well as Nice, Le Havre, and Caen. »

Sylvie Cassan, Director, Business Development,
SYSTRA France

The teams at SYSTRA are currently working on 11 project management assignments for tramways in France, in eight different regions.

The tramway, driving requalification of urban centres

Opting for a tramway comes after carefully considering public transport demand, the structuring needs of the territory in question, and plans for urban renewal. This approach lies at the heart of the tram à la française. For this specificity, SYSTRA proposes innovative and sustainable transformations tailored to the needs of individual clients. Our expertise goes above and beyond the transport system to encompass the project in its entirety:

- During the preparatory phases, consulting and planning the project integration based on needs and the functioning of the territory.
- During the study phase, supporting clients on a day-to-day basis in preparing their project and anticipating the impacts.
- Supervising the whole process, from the project implementation phase to entry into service and maintenance.
- We bring unique know-how to the engineering by taking charge of the strategic consulting, urban planning, public dialogue, and urban integration phases, to contribute to the transformation of the public spaces along the route.

EXPERT VOICE

« SYSTRA has really established itself as a reference in the tramway market, delivering projects from A to Z. We draw on a wide range of expertise to complete these projects successfully: systems engineering for the whole of the line, energy, designing the depots, passenger information, and even ticketing. Especially crucial when working on a tramway is ensuring its successful integration with city planning. We must consider aspects like road management, interfaces with the urban sphere and road users, as well as correctly managing crossroads for traffic flow. All this is part of good landscape integration and so is part of the performance of our projects. »

Stéphane Sirault,
Director, Tenders, Projects & Performance
Systems Business Unit, SYSTRA France

Some of our milestone tram projects have become real benchmarks in architecture: as in Tours, with the development of Line A, in service since 2013, whose trams are designed to reflect the river Loire and artworks by Daniel Buren along the route. The architecture agency Urbanica is currently working with SYSTRA on designing Line B, which will involve overhauling several city landmarks; like, for instance, Jean-Jaurès square or the pedestrian zone on boulevard Béranger, where the trams will operate alongside the famous flower market...

In Paris, at present we are working on two project management mandates to extend tramline T3b westwards to Porte-Dauphine: the first for the tramway platform itself; the second for urban development around the tracks up to the surrounding buildings.

In addition to these architectural aspects, we are highly experienced in consultation procedures. So, for the Tours tramway project, we used our certified tools and work methods to factor in the needs of local inhabitants and establish how the works might impact their everyday lives.





THE TECH +

CATENARY-FREE TRAMWAYS!

What have the tramway projects in Bordeaux, Tours, Orleans, Reims, Rio, Dubai and Lusail got in common? Each one is designed by SYSTRA and conceals a 'groundbreaking' hidden gem – the Ground Level Power Supply (GLPS) system.

SYSTRA first rolled out this tramway innovation in Bordeaux, which opened its first line in 2003. In 1997, Communauté Urbaine de Bordeaux chose our Group to lead a project management consortium. Up to 2020, we studied, built, then commissioned four lines, all interconnected, with a view to serving the whole of the agglomeration of Bordeaux, with the lines covering a total of 81.1km, of which 28km are equipped with our GLPS system.

This world first, which has since inspired many other cities across the globe, avoids the need for overhead electric wires and so safeguards the beauty of historic cityscapes and architecture. Without a catenary, the trams lower their pantographs and contact shoes capture electricity via a third rail in the middle of the track. A further benefit of this technology – it allows other vehicles to drive over the tram tracks without any height restrictions.

In November 2014, SYSTRA completed commissioning of the first tram line in the world that fully operates with a GLPS system – Dubai's tramway in the district of Al Sufouh. Since 2016, we have been preparing its extension to the district of Jumeirah. In total and worldwide, SYSTRA has completed 70km of tram lines with the GLPS system, of which 35.6km for the French market alone.

Customised networks to boost mobility

Since every city and agglomeration is different, every tramway must meet specific needs in terms of topography and specific urban contexts. For Le Havre, whose two tram lines built with SYSTRA as project manager opened in 2021, the Y-shaped route was chosen to improve connections between the rebuilt historic centre, listed a World Heritage site by UNESCO, and the dense districts of housing estates on the city heights.

In Besançon, the major concern was how much the tramway would cost: as a result, the city boasts the first tramway network built for 17 million euros/km, compared to the average 20 to 25 million euros/km. The initial funding envelope of 228 million euros remained on target, especially thanks to technical and administrative project management assistance provided by SYSTRA from 2008 to 2014.

Improving its environmental performance while limiting costs– this equation is why Brest Métropole chose SYSTRA: initially for its first tram line, inaugurated in 2012; then, from 2021, for a multimodal project. The city authorities are counting on a second tram line to boost mobility in the territory, as well as an electric Bus Rapid Transit (BRT) line, a first in France, to further extend the reach of the tram while keeping infrastructure spending down.

"The Brest authorities were particularly impressed by SYSTRA's approach to sustainable design," points out **Sofia Fotiadou**, Head of Sustainable Design, SYSTRA Group.

"As leader of a project management consortium, we successfully brought together the best co-contractors and sub-contractors in their fields to address issues like noise pollution, urban integration, developing cycling, and architecture," explains **Hervé Abjean**, Project Management Director.



EXCELLENCE IN ACTION:

Paris, capital of 'tramways by SYSTRA'

For over 20 years, SYSTRA has been actively involved in transforming mobility for Parisians by developing the city's tram network. We participated in designing the T3 line, the so-called Maréchaux tram, which entered into service in 2006. Then we were chosen again, this time to project manage the extension of the T3 to Porte de la Chapelle, commissioned in 2012.

In the meantime, the Group worked on reviving the Coquetiers line, the current T4 tram-train section between Bondy and Aulnay-sous-Bois, together with two other lines that symbolise the tram revival in Île-de-France: the T7 (Villejuif – Orly) and T8 (Saint-Denis – Villetaneuse – Epinay sur Seine) lines. More recently, tram-trains (T11 Express in 2017, extending the T4 in 2020) were added to the network, for which SYSTRA completed several study and supervisory assignments.

Today our teams are working on the projects to build the T10 (Antony – Clamart) and T13 Express (Saint-Cyr – Saint-Germain en Laye – Achères) lines, as well as extensions of two lines of crucial importance for the Paris region: the T1 to Colombes and the T3b to Porte Dauphine. In extremely dense urban areas, we are in charge of project managing the design and construction of the tramway platforms, as well as urban renovation work and all the surroundings.

For the second tram line in Nice, linking to the airport, the city opted to go underground to avoid disrupting surface transport systems in an extremely dense urban area; consequently, over a third of the line runs in a tunnel. Métropole Rouen Normandie decided likewise for its tramway inaugurated in 1994, with the central section serving the Palais de Justice and Rouen-Rive Droite railway station operating in a tunnel with underground stations.

In Nice, SYSTRA has carried out engineering assignments for the construction studies, and in Rouen we acted as design consultant for the construction consortium.

For a mobility offer, an interchange network is the key to success. So the aim of Montpellier's tram line 5 is to serve the underprivileged neighbourhoods where demand for public transport is high. SYSTRA has been part of the general project management consortium since 2019. The tram will also provide access to the main activity hubs in the agglomeration – like University Paul-Valéry, the Agropolis research hub and science faculty.

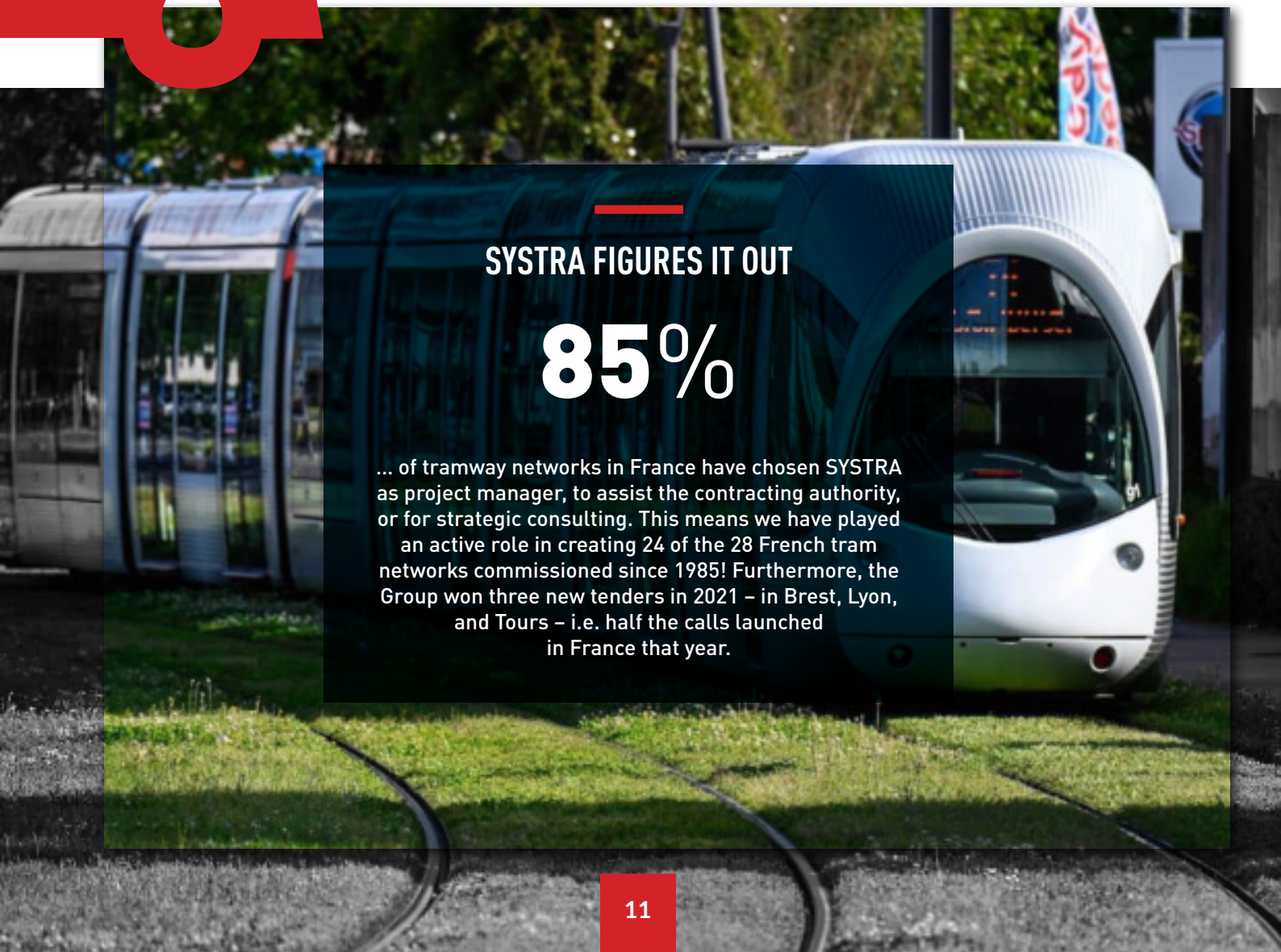
In the Provence-Alpes-Côte d'Azur region, the metropole of Aix-Marseille-Provence chose SYSTRA for land project management assistance, a crucial job when preparing a tramway project, for two extensions to Line 3. Since 1981, the Group has carried out studies for upgrading tramway line 68, whose route has in part been taken over for the T1 line, in service since 2007. Today this line has become the backbone of the surface transport network in Marseille.

Then there's the extension of tram Line E in Toulouse – which SYSTRA project managed from 2007 to 2014 – connecting the city centre to the heart of airport industry and tertiary activities in Blagnac, i.e. over 15,000 jobs.

SYSTRA also offers services adapted for clients keen to prolong their current tramway operations. The city of Saint-Etienne, for instance, for which SYSTRA acted as assistant project manager, wanted to modernise its rolling stock. In Lille, we provided strategic consulting with Keolis to carry out the studies for upgrading the stops along the Lille-

Roubaix-Tourcoing, 'le Mongy', metric gauge tramway. Our Group was also actively involved in the project for the Clermont-Ferrand line, the most iconic of rubber-tyred lines, in service since 2006.

Yet another highlight, SYSTRA chose Lyon – which showcases the full range of the Group's tramway skills and know-how in action – as the home for its international centre for tramway engineering expertise. Following preliminary studies from 1998 on, for building the first lines of the network, our initial assignment as project manager dates from 2005. Since then, projects have followed on the T2, T3, T4 and T6 lines: in just over 15 years, the teams at SYSTRA France have completed nearly 30km of lines, i.e. almost half the tramway network and stops in the agglomeration of Lyon. Most recently, in 2021, the Group won the project management contract for the future T10 line: on entering service in 2026, it will link up the municipalities of Vénissieux and St Fons, in the suburbs of Lyon.



SYSTRA FIGURES IT OUT

85%

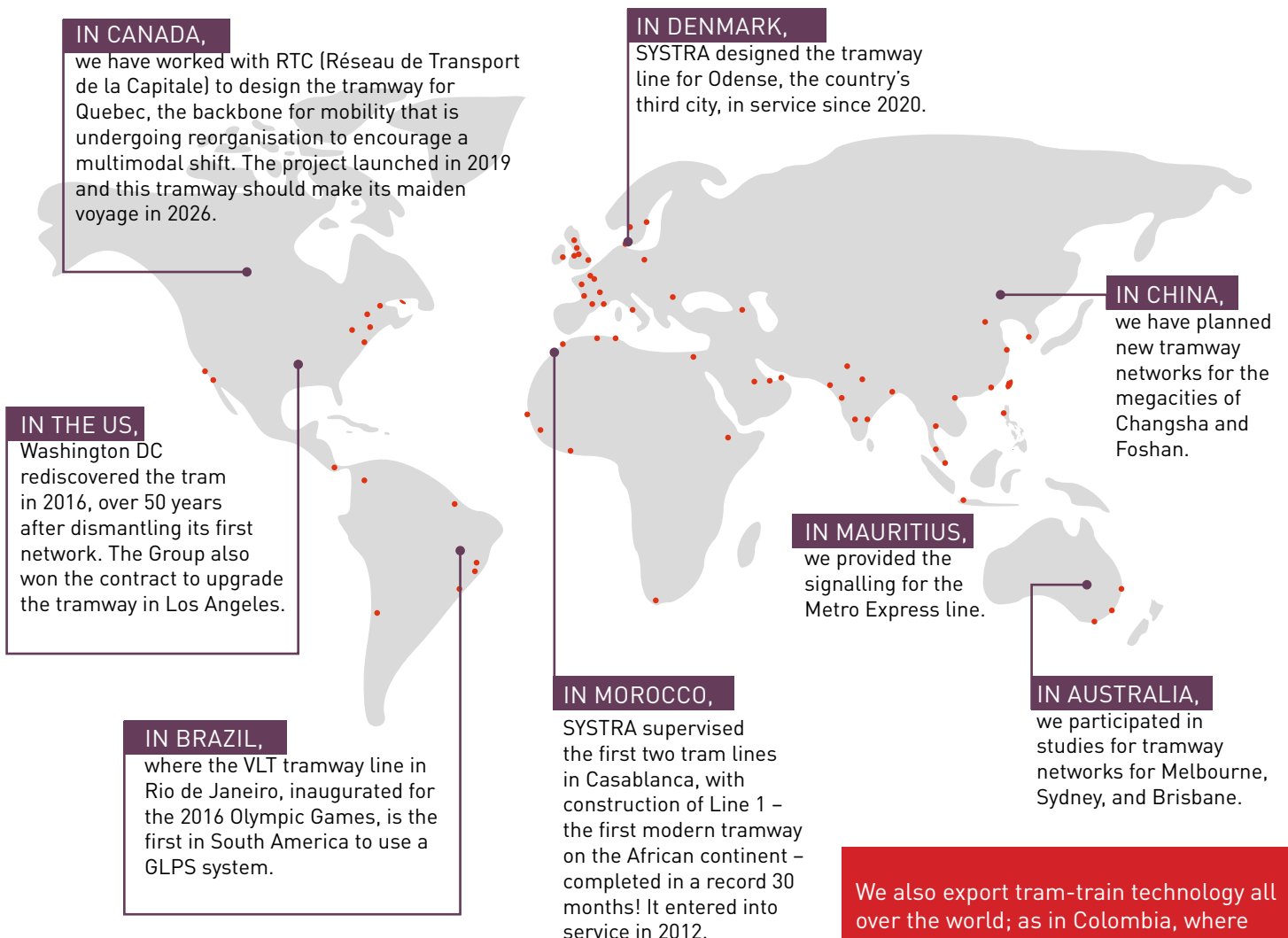
... of tramway networks in France have chosen SYSTRA as project manager, to assist the contracting authority, or for strategic consulting. This means we have played an active role in creating 24 of the 28 French tram networks commissioned since 1985! Furthermore, the Group won three new tenders in 2021 – in Brest, Lyon, and Tours – i.e. half the calls launched in France that year.



EXPORTING THE TRAMWAY: FROM FRENCH MODEL TO GLOBAL SUCCESS STORY, SYSTRA LEADS THE WAY

Exporting French rail expertise lies at the heart of SYSTRA: from 1957, our first project was to electrify the Indian railway network. Today, over 70% of our assignments are outside France and the Group's know-how is exported the world over. For tramways, SYSTRA is actively involved in projects in 120+ cities in 50 countries, and every year we continue rolling out new networks across the globe.

Indeed, the French tramway model exports to every continent:



We also export tram-train technology all over the world; as in Colombia, where SYSTRA is managing two such projects: the RegioTram in Bogotá and the Tram-Train for Cali.

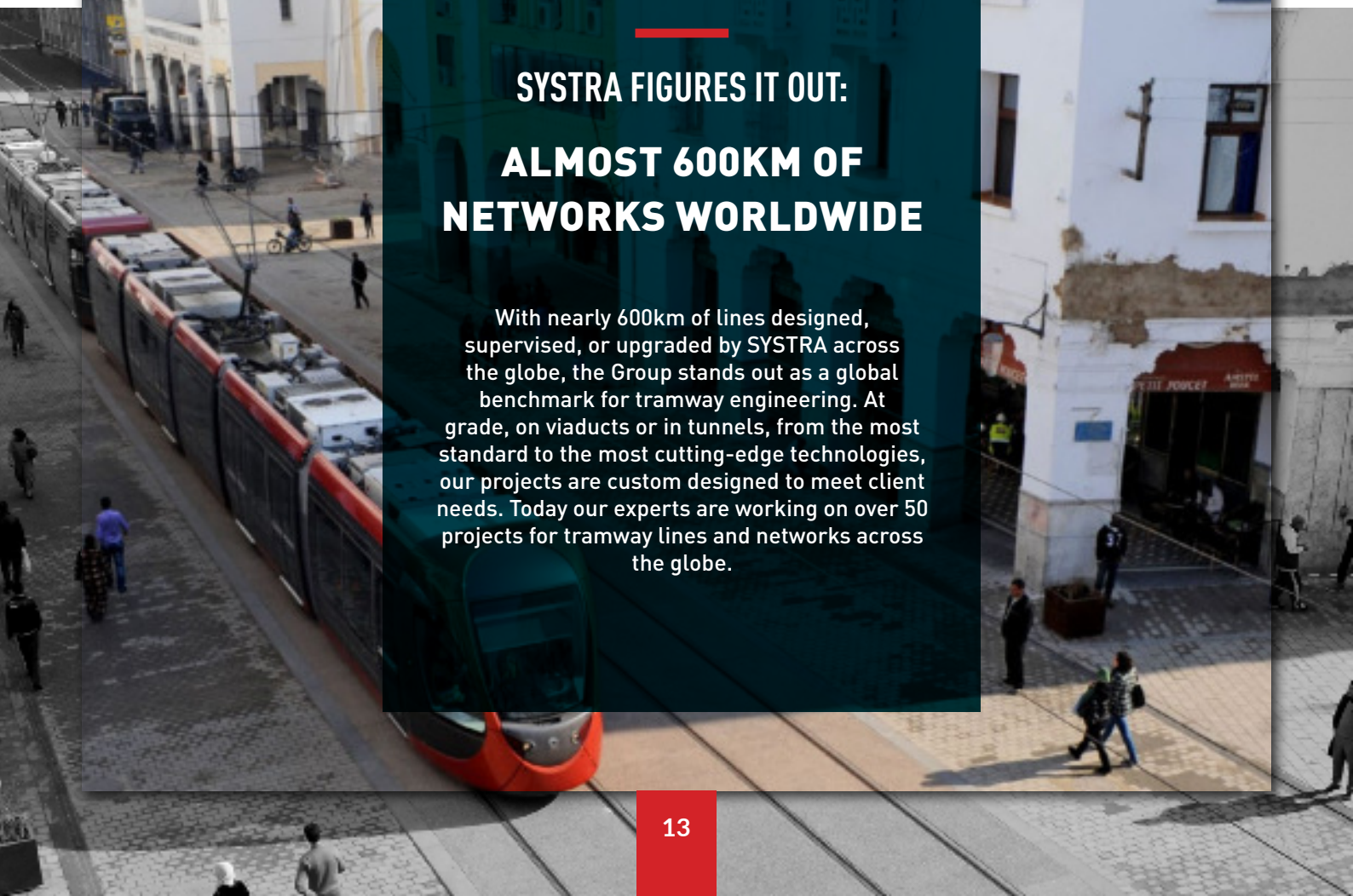
Tramways that adapt to every environment

There are no limits to developing tramways all over the world. For every constraint, there is a solution.

The main constraints are climate related. This is very much the case on the African continent. The tramway in Ouargla, built at the gateway to the Sahara in Algeria, operates in extreme climate conditions: temperatures exceeding 50°C as well as sandstorms. To cope, all the external equipment is designed to resist temperatures up to 70°C and complies with protection rating for the most challenging of dust (IP65). Materials resistant to salt water and sulphates are also used to overcome the constraints posed by the local groundwater tables. The other tramway lines built by SYSTRA in the Maghreb must operate in similar conditions – be they in Rabat-Salé, Algiers, Tunis, Batna, or Sfax. At the other extreme, our tramway projects are also designed to cope with icy temperatures, like in Denmark, in the Baltic capitals of Tallinn, Riga, and Vilnius, for the Polish network in Krasinski, in Quebec, too.

The constraints may be urban related, too. In Egypt, restoring the Raml – the historic, double deck tramway system in the city of Alexandria – first and foremost represents a social challenge: the project requires precise phasing to cause the least possible impacts on road traffic, which is heavily congested. To do this, the network will be simplified, stops moved or removed, the tram tracks separated from the road by building viaducts and underpasses, footbridges built, and electronic luminous infrastructure introduced at junctions. This approach should triple passenger capacity by the time the project is completed, without congesting the city during works.

In some megacities in South-East Asia, similar limitations due to demography and the density of city centres mean light metro projects must take up the least land space possible. Therefore, in the Philippines, the LRT1 line in Manila – which SYSTRA has been working on since 2018 – has been almost entirely rebuilt on viaducts.



SYSTRA FIGURES IT OUT: ALMOST 600KM OF NETWORKS WORLDWIDE

With nearly 600km of lines designed, supervised, or upgraded by SYSTRA across the globe, the Group stands out as a global benchmark for tramway engineering. At grade, on viaducts or in tunnels, from the most standard to the most cutting-edge technologies, our projects are custom designed to meet client needs. Today our experts are working on over 50 projects for tramway lines and networks across the globe.

EXPERT VOICE

« As for every infrastructure or mobility project, you can't improvise designing a tramway. SYSTRA is the only engineering firm to offer the full range of services needed to undertake this kind of mission from A to Z – from consulting to commissioning. The Group's strength lies in its ability to rapidly mobilise the best skills from all over in the world to give our clients the very best of our know-how for their tramway projects. »

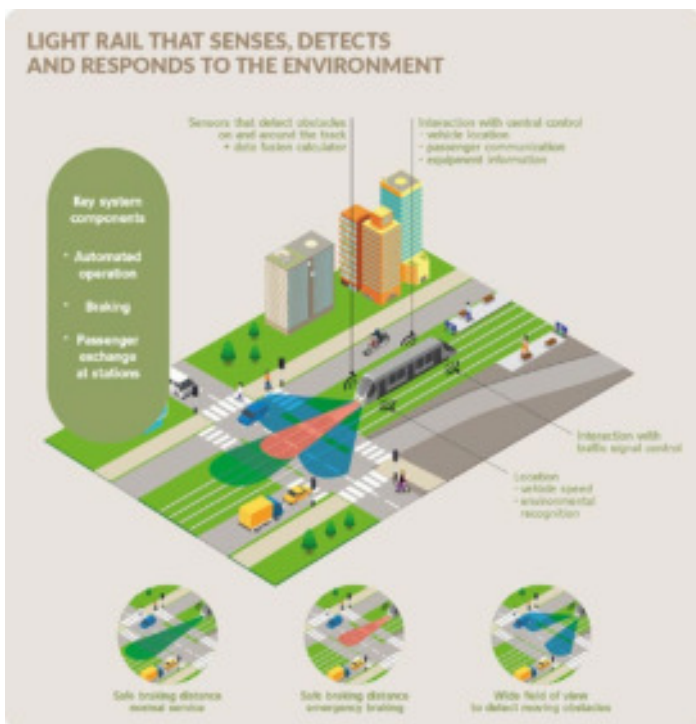
**Prisca Flattot, Director, International Production,
SYSTRA Group**

EXCELLENCE IN ACTION:

SYSTRA BRINGS ITALY ON TRACK

In Italy over recent years, SYSTRA has established a strong presence in the tramway market. Indeed, our local subsidiary, SYSTRA SOTECNI, is carrying out several projects in the cities of Florence, Bologna, Cagliari, and Messina. Furthermore, SYSTRA has previous valuable experience under its belt: studies and audits in Tarenta and Rome in the 1990s; modernising the Naples line in the 2000s.





Cutting-edge tramways for the Middle East

Expo 2020 Dubai, held from 1 October 2021 to 31 March 2022, is sketching out tomorrow's world. Likewise, the future of the tramway can be seen here and now in the Middle East, with two lines featuring state-of-the-art technologies and both designed by SYSTRA.

Between 2006 and 2014, the Group was actively involved in the tramway project design for Dubai, which brings together an unprecedented number of technologies for such a mode of transport. This tramway stands out for many reasons: 100% powered by a ground supply system, so catenary-free; air-conditioned stations with platform screen doors; an automatic protection and control system for the trains. It is the first tramway to be equipped with a system coming from CBTC (Communications-Based Train Control) automatic metro technologies, with human drivers permanently controlled by ATP (Automatic Train Protection) to ensure operations are fully reliable and safe: when a train is 200 metres from a station, it helps the driver line up exactly opposite the platform screen doors. Thanks to these technologies, the line has gained 4km/h in commercial operating speed compared to a traditional line, which in turn is a great benefit for regularity.

In Qatar, the authorities chose SYSTRA to build a state-of-the-art tramway in the run-up to the Football World Cup in 2022, and to create a new city in Lusail, on the outskirts of the capital Doha. Since the earliest stages in 2009 up until 2020, SYSTRA has worked every step of the way to build this tramway totalling 35km in length, of which 27km at surface level or in viaducts and 8km underground, with a total of 37 stations. As lead designer for the Franco-Qatari consortium QDVC (Qatar Diar Vinci Construction major projects), we delivered the technical review of the system design, integration studies, studies for the surface stations and buildings on the maintenance and tram stabling site. Technically speaking, this project is truly one of a kind since it combines a panoply of skills with a mixed charging system – ground level supply; rigid catenary underground; and traditional catenary for the maintenance centre.

THE TECH +

TOWARDS A DRIVERLESS TRAMWAY?

Transport automation is a deep-rooted trend in mobility engineering. It delivers a great many benefits, first and foremost enhanced safety, but also operating gains in terms of energy consumption, frequency, availability, and regularity. At SYSTRA we are focusing on two lines of development for the short- and medium-term:

- Full automation of tram operations within the confines of depots, for automatic stabling as well as washing, sanding, and preparing the vehicles.
- For tram drivers, support to help them drive more efficiently and safely.

As with the autonomous car, we believe driver assistance technologies – for avoiding collisions, providing tram speed protection, supporting driving in poor visibility, or for training purposes – should be introduced step by step.

For tomorrow's tramways, we also believe there will be more connectivity between trams and infrastructure – to deliver an augmented vision of the surroundings, the operating conditions, obstacles, and dangers – as well as 'safety bubbles' around the tramway, to delimit in real time the areas where trams can stop or not, based on the speeds they are travelling at.

And the winner is...

2020: Global Light Rail Awards (U.K.)

2017: Global Light Rail Awards (U.K.): for the White Book on transport automation, which includes tram and metro operations

2012: Worldwide Light Rail Project of the Year (U.K.): awarded by the British Light Rail Association for the tramway projects in Brest and Casablanca



SYSTRA

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