LIGHT RAIL TRANSIT.

egis

© Samuel Duplay

Montpellier LRT

OUR VISION

As a leading figure in light rail projects and credited with more than 70 lines in service around the world, we are a unique industry player with an wide range of skills and expertise in transport and construction for the development of our cities.

With our passion for innovative and responsible public transport projects, we work every day to help LRT become a transformative tool for cities that meets the challenges of the day: cities where active transport modes recover the central role that they deserve, cities where nature returns and thrives, more inclusive cities where districts are connected by fast, safe and efficient tram lines.

We have a straightforward mission: meet the needs of our clients and provide them with all the expertise they need to build and maintain their LRT networks.

Delving deep into our history, we invent the LRT systems of the future: ones that are financeable, eco-designed and connected. Project after project, we develop complementary approaches that make it possible to reduce the consumption of natural resources used in LRT operations, resulting in low-resource, low-fixture tram projects.

This reduces project's carbon footprint, and makes LRT an accessible prospect for many medium-sized towns with various urban configurations. This is why we offer a wide range of LRT systems with optimised capital expenditure costs.

To ensure that cities will be ever more accessible, peaceful and sustainable places to live, we will always be here to support you.

EGIS - AN LRT PIONEER AND LEADER IN FRANCE AND WORLDWIDE

2/3 **of new-generation LRTs commissioned by EGIS**

Already present at the advent of modern tram systems in the 1980s, Egis has become the leading LRT engineering firm in Europe, contributing technical skills and experience to bring excellence to all its projects.

Our experience amounts to

> 900 km

of custom-built LRT lines, spanning more than **40 years**

- Close client relations and attentiveness to client needs,
- Infallible commitment to ensure successful projects,
- Innovation supporting the transition to the green economy, end users and operators,
- The ability to bring together all necessary skills for a project,
- Proven proficiency in complex projects,
- Technical expertise.

1980

- **Nantes** Line 1
- **Grenoble** Line A

1990

- **Grenoble** Line B - 1st and 2nd extensions of line A
- **Strasbourg** Line A and extension - Line D

2000

- **Nantes** Extension of line 1, and phase 1 of line 3
- **Lyon** Lines T1 and T2 and their extensions - Line T3
- **Porto** Lines A, B, C and E
- **Grenoble** Extension of lines B and C - Line D
- **Montpellier** Line 1 and extension - Line 2
- **Paris** Line T3 a
- **Valenciennes** 1st Transville line and extension
- **Le Mans** Line 1
- **Marseille** Lines 1, 2 and 3
- **Strasbourg** Lines B, C, E and their extensions
- **Krakow** 1st and 2nd phase of the FastTram
- **Mulhouse** Extension of line 1

2010

- **Lyon** RhônExpress - Extension line T2
- **Grenoble** Line E
- **Toulouse** Line T1
- **Rabat** Lines T1 and T2
- **Paris** lines T3a and T3b
- **Besançon** Line 1
- **Dijon** Lines A and B
- **Brest** Line 1
- **Montpellier** Lines 3, 4 and 5
- **Orleans -** Line 1
- **Constantine** Line 1
- **Aubagne** Line 1
- **Sidi bel Abbes** Line 1
- **Alger -** Line 1
- **Caen** Lines 1 and 2
- **Saint-Etienne** Extension of line T3
- **Clermont-Ferrand** Maintenance of line A
- **Valenciennes -** Line 2

2020

- **Nantes** Development of new LRT lines
- **Strasbourg** Network extension
- **Birmingham** Network extension
- **Paris** Extension of line T4 - T9 T12 - T13 express
- **Marseille** North and South - 4th September Tramway
- **Nice** Line 2,3,4 et T5
- **Casablanca** Lines 3 and 4
- **Alexandria** Upgrading of the Al Ramleh line
- **Luxembourg** Findel airport - Cloche d'Or line
- **Angers** Lines B and C
- **Lyon** T6 North and extension of line T2
- **Brest** Line 2
- **Stockholm** Kista line
- **Dublin** Extension of the Green Line
- **Medellin** 80th Avenue Tramway
- **Le Havre** T3

ADAPTING TO THE ISSUES SPECIFIC TO EACH CITY

For over 40 years, we have been adapting our methods and designing innovative projects to meet our clients' requirements in terms of mobility, financing and urban integration.

Using the full range of expertise available at Egis, we create customised projects providing solutions to local and regional issues. Pushing the limits of innovation to benefit both users and residents is a source of fulfilment for us.

Besançon LRT

Introduction of modern LRT systems
in France 1985, Nantes

Design of the first low-floor LRT
1987, Grenoble

First fully low-floor LRT
1994, Strasbourg

First developments to reduce motor vehicle traffic to prioritise the LRT
1994, Strasbourg

Re-use of a railway track bed
2006, Lyon T3

Design of the first short, cost-effective LRT
2012, Besançon

Integration of the first LRT with supercapacitor batteries
2019, Nice T2-T3

A GLOBAL OFFERING, FROM UPSTREAM TO OPERATION

We offer services at all phases of an LRT project.

CONSULTING AND UPSTREAM STUDIES

Study of transport corridors, assistance within the choice of transport mode, economic and financial feasibility...

PRELIMINARY DESIGN

Design development

EPC MANAGEMENT

EPC design studies, works contract awards, procurement, work supervision

© Serge Gounand

© G. Parent


© Mario Renzi

MANDATES AND TECHNICAL CONSULTANCY

Assistance to project owners for the implementation of LRT projects: EPC contract awards, administrative and financial contract management, technical coordination, communication

SPECIALIST AUDITS

Track, track bed, Overhead contact line, power, telecommunication, ticketing, railway signalling, rolling stock, maintenance depots cycling and pedestrian paths, cybersecurity, operational improvements, etc.

ASSET MANAGEMENT

Network diagnosis and obsolescence analysis, asset maintenance strategy, medium and long term investment and maintenance plans, work on the network during operations, etc.

FOCUS ON...

MANDATES AND TECHNICAL CONSULTANCY

Our long-standing expertise in LRT projects in France enables us to support our clients in carrying forward their LRT projects, whether through project owner mandates or technical consultancy assignments.

As mandated project owners, we can act on behalf of clients on missions including: the coordination of the project, general planning, scheduling and coordination, awarding and overseeing EPCM and rolling stock procurement contracts, administrative and financial management, communications, etc.

As General Consultants, we work alongside the project owner, providing the additional requisite skills to drive the project to completion; general studies, rolling stock, rail track or systems expertise, planning, etc.

Brest, 2020 - 2026
LRT line 2, technical consultancy

Caen, 2013 - 2019
Project owner mandate
Replacement of line 1 and creation of line 2

Orléans, 2007-2012
LRT line 2, Technical consultancy

Caen line 1

Work on a network in operation, Grenoble LRT

NETWORK MAINTENANCE AND UPGRADING

Assessment of the network and analysis of obsolescence, fleet maintenance strategy, mid- to long-term investment and maintenance plans, asset management, heavy works on networks in operation, etc.

Our detailed knowledge of LRT system components makes us the ideal partner for the long-term maintenance and adaptation of your LRT networks.

In addition to our expertise in design services and asset management, Egis is the leading provider of "blitz" assignments on networks in operation, ensuring a rapid response with low operational impact and effective safety management with regard to residents.

Replacement of the T1-T2 intersection
Lyon, Pont Gallieni - Quai Claude Bernard - Perrache

Creation of double junctions with network in operation
Strasbourg lines F-B I Valenciennes lines 1-2

Post-incident repairs
Blitz 72h operation involving prefabricated installations
Tours line 1

Assessment, upgrading and replacement of tracks and bed
Grenoble LRT, framework agreement since 2017

Maintenance of the complete transport system
Strasbourg network, framework agreement since 2012

WE DESIGN PROJECTS...

© Samuel Duplaix


CA

TO CREATE CITIES CENTRED ON ACTIVE MODES

LRT projects offer an opportunity to re-design a city and create highly versatile public spaces.

Through the choices made on integrating transport, the urban furniture, through the comfort of urban space and its clarity to users, we are designing a more liveable, more desirable and more urban cityscape.

Bicycles, pedestrians and active transport modes regain their rightful key status in our cities.

Dedicated active transport infrastructure
Luxembourg line 1, Lyon T2 Montrochet, etc.

Calming of urban spaces
Luxembourg Place de la Gare,
Lyon T2 Place des Archives, etc.

Elimination of traffic lanes
Besançon line 1, Luxembourg line 1, Angers lines B and C, Nice T4, Lyon T2 Montrochet, etc.

Implementation of priority for bicycles at traffic lights
Lyon C3

Besançon line 1, Place de la Révolution

Luxembourg line 1, avenue de la Liberté

Lyon, avenue Thiers, tree canopy, lines 1 & 4

Nice, avenue de la Californie, line 2

TO CREATE GREEN, PERMEABLE DISTRICTS

We act to create more permeable greener and livelier cities.

Our solutions include rainwater absorption to create a permeable urban environment and reduce the pressure on drainage networks.

We also strive to develop ecological connectivity with existing natural areas throughout our projects. This connectivity is fundamental to ensuring biodiversity returns to our cities.

By selecting appropriate surfacing materials and creating overhead tree canopies, we offer feasible solutions to reduce the urban heat island effect and develop a more pleasant, attractive city.

Track bed rainwater absorption
Nice lines 2 & 3, St-Etienne line 3, etc.

Tree canopies
Lyon avenue Thiers T1

Reintroduction of green corridors
Angers lines B and C, Nice lines 2 & 3, Lyon T3, etc.

Elimination of the heat island effect
Design by ScorelCU® Lyon T6 Nord, Nice T4

Reintroduction of biodiversity with Landboost® modules, an Egis concept
In design phase for Lyon T6 Nord and Nice T4

Pooling of water resources for watering
Dijon line 1

Use of untreated groundwater
Grenoble line E

A permeable urban environment where nature can return and thrive

TO ACHIEVE A RESOURCE-EFFICIENT, FRUGAL LRT

Before beginning the design studies, we advocate a resource-efficient and frugal design to our clients, by studying the structures or equipment that could be optimised or eliminated to avoid:

- Impacts on the biosphere and biodiversity in areas crossed by the LRT
- Inappropriate use of raw materials
- The use of materials with high GHG emissions in their total life cycle

The optimisations are presented along with the corresponding carbon emission savings, financial impact and impacts on the project.

Design choices can then be made by the project owner and stakeholders will have full knowledge of the benefits and impact on the project.

Re-thinking LRT for the most appropriate use of resources

Luxembourg LRT maintenance centre

Dijon Chenôve maintenance depot Engineering: Egis - Architectural Design: Ferrand-Sigal


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© DR


© Daniel Plazanet


© Mario Renzi

TO ACHIEVE A LOW-CARBON CITY

Construction activities can no longer be envisaged without considering the resources available and the carbon emissions in a total life-cycle approach.

Egis is a pioneer in the design of more energy-efficient projects using fewer resources, which reduces the carbon footprint of the infrastructure whilst maintaining its durability.

We incorporate this dimension into the design of maintenance and stabling facilities, and we design energy-positive buildings (extra thermal insulation, photovoltaic panels, geothermal sources).

Low-energy building and solar farm
Dijon line 1, Besançon line 1, Luxembourg line 1

Grass-covered, sliding formwork track
that reduces concrete volumes in exchange for more earth
Besançon line 1

Duct bank
Besançon line 1

Asphalt in the foundations
Besançon line 1, Strasbourg depot, Dijon line 1

And in the future...

Low-carbon concrete and biobased materials
for the track bed, station platforms, buildings along the line, depots and workshops, etc.

Reduction in track bed concrete volumes
by installing thin slab track systems, by modifying the thickness of foundation concrete depending on soil bearing capacity,

Cellular structure
for station platforms

Low-carbon concrete and biobased materials

FOR DESIGNS SUITED TO NEEDS AND FUNDING CONSTRAINTS

Each local area has its own particular characteristics, and projects must therefore be designed to take into account specific urban integration and investment constraints.

Thanks to its unique experience in bringing together all aspects of an LRT project ranging from urban development to the transport system components, Egis has developed various types of LRT projects which allow for modularity according to investment capacities.

Valenciennes line 1

Lyon: T3 / Rhônexpress

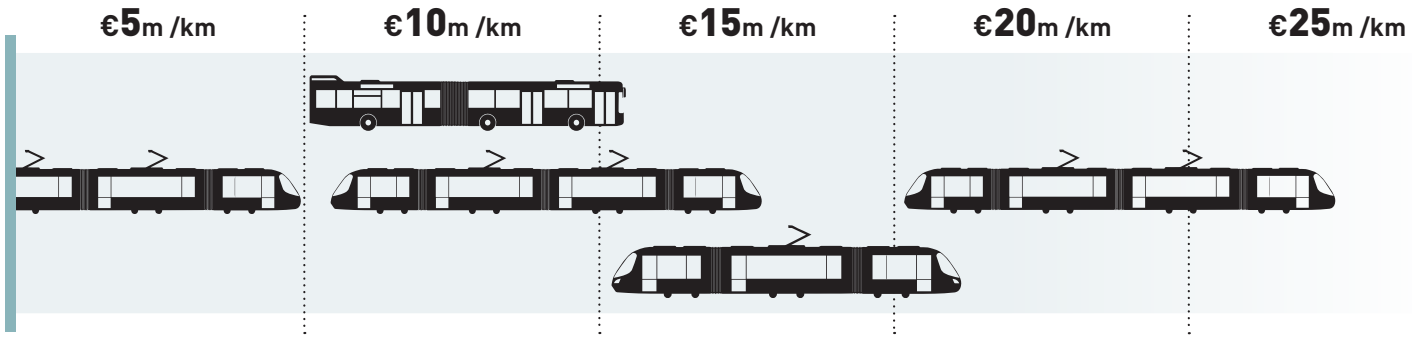
Besançon line 1

Express LRT - €8m /km
Valenciennes line 1

Cost-effective LRT - €13m /km
Lyon T3 / RhônExpress

Short LRT - €16.5m /km
Besançon line 1

Egis proposes a full range of Capex costs to allow all types of city with a population of more than 100,000 to benefit from an LRT.



Express LRT
€5m - 10m /km, long interstation distances and lower frequency, suitable for outlying suburbs

BRT
€10m - 16m / km

Cost-effective LRT
€12m - 18m /km
Economical in terms of systems and equipment

Short LRT
€16m - 18m /km
The size of an articulated bus

Conventional LRT
€20m - 26m /km

Paris CCR line 1

TO EMBRACE THE DIGITAL TRANSITION

IMPROVING THE USER EXPERIENCE

Passengers wishing to optimise transport connections or make the most of waiting times must have information available at the right time.

We have developed an augmented station concept connecting with the surrounding urban environment:

- Secure parking for bikes and kick scooters,
- Charging stations,
- Street library,
- Information on local services,
- ... the possibilities are endless!

MANAGING YOUR TRANSPORT NETWORK DATA

Your network data is key to maintenance, upkeep and providing passenger information.

We propose technical solutions to collect data from the OCC structure it and make it available to the public transport authority.

This data can then be made available and used in the production of technical or passenger apps. We also use this data for customised asset management solutions.

In today's world, the security of your network is a paramount concern. The cybersecurity solutions we propose guarantee that your installations are protected against piracy.

Saint-Etienne augmented station line 3

Augmented stations
Specific design, charging stations, street library, etc.
Saint-Etienne line 3

TO RESOLVE COMPLEX PROBLEMS

CROSSING MAJOR NATURAL FEATURES

Rivers, waterways, hills and steep gradients are part of the urban fabric of certain cities and represent major challenges in designing LRT projects.

Due to the diversity of its expertise, Egis can call on a team of in-house experts and architects and thus offer our clients the best technical, landscaping and urban integration solutions.

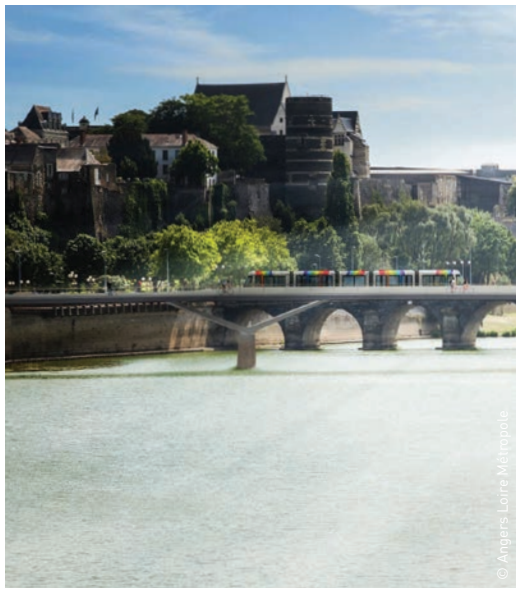
Egis possesses integrated technical expertise, and is therefore able to design and supervise works on non-standard civil engineering structures, whether new or renovated.

Citadelle bridge - 2016 national engineering award
Strasbourg line D

Bridge across the river Maine
Angers lines B and C

Grand Duchesse Charlotte bridge (Pont Rouge)
across Alzette valley
Luxembourg line 1

Strasbourg line D, Citadelle Bridge across the Vauban basin



Angers line B and C, bridge across the river Maine

Luxembourg line 1, Pont Rouge

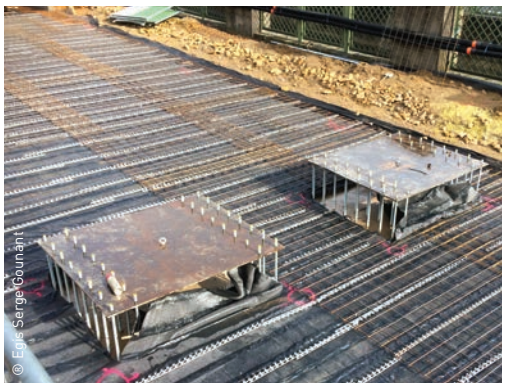
Innovative system for static ground-level recharging
Recharging of super-capacitor banks in 20 seconds at stations
Nice line 2

1.6 km of tunnel
passing under the Meudon forest
Paris suburbs, line T6

3.2 km of tunnel passing under the city centre
Nice line 2

Viroflay LRT T6, Paris region

Nice line 2, underground section for optimal service provision in the city centre



Luxembourg line 1, installation of a track with spring vibration isolators

INTEGRATING LRT SYSTEMS IN DENSE URBAN ENVIRONMENTS

Integrating an LRT in a city centre or any other dense or historical urban environment can be a complex task.

We have developed several solutions in response to these issues, such as replacing overhead power by super-capacitor banks with ground-level recharging in 20 seconds at stations.

On the strength of our expertise in building metro lines, we have unique experience in designing LRT tunnel sections. With one-off developments of this kind, lines can reach urban areas that cannot be served by overground systems.

DESIGNING AND INSTALLING SPECIAL TRACKS

Vibration risks can affect the surrounding built environment.

We have completed several designs using anti-vibration tracks, which mitigate the impact of vibrations on buildings and the immediate environment.

The design of a track with medium attenuation springs (4 Hz) for the Luxembourg LRT is a first in Europe.

Track with spring vibration isolators
Near the theatre, Luxembourg line 1

Shock- and vibration-resistant fibre-reinforced concrete track
Birmingham, line 1

Very low frequency anti-vibration system
Pont Rouge, Luxembourg line 1

Antivibration track
Saint-Etienne, line 1

FOR LOW IMPACT BUILDING SITES

Some projects to build, upgrade or refurbish infrastructure, roads or buildings can have undesirable repercussions on local residents, traders or users of public space.

People's everyday lives can be impacted by a change in traffic direction, the closure of streets or pavements, poorer access to shops and, public services, electricity or gas cuts, and so on.

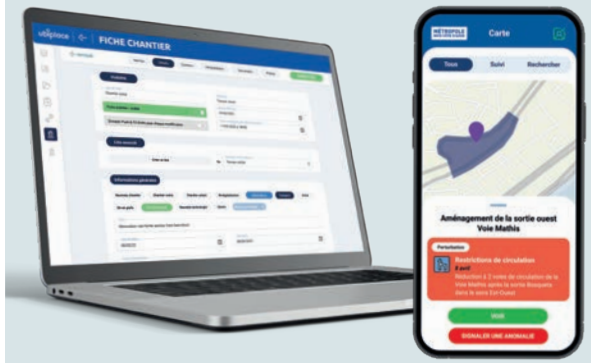
Residents and public authorities alike are in demand of timely, reliable information on the impact of such works. Making our cities "smart" also means improving people's everyday living conditions by harnessing new technologies and innovative applications.

From design phase and throughout the project, communicate appropriately to create a shared achievement.

Participative design
Lyon LRT line T6 Nord

Resident liaison with Smart Chantier app
Nice LRT lines T1 and T2

SMART CHANTIER®



Smart Chantier is a digital platform that allow organisations involved in a worksite to be better organised and coordinate communication towards residents who may suffer disturbances due to the ongoing works.

Whether in the form of a push notification, a text message or a flyer, residents and users will be informed of any unexpected difficulties that might occur during the construction work (traffic problems, noise, water/ electricity cut-off, etc.).

Through this solution, the project owner can organis structured communications through various channels with the programme manager, contractors and all other entities invoved in delivering the project.

General Consultant for LRT network asset management strategy
Toulouse

Certification to ISO 55001 standard
Londres, Docklands Light Rail

100% BIM design
Marseille LRT line 3 "North-South"
Birmingham

Grenoble, construction work on LRT network

Marseille, use of BIM for design then maintenance

TO MANAGE ASSETS IN THE LONG TERM

ASSET MANAGEMENT

Drawing on detailed knowledge of every aspect of an LRT network, we support our clients in implementing a genuine long-term maintenance strategy.

We offer our contribution in three areas:

- Supporting PTAs in introducing the process
- Contributing to asset management (inventory, diagnosis, planning repair work)
- Planning the digitalisation of asset management

DIGITAL TWIN

With the "digital twin" service offering, Egis harnesses its know-how in BIM management, its involvement in the ongoing development of BIM standards (MINnD, IFC Rail, ISO 19650) and its expertise in interface coordination and control, for the benefit of transport infrastructure owners or operators wishing to have a reliable, up-to-date inventory that facilitates anticipations in their fixtures to:

- Optimise the cost and duration of any work on site
- Simplify asset management
- Obtain more fluid dialogue between emergency services, operators, residents, users, etc.
- Accelerate and secure the start-up of new build or modernisation projects
- Measure and visualise the carbon footprint of a building project or an operation
- Better guarantee the safety of workers

TO ASSIST OUR CLIENTS WITH NEW SOLUTIONS

TURNKEY SOLUTIONS

Some projects may require contractual arrangements to be set up between engineers and contractors.

We are regularly involved in turnkey operations alongside contractors, whether to create specific equipment, build maintenance depots or build a complete LRT line.

Egis also has in-house expertise in carrying out signalling engineering works via its subsidiaries Sintra and Est Signalisation.

A partnership contract between the engineer, the contractor and the project owner,
Birmingham network extension

Addition of a station and a crossroads
in a turnkey contract entirely by Egis (design services & works phases)
Reims line 1

PPP contract for power and low voltage
Dijon line 1

Modification of railway signalling at the St-Priest maintenance depot
Lyon LRT network

© Egis

OUR PROJECTS

FRANCE

ANGERS LINE B

Design services
Legal applications
Works supervision
Scheduling - Coordination
Testing
LRT system
Urban development works

In 2015, Angers metropolitan authority commissioned Egis to create the second line of its LRT network, including a trunk section in common with the existing line. It includes a ground-level power supply section (APS system) of more than 1.3 km connected to the existing APS section.

Egis performed the feasibility studies and general design services and works supervision, integrating the engineering aspects of the new Pont des Arts et Métiers that features a mixed LRT-bus section and carries all sustainable transport modes.

Project Owner
Alter Public

Dates	Length	Cost of works
2015 - 2024	10 km	€145m

SPECIAL FEATURES

- **Ground-level power supply** in the vicinity of historic monuments and on the Pont des Arts et Métiers
- **80% of the alignment consisting of grassed track**
- **Perfect compliance with operation interruption deadlines** when connecting track to the existing line
- **Innovative joint signalling for rail and traffic lights**

Angers LRT

Design services · Legal applications · Works supervision · Scheduling - Coordination · Testing · LRT system · Urban development works · Maintenance - Stabling · Rolling stock

FRANCE

BESANÇON LINE 1

Besançon, place de la Révolution, line 1

In 2009, the Greater Besançon Authority took the decision to adopt a wide-ranging sustainability policy.

From a transport perspective, this resulted in the council appointing Egis and its partners to build its first, ecological and economical LRT line, starting with preliminary studies, through to commissioning.

Project Owner
Communauté d'Agglomération du Grand Besançon

Dates	Length	Cost of works
2003 (PS)	14.5 km	€230m
2009 - 2014 (design & supervision of works)		

SPECIAL FEATURES

- **Reduction in road traffic** for a calm city centre
- **Cost-effective LRT €16.5m/km** close to the cost of a BRT
- **Short LRV, 23m long,** adapted to the city's constraints
- **Sustainable LRT** with a low carbon footprint using resource- and energy-efficient design choices
- **Integration in roads up to 10m wide**
- **Commissioning ahead of schedule**

BIRMINGHAM - ENGLAND

DESIGN OF EXTENSIONS TO THE MIDLAND METRO SYSTEM

A series of network extensions to the existing Midland Metro Line 1 (opened in 1996) was proposed and is being delivered by Transport for West Midlands (TfWM), as the passenger transport executive for the West Midlands Combined Authority (WMCA), to improve connectivity and generate economic development within the wider metropolitan region of the West Midlands.

Egis is the lead designer and majority shareholder (50%) in a design joint venture formed with Pell Frischmann and Tony Gee. The design JV is a Non-Owner Participant in the Midland Metro Alliance (MMA) formed by TfWM (Owner) and Colas Rail, the delivery Non-Owner Participant.

Project Owner
West Midlands Combined Authority (WMCA)

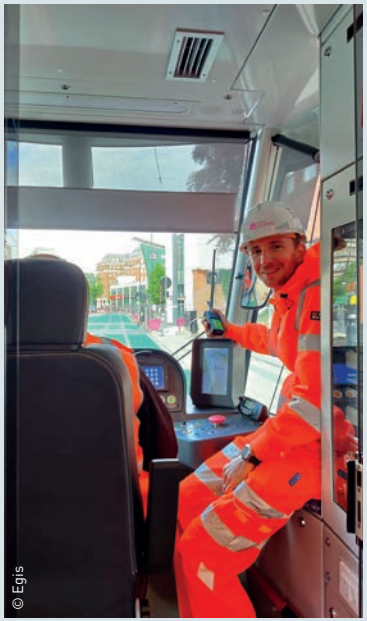
Dates	Length	Lines
2016 - 2026	34 km	6

SPECIAL FEATURES

- Reduced carbon footprint through the use of fibre reinforced concrete trackform, rather than traditional steel reinforced concrete
- Some complex technical challenges were overcome by the Egis team, including resolution of very difficult track geometry initially produced but not completed by a preceding designer for the Birmingham Eastside Extension.

Tram, Birmingham

ADDED VALUE



INNOVATION

Egis proactively helped the WMCA and their tram operator, Midland Metro Limited, develop dynamic OLE and static charging points to support use of battery operated trams as part of the catenary-free Centenary Square Extension (CSQ) scheme through Birmingham city centre to reduce visual impact in this historical location and other heritage critical locations on the wider network. This was the first use of battery operated trams in the UK. This resulted in an **infrastructure capital cost reduction estimated at £9.24M** for the CSQ scheme alone.

Digital Solutions. To improve system integration capability, Egis developed INMASYST: a web-based tool to manage complex interfaces, using open-source data (ISO AP 239). INMASYST links seamlessly to other software systems like ProjectWise, ArcGIS, Primavera and BIM/GIS. This helped us move away from a basic interface management approach to manage interfaces effectively accurately between design disciplines and wider stakeholders. This helped to clarify who was responsible for various activities and what each party would need to provide to another to improve design efficiency.

Sharedknowledge. Using the Engineering Management Team's experience, we produced a matrix of detailed roles and responsibilities for all members of the MMA relating to design; and led Safety by Design seminars to share general design best practice and lessons learnt activities.

Delivering Social Value. By working with the Institute for Apprenticeships & Technical Education (IfATE) we introduced a new apprenticeship programme in Tramway Construction in 2019, from which over 50 local people have qualified since. We have also promoted the use of local SMEs to reach the target of 80% reliance on local businesses within the supply chain.

FRANCE

CAEN, TRANSFORMATION FROM GLT TO RAIL LRT PROJECT OWNER MANDATE

From its first years in operation, the rubber-tyred TVR guided light transit (GLT) system encountered serious reliability, availability and crowding problems, which in the short term threatened the entire Caen tram operation the Caen la Mer council consequently launched the "2019 LRT" operation in 2012 to transform the existing GLT line into three standard track-mounted LRT lines.

The Caen la Mer council commissioned Tramcités (an Egis - SEM Normandie aménagement consortium) to lead the 2019 LRT project on its behalf via a project owner mandate.

Project Owner
Communauté urbaine Caen la Mer

Dates	Length	Cost of works
2013 - 2019	16.2 km - 3 lines	€275m

SPECIAL FEATURES

- **Management of the entire project:** timeframes cost, quality
- **Optimisation of construction period:**
  > 18 months to transform and extend line 1
  > 11 months to build the maintenance depot (13 months faster than usual).
- **Controlled Capex costs**
- **Transport service continuity** use of 50 articulated buses to replace the GLT during the works, as near as possible to the track route.
- **Transformation of a rubber-tyred system into a rail LRT**

Caen trunk section, Place Saint-Pierre, lines 1, 2 and 3

© Agglomération Caen la mer, Solveig de la Hougue

IRELAND

DUBLIN – 2 LRT LINES

Dublin is both the capital of Ireland and the country's largest city. In the 1990s, its economic growth occurred together with similarly rapid and continuous population growth. This prompted the public authorities to plan the construction of a three-branch light rail network, with two of the lines entering into revenue service at the beginning of the Noughties.

Egis was appointed to carry out the engineering, procurement and testing & commissioning of the first two lines of Dublin's LRT system, comprising 25 km of track, 14 Citadis 401 40 m tram sets, 26 Citadis 301 30m tram sets, 36 stations, a main depot (Redcow), and the line depot at Sandyford.

Project Owner
CIE (Córas Iompair Éireann), then RPA (Railway Procurement Agency)

Dates	Length
1994 - 2004	25 km

SPECIAL FEATURES

- Technical design of a comprehensive range of the system's
- Supervision of rolling stock manufacturing and of testing & commissioning
- Assistance in formulating maintenance contract with rolling stock manufacturer


© DR

FRANCE

ENTIRE STRASBOURG NETWORK

2016 NATIONAL ENGINEERING AWARD FOR THE CITADELLE BRIDGE

Design services
Legal applications
Works supervision
Scheduling - OPC
Testing
LRT system
Urban development works
Maintenance - Stabling
Rolling stock

A pioneer of LRT renaissance in the 1990s, the Strasbourg Eurométropole authority (EMS) commissioned the Serue Ingénierie - Egis - Alfred Peter consortium to build the first LRT line followed by five further lines and various extensions.

Thanks to this LRT network, Strasbourg now has an effective network serving several municipalities in the urban area, as well as the neighbouring German town of Kehl.

Project Owner
Eurométropole de Strasbourg (EMS)

Dates	Length	Lines
1984 - 2015	70 km	6

SPECIAL FEATURES

- **Integrated Egis design of the Citadelle bridge** over Bassin Vauban, next to the Rhine, with a 163m-long suspended curved deck
- **Blitz assignments on networks in operation** for heavy maintenance works
- **Management of interfaces with sensitive associated projects**
- **Design and works supervision interfaced with the SNCF network in operation**
- **Unique know-how on the Strasbourg network** thanks to the stability of the consortium

Strasbourg line F, extension to Koenigshoffen

CITADELLE BRIDGE

A complex structure of elegant simplicity.

A team of engineers and architects from the Egis group was brought together for the original design of the Citadelle bridge across the Vauban basin in Strasbourg, allowing the LRT network to be extended towards Germany.

The 163m-long deck with its very thin continuous curved shape, contributes to its urban appearance. This is both an intentionally graceful shape but also the result of an analysis of the forces exerted, in order to optimise the use of resources, reflecting our approach to sustainable construction.

This world first was recognised by the 2016 national engineering award (GPNI) for its elegant simplicity, originality and clarity of form. The structure is the outcome of highly integrated design between architects and engineers at Egis.

The design process used a 3D digital model from the outset, allowing the engineering and architecture teams to discuss the outline designs produced, and in order to fully meet the Project Owner's expectations.

Design faults could be detected very quickly thanks to the 3D digital model, and any imprecision in the project was avoided. At all design phases, the team sought to reconcile the requirements of the LRT, in particular a certain rigidity of the deck supporting the rails, with the flexibility of the suspended steel structure.

The Citadelle bridge across the Vauban basin linking Strasbourg to the German town of Kehl

A FIRST PROJECT IN SWEDEN FOR EGIS: THE KISTA TRAMLINE

Region Stockholm is expanding its tramway network called "Tvärbanan" in the northern part of Stockholm. Storstockholms Lokaltrafik (SL) has appointed Gülermak through a Design & Build contract. The project is named KG40 Kistagrenen.

As sub-contractor of the design & build project, Egis with its first contract in Sweden, is in charge of the following topics:

- Project management associated with the design,
- Alignment, tracks and duct banks,
- Power Supply,
- Overhead Contact Line,
- Low voltage systems and telecoms,
- Tram stops,
- Internal interface management.

In its role as designer, Egis is supported by its Swedish partner Tyréns itself tasked with civil works.

SPECIAL FEATURES

- Multiple engineering structures, comprising 15% of the line length (with 3 viaducts and a cutting)
- The extension runs from Bromma Airport via Sundbyberg and Kista, to Helenelund. With 6.8 km of new infrastructure and 8 tram stops, It will pass by the famous Solvalla horse racetrack, and a residential area before calling at an on-going development area in Rissne, then Kista Centrum to terminate at the Helenelund commuter train station.

EGIS ADDED VALUE

SL has asked for this project to implement a **slab track** as most of the existing network is built with ballasted tracks. With its experience in numerous slab track-mounted tram projects around the world, Egis brings its valuable expertise to this project.

As so much of the line is built on engineering structures, KG40 constitutes a challenge regarding **technical interfaces between tracks and structures.** In particular, precise Rail Structure Interaction studies were conducted, followed by additional studies to situate Rail Expansion Devices and to adjusted longitudinal profiles to optimize the loads.

SL and the local councils conducted preparatory works including streetscape and kerbing works. This initiative generated several constraints which were resolved through excellent collaboration between project contributors.

LUXEMBOURG LINE 1

2018 GLOBAL LIGHT RAIL AWARD WINNER

Design services
Legal applications
Works supervision
Scheduling - coordination
Testing
LRT system
Urban development works
Maintenance - Stabling

The city of Luxembourg wished to create an LRT to optimise journeys and reduce road traffic, thus promoting active transport modes accessible for its residents and pedestrians.

In 2005, Luxtram commissioned the e-Tram consortium led by Egis and the local firm LuxPlan to carry out a complete design services and works supervision assignment to create its first LRT line.

Project Owner
Luxtram

Dates	Length	Cost of works
2015 - 2020	16 km	€220m

SPECIAL FEATURES

- **Longest LRT bridge in Europe:** Pont Rouge, a 335m metal batter-post bridge
- **Innovative** energy capture system with **flash charging** along 3.6 km of line
- **ORTEC® anti-vibration system:** integrated into rails on the Pont Rouge and able to absorb very low frequencies (6 Hz)
- **Installation of spring-damped tracks:** Grundey spring vibration isolators ensuring exceptional damping (4Hz) to avoid propagation to the nearby theatre.

Luxembourg, Boulevard Robert Schumann, line 1

Studies (preliminary, feasibility, design studies) · Legal applications · Works supervision · Scheduling - coordination · Testing · LRT system · Urban development works · Maintenance - Stabling · Rolling stock

FRANCE

LYON, T1, T2, T3 - RHÔNEXPRESS, T6 NORTH

Lyon T2, Cours Charlemagne

Lyon T3 - Rhônexpress, embedded grass-covered ballast track, mixed urban and railway section

Lyon Rhônexpress, ballast track, rail section

In 1997, SYTRAL commissioned Egis to create the first two lines of its LRT network; a true challenge with 20 km constructed in only 3 years between the start of the preliminary design and its commissioning in January 2001.

In 2002, construction of the T3-Rhônexpress line required research and development of innovative solutions enabling the LRT to run on a former railway line and an urban LRT line to be operated simultaneously with an express line.

In 2020, Egis began the north extension of line 6, supported by an ongoing consultation process with local residents and elected representatives throughout the design phase.

Project Owner
Syndicat mixte des transports pour le Rhône et l'agglomération lyonnaise (SYTRAL)

Dates	Length	Lines
2002 - ongoing	41 km	4

SPECIAL FEATURES

- Construction of a **permeable platform with longitudinal infiltration**
- **Completion of Design and Works in 3 years** (20 km, 41 stations and 1 depot-workshop)
- **Continuous welded rails:** adaptation of rail techniques to the urban environment
- **Creation of a mixed mode of operation** with two different line speeds and intersections equipped with barriers
- **Adaptation of stations to railway safety requirements**
- **Track on grass-covered embedded ballast bed** in an urban environment

FRANCE

MONTPELLIER LINES 1 TO 5

Studies (preliminary, feasibility, design studies)
Legal applications
Works supervision
Scheduling - coordination
Testing
LRT system
Urban development works
Maintenance - Stabling
Rolling stock

In 1995, the Montpellier metropolitan authority selected Egis for construction of the first two lines of a modern, high-performance LRT. In 2005, Egis was again appointed for general design services and works supervision on lines 3 and 4. In 2011, Egis performed the preliminary studies and the preliminary and final design for line 5.

Today, the city's inhabitants benefit from one of the best LRT systems in France, in terms of service for residents and efficiency, serving 50% of the population of Montpellier and 57% of jobs.

Project Owner
Transports de l'Agglomération de Montpellier (TAM)

Dates	Length	Lines
1995 - 2020	79 km	4

SPECIAL FEATURES

- **Understanding and translating the metropolitan authority's political choices into projects,** made possible thanks to the long relationship between Egis and the Project Owner
- **Adaptation of projects** and the network to **mobility issues within the metropolitan area**
- **Numerous** examples of the perfect management of **works carried out with the network still in operation**

© Samuel Duplaix

Montpellier, Saint Roch station

Montpellier, line intersections

Lyon, replacement of the T1-T2 Gallieni bridge intersection

WORKS ON NETWORKS IN OPERATION

With examples such as **Montpellier, Strasbourg, Lyon, Grenoble, Valenciennes, etc.,** Egis is regularly involved in works on networks in operation, whether to connect a new line, install track equipment or for network maintenance.

We have extensive experience in works on networks in operation. **This renowned expertise is a guarantee for the Project Owner** that rapid, complex operations will be performed to **complete works efficiently and safely**.

These operations are performed within a very restricted time window, varying from a few days to a few weeks, focusing on a specific sector or structure involving a potentially serious risk for operations or in terms of disturbance to local residents.

Scheduling is prepared years in advance, to the very day and in coordination with many external participants.

Success in these operations depends in particular on working closely with the operator, from the start of the studies, to define in detail each party's working methods, and how network traffic is to be interrupted and resumed following trial runs.

To limit the impact on network operation, we deploy customised solutions, which may even include prefabricating items off site before installing them during "blitz" assignments (as we have already done in Lyon, Valenciennes, Strasbourg, etc.).

FRANCE

NICE LINES 2, 3, 4 & 5

Design services · Legal applications · Works supervision · Scheduling - OPC · Testing · LRT system · Urban development works · Maintenance - Stabling · Rolling stock

To meet passenger travel needs in its geographical area, Nice metropolitan authority commissioned Egis to extend its LRT network by creating lines 2 and 3.

This large-scale project with 16 km of new line is a melting pot of innovations, showcasing a new generation of LRTs even more successfully integrated into their urban environment.

In early 2021, Nice commissioned Egis and its partners to design and build line 4 of the LRT network.

Then in 2022, the same group was appointed for preliminary studies on a future fifth line.

Project Owner
Nice Métropole Côte d'Azur

Dates	Length	Cost of works
2010 - ongoing	16 km	€780m

SPECIAL FEATURES

- **4 km of tunnels** and **4 underground stations**
- 12 km section without overhead contact lines, using a **unique system of ground-level charging when stationary** (see box opposite)
- **Completed in 3 years**, 2 years ahead of schedule
- **Greening:** 2,500 trees planted
- 60% of the route with **grassed permeable track**
- **Innovative commissioning in sections** to meet the Client's targets.

Nice, Avenue de Californie, line 2

Nice lines 2 & 3, Opportunity recharging system in stations

RAPID CHARGING SYSTEM

The LRT runs for 12 km without overhead contact lines (except in tunnels) thanks to the new Alstom Citadis X05 vehicles equipped with an on-board energy system: Lithium Capacitor super-capacitors - Alstom Citadis Ecopack© technology.

This system is installed on the tram's roof and provides enough power for autonomous travel between stations. Recharging takes 20 seconds with the static charging technique in stations: collector shoes make contact with the charging rail beneauth the vehicle.

With this solution, overhead contact lines are no longer necessary, and their potentially unsightly presence in the city can be eliminated.

The project in Nice allowed Alstom to develop this technology known as SRS©.

TUNNEL UNDER THE OLD TOWN

The works on line 1 had left a lasting memory through their devastating impact on the city's finances and historical heritage.

To avoid a repeat of the previous pitfalls, an innovative tunnel solution was implemented by Egis and its partners.

Integrating this solution was a true technical challenge with a number of risks needing to be tackled: flooding, coastal flooding, earthquakes, historic buildings, geotechnical aspects, above-ground stations and buildings in the old town, etc.

All these risks were addressed to create a rapid transport system with a low impact on the city centre compared to an at-grade LRT.

Nice line 2

FRANCE

PARIS REGION LINE T4

Design services
Legal applications
Works supervision
Scheduling - OPC
Testing
LRT system
Urban development works
Maintenance

Commissioned in 2006 and operated by SNCF (French national railways), the T4 tram-train line runs between Aulnay-sous-Bois and Bondy. In 2013, Ile-de-France Mobilités commissioned Egis to extend this LRT line to Clichy-sous-Bois and Montfermeil.

This project helps open up access to and from districts on the Clichy-Montfermeil plateau, and will in the long term connect with Grand Paris Express line 16 planned for 2024.

Project Owner
Ile-de-France Mobilités

Dates	Length	Cost of works
2013 - 2020	6.5 km	€270m

SPECIAL FEATURES

- **Significant interfacing between the LRT project and urban renovation** in the districts it passes through
- **Connection to the existing light rail network**

T4 Clichy-Montfermeil

Design services · Legal applications · Works supervision · Scheduling - OPC · Testing · LRT system · Urban development works · Maintenance

PARIS REGION T12 EXPRESS

TRAM-TRAIN

T12 Express, municipality of Ris-Orangis, Avenue Ambroise Croizat

T12 Express, Epinay-sur-Orge, rail bridge over the LRT

T12 Express, municipality of Ris-Orangis, Avenue Ambroise Croizat

In 2013, Ile-de-France Mobilités commissioned a consortium led by Egis to carry out design studies and supervise works for all infrastructure and systems required to extend line T12. This 10.3 km extension includes three bridges over the A6 motorway and two bridges over local roads.

Running primarily on the national rail network, the T12 extension is a tram-train line continuing from the existing line between Epinay and Evry, which in due course will replace the C8 branch of the RER C regional express.

Project Owner
Ile-de-France Mobilités

Dates	Length	Cost of works
2013 - 2024	10.3 km	€270m

SPECIAL FEATURES

- **Design adaptation** for creation of an LRT **on an existing railway track bed**
- **Technical interfaces relating to operation of an LRT on a railway line:** power supply, track equipment, rolling stock
- **Land tenure in a highly restricted environment:** motorway, very dense built environment, rail track, etc.

AUSTRALIA

PARRAMATTA LIGHT RAIL

The Parramatta LRT project is part of the major development program of Greater Parramatta. Over the next 20 years, Parramatta will see its population grow by 72,000 inhabitants while its density will double between now and by 2050. Parramatta is to become a second node of connectivity in Greater Sydney, such as the central business district (CBD) is now, notably with the Parramatta LRT and Sydney Metro West.

Great River City, the consortium formed by Transdev and CAF to deliver the System Operation and Maintenance (SOM) contract for stage 1, appointed Egis to perform critical early activities on the project. In particular, Egis performed the operability and maintainability design review on behalf of Transdev, prepared the Concept of Operation and Maintenance to be used as an O&M handbook by all designers on the project (system and civil) and sat on design review meetings on behalf of the operator to ensure operator requirements were taken into account.

Project Owner

Great River City Consortium : Transdev Australasia Pty Ltd & CAF Rail Australia

Dates	Length	Total Project cost
2019 - 2020	12 km	€1.475 bn

SPECIAL FEATURES

- Providing Operability & Maintainability Design Review
- Preparation of the Concept of Operation for the project
- Preparation of the Concept of Maintenance for the Rolling Stock and the Depot
- Assistance to project management during the delivery of the first phase of the project (participation in meetings, acting on behalf of GRC during design review meetings, management of interfaces between GRC subcontractors)

© Hugh Llewelyn

Parramatta LRT

PORTUGAL

PORTO – 4 LRT LINES

In 1998, the city of Porto launched the design, construction and operation of four LRT lines, with the aim of delivering a modern and attractive transport system by 2009.

This project marked the beginnings of transformation for the city of Porto. The system comprised a total of 68 km of lines (including 40 km of existing track to upgrade and double), and the construction of 8 km of tunnels.

Egis' assignment was to design, build, operate and transfer lines A, B, C and D.

Project Owner
Metro do Porto

Dates	Length	Total Project cost
1998 - 2009	68 km	€2 bn

SPECIAL FEATURES

- Capacity to work within the BOT framework
- Smart blend of three technologies: regional, urban light rail and underground metro
- LRT passes underground through UNESCO listed historical city centre
- Unique ability to efficiently drive all the different group members towards the same goal of time and budget compliant commissioning.
- Met the deadlines for:
  - The election for European capital of culture 2001
  - The Euro 2004 Football Championships

MOROCCO

RABAT – SALÉ LRT

Infrastructure
Various facilities
Urban and landscape engineering
Trackside and on-board equipment
Rolling stock
Workshop/ depot
Utilities relocation coordination

To meet the needs of a growing population and a region undergoing considerable change, the city of Rabat started up the construction in 2007 of the first two light rail lines in the Rabat-Salé metropolitan area.

Egis was appointed to carry out the design and construction project management for this project.

Egis was also in charge of the general management and coordination of the project.

Today the first line is 11.7 km long and the second 9.6 km. They come together for 2.6 km where they cross the river Bouregeg, which separates Rabat from Salé. Together, the lines have 31 stations spaced 60m apart on average. Headway is at 8 minutes (4 minutes on the joint stretch) and the fleet purchased consists of 23 high-capacity vehicles measuring 60m in length.

Project Owner
City of Rabat

Dates	Length	Project budget
2007 - 2011	20.5 km	€472 million


© Egis - Christophe Tatcher


© Egis Rail Alain Rousseau

ENSURING THE FEASIBILITY OF AN EXCEPTIONAL BRIDGE

Egis carried out all the calculations for the Société Générale des Travaux du Maroc (SGTM) for the Hassan II Bridge designed by Marc Mimram. On the basis of these calculations and the architect's design, the shop drawings (1,500 plans and 120 notes) took exactly 3 years, from February 2008 to February 2011.

The shop drawings contract awarded to Egis concerned the main Bouregreg crossing structure as well as a very sophisticated auxiliary structure called the "Nautical Base Bridge", crossing a crossroads on the Rabat side. The latter work was subcontracted to the Swiss design office T-ingénierie.

For the other two parts of the crossing built by SGTM, called Culée Creuse and Rampe tramway ramp, Egis Jmi supervised the shop drawings carried out by the Rabat design office, Team Maroc.

The Hassan II Bridge consists of three parallel decks, each 330 m long:

- Two decks dedicated to road traffic (11.1 m wide for 3 lanes, and 14.6 m wide for 3 lanes and a footpath)
- One deck 14.5 m wide shop drawings used for tramway traffic, pedestrians and cyclists.

FRANCE

ENTIRE GRENOBLE NETWORK

Design services
Legal applications
Works supervision
Scheduling - coordination
Testing
LRT system
Urban development works
Maintenance - Stabling
Rolling stock

Since the 1980s, the Grenoble urban area has been implementing innovative mobility management processes, also pioneering the reintroduction of LRT networks in France.

The Greater Grenoble council appointed Egis to implement the first low-floor LRT in the world. Since then, we have built the five lines that serve the main residential, shopping and services districts. Today, this interlinked, large capacity LRT network benefits from high ridership across the entire public transport network, transforming Grenoble into a sustainable transport capital.

Project Owner
Syndicat Mixte des Mobilités de l'Air Grenobloise (SMMAG)

Dates	Length	Lines
1984 - 2015	49 km	5

SPECIAL FEATURES

- **Reintroduction of the LRT in 1987**
- **Complete design** of an interlinked, scalable **network**
- **A more peaceful Cours Jean-Jaurès** by reducing car traffic and allocating more space to active transport modes
- **Multiple operations on infrastructure in service** as part of a rail track replacement EPC contract commenced in 2017

Grenoble, Rue de la Résistance, line E

Grenoble, Cours Jean-Jaurès, line E

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Design and production: Benoit GINOT / DSD - Gilles L'HOSPITALIER
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