Enabling light rail solutions

Consultancy services for sustainable cities

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Sustainable change.

Content

Sustainable mobility 3
A sustainable solution on track 4
Holistic consultancy for sustainable growth 6
Infrastructure 10
Rolling stock 12
Systems 14
Operations & maintenance 16

Feature project

Feasibility study for Kiel, Germany 8

Key projects

World-class light rail expertise 18

Contact 19

Cover: Wellingdorf top in Kiel, Germany
Visualisation: Ramboll / Henning Larsen Architects

Sustainable mobility

Mobility fuels economic and social development. And with more than half of the world's population now living in urban areas, efficient and sustainable transport systems are vital to ensure liveable cities.

All over the world, more and more people move to urban areas to live and work. This development puts an immense pressure on the urban infrastructure, and results in road congestion, air pollution and limited mobility. It also makes a strong case for light rail, being a high capacity, zero-emission alternative to road traffic. In recent years, a long list of densely populated cities from Stockholm to Sydney have introduced light rail transport as a means for efficient and sustainable public transport. And the fact that light rail has proven to act as a powerful enabler for urban growth and development as well, has only made the case stronger.

Ramboll has assisted numerous cities on light rail projects covering all aspects of infrastructure, systems, rolling stock as well as operations and maintenance of a light rail system. In 2014, we established the Light Rail Competence Centre in Karlsruhe, Germany, as part of the Global Rail Division. Our experts are dedicated to developing world-class light rail solutions – located in a city renowned for continuously optimising its urban and regional light rail system towards higher operational speeds and increased comfort.

About Ramboll

Ramboll is a global architecture, engineering and consultancy company founded in Denmark in 1945. Our 18,000 experts create sustainable solutions across Buildings, Transport, Energy, Environment & Health, Water, Management Consulting and Architecture & Landscape.

Across the world, Ramboll combines local experience with a global knowledge base to create sustainable cities and societies. We combine insights with the power to drive positive change for our clients, in the form of ideas that can be realised and implemented. We call it: Bright ideas. Sustainable change.

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A sustainable solution on track

Light rail not only provides efficient and sustainable public transport – it also has a proven track record to vitalise the urban landscape and foster substantial urban development and growth. No wonder that cities all over the world are starting to look at light rail to relieve road congestion and improve liveability.

Why light rail and why now?

Cities all over the world are starting to look at light rail to relieve road congestion and improve liveability. Why? Because light rail systems meet some of the key requirements for today's rapidly growing cities:

- **It's electric!**
  Electrically powered light rail systems can be equipped to run exclusively on renewable energy sources, thereby lightening the city's carbon footprint.
- **Zero local emissions**
  Unlike petrol- or diesel-powered vehicles, electrically powered light rail systems do not emit particles that pollute the air.
- **High capacity and space efficiency**
  Light rail is highly scalable to local capacity needs and generally provides a high quality as well as capacity compared to buses – thus being a real alternative to the private car.
- **The rail effect**
  Light rail is a comfortable way to travel. Experience shows that people tend to prefer light rail over buses even in cases where there is no significant difference in travel time.
- **Enabler for urban growth**
  Light rail and metro projects around the world have shown that permanent rail-based infrastructure potentially attracts long-term investments and influences patterns of settlement in a fundamental way.

Today's rapidly growing cities call for cost-effective, reliable and sustainable public transport solutions. And as a high capacity electrically powered transport system – that has also proven to act as a powerful enabler for urban growth – light rail seems to offer a desirable solution to these requirements in a wide range of cities around the world.

While a bus line can be changed or closed down, a rail-based transport system provides a permanent infrastructure that can attract long-term investments and influence patterns of settlement in a substantial way. In fact, Nordic cities such as Malmö, Lund, Helsingborg, Tampere, Turku, Stavanger, Copenhagen, Odense and Aarhus are all developing or considering light rail as part of urban development plans.

The light rail renaissance

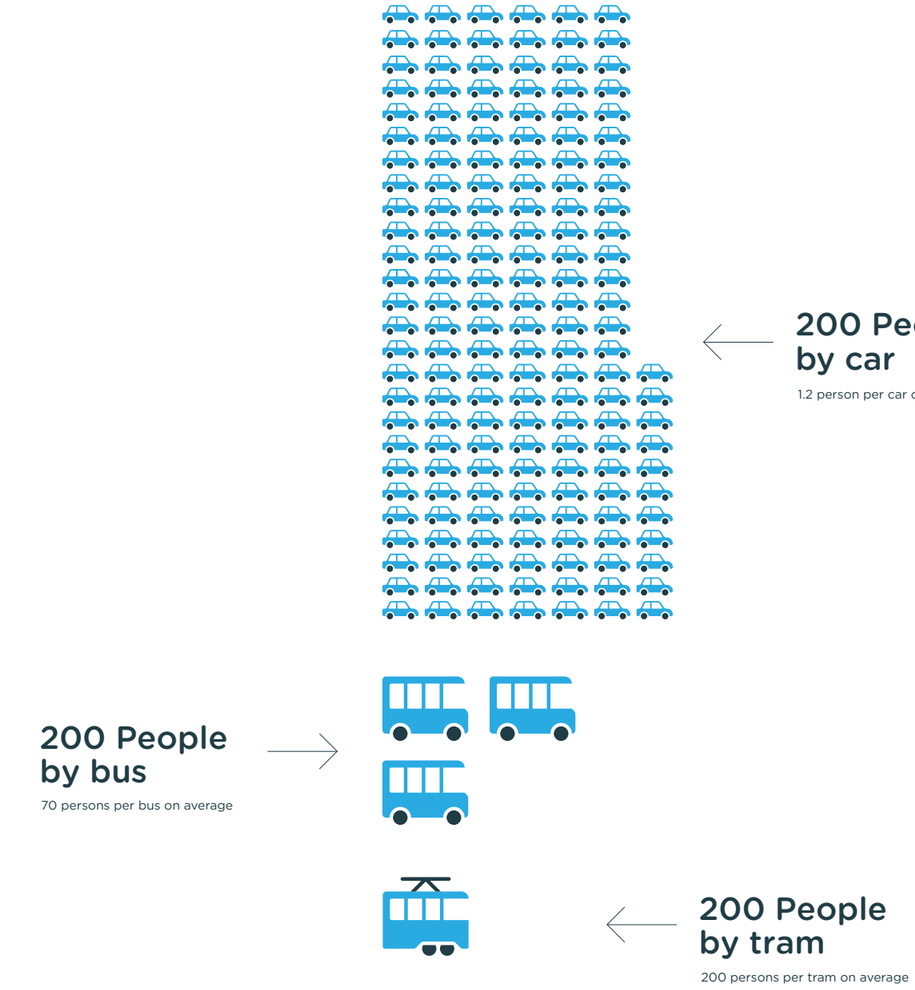
While Germany still has one of the highest densities of tramway and light rail systems worldwide – counting 59 systems in total – light rail is becoming increasingly popular in particularly the Nordic countries.

Several Norwegian and Swedish cities have already introduced light rail transportation, and cities such as Stockholm, Gothenburg, Norrköping, Helsinki, Bergen, Trondheim and Oslo are currently studying and conducting network extensions. In France, like in many other countries in Europe, tramways had almost vanished from the streets by the late 1960s and were replaced by buses or underground metro systems. This changed with the introduction of tramways in cities such as Strasbourg, where one of the first new French light rail systems (called tramway in France) opened in 1994. Paris, Lyon, Nice, Rouen, Montpellier, Bordeaux and many others followed suit in developing modern tramway systems.

Since then, a veritable light rail 'renaissance' has spread to a large number of cities in France, in the UK, Ireland, Spain and Portugal. San Diego, California pioneered the re-introduction of light rail in the United States, with the first services of the San Diego Trolley operating in July 1981 initially with LRVs similar tothose used in Frankfurt, Germany.

Following this spark, the US, Canada and Australia have recently introduced light rail in numerous metropolitan areas including Portland, Seattle, Phoenix, Minneapolis, Edmonton, Calgary, Melbourne, Sydney, Adelaide and the Gold Coast.

Sustainable public transportation: How to move 200 people in an efficient way



Light rail provides efficient and sustainable public transport and is significantly more capacity-effective than a car or even a bus.

Holistic consultancy for sustainable growth

Cities have become the engines of economic prosperity and development – and the global middle class is expected to expand further over the next two decades.

Complex challenges call for an integrated approach. Consequently, our services bring together engineering, design and management consultancy to provide world-class expert knowledge, qualified guidance and support at every stage of the value chain. We advise from an early stage with strategy development and decisionmaking, provide consultancy on tendering, as well as manage and supervise the entire project to ensure that all requirements are met – at the right price, quality and time.
Our breadth of resources and depth of knowledge allows us to provide services suited best for our clients' needs – from large client-based project teams to ad hoc advice by individual specialists or any combination of the above ideally tailored to the project.

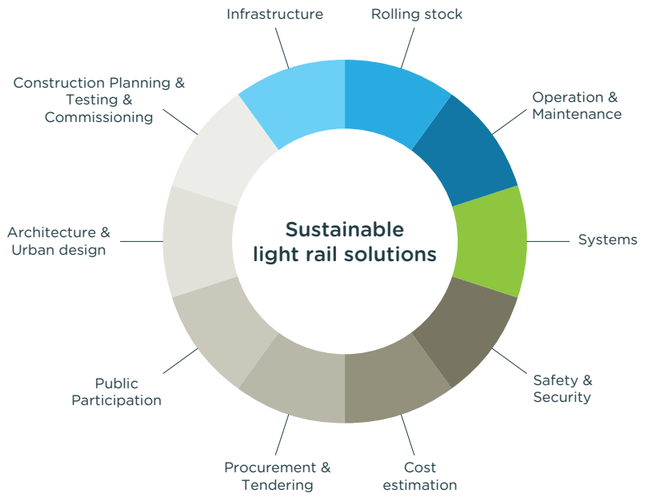
A single point of contact for everything light rail

Ramboll's Light Rail Competence Centre in Karlsruhe, Germany, serves as a single point of contact in all questions concerning infrastructure, systems, rolling stock as well as operations and maintenance of light rail systems.

Ramboll light rail experts draw on extensive experience from light rail projects all across Europe and support the entire planning process – from feasibility studies to the conception, design and tender of all operational and maintenance elements, not to mention life cycle cost evaluation for the light rail system as a whole.

Global project management framework

All of Ramboll's experts around the world share the same project management framework and system based on internationally recognised standards and best practices. The main objective is to exceed client expectations – consistently delivering optimised solutions and setting new standards.



Light rail projects draw on specific rail and complementary multidisciplinary services to develop truly sustainable solutions.

01

01 Tram Berlin – extension of the network section turmstraße, line M10.
The planned light rail line Turmstraße II will connect with Turmstraße I, stretching four kilometers from Moabit through Kaiserin-Augusta-Allee to Jungfernheide station in Berlin-Charlottenburg. Commissioned by Berlin's Transport Authority, the project aims to develop the most favorable route along Kaiserin-Augusta-Allee. Ramboll, in partnership with Krebs+Kiefer, is responsible for project management and handling all light rail-related disciplines. Challenges include planning through congested shopping streets while preserving trees, managing narrow cross-sections with varied road users, and ensuring smooth transit amidst heavy pedestrian and cyclist traffic. Public participation was encouraged via digital events and online tools due to COVID-19. Tasks include tram operation simulations, visualizations, bridge load capacity tests, cost-benefit analyses, and coordination of public service relocations.

02

02 Jokeri Line, Helsinki, Finland - Traffic engineering, transport planning and safety, light rail design, operational modelling, depot design.
The Raide-Jokeri line is a 25 km light rail line with 31 stations forming an orbital link between the outskirts of Helsinki.
In a joint venture with WSP Finland, Ramboll developed the conceptual design for the line, including horizontal and vertical alignment design, urban integration, a cost-benefit analysis to underpin the project's business case and a dynamic simulation of the intended operational programme as well as involvement of the public. Ramboll was also responsible for the conceptual design of the control and maintenance centre and stabling area.

Feature project

What is the most sustainable public transport system?

With a very detailed feasibility study and intensive participation of the public we supported the city of Kiel to find the best solution for its public transport services. Bus rapid transit (BRT) or Light Rail (LRT)? The winner was: LRT

To achieve its climate targets by 2035, the city of Kiel, Germany, needs to optimise its public transport services. Currently the city's residents can choose between bus, ferry or regional rail services to get from A to B. But due to the location on the Kiel Fjord, travel times with public transport are long and cumbersome, which brings the entire transport system to the limit of its capacity. That's why the municipal administration of Kiel asked Ramboll to develop recommendations for the system and the core network.

The best option for sustainable urban transport

As a first step in this complex process, a baseline study, was already completed in 2019. Key finding found that two means of transportation are most likely to improve the existing public transport system: Tram or Bus Rapid Transit (BRT). However, the previous results of the mobility concept in the baseline study were only expert recommendations that do not document the derivation of the exact route of the lines under consideration. With a detailed route study Ramboll's experienced team of transport planners examine these expert recommendations and take input from local residents into account.

During a comprehensive public participation process all Kiel residents were called upon to express their wishes for future mobility. Ramboll accompanied this process with various online formats and on-site events.

Until the end of 2022 both systems have been studied in equal detail in several stages. For the ranking, i.e. the layering of all conceivable route sections in the corridors down to the core network have been derived from a formalized German route evaluation methodology (FAR: formalisiertes Abwägungs- und Rangordnungsverfahren). With a balanced selection of the evaluation criteria, this is considered to be legally watertight.

In addition to examining different routes, Ramboll also developed, among other things, a concept for linking other modes of transport, as well as an operational concept and operational modelling. In this way, Ramboll provided all the basics for sustainable local transport, which also includes paths for pedestrians and cyclists.

Nils Jänig from Ramboll, explains: "Evaluating the full impacts of particular transit services is vital if the goal of the system is to meet climate targets. Helping clients measure various categories of impacts allows for common errors to be identified that distort network performance. With such knowledge, transit systems can be developed for increased system efficiency, increased ridership, lower costs, and more transit-oriented land use patterns."

In November 2022, the decision in favor of the tram was then made at the Kiel council meeting. The main reasons were:

- GVFG funding under German law is only available for the tram, not for BRT.
- From the beginning, the BRT would have to run every 5 minutes on its own route, which represents the limit of performance in the inner city area at junctions.
- Significantly more vehicles and drivers are needed
- The BRT system can no longer be expanded, as no second inner-city route can be built in Kiel due to the topographical location around the fjord. Thus, the high investment with public money is not sustainable.
- The BRT also requires a high proportion of its own route for operational stability, with investment costs amounting to around 65-70% of that of a tram.

Since 2023, Ramboll has been working on planning phases 1 and 2 of the HOAI for a 36 km long light rail network. Ramboll is responsible for all technical disciplines with once again intensive public relations work as the sole contractor with a local subcontractor Merkel. In March 2025, the decision for further planning was made in the Kiel City Council: design and approval planning for the first commissioning stage of 12.5 km, including the establishment of a project company for implementation by 2034.

German engineering meets Nordic innovation

Ramboll is also contributing comprehensive and international know-how to the planning phase. In addition to traffic planners, the project team also includes experts in landscape planning, environmental aspects and public relations. Experts from Helsinki, Copenhagen, Kiel's partner city Aarhus and from the Ramboll Engineering Center in India were also on board and shared their expertise from similar projects. In Aarhus, Ramboll has successfully planned the light rail system and will also accompany the expansion planning for the second phase, over the next 10 years.

What we do

The final recommendation will among others include:

- Infrastructure planning
- Cost estimation
- Operational concept, signalisation
- Power supply
- Urban integration
- Depot planning
- Construction planning
- Financial concept
- Approval concept
- Visualisation and videos
- Environmental aspects
- Bus concept
- Interface to Cost-benefit-Analysis (CBA)

Infrastructure

Track superstructure, traction power, stations and depots are the key ‘fixed’ elements of the light rail infrastructure.

What we do

Ramboll provides consultancy on almost every aspect of light rail infrastructure:

- Alignment
- Permanent way
- Acoustics and noise
- Station design and accessibility
- Lighting design for stations and outdoor space
- Traction power
- Depot design
- Buildings
- Road design and engineering
- Tunnel and bridge engineering
- Geotechnics
- Infrastructure asset management
- Construction and contract management
- Risk and safety management

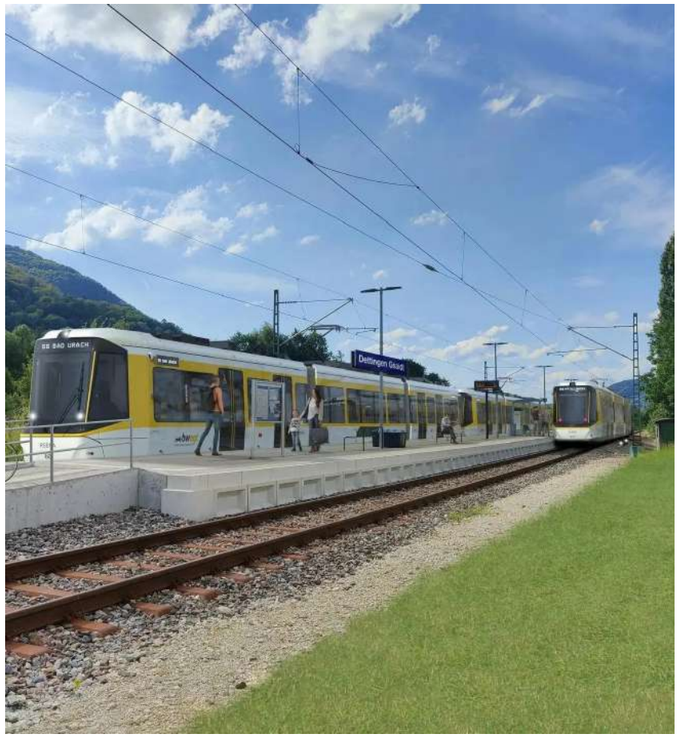
Every city has its individual character – and so has every light rail system! Sometimes high operating speed is paramount, at other times maximising system accessibility is a crucial factor. In many cases, a balance needs to be achieved between operational efficiency, the overall system’s whole life cost and visual amenity. At Ramboll, we draw on international experience in developing solutions that provide just the right customisation for the unique qualities and requirements of the local environment – and that balances interests and considerations in a way that allows all parties to endorse the final solution. For instance, depots can be highly efficient in terms of track layout and arrangement of the workshop but still make up an architectural landmark and minimise noise emissions to the surrounding area.

In order to provide sustainable light rail infrastructure that leads to a better urban environment, particular attention needs to be paid to the design of various light rail infrastructure assets. This is vital to ensure that all assets are attractive, durable, safe to use, easy to maintain and economically sustainable both in investment and operation.

The interfaces between infrastructure and other systems such as rolling stock (wheel-rail contact, traction power, barrier-free stations) or operation (signal cabling, cant calculations) are also important in the alignment, station and depot design. Mismatches in these areas may lead to reduced operating speeds, undue noise, excessive wear or an unattractive appearance of the system in the public realm.

“We have acquired a unique understanding of the different stakeholder needs and this gives us a valuable insight for finding solutions for all stakeholders in the projects we engage in.”

Director, Rail Germany
– Nils Jänig



04

04 Tramtrain Neckar-Alb, Pfullingen - Reutlingen, Germany - General planning services.
The tramtrain Neckar-Alb project aims to create a sustainable and efficient transit solution connecting various municipalities through a dual-mode light rail system, merging existing railway lines with urban tram networks to enhance regional access. Ramboll has undertaken general planning services for the northern segment of the project, addressing key technical, infrastructural, and environmental considerations such as water source protection and alignment with concurrent road projects. The planning integrates a comprehensive analysis of old and potential new rail tracks, station requirements, and innovative solutions for museum operations on steep and urban sections, ensuring project feasibility and minimal environmental impact.

05

05 Bergen light rail extension: contributing to low carbon mobility and liveability.
The 12.7 km extension of Bergen’s light rail network from the city centre to Åsane is more than a railway project. It contributes to green mobility and increased quality of life in Norway’s second largest city. The project is key to achieving safe, efficient, and low-carbon collective transport for passengers in Bergen and is the city’s most important initiative to prevent additional growth in car traffic. Around 60,000 people are estimated to use the public transport route every day by 2040. The extension includes tunnels, an underground stop, and large stretches passing through dense urban areas, with an additional 3 km extension to the Fløyfjell mountain tunnel. Ramboll, alongside COWI and Asplan Viak, is responsible for designing the fifth construction phase, utilizing the Virtual Design and Construction (VDC) methodology to ensure efficient collaboration and project execution.

Rolling stock

A light rail vehicle makes a bold statement in the urban landscape and works as a visible and moving ‘business card’ for the light rail system as a whole. This is just one of the reasons why choosing the right rolling stock solution is crucial to ensure the success of the system.

What we do

Ramboll provides consultancy on almost every aspect of rolling stock:

- OHL free battery operations
- Accessibility and capacity analysis
- Energy consumption
- Technical studies and investigations for individual vehicle aspects
- Wheel-rail interface
- Support during the entire procurement process
- Tender design
- Offer preparation
- Contract negotiations
- Approval of delivery
- Solutions for cost-effective maintenance/life cycle cost
- Service vehicles for infrastructure maintenance

Not only does the light rail vehicle have a very visual and important interface with passengers, but the vehicle serves as the workplace for a large share of the light rail operator’s workforce – the drivers.

In addition, the light rail vehicles constitute one of the most significant contributions to the system’s whole life cost, as they amount to a large proportion of both the initial investment but also the ongoing maintenance cost. All things considered, choosing a rolling stock solution is anything but straightforward.

As in many other areas, a balance needs to be achieved between the desire for an attractive and presentable vehicle and the need for a vehicle that is engineered to last for the duration of its entire operational life, which generally spans about 30 years, but can be up to 40 years.

This means that the choice of rolling stock needs to be a farsighted decision that takes both the vehicle’s durability and ability to adapt to future needs into consideration.

At Ramboll, we strive to find the best solutions within these potentially conflicting requirements. We draw on our experience with rolling stock technology as well as operations and maintenance to determine the unique requirements for each system and suggest the right rolling stock solution for the local environment.

As in many cases, it is of great value to consider passenger needs first, followed by requirements for the usability of the rolling stock, such as operability and maintainability.

06

06 Procurement of low-floor trams, Bonn, Germany - Tender documentation and project support.
The procurement initiative for low-floor trams in Bonn involves comprehensive market research and the preparation of tender documents, including a detailed specifications sheet. Ramboll’s involvement extends from guiding the tender process through developing evaluation matrices and specifying spare parts requirements and safety standards, to supporting the drafting of the system requirements, design, and commissioning phases. The project encompasses the procurement of 22 tram units with an option for an additional 15, with Skoda winning the contract. Running from 2017 to 2026, this extensive project is commissioned by Stadtwerke Bonn (SWB), ensuring advanced and secure transportation options in the region.

07

07 Bergen light rail vehicles procurement: 20 year consultancy framework enhancing sustainable transportation in urban Norway.
The procurement project for new light rail vehicles for Bergen focuses on supplying advanced, low-carbon transit options to support the city’s ambitious mobility and environmental goals. Ramboll’s expert team, combining local Norwegian knowledge with international experience, is tasked with developing detailed technical specifications, managing the tender and evaluation process, and overseeing the design and commissioning phases. This project includes the formulation of a comprehensive procurement strategy, ensuring seamless integration with existing infrastructure and delivering high-quality vehicles on time and within budget. The initiative, set to run 20 years until 2045, aims to enhance passenger experiences and operational efficiency for Bergen’s expanding light rail network.

Systems

A light rail system must integrate numerous interfaces involving passengers, staff, car drivers, cyclists, pedestrians, and the general public. It is crucial that all these interfaces function seamlessly and intuitively in an integrated fashion, distinguishing the light rail system from the a more conventional, “stand alone” mass transit.

What we do

Ramboll delivers consultancy services across nearly every facet of light rail systems:

- Conceptual design of communi cation systems
- Intermodal transport control systems
- Radio and telecommunications
- Passenger information systems
- Signalling systems
- Control room configuration
- Traction power supply design and implementation
- Tender design and documenta tion
- Support throughout the procure ment process
- Offer preparation and evaluation
- Contract negotiations and man agement
- Approval and acceptance of delivery

08 Regional Tangente West (RTW), Frankfurt am Main, Germany - Planning and implementation of electronic signal systems.
The Regionaltangente West (RTW) project involves the strategic planning, delivery, and commissioning of a regional railway and tram line including the central electronic signal box (ESTW-Z) along with associated signal technology and control systems essential for integrating into existing operational frameworks. With a focus on reducing congestion in central Frankfurt, the RTW enhances regional connectivity through a dual-mode light rail network spanning approximately 52 km. The project is divided into northern, middle, and southern sections, including significant nodes like Bad Homburg and Neu-Isenburg. Ramboll is involved in the project in an advisory capacity with regard to plant management, operation and safety technology, ensuring each segment meets stringent technical standards while accommodating future upgrades. The client is assured of a seamless operational transition within the assigned project timeline.

From a passenger perspective, our goal is to make the ticket purchase and validation system intuitive and effortless, ensuring it does not disrupt or delay boarding and alighting. Passengers should have access to real-time information regarding upcoming stops and connections (including other transport modes) both on platforms and on board, informing about any potential delays.

To mitigate delays initially, an intermodal transport control system must ensure that operational staff at the Operations Control Centre (OCC) maintain a comprehensive overview of light rail operations at all times. Traffic light prioritisation at road crossings should favour the movement of light rail vehicles, ensuring stops occur only at designated stations, while signalling systems guarantee safe operations at single track sections, tunnels, and terminal stations.

Accessibility for all is another essential part of the overall light rail system, which should be ensured not only by the vehicles and infrastructure but also by the supporting systems for ticketing and information dissemination.

To maintain seamless and efficient operations, diagnostic data from vehicles and installations should be automatically relayed to the control and maintenance centre to facilitate proactive maintenance and enhance overall system availability. Traction and auxiliary power supply systems should be equipped with self-monitoring capabilities to ensure reliability and efficiency.

At Ramboll, we assist in striking the right balance between desired functionalities, economic investment, and operational efficiency. For existing systems, we evaluate potential enhancements to improve system reliability, user acceptance, and the efficiency of operations and maintenance.

Ultimately, technical equipment should be utilised where it offers tangible benefits in terms of safety, passenger convenience, accessibility, or operational and maintenance efficiency. The overarching strategy should be to implement a light rail system that is as simple as possible, yet as technically sophisticated as necessary.

08

Image: Main Station in Kiel, Germany

Operations & maintenance

Operations & maintenance are essential for the entire life cycle of the light rail system guaranteeing reliable services throughout.

What we do

Ramboll provides consultancy on almost every aspect of light rail operations and maintenance:

- Operational modelling
- Runtime estimation
- Timetable planning and design
- Operational control centre
- Staffing and duty rosters
- Vehicle rosters including phasing in of service vehicle runs
- Maintenance of rolling stock, infrastructure and systems
- Key Performance Indicators (KPI)
- Performance monitoring and payment regimes

High operational performance and reliability are key to ensure that light rail poses an attractive alternative to private car use and hence becomes a driving factor for sustainable mobility and city development.

Operations bring together all elements of the light rail system – from infrastructure to rolling stock, power supply, intelligent transport systems etc. – and put them into motion and use within the urban environment.

Maintenance, on the other hand, is crucial to keep the light rail system in adequate condition to ensure safe and reliable operation and keep it in a presentable state. And together, operation and maintenance represent the light rail system's ongoing cost (opex) that is to be balanced against the initial investment cost (capex).

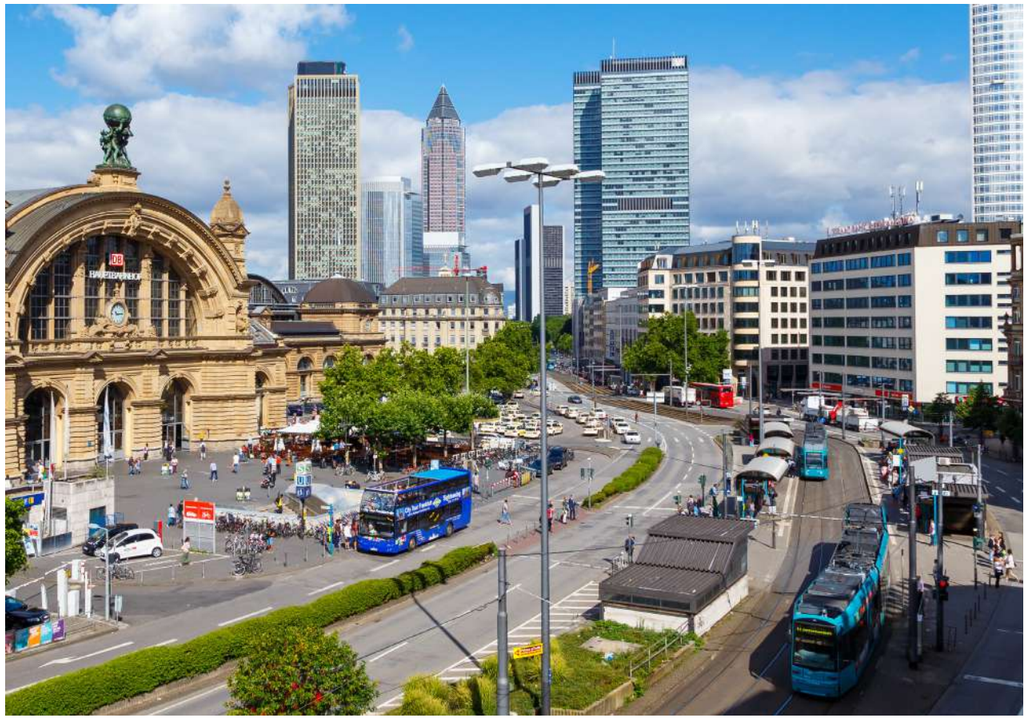
At Ramboll, we consider operation and maintenance right from the initial planning stages of a light rail project. This includes integrating regular operating conditions as well as possible fall backs during disturbances. In the end, it is the way the light rail operation can effectively deal with any such disturbances that to a significant extent will drive the public perception of the system.

From our experience in designing operational and maintenance concepts as well as infrastructure and rolling stock design, we identify the main issues and risks of the project and propose a tailored solution, considering the delicate balance between capex and opex especially when these are funded by different sources.

In the end, technical equipment should only be used where it provides significant benefits for safety, passenger convenience or efficiency gains in operations and maintenance. The overall approach should be to implement a light rail system which is simple as possible and as technically complex as necessary.

09 Redesigning Frankfurt Central Square to Enhance Urban Mobility.
The redesign of the central square at Frankfurt's main railway station addresses current operational limitations and contributes to streamlined urban mobility and improved commuter experience in one of Germany's busiest transport hubs. By reorganizing and optimizing the tram station, which presently handles 36 stops per hour per direction at maximum capacity, the initiative aims to reduce delays and enhance service reliability, accommodating increased passenger volumes and improving connectivity. Various infrastructure enhancements include extending platforms to 70 meters, optimizing track layouts with up to 4 tracks, and reconfiguring bus terminals. A comprehensive operation simulation calibrated with real-time tram operation data evaluated different infrastructure and schedule variants, examining schedules with 10-minute intervals on all lines, new tram lines, and bus integrations for the 4-track expansion carried out with the help of VISSIM and open Track. Supported by traffiQ Lokale Nahverkehrsgesellschaft Frankfurt, the project tested ten different scenarios, resulting in recommendations for operational and infrastructure configurations to enhance passenger experience, reduce congestion, and promote sustainable urban mobility.

10 Frankfurt 'Dreieich' feasibility study.
Ramboll conducted a feasibility study to explore extending the tram network from Frankfurt through Neu-Isenburg and Dreieich to Langen. The study follows a potential analysis completed in June 2021, which indicated the viability of the extension. With a project volume of €390,000 and duration from 2022 to 2024, it involved the city of Frankfurt as well as the authorities of Neu-Isenburg, Dreieich, and Langen, as well as traffiQ, public transport company for Frankfurt. The feasibility study was divided into two phases, addressing unresolved questions from the initial analysis, evaluating possible routes, and conducting detailed assessments of traffic, technical aspects, urban planning, operational concepts, and cost-benefit analysis. The preferred variant identified in Phase 1 was further investigated in Phase 2, including the examination of interim endpoints and the potential early termination point in Dreieich.



09

10

World-class light rail expertise

Internationally recognised,
world leading consultancy

Combining local presence on
five continents with global knowledge

Specialists from Ramboll's Light Rail
Competence Centre collaborate closely
with local Ramboll engineers

Ramboll offices all over the world
provide a local point of contact for our clients

Key projects

01
Tram Berlin, Germany
Extension of the network section turmstraße, line M10 and infrastructure planning HOAI 1-4.

02
Jokeri line, Helsinki, Finland
Traffic engineering, transport planning and safety, light rail design, operational modelling, depot design. Ramboll was alliance partner for the project realisation.

03
LRT Kiel, Germany
Feasiblility study and HOAI Planning 1-4 for a new LRT network including among others infrastructure planning, cost estimation, operational concept.

04
Tramtrain Neckar-Alb, Pfullingen – Reutlingen, Germany
General planning services and infrastructure planning HOAI 1-2.

05
Bergen light rail, Norway
Light Rail extension line 5, all engineering services: contributing to low carbon mobility and liveability.

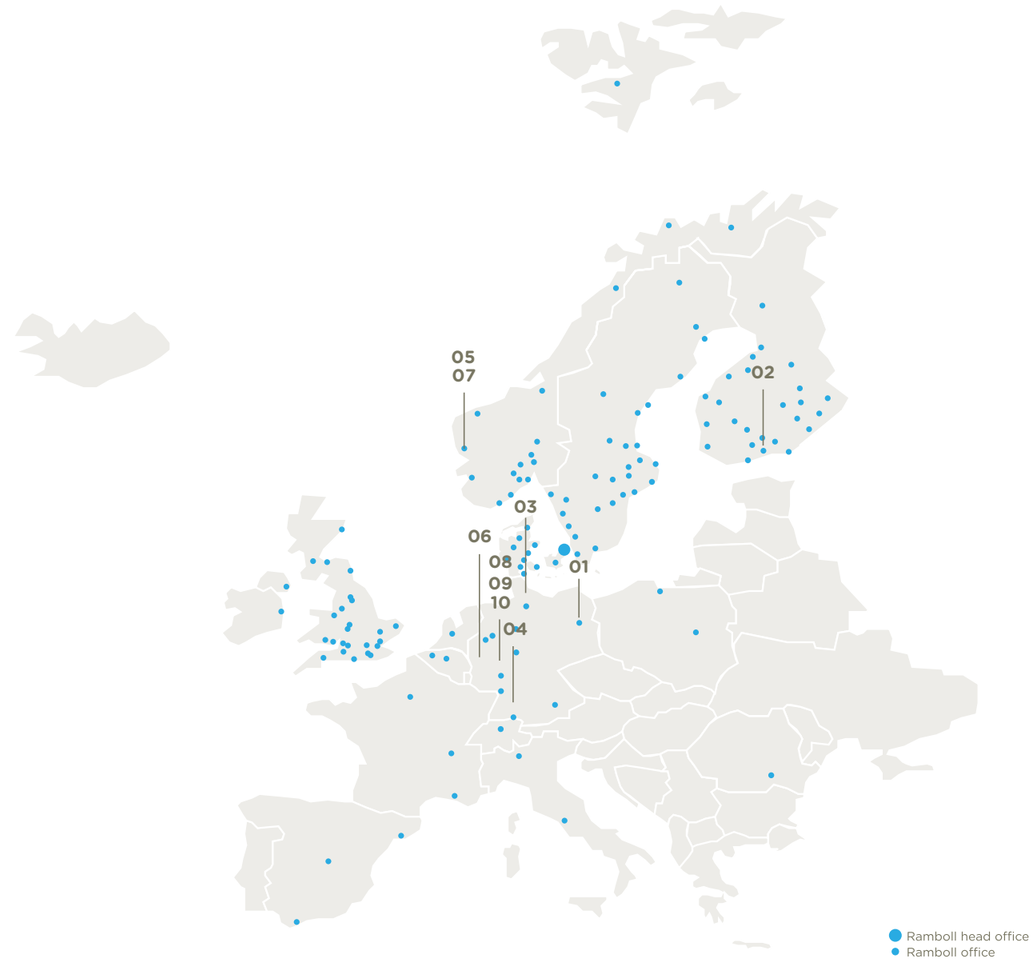
06
Bonn trams, Germany
Procurement of low-floor trams - Tender documentation and project support.

07
Bergen light rail, Norway
Light rail vehicles procurement: enhancing sustainable transportation in urban Norway.

08
Regional Tangente West (RTW), Frankfurt am Main, Germany
Consultancy services for signalling and operations, project management.

09
Frankfurt Central Square, Germany
Redesigning Frankfurt Central Square to enhance Urban Mobility.

10
Frankfurt 'Dreieich', Germany
Feasibility study.



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