URBAN LAB - SYNTHESES 2024

The Future of High Speed Rail

Accelerating Connectivity & Sustainability Across Europe

MASTER Governing the Large Metropolis

Nathan BENAMOUZIG
Joshua CLAXTON
Rachel KOVINSKY
Jiaqi LI
Anna WARD

AREP × SciencesPo URBAN SCHOOL

THE PREFACE

For this capstone project, AREP requested that students from the Urban School at Sciences Po develop an **"Atlas of European Stations,"** studying upcoming station renovation and construction projects pertaining to high-speed rail across Europe. Beginning in February 2024, graduate students from the dual degree program between Sciences Po and UCLA conducted **a thorough analysis of a selection of upcoming high-speed rail projects across Europe**.

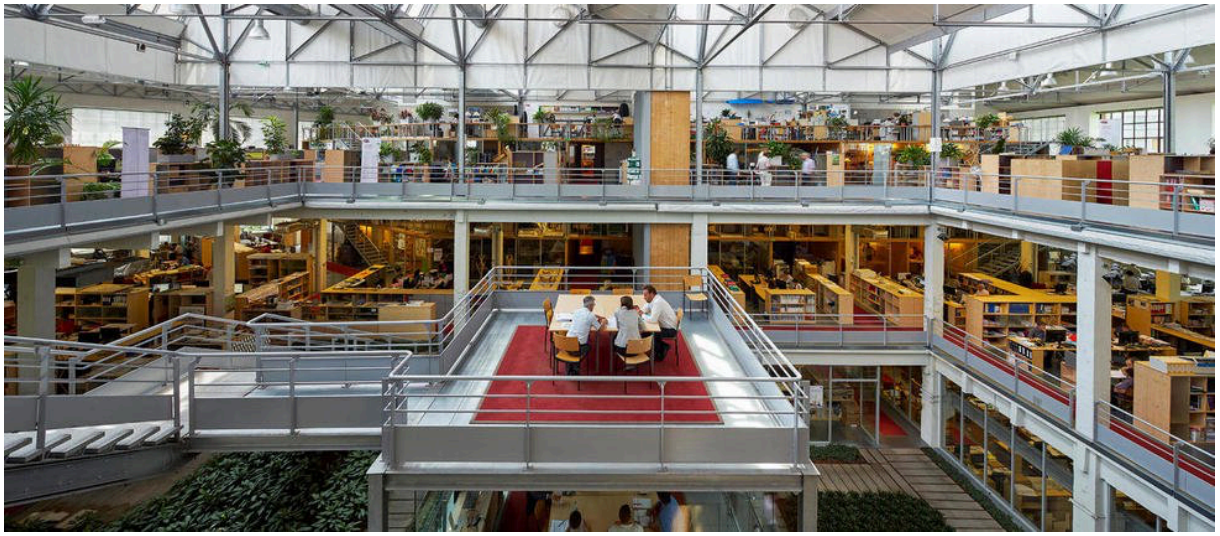
This capstone unfolded as major **funding for sustainable transit infrastructure** was deployed by the European Union, mainly structured around environmental transition programs (including the European Green Deal and the Trans-European Network Policy). Such programs and policies generate new business development opportunities for AREP, which seeks to deploy its expertise beyond France.

The close collaboration between the Sciences Po and AREP teams culminated in the selection of **15 stations located across seven European countries** for further study**.** Students conducted an in-depth analysis of the station context (including historical backgrounds, key stakeholders, and timelines), the level of environmental engagement, solicitation processes and funding mechanisms. Through **desk research, nine interviews with over a dozen stakeholders, and visits to four different countries**, students developed several tools to provide AREP with a **comprehensive understanding of the investment landscape of selected HSR projects**. Specific deliverables included station briefs, an interactive map and a pedagogical final presentation and syntheses.

Through this capstone project, the Sciences Po team developed **a tool to help AREP better understand and analyse the opportunities and challenges posed by upcoming European HSR infrastructure projects**. Ultimately, these tools can be applied to support AREP's business development strategy across Europe, in alignment with its overarching commitment to advancing sustainable mobility and the broader ecological transition.

THE PARTNER

AREP



AREP Headquarters in Paris, France (source: AREP's Website)

A multidisciplinary architecture and consulting firm, **AREP** is well-known for its expertise in urban planning, architecture, and engineering. Established in 1997, AREP is a subsidiary of SNCF Gares & Connexions that now includes more than 1,000 professionals from 30 nationalities. Today, the firm is defined by its holistic approach to projects that brings together diverse disciplines such as architecture, urban planning, engineering, and environmental studies in order to tackle complex urban challenges in France and beyond.

The acronym 'AREP' stands for '**Architecture, Research, Engagement, Post-Carbon**,' reflective of the firm's clear commitment to the ecological transition. This guiding value is particularly evident in the firm's use of green building practices, promotion of energy efficiency, and emphasis on the integration of green spaces into urban environments. Across their many projects, AREP provides concrete and adapted responses to the ecological emergency. Through doing so, they create spaces that are functional, aesthetically pleasing, and environmentally responsible.

Innovation is another hallmark of AREP. For decades, the firm has leveraged cutting-edge technology and design thinking to develop solutions that meet the evolving needs of modern cities. Often, these solutions encompass smart city concepts, adaptive reuse, and the integration of new transportation technologies. Across all of their work, AREP prioritizes the integration of a project into its respective historical context and social environments.

Today, AREP has a significant international presence, particularly in Europe, China, and Vietnam. With over 500 active projects per year, the firm works on a global scale and serves a wide range of clients – from public sector entities to private developers and international organizations. Notable and recent AREP projects include the refurbishment of the Gare du Nord in Paris, the master planning of urban areas in China, and the restructuring of the Nyugati station in Budapest, Hungary.

METHODOLOGY

Throughout this capstone project, research was structured into several phases that spanned February to June 2024. AREP and the Sciences Po team first came to an agreement on the scope and expectations of the completed capstone project. We then began to conduct broad but thorough desk research to better understand the general state of high-speed rail (HSR) across Europe. Funding mechanisms and policy agendas like the European Green Deal and the Trans-European Transport Network (TEN-T) were further explored, followed by a review of AREP's past competitive bid submissions for stations.

Subsequently, we focused on country-specific research, paying particular attention to national investment plans, governance structures, and geopolitical contexts. At this point, our team met again with AREP to determine how such cursory research would inform a more targeted study and final deliverables. Together, the two teams agreed to focus on 15 HSR stations located across seven European countries, as determined by applying the following criteria: environmental implications, financial mechanisms, and connectivity. These three criteria were deemed most consequential for identifying upcoming HSR station projects that are the most viable business opportunities for AREP.

Norrköping Central Station in Sweden (photo by Jiaqi Li)

During the research phase that followed, our team analysed municipal master plans, reviewed strategic plans and policy reports, and tracked relevant news sources. From April to May, we conducted interviews with over a dozen stakeholders, ranging from local officials to supranational mobility policy makers. We also visited many of the 15 stations of interest across Germany, Poland, Norway and Sweden. Specific cities visited included Frankfurt, Berlin, Katowice, Wrocław, Oslo, Hamar, Stockholm, Linköping and Norrköping. The decision to visit each of these cities was intentional and strategic, motivated by the presence of at least one HSR train station projected to undergo renovation – implying a potential opportunity for AREP. These site visits allowed for ethnographic research and reflections on the context surrounding such infrastructure projects, as well as a more in-depth understanding of the bureaucratic challenges to the successful expansion of HSR infrastructure.

Ultimately, the data that we collected was primarily qualitative. Information surrounding financial investments and ecological footprints was often difficult to find, but interviews with stakeholders provided important context and a deeper level of understanding. Our cumulative findings, data and analysis were then consolidated into a Station Atlas and final presentation.

FIELD RESEARCH

The focus of this capstone project was the future of high-speed rail (HSR) in Europe, and implications for corresponding infrastructure projects. Critically, we organized three research trips related to the capstone to gain a better understanding of the context and stakeholders involved in the development of HSR across Poland, Germany, Sweden, and Norway. Our objectives were threefold: (1) to meet with different stakeholders to gather information on upcoming HSR station refurbishment, extension, or construction projects; (2) to appreciate the local and national ambitions and motivations for the development of HSR in European countries; and (3) to comprehend the political and financial mechanisms driving the transformation of HSR across Europe.

A Deutsche Bahn high-speed train pulls into a station in Berlin, Germany (photo by Rachel Kovinsky)

Although our capstone project and research trips had a wide geographic scope, a comparative analysis of varying European contexts was key to building the foundation for the final delivery to AREP. The dependency on European financing mechanisms, role of national and local governments, and the priority given to expanding and improving HSR infrastructure and station capacity differed dramatically by country. During our site visits in Frankfurt, Berlin, Katowice, Wrocław, Oslo, Hamar, Stockholm, Linköping, and Norrköping, we experienced very different circumstances in regard to governance structures and geopolitics. A lack of transparency, national political dynamics, and citizen engagement were often criticized by stakeholders for slowing down the process of HSR development. However, these democratic components connecting the European Union to a great variety of contexts are notable particularities of our project.

In retrospect, the field research conducted during this capstone allowed for a comparative approach that revealed both differences and similarities in the governance of HSR infrastructure and networks, as well as the environmental transition in European countries more broadly.

ISSUE

High-speed rail (HSR) is gaining speed across Europe. In the coming decades, European HSR networks are projected to expand significantly in order to meet rapidly rising demand. Accordingly, this expansion will necessitate the renovation of existing train stations, as well as the creation of entirely new HSR stations, in countries all across Europe.

Trains and passengers arrive at Berlin Hauptbahnhof (photo by Rachel Kovinsky)

As a multidisciplinary architecture and consulting firm, AREP is a leading expert in HSR station design and retrofitting. The firm is deeply invested in the future of HSR across Europe, and understands that any expansion of the HSR network will necessitate the adaptation of existing railway stations, as well as the creation of new ones – both of which present opportunities for AREP to apply its expertise.

While AREP is deeply familiar with the landscape of HSR stations in France, they came to this capstone with a deep curiosity about the challenges and opportunities of future HSR development in other European countries. Given the complexity of implementing such infrastructure projects across varying socioeconomic and geopolitical contexts, AREP requested a comprehensive study on upcoming HSR projects and their funding mechanisms, market solicitation strategies, operational conditions, and environmental objectives. Broadly, the goal of this capstone project was to provide AREP with a comprehensive tool for analyzing the challenges and opportunities associated with upcoming HSR projects across Europe that align with the firm's commitment to advancing sustainable mobility and a post-carbon future.

Specifically, AREP mandated the creation of a so-called Station Atlas, mapping the characteristics of upcoming HSR station projects all across Europe. AREP expressed interest in screening all stations within the Atlas through criteria such as environmental engagement, connectivity to major transportation hubs and regions, surrounding governance structures, and financing mechanisms. This project proposal necessitated an exhaustive and systematic approach, justifying the sixth-month duration of this capstone project. This extended time

frame allowed for thorough research, interviews with diverse stakeholders, detailed analysis, and the synthesis of findings into actionable insights and final deliverables.

Passengers at the HSR platform at Berlin Südkreuz (photo by Rachel Kovinsky)

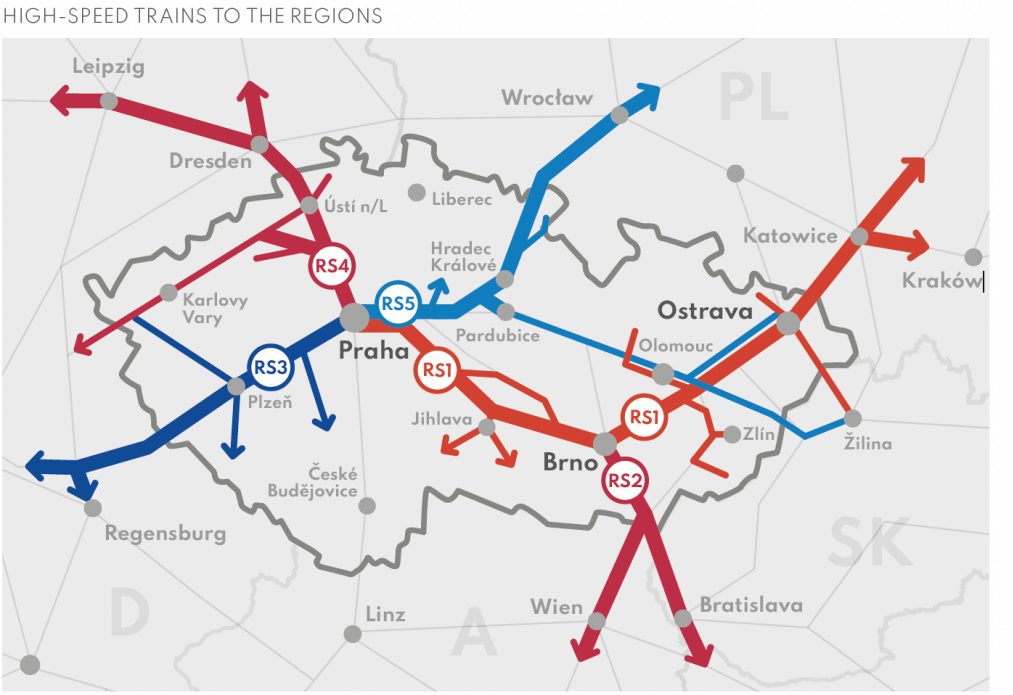
The focus of this capstone project is significant on both a local and global scale. Within the context of the European Union (EU), there has been a notable increase in funding and attention towards the intersection of mobility and the ecological transition. Major climate initiatives and EU-level policies like the European Green Deal and the Trans-European Transport Network (TEN-T) have become increasingly influential, particularly in relation to the expansion of HSR. Considering AREP's interest in applying its expertise in countries besides France, a thorough understanding of the socioeconomic and geopolitical circumstances surrounding HSR expansion across Europe is critical.

This capstone project also has several notable links to the ecological transition and the priorities of the Urban School at Science Po. Like AREP, the Urban School is committed to building a just and sustainable urban future. The expansion of HSR networks will play a key role in enabling such a future, particularly in Europe. Many European countries view HSR as a promising and environmentally friendly alternative to short-haul flights, but the current infrastructure cannot support projected increases in ridership and demand. In the coming years, increased funding and the development of new HSR lines will be crucial – as will the renovation of existing stations and the creation of new ones. Such efforts will play an essential role in combating climate change and advancing the ecological transition in Europe and beyond.

MAIN RESULTS

Given the nature of our capstone project, results are best categorized into country-specific findings. As such, this section includes key lessons and takeaways from each of the seven countries – the Czech Republic, Germany, Latvia, and Lithuania (grouped together in Rail Baltica), Norway, Poland, and Sweden – that comprised the focus of the final iteration of this project and corresponding deliverables.

Czech Republic



National Map of Rapid Service network. (source: 2023 Správa železnic brochure)

The Czech Republic faces challenges in a number of areas, such as the need to improve the accessibility of metropolises, engage remote or structurally and economically disadvantaged regions, and reduce the negative environmental impacts of transport. The national railway infrastructure manager, Správa železnic (SZDC), is addressing these challenges through the development and maintenance of high-quality, fast, and high-capacity rail transport, with high-speed rail as its backbone.

This project is being conducted under the Rapid Service (RS, Rychlá spojení) brand, which entails both line and rolling stock renovation as well as new construction. And it is through this particular framework that the state will invest 34 billion euro by 2050. The main benefit of RS is a significant reduction in travel time and improved domestic accessibility to all territories of the country. RS serves metropolitan areas and offers fast transport outside them – i.e. into the regions of Bohemia, Moravia, and Silesia. The new lines will also be renewably-powered and will increase the capacity of the railway network, thus contributing to the further development of regional passenger and freight transport by rail. The speeds achieved on the high-speed lines will be up to 320 km/h. The new lines will also be sensitively integrated in the landscape, accounting for wildlife habitat, ecologically protected areas, and noise pollution. The Rapid Service trains will offer comfortable, affordable, and

reliable transport to the general public for commuter, business, leisure, or holiday travel. Additionally, at the international scale, RS will fulfill the EU TEN-T initiative agenda by seamlessly connecting the Czech Republic to surrounding European nations (Germany, Poland, Austria, and Slovakia).

AREP was recently awarded the architectural bid to renovate the RS Jihlava Terminal, and SNCF, AREP's parent company, maintains an ongoing symbiotic relationship with SZDC. The Czech Republic will continue to be a generative business partner as AREP is uniquely positioned to offer insights and expertise that will further HSR projects around Europe.

Germany

Looking out towards the station forecourt and mobility hub at Berlin Hauptbahnhof (photo by Rachel Kovinsky)

From a combination of desk research, site visits to stations in both Berlin and Frankfurt, and interviews with transportation policy-makers and researchers, several overarching findings on the HSR network in Germany became clear. Notably, obtaining information from the national railway company, Deutsche Bahn, and its subsidiaries (including DB InfraGO and DB SmartCity) proved to be quite difficult. Public information on financing and investment plans, environmental assessments, and architectural competitions for station renovations was often limited and opaque. In essence, the current and future landscape of HSR in Germany is complicated.

Interviews with individuals in the European Commission and the German Bundestag revealed that HSR is a major priority throughout the country. A significant increase in rail traffic is anticipated by 2030, and ambitious plans are in place for a Germany-wide coordinated timetable, known as Deutschlandtakt. However, a combination of limited federal funding, and regulatory and bureaucratic challenges has exacerbated issues in a rail network that is already under immense stress. The German rail network is impaired by the absence of specific tracks dedicated to high-speed lines in the proximity of transportation hubs (e.g., Frankfurt, Berlin, or Hamburg), slowing down the speed of trains and the flow of passengers. As a result, investment is often directed towards critical track renovations and technology

upgrades, rather than station renovations. Thus, in the context of AREP and its work, although Germany remains a massive and strategic market to monitor (especially considering planned renovations to the Frankfurt and Berlin Südkreuz stations), the unavoidable constraints of funding and governance structures must be understood and considered accordingly.

Rail Baltica (Latvia & Lithuania)

Safety drills taking place on a completed stretch of Rail Baltica (source: Rail Baltica Press Release)

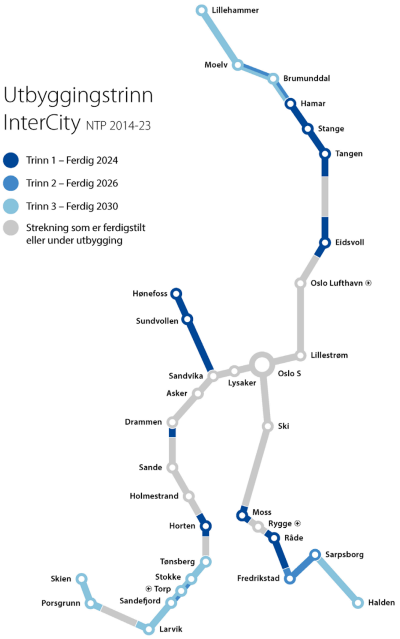
Currently underway, Rail Baltica is a major infrastructure project aimed at developing 870 kilometers worth of high-speed railways to integrate the Baltic States into the European rail network. Critically, the project aims to connect the capitals of the three Baltic states – Estonia, Latvia, and Lithuania – to Warsaw and the wider rail network of Western Europe. Planning for Rail Baltica began in the early 2000s, but formal construction of the railway infrastructure did not begin until the late 2010s. The project is projected to be completed by 2030, though this is subject to complications from construction delays and rising costs. Notably, the European Union (EU) has committed an overwhelming majority of funding for the Rail Baltica project, primarily through financing mechanisms such as the Connecting Europe Facility.

Rail Baltica is widely viewed as a massive investment and historic effort within the Baltic region, as well as for Europe more broadly. Given past and present geopolitical contexts, the project is not only a matter of improving efficiency and logistics – it is also largely symbolic. Rail Baltica reflects the Baltic states' efforts to further align with Western Europe, shifting away from physical rail infrastructure and historic ties to the Soviet Union. Once fully operational, Rail Baltica will improve connectivity between the Baltic States, stimulate economic development, and enhance integration with the EU.

Given the project's focus on improving connectivity to Europe, Rail Baltica has been particularly receptive to international investment, partnership, and support. For AREP, the

project represents an opportunity to apply its expertise in HSR station design and retrofitting. Based upon our research, upcoming renovations to the stations located in Riga (Latvia) and Vilnius (Lithuania) may be the most viable and strategic opportunities, given their potential to become major transport hubs for the region. For Vilnius, specifically, an architectural competition has already been held for the redesign of the station – but designs have not yet been implemented. Regardless of how the municipality chooses to move forward, Vilnius represents an important case study to better understand the priorities, selection criteria and potential challenges of future architectural competitions in Lithuania, and within the Rail Baltica network more broadly.

Norway



The Intercity Railway Plan that guides the railway planning in the last decade
(source: published in 2014 by the National Transportation Authority)

Since 2013, Norway has proposed further implementation of the Intercity Rail Project to enhance regional transit connectivity and increase railway speed. However, geographical characteristics and population needs have constrained the actual development of high-speed rail (HSR). Instead, efforts focus on improving regional transit efficiency and capacity building. The strategic goal is to accommodate expected passenger flow growth and enhance inclusive urban plans, while these initiatives are not directly led and governed at the national level.

Generally, HSR development is influenced by governance structures, political agendas, and financing mechanisms. Municipalities have extensive control over their territories and independently govern regional projects, negotiating with higher-level stakeholders when conflicts arise. This decentralized approach allows for tailored local projects and greater financial independence over regional developmental projects. While HSR development is recognized for its potential benefits, it remains secondary to other transit enhancements in the country. Within the context of AREP and the scope of our project, however, collaborative opportunities for inclusive urban transit development with municipalities that include station

renovations may stay on AREP's radar, to aim for a low-carbon transit future with more international collaboration.

Poland

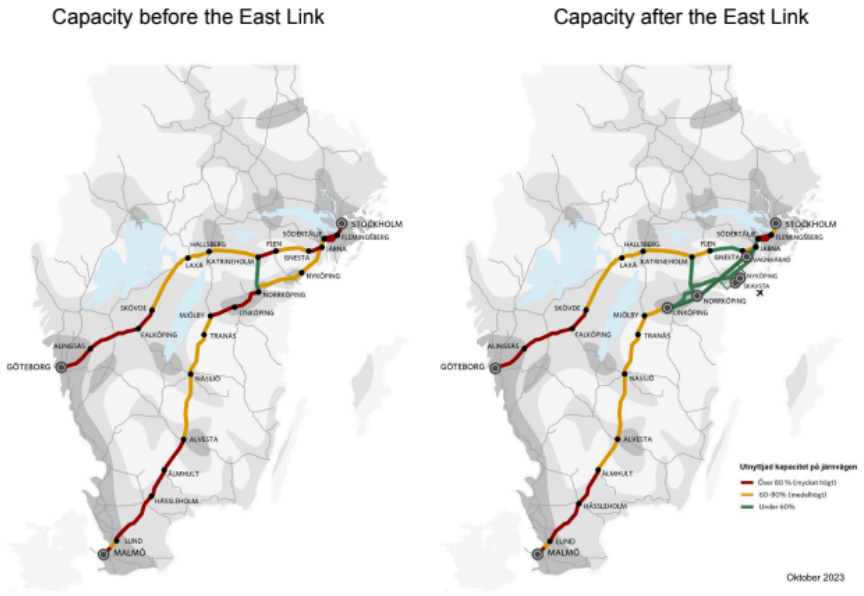
Photo of the Katowice tracks and transit center (photo by Joshua Claxton)

Centralny Port Komunikacyjny (CPK) is Poland's new HSR system that will be centrally located within the Three Seas Region, connecting the Baltic, Black, and Adriatic areas. CPK has a dual emphasis on air and rail travel. The new development and line renovation will radiate from the new airport located between Warsaw and Łódź. It will be the future multimodal heart of the Central and Eastern European transport system as elaborated by the EU's TEN-T development plan. CPK specifically is a temporary special purpose vehicle under the Ministry of Infrastructure that is focused on new HSR infrastructure and its associated feasibility studies. They are partnered with the current national railway manager, PKP Polskie Linie Kolejowe (PKP PLK), who particularly oversees renovations and station management. Collectively, the program will add 2000 km of HSR to the existing system in partnership with PKP PLK.

CPK calculates ridership predictions based on voivodeship (regional) populations and density, and behavioural studies surveying 200000 inhabitants and 80000 households. All future stations are ecologically evaluated using public participation–community level input to determine the environmental implications for HSR development throughout Poland. Robust topological, geological, and hydrological assessments are conducted as well. Their studies assess the rain levels, changes in altitude, and natural mineral deposits for the surrounding areas of each feature of the new rail system. CPK also uses a comprehensive cost benefit analysis tool to measure socio-economic benefits of all their rail and station investments. The CPK system is funded predominantly by natural treasury securities with the remainder of funds provided by the EU and commercial investments. The Polish national funding mechanisms expect to allocate 16bn euro to CPK over the next few years.

CPK is also researching a Local Mobility Hub (LMH) design plan, enabling a convenient change of means of transport (e.g. bus, train, tram, passenger cars) within urban centres. LMH solutions strive to organise the functional and spatial connections in their vicinity while maintaining the legibility of the space. These transfer hubs blend into the city. The idea is to dissolve spatial boundaries so users benefit from the functional connections provided by the passenger infrastructure. They integrate parts of the city that are often separated by a railway line, transforming the surroundings of the railway line into areas with excellent access to public and individual transport services.

Sweden

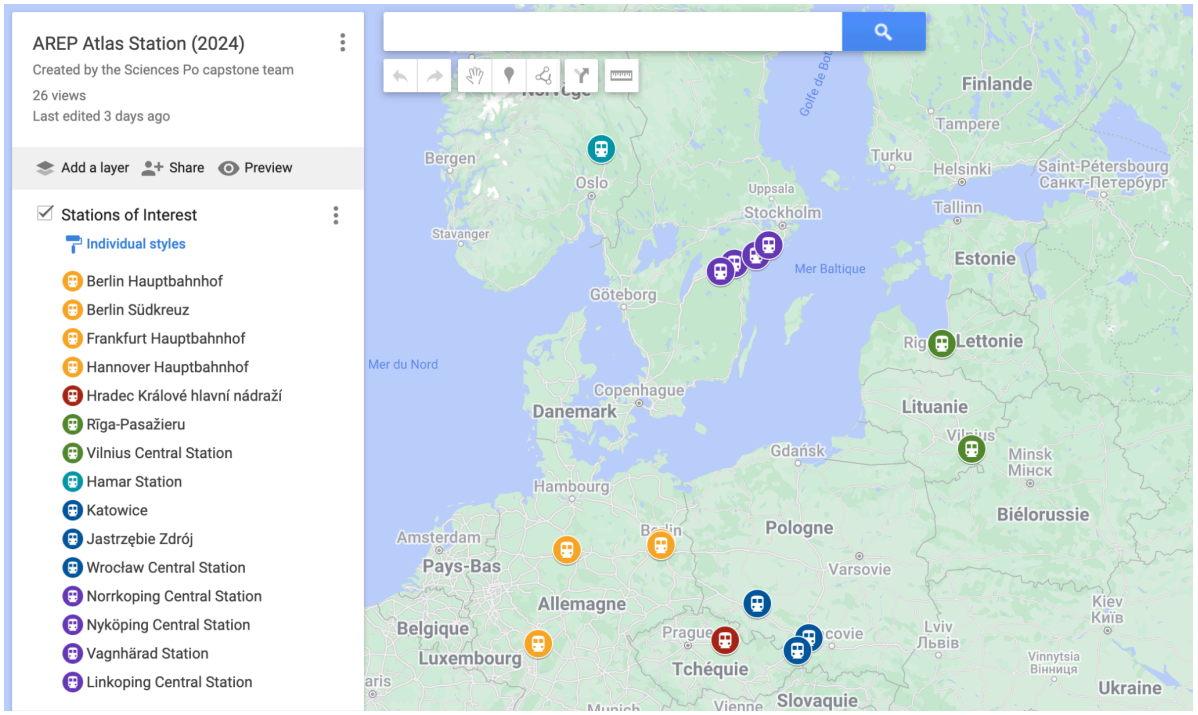


Railway Capacity before and after the East Link (source: extracted from the slides shared during the interview)

At the beginning of our desk research, Sweden's high-speed rail development seemed to stagnate due to opposition from the right-wing government and thus is not an optimistic market for HSR development. However, from site visits to key stations and interviews with relevant local project managers, it is found that despite the governmental efforts to slow down the HSR development, regional efforts on capacity building and connectivity enhancement remain robust. Most municipalities have established plans to enhance regional transit efficiency and promote urban development. Specifically, stations that are located on the East Link Project strongly stand out as promising opportunities for AREP due to their strategic location and potential for renovations.

Interviews with stakeholders indicate that while national-level support for HSR is limited, local initiatives to strengthen rail capacity are actively driving improvements in regional transit systems which makes Sweden a worthwhile market to monitor in the coming years. Future transit improvement will be collectively led and operated by three key stakeholders: Trafikverket governing mainly rail infrastructure, Jernhusen owning a majority of existing station buildings and services, and municipalities that have greater administrative and territorial control of future transit plans. The emphasis on enhancing existing infrastructure

and rail capacity aligns with the broader goals of increasing urban integration and improving intercity flow. Thus, despite the challenges posed by the current political climate, the strategic importance of Sweden's regional transit projects, particularly in key locations like Linköping, should not be underestimated.



Screenshot of a final project deliverable, an interactive map of the 15 identified stations of interest

LEARNINGS

Completed in close collaboration with our partner, this capstone aimed to address knowledge gaps surrounding the potential adaptation and creation of high-speed rail (HSR) stations across Europe. This topic is particularly salient considering growing demand for rail, alongside increased funding and support for sustainable mobility initiatives within the European Union. While AREP has extensive experience designing and managing complex infrastructure projects, the goal of this capstone project was to provide AREP with a comprehensive overview of promising opportunities and potential challenges associated with future HSR projects.

Through analyzing railway investment plans, reviewing governance and institutional frameworks, and conducting site visits and stakeholder interviews, this capstone project provides further insight into funding mechanisms, market solicitation, environmental objectives, and the socioeconomic and political contexts surrounding fifteen HSR stations of interest across Europe. More broadly, this capstone project confirms that the future of HSR remains a high priority for the European Union and its members. National and local governments are coordinating innovative policies, projects, and financing mechanisms to expand the European HSR network and increase its capacity. While our findings vary according to the context of each country of study, we have ultimately built a cohesive analysis based on defined environmental, social, political, and financial criteria.

In a greater sense, this capstone project contributes to a larger discussion on the role of governments and politics in shaping the future of the environmental transition in Europe. The relations and power dynamics between various stakeholders involved in HSR – ranging from the European Commission to local citizens' initiatives – all play a role in either advancing or limiting the development of the HSR network. Policy agendas and funding mechanisms such as the European TEN-T corridors, the Connecting Europe Facility, and the European Green Deal can all be understood as tools to strengthen cooperation between countries and reach collective sustainability targets. Across Europe, many countries share common goals when it comes to developing a clean, low-carbon and efficient transportation network – and further expansion of HSR networks provides an opportunity to do exactly that.

Ultimately, this capstone project was an important culmination of our graduate studies, skills and professional interests. We hope that this capstone provides AREP with valuable insights and tools for forecasting future HSR projects and potential partnerships across Europe. Further, we hope that this project supports AREP as it continues to advance the ecological transition and a post-carbon world.

FIND OUT MORE

To learn more about AREP's work, interested individuals can visit their website and explore past projects and the application of their distinct EMC2B approach.

For those interested in learning more about Rail Baltica, specifically, the official website of the Rail Baltica Global Project provides timely updates and news on the project and its progression.

The European Commission is also an important source of information on EU policy agendas influencing transportation and sustainability initiatives across Europe. Particularly relevant to this capstone is information on the Trans-European Transport Network (TEN-T), the Connecting Europe Facility, and The European Green Deal. Together, these policies, initiatives, and funding mechanisms are shaping the future of the European high-speed rail network.

For more information, visit:

Architecture, research, commitment, post-carbon. AREP. (2023, October 5). https://www.arep.fr/en/home-english/

Connecting Europe facility. European Climate, Infrastructure and Environment Executive Agency. https://cinea.ec.europa.eu/programmes/connecting-europe-facility_en

The European Green Deal. European Commission. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

Rail Baltica. (2024). https://www.railbaltica.org/

Trans-European Transport Network (TEN-T). Mobility and Transport. (n.d.). https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment/trans-european-transport-network-ten-t_en

The Capstone project: an original educational tool

Thanks to this original tool, students are placed in a work situation on a real problem posed by a public, private, or associative organisation. For all the Masters of the Urban School, the structure and management are identical: the project is jointly monitored by the the Urban School and the partners, at all phases of the project, and regular methodological supervision is provided by a professional or academic tutor specialised in the issue. The Capstone projects allow the partners to take advantage of the research and training acquired within the Urban School, to benefit from the production of studies and quality work, and to have a capacity for innovation.

Capstone projects are a great tool to study, diagnose, forecast, lead a comparative analysis, even to prepare for evaluation, and more generally to deal with any problem that can enlighten the organisation concerned in a logic of "R&D ". Each project mobilises a group of first-year students from one of the Urban School's Master’s. Students work between 1.5 days and 2 days per week on dedicated time slots, for a period of 6 to 9 months (depending on the Master’s concerned). In Executive education, collective projects concern the Executive Master “Territorial governance and urban development” and mobilize professionals for a period of 4 months.