**DEMANDES D'ACCÈS À L'INFORMATION COMPLÉTÉES**

**BANQUE DE L'INFRASTRUCTURE DU CANADA**

| Numéro de la demande | Résumé de la demande | Traitement de la demande | Nombre de pages divulguées |
|---|---|---|---|
| A-2024-004 | Obtenir copie complète de toute les études/analyses/recherches, évaluations/ ou autres rapports faisant référence ou ayant un lien avec le du dossier d'un train à grande fréquences ou train à grande vitesse du gouvernement fédérale et ce depuis 2 ans à ce jour. | Communication partielle | 293 |

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| A-2024-004 | Obtain a complete copy of all studies/analyses/research, evaluations/ or other reports referring to or related to the federal government's high frequency or high speed rail file for the past 2 years to date. | Disclosed in part | 293 |

# JOINT PROJECT OFFICE HIGH FREQUENCY RAIL PROJECT

## Project Status Report - DRAFT

V.002 – April 2021

BANQUE DE L'INFRASTRUCTURE DU CANADA

VIA Rail Canada

CANADA INFRASTRUCTURE BANK

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# 1. Executive Summary

This Project Status Report provides a summary of the planning, due diligence, and pre-procurement activities for the High Frequency Rail (HFR) project to the end of December 2020, or where identified, as updated to the end of February 2021.

The HFR project is a project to deliver mostly dedicated and reliable rail infrastructure and systems to support the future growth of the region between Toronto and Québec City. HFR is an opportunity to transform the travel experience with increased frequencies, lower journey times, better integration with the wider transportation network, and an improvement to on-time performance.

The Government of Canada established the Joint Project Office ("JPO") as a joint venture between the Canada Infrastructure Bank and VIA Rail Canada to conduct de-risking, due diligence, pre-procurement and planning activities, explore and analyze operating models and develop evidence-based options of procurement and financing for the HFR project and to assess the project's viability.

Alignment

The JPO studied and evaluated [redacted]

The evidence and analysis presented in this document focuses on [redacted] refinement of the engineering design and supported financial modelling and analysis to the end of 2020.

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[redacted]

For the Toronto – Ottawa – Montréal section, Option 2 follows existing freight rail corridors connecting Toronto, Peterborough, Ottawa, and Montréal and also a former freight corridor [redacted]. Option 2 enables direct services between Toronto and Ottawa, and Toronto and Montréal. Between Montréal and Québec City, the proposed alignment follows the existing freight corridor north of the St. Lawrence River. Securing HFR access to both the T-O-M and M-Q alignments is dependent on securing a commercial arrangement with host railways (e.g., CP, QGRY, MX, CN) in respect of the freight alignment and [redacted].

With HFR, journey times between most of the major cities on the corridor are significantly enhanced over those available today.

*Table 1 Existing VIA and future HFR travel times between major routes*

| Segment | Jan 2020 VIA Average Journey Times | HFR – Average Journey Times | Jan 2020 VIA Fastest Journey Time | HFR – Fastest Journey Time |
|---|---|---|---|---|
| Toronto - Montréal | 5:03 | [redacted] | 4:49 | [redacted] |
| Toronto – Ottawa | 4:27 | | 4:05 | |
| Ottawa – Montréal | 2:02 | | 1:50 | |
| Montréal – Québec City | 3:24 | | 3:11 | |

HFR is planned to provide more daily frequencies between the major cities across the Toronto and Québec City corridor. This will give passengers more options and greater flexibility. Frequencies and the service offering will continue to be refined through the development of the project.

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*Table 2 Indicative HFR Service Levels*

| HFR Service Levels | |
|---|---|
| Time Frame | [redacted] |
| | |
| Montréal – Toronto | |
| Toronto – Ottawa | |
| Ottawa – Montréal | |
| Montréal – Québec City | |

HFR Project schedule

The JPO's projected project schedule for creation of the HFR alignment and commencement of services (including a Public Private Partnership procurement exercise, the design, construction, Impact Assessment (IA) and procurement) is in the range [redacted]. The timing and critical path of the project is largely driven by the duration of the IA, ranging between [redacted] years.

City Access and Host Railways

While the HFR Project has identified the above alignment between Cities to provide primarily dedicated passenger rail usage, access to Toronto, Montréal, and Québec City would continue to use shared track or station facilities owned and operated by others (i.e., freight or commuter rail operators). [redacted]

Under the current proposal, rail traffic control in these shared areas remains under host railway control. Dialogue is on-going with these host railways on the physical infrastructure requirements and costs for City Access, the operating agreements and commercial consideration to support HFR higher frequencies. [redacted]

[redacted]

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[redacted]

The JPO has not completed de-risking work in this area [redacted]

Technology

The JPO has presented and provided costing for two propulsion technology solutions for HFR including Diesel and Electrified routes.

An opportunity exists to develop HFR as electrified routes. Approximately 90% of the proposed dedicated alignment can be electrified. Current alignment proposals suggest that full electrification would create operational and maintenance constraints forhost railways on certain segments of the shared corridors. Electrified HFR routes are still possible with a bi-mode train that can operate in both electric and non-electric modes.

With electrification, HFR could eliminate GHG emissions at the train source (when in electric mode) and would further support Canada's environmental commitments. Over 30 years, HFR with bi-mode operation would bring a [redacted] tonnes reduction of $CO_2$ equivalents compared to a business-as usual scenario with today's existing fleet of diesel trains.

The option for developing HFR as a diesel railway gives the more favourable project NPV but would contrast with Policy objectives in respect of GHG reductions.

Capital costs

While the JPO presents cost ranges within this Project Status Report, the likely capital cost for the HFR diesel option is $[redacted]

The likely capital cost for the HFR electrification option is [redacted]

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[redacted]

Revenues and Operating, Maintenance and Renewal costs

The projected total revenue over a 30-year period is [redacted] (in 2019 prices excluding inflation) based on the journey times and indicative opening day timetables. The likely Operations, Maintenance, and Rehabilitation (OMR) costs are outlined in Table 3 forthe diesel and electric options.

*Table 3 Total lifecycle costs (LCC) and operations, maintenance, rehabilitation (OMR) costs for HFR under both technology options*

| $2020 $000s (2030-2059) | Electric | Diesel |
|---|---|---|
| Total Operations | [redacted] | |
| Total Maintenance | | |
| Total Rehabilitation / Life Cycle Costs | | |
| **Total OMR Costs** | | |

Benefit Cost Ratio

An expanded benefit cost ratio (including traveler benefits, externalities, and wider economic benefits) for the project is [redacted] over a 30-year evaluation period. The project is expected to create [redacted] annualequivalent jobs under the diesel option and [redacted] annual equivalent jobs under the electric option throughout the construction period.

Net Present Value

A net present value analysis was conducted to compare the alignment and technology options of the project. This assessment includes capital, operating, maintenance and lifecycle costs, net of revenue totaled over a 30-year period (representing the potential length of an initial concession). The net present value was calculated over a 30-year evaluation period as a metric for the purposes of comparison of alignment options. This analysis has progressed since the July comparison of alignment options based on the work through to the end of 2020.

Over a 30-year evaluation period, the NPV for [redacted] the diesel option is [redacted] and the NPV for the electrified option is [redacted]. Based on this analysis, the discounted total 30-year revenue for the project is less than the sum of the discounted initial capital investment and the discounted 30-year total of operating, maintenance and rehabilitation costs. The option for developing HFR as a diesel railway provides a more favourable NPV, but would contrast with Policy objectives in respect of GHG reductions. The NPV analysis does not consider the value of greenhouse gas reductions.

Procurement model and Financial Structuring

The JPO has assessed the Design-Build-Finance-Maintain ("DBFM") and Design-Build-Finance-Operate-Maintain ("DBFOM") procurement delivery models, which represent two distinct options for involving the private sector in the project. The financial structures that were

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proposed under each procurement delivery model allow the Government of Canada to leverage private sector involvement to 1) finance capital expenditures during the construction period and 2) receive at financial close committed Public sector subsidy requirements for a 30-year contract term.

The JPO has outlined five scenarios representing varying degrees of potential private sector involvement. [redacted]

At this time, all financial structures considered have been modelled with no economies of scale, optimization, or assumed efficiencies through integration of activities that are expected to be proposed by a private sector if afforded the opportunity to do so. [redacted]

*Table 4: Project life subsidies (over 30-years) and required operator efficiencies for the electric option*

[redacted]

*Table 5 Project life subsidies (over 30-years) and required operator efficiencies for the diesel option*

[redacted]

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Strategic and Tactical Project Optimization

The JPO has developed a framework to assess changes to key project parameters to strengthen the project proposition while balancing economic, financial and social considerations. Further assessment is ongoing in optimization of the project.

Subsequent analysis and developments since December 2020

Subsequent to presentation of the findings of the data and analysis within the update to DMOC in December 2020 the JPO has continued to progress work to de-risk the Project and address the JPO Mandate.

Significant to the work of the JPO attention is drawn to the following areas of on-going consideration:

Alignment host railway dependency:

[redacted]

City Access considerations:

[redacted]

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[redacted]

Tactical and Strategic Optimisation:

JPO initial results demonstrate that Project NPV may be enhanced through continued scenario optimisation [redacted]

Strategic optimisation will await results of host railway and City Access work currently on-going.

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# 2. Introduction

## 2.1. Intent of the Document

This Project Status Report provides a summary of the planning, due diligence, and pre-procurement activities for the High Frequency Rail project until the end of December 2020. This summary document supplements the "Update on High Frequency Rail" (submitted to Transport Canada on December 4th 2020) which provided the direction of travel for the Revised Business Case for the Project to the Government.

This document provides analysis based on the current progress of the intercity alignment, urban alignment, technology, and procurement options. [redacted] This document also sets out the next steps required to make this project a reality.

## 2.2. Project Context

Transportation 2030 outlines the Government of Canada's aspirations and strategy to develop an integrated national transportation system that:

- provides travelers with greater choice and better service;
- builds a safer and more secure transportation system;
- reduces air pollution and embrace new technologies; and
- improves the performance of the transportation system to grow the economy.

The High Frequency Rail (HFR) project is a proposed investment in intercity rail that aligns with this strategy and addresses the needs of a growing region:

- Canada's most densely populated region will continue to grow and will require a transportation system that meets the need of its passengers. By 2043, an additional five million people, an increase of 21% from 2020, will call Quebec and Ontario home[1]; over half of the projected growth in Canada. Many are expected to live in the communities across the Toronto, Ottawa, Montréal, and Québec City regions. This region is an economic engine for the country as it accounts for more than 40% of the national GDP [2]. People will need efficient transportation to facilitate economic activity.
- Canada is committed to reducing greenhouse gas emissions. Climate change is an environmental challenge that impacts the wellbeing for current and future generations. With the transportation sector as the second largest source of emissions in Canada, there is the

[redacted]

need to develop alternatives that enable Canada to progress towards its emission reduction targets and international commitments on climate change.

- The current passenger experience is influenced by operating in shared corridors with freight. VIA Rail primarily operates on tracks owned and controlled by host railways, relying on their cooperation for track capacity, train schedules, and on-time performance, which has been decreasing over time. Scheduled train journey times are similar to driving as trains travel up to a maximum speed of 160 km/h on its current route. As Canada grows, there will be increased demand for both passenger and freight rail services in this region requiring an investment to improve the passenger experience and accommodate future growthto freight, commuter, and intercity rail.

HFR provides an opportunity to transform the travel experience between the major cities across Canada's mega region through modern, resilient, and sustainable rail service. HFR is an opportunity to invest in resilient infrastructure in a dedicated corridorthat supports the long-term growth of the nation's most densely populated region and Canada's commitment to reducing greenhouse gases.

## 2.3. Joint Project Office Mandate

The Government of Canada established the JPO as a joint venture between the Canada Infrastructure Bank and VIA Rail Canada to conduct de-risking, due diligence, pre-procurement and planning activities, explore and analyze operating models and develop evidence-based options of procurement and financing for the HFR project and to assess the project's viability.

- VIA Rail Canada ( VIA) is a crown corporation and is the national passenger rail operator providing intercity, long-distance, and essential regional rail transportation. VIA Rail prepared a business case for the Government of Canada and commissioned a study in 2016 to assess the technical and economic feasibility for the HFR Project.
- The Canada Infrastructure Bank (CIB) has a mandate to invest and attract investment from the private sector and institutional investors in revenue-generating infrastructure projects that are in the public interest. In 2019, the Government requested that the CIB assess the initial VIA business case, and as a result of that assessment, was asked to take on the role of advisor to, and potential investor in the project.

This document presents the progress as of late 2020 and supporting evidence for the following elements within the JPO mandate:

- Intercity Alignment – assess alignment options for the recommended and optimized option for the alignment between Toronto and Montréal, and between Montréal and Québec City;
- Urban Alignment (City Access) – assess options for access into major cities (e.g., Toronto, Montréal, and Québec City) and integration of HFR with tracks used by regional transit and freight operators;
- Technology – examine rolling stock propulsion technologies; electrification and diesel; and
- Procurement – develop options to procure and finance the optimal HFR project under a Design-Build-Finance-Maintain (DBFM) or Design-Build-Finance-Operate-Maintain (DBFOM - availability and revenue) model.

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## 2.4. Document Structure

As a supplemental summary of the "Update on High Frequency Rail" presentation (submitted to Transport Canada on December 4th, 2020), this document is organized in a similar structure with the following nine sections and provides a progress update under these themes:

- Section 2 Introduction outlines the need and context for the High Frequency Rail project and outlines the mandate of the Joint Project Office;
- Section 3 VIA Rail Background provides a summary of the existing passenger experience and performance for Toronto – Québec City services;
- Section 4 Opportunity and Vision sets out the overall opportunity of the HFR project that also aligns with Government policy and objectives;
- Section 5 Project Definition summarizes the current proposition and definition for the HFR project within the JPO mandate;
- Section 6 Strategic Case focuses on the long-term strategic benefits for the project and its alignment with the opportunity and vision;
- Section 7 Economic Casepresents the progress on the economic analysis comparing the benefit and costs for the project;
- Section 8 Procurement Case presents the approaches to advance the project to market including analysis on options to procure and finance the project;
- Section 9 Financial Case presents the progress on the financial analysis including the capital costs, operating costs, lifecycle costs, ridership and revenue for the current state for the HFR project;
- Section 10 Deliverability and Operations Case summarizes technical considerations for the delivery and operations of the project;
- Section 11 Role of VIA [redacted] and
- Section 12 Communications Plan outlines the overall communications strategy and plan for the Project.

## 3. VIA Rail Background

VIA Rail Canada is the national passenger rail operator providing train services on behalf of the federal government. VIA Rail is the current operator of intercity trains between Toronto and Québec City, and also provides intercity service to communities in South Western Ontario (Figure 2).


*Figure 2 Map of the Corridor routes and stations (Source: VIA Rail Canada)*

Current Service and Passenger Experience

VIA operates its intercity services on track and stations (e.g., Union Station) that are mostly owned and controlled by host railways, which influences the frequency, speed, and on-time performance of VIA's train services. Within the Toronto – Québec City corridor, VIA currently owns track between Brockville, Ottawa, and Coteau (shown in yellow in Figure 2), which represents 3% of the track infrastructure it operates on nationally. This is operated through a services contract with Railterm Inc.

VIA currently operates between five and ten trains per day between Toronto and Québec City depending on the city pair. The ability to operate additional frequencies are currently dependent on the available capacity and access granted by the host railway. On its current routes, the maximum operating speed for these train services is 160km/h, which is one of the factors that affects overall journey times. Current train journey times, shown in Table 6, are similar to car journey times.

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*Table 6 Current frequencies and travel times on VIA routes*

| Routes | Daily Frequencies | Average Travel Time | Shortest Scheduled Travel Time |
|---|---|---|---|
| Toronto – Ottawa | 10 | 4:27 | 4:05 |
| Ottawa – Montréal | 6 | 2:02 | 1:50 |
| Toronto – Montréal | 6 | 5:03 | 4:49 |
| Montréal – Québec City | 5 | 3:24 | 3:11 |

Operations in corridors shared with other regional and freight trains affect overall on-time performance and passenger experience. Average on-time performance[3] for all services between Québec City and Windsor was 67% in 2019 (Figure 3). On-time performance varies by train service and is dependent on track control. On track that VIA controls, trains run to within 90% of schedule in the section, with higher on-time performance for trains between Ottawa and Montréal. [redacted]

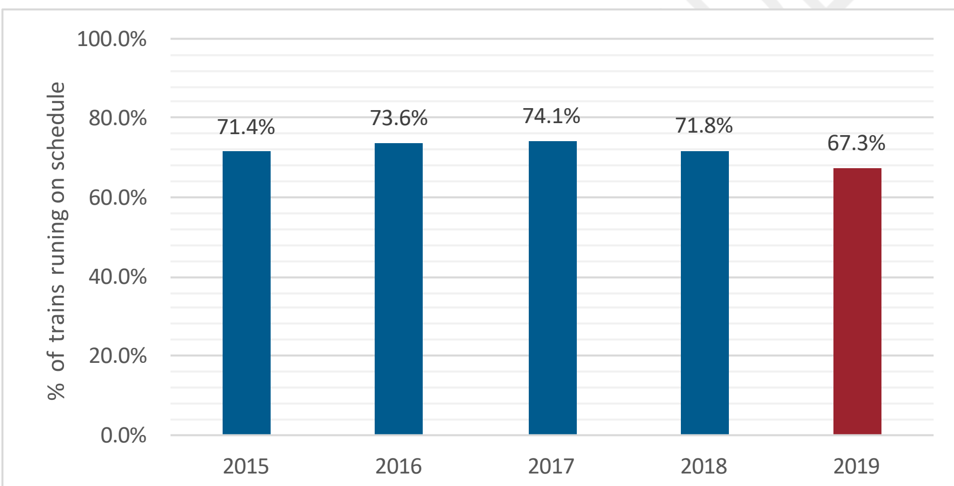


*Figure 3 Total Corridor on-time performance %*

Ridership between Toronto, Ottawa, and Montréal represents 75% of all ridership between Québec City and Windsor (Figure 5). Changes to the passenger experience on these routes has the greatest impact on total ridership. The ridership between these major hubs therefore accounts for a majority of VIA's ridership and improvements in these sections would have the greatest impact on total ridership.

[3] VIA Rail defines a train is on-time if it arrives within 10 minutes of its scheduled time for a journey less than 3 hours and within 15 minutes of its scheduled time for a journey greater than three hours.

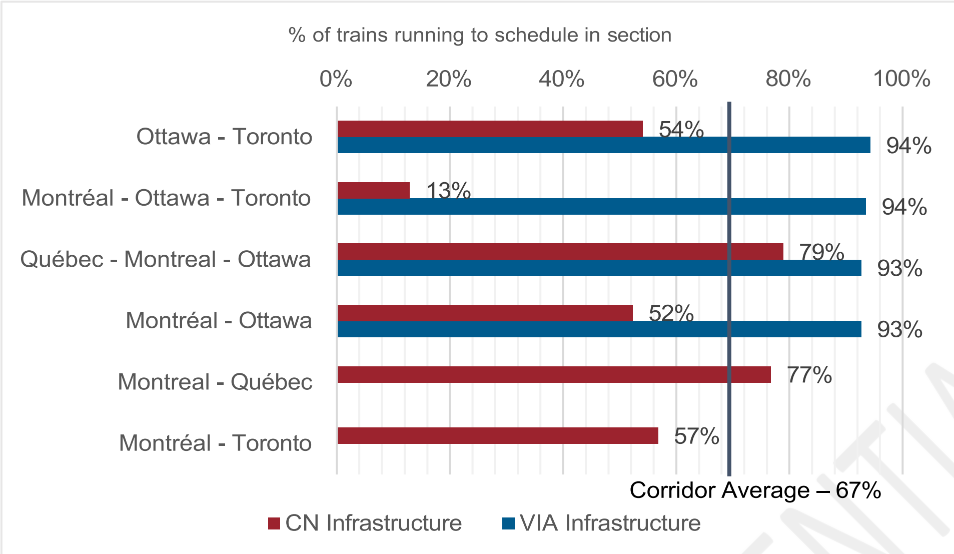


*Figure 4 On-time performance by route and track control in 2019*

Ridership in the Corridor accounts for approximately 96% of all passenger trips in VIA's entire network. It has steadily increased 30% over five years, from 3.6 million in 2015 to 4.7 million in 2019, which can be attributed to a combination of factors including:

- Increase in services between Toronto to Ottawa;
- Increase in seat capacity on the busier routes; and
- Targeted marketing through the adoption of a customer relationship management program.

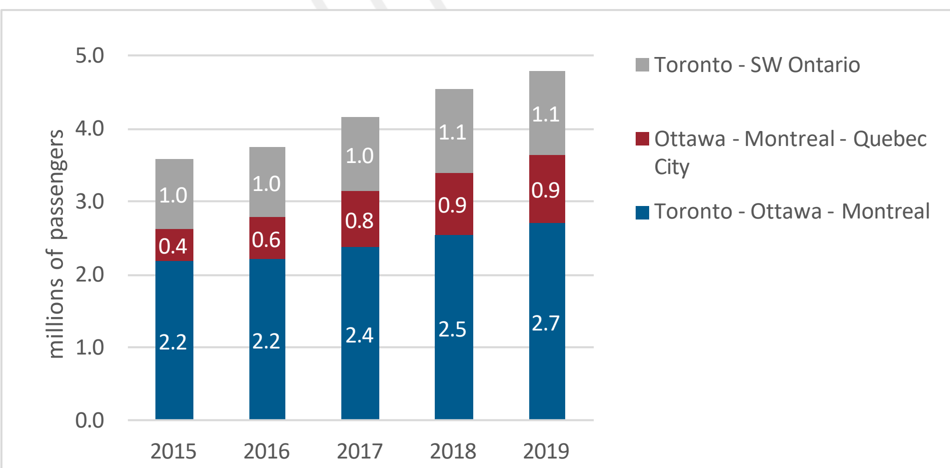


*Figure 5 Corridor ridership has increased between 2015 and 2019 (Source: VIA Rail Annual Reports)*

Revenues in the Corridor totaled $325 million in 2019, accounting for 79% of all passenger revenue across VIA Rail. Corridor revenues have steadily increased from $226 million in 2015 to $325 million in 2019, which is attributed to both an increase in ridership, and an increase in yield with the application of a revenue management system. Operating costs for the Corridor have also increased from $380 million in 2015 to $470 million in 2019.

VIA requires an annual government subsidy to offset operating costs (Figure 6). The annual subsidy for the Corridor has remained between $140 million and $150 million over the past five years. In 2019, the Corridor required a subsidy of ~$145 million or approximately $30 per Corridor passenger.

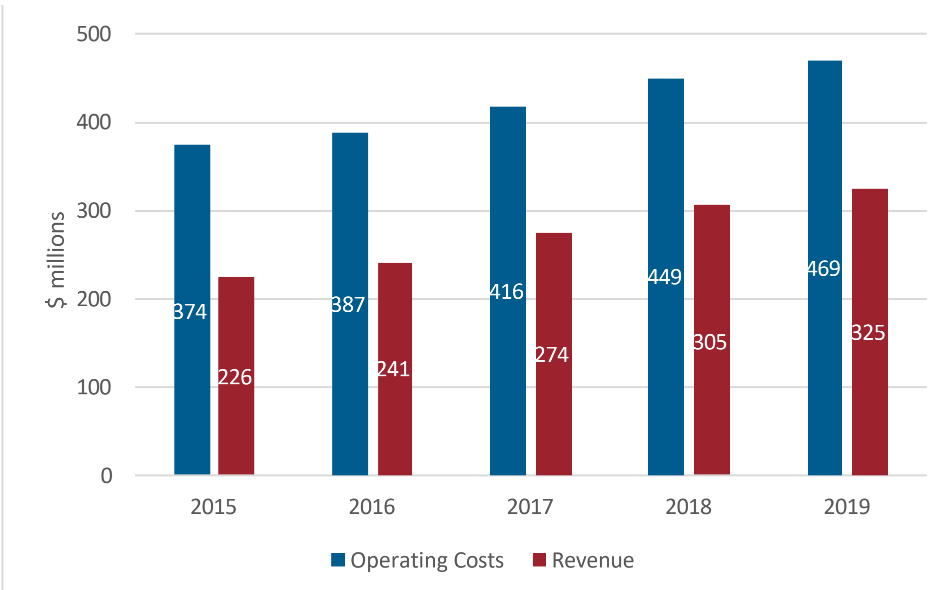


*Figure 6 Corridor revenue and operating costs have increased between 2015 and 2019 (Source: VIA General Ledger)*

VIA Current Capital Investments

With financial support from the Federal Government, VIA is investing $1.5 billion in a fleet of new intercity trains to operate on the Corridor. The first trains are planned to arrive in 2022. VIA has further identified $ 500 million to be invested in initiatives across its owned track and IT infrastructure, maintenance centre improvements and repair and upgrade of stations.

# 4. Opportunity and Vision

HFR provides an opportunity to transform the travel experience between the major cities across Canada's mega region through modern, resilient and sustainable rail service; while supporting Government priorities, including economic development, social and environmental benefits.

## 4.1. Government Priorities in *Transportation 2030*

The Government of Canada has outlined priorities and aspirations for the future of transportation in Canada in Transportation 2030: 'A Strategic Plan for the Future of Transportation in Canada', the following key themes relate to the HFR opportunity:

- The Traveller: To provide travelers with: greater choice, better service, lower costs, and enhanced rights;
- Safer Transportation: To build a safer, more secure transportation system that Canadians trust;
- Green and Innovative Transportation: To improve Canadians' lives by reducing environmental impacts, including air pollution, and embracing new, more sustainable technologies; and
- Trade Corridors to Global Markets: To improve the performance of our transportation system to get products to markets and grow Canada's economy.

## 4.2. Vision

HFR will deliver modern rail infrastructure and systems with capacity that can scale with the future growth in demand for intercity rail. HFR is an opportunity to invest in a broader vision that builds a better future for Canadians by:

- Advancing the public interest including respecting Indigenous interests, improved safety, and optimizing financial commitment from Government, and aligning with provincial priorities;
- Enhancing the passenger experience with a new passenger rail service operating at higher speeds, higher frequencies, and greater reliability;
- Achieving greater connectivity for people living in major cities and communities between Toronto and Québec City;
- Reducing the environmental footprint with a reduction in Greenhouse Gases (GHG), improved sustainability;
- Supporting economic growth by creating new employment opportunities in infrastructure and bringing people closer to markets, businesses and activity;
- Promoting a competitive marketplace that gives Canadians more flexibility and affordable options for intercity travel; and
- Increasing equitable access to passenger services for all people regardless of physical ability or socio-economic background.

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## 4.3. Project Opportunity

The HFR project is compatible with the overall themes in Canada's transportation strategy. HFR is a long-term investment in passenger rail that can deliver:

- Increased frequencies connecting Canada's major cities that provide travelers with greater flexibility and choice;
- Lower journey times that can attract higher ridership from other modes of transportation, in particular private vehicles, and provides a safer and more reliable service for travellers;
- Improved integration with the wider transportation network and other transport modes with connections to local and regional transit services and airports;
- An improvement to on-time performance;
- A reduction of greenhouse gases emitted by operations of intercity passenger rail;
- An attractive and reliable alternative to private vehicle and air travel across the corridor - allowing for productive time and a sustainable travel option for passengers;
- Creation of new skills and employment during the build, maintenanceand operations of HFR. During the construction phase of the project, an estimated [redacted] annual equivalent jobs could be created;
- Improvement in productivity of the region through connections between major employment hubs, business centres, universities, and major tourism destinations- bringing people and places closer together;
- An opportunity to increase revenues compared to a business-as-usual scenario over a 30 year period, assuming fares are unchanged in real terms at 2019 VIA Rail fare levels; and
- New and rebuilt infrastructure for ~90% of the alignment provides lasting benefits and furthers the resiliency of the service offering offered to passengers. HFR will deliver modern rail infrastructure and systems with capacity that can scale with the future growth in demand for intercity rail.

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# 5. Project Definition

## 5.1. What is High Frequency Rail?

HFR is a proposed 1000+ km passenger rail line with new tracks, structures, stations, rail systems, and rolling stock that can be delivered under a DBFM or DBFOM Public Private Procurement model.

The HFR infrastructure will enable new train services between Toronto and Québec City, and complements the existing service offering between Windsor and Québec City. Both Local and HFR services are currently envisaged to be part of a combined Corridor maintenance and operating entity. The conceptual service offering and timetables are discussed in further detail in Section 9.2 and 9.3.

[redacted]

The HFR project will broadly require:

- Construction of new and upgraded tracks along VIA, host railway, and new right-of-way (ROW), structures, stations, and rail systems to enable a faster, more frequent, and resilient passenger rail service;
- Collaboration with railway owners [redacted] to facilitate track access on shared passenger and freight corridors and on the approaches to major urban centres;
- Procurement of rolling stock suitable for HFR; and
- Selection of a private partner to support the design, construction, financing, maintenance and / or operations of the new HFR service.

[redacted]

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[redacted]

*Figure 8 Schematic map and project definition*

[redacted]

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## 5.2. Alignment

The JPO was tasked to review and optimize alignment options and to develop new routes between Toronto and Québec City. The alignment options were screened using a multi-criteria analysis (MCA) which evaluated each option against a range of criteria, such as: Financial, Engineering, Social and Environmental considerations.

The alignment is further discussed in the following two subsections:

- Toronto – Ottawa – Montréal
- Montréal – Québec City

### 5.2.1. Toronto – Ottawa – Montréal

The JPO assessed various alignments to develop a range of options in the Toronto – Ottawa – Montréal section and were guided to the following shortlisted alignments:

[redacted]

*Table 7 A July 2020 comparison of main trade-offs between alignments*

[redacted]

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[redacted]

Activities through to the end of 2020 refined Option 2 from the July 2020 comparison. [redacted]

The JPO is continuing due diligence and de-risking activities that may change the information and conclusions derived from this report.

[redacted]

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[redacted]

*Figure 10 Proposed alignment from Montréal and Québec City*

## 5.3. City Access

The JPO was tasked with reviewing and assessing alignment options and commercial agreements with host railways for access in Toronto, Montréal, and Québec City, where there is potential interface between HFR and other freight or regional transit operators. The focus to date has been on Toronto and Montréal, as they carry the most complex challenges with regards to bringing HFR to these major nodes - in particular, with regards to capacity, future proofing and on-time journey performance aspects through either shared track or station facilities owned and operated by others.

Further assessment is required by the JPO to de-risk the City access along with defining the optimum solution that caters for the operational and performance needs of HFR. [redacted]

[redacted]

## 5.4. Technology

The JPO mandate included analysis with regards to rolling stock propulsion technologies, focusing on a comparison of electrified and diesel. Each technology was assessed in terms of economic and operational benefits where an electrified or partially electrified solution may further benefit key Government of Canada objectives such as advancement of public interest, reduction in environmental footprint, support of economic growth, and enhanced network interoperability.

The reference concept vehicle for HFR is a modern EPA Tier 4 compliant diesel locomotive. These offer reduced environmental impacts and related greenhouse gas (GHG) emissions compared to current VIA trainsets, however, they do continue to emit pollutants and carbon dioxide equivalents ($CO_2e$).

Electrification brings environmental benefits by eliminating GHG emissions at the train source, provides lower audible noise, may offer increased operational performance due to lower vehicle weights and acceleration characteristics, and provides lower operating and maintenance costs compared to diesel equivalent vehicles.

Current alignment proposals suggest that full electrification would create operational and maintenance constraints forhost railways on certain segments of the shared corridors, in particular city access. The extent of these constraints, possible resolutions, and the impact on the extent of electrification is still being assessed. However, even if these constraints are not further optimized, approximately 90% of the HFR alignment can be electrified. If these constraints cannot be eliminated, this current configuration would require the use of a bi-mode trainset which can operate both in electric and non-electric sections of the alignment.

Bi-mode vehicles would provide the possibility of elimination of diesel pollution and associated health hazards when operating in electric mode, further enhancing Canada's environmental commitments to the Paris Agreement. At the same time, bi-mode vehicles could offer greater efficiency through regenerative braking, lower audible noise at lower speeds, and greater resiliency in operations due to down overhead catenary or extreme weather conditions.

Material performance enhancements for bi-mode(including possibility of an electric-battery bi-mode) and fully electric locomotives compared to diesel locomotives have not yet been assessed and modeled. These technologies would eliminate the need for diesel, eliminating emissions at source and further reducing operation and maintenance costs.

Electrification would bring modern, electrified intercity passenger rail to Canada. Building and maintaining an electrified intercity railway would create a new industry, a new supply chain, and the need for skilled employment, as well as opportunities during the construction phase for the creation of an electrical supply backbone for HFR. Having electric-capable rolling stock for HFR also maximizes the benefits and interoperability of future Metrolinx On-Corridor GO electrification. Further details on Electrification are outlined in Section 10.2.

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

## 5.5. Procurement

The October 24th, 2019 DMOC meeting provided direction to the JPO to assess and develop fully implementable DBFM and DBFOM options to deliver the HFR Project. [redacted]

[redacted]

[redacted] It is important to note that a project definition that is too specific may impact the procurement in terms of private sector innovation and efficiencies. This Project Update provides an outline of the procurement options assessed.

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

## 5.6. Futureproofing

The current scheme for HFR requires approximately 90% of new or rebuilt infrastructure. Infrastructure corridors are often designed with a design life (e.g., up to 100 years) which provides lasting benefits that reach well beyond the initial concession period. HFR can be progressed and built today on the advanced alignment; the definition of this corridor sets the foundation for future HFR operations and ability to achieve of long-term Government objectives. The JPO has considered futureproofing HFR in terms of speed, capacity, safety and the environment themes. Progress to date is summarized in Table 8.

*Table 8 Futureproofing considerations*

| Theme | Description |
|---|---|
| Speed | [redacted] |
| Capacity | |
| Safety | |
| Environment | |

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

# 6. Strategic Case

HFR is an opportunity to transform intercity rail travel and build a stronger economic and sustainable future for Canada. Investment in a high frequency rail corridor between Toronto and Québec City can deliver lasting infrastructure with long-term value in the nation's most densely populated region. This Strategic Case discusses the benefits [redacted]

## 6.1. Enhancing the passenger experience

HFR could have the potential to transform the passenger experience with improved journey times, additional frequencies, and better reliability for intercity rail connections between Toronto, Ottawa, Montréal, and Québec City. In addition, new rolling stock, new and upgraded stations can reshape the customers experience of train travel in the region and provide a viable alternative mode of travel to existing options.

HFR is planned to improve journey times between the major cities in the Corridor compared to today's rail service offering. The current HFR alignment is planned for a maximum operating speed of 177 kph (110 mph), limited by current regulations for passenger rail movements across at-grade road crossings. Optimization and de-risking work continues on the Option 2 alignment, with focus on infrastructure improvements that could facilitate journey time [redacted]

Service reliability and on-time performance is also an important factor to the passenger experience. Today, 67% of VIA's intercity services arrive within 15 minutes of the scheduled arrival time. The delays are mainly due to the significant use of host tracks owned and controlled by CN and Metrolinx. HFR services are planned to operate on routes where its

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[redacted]

s. 18(a)
s. 18(b)
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operator will have control of over ~90% of the track. This provides an opportunity to improve on-time performance for trips between Toronto, Ottawa, Montréal, and Québec City, as currently approximately 90% of VIA's intercity services operate to time on VIA controlled rail infrastructure. At this time, service reliability and on-time performance cannot be guaranteed as city access approaches to the current city destination stations of Union Station and Gare Central are not controlled by HFR. Further de-risking activities are required to achieve higher on-time performance on the city access portions of the alignment.

HFR is planned to provide more daily passenger train frequencies between the major cities across the Toronto and Québec City corridor. This will give passengers more options and greater flexibility. On opening day, there could be a total (combined HFR and local) [redacted] frequencies per day or a train every 90-120 minutes each weekday (Figure 12). New track infrastructure can support additional HFR frequencies for Toronto – Ottawa and Toronto – Montréal routes with up to [redacted] HFR frequencies planned within the first 30-year concession period. Beyond the first 30-year period, ridership is expected to continue to grow, and additional frequencies may be required to meet demand.

[redacted]

## 6.2. Achieving greater connectivity

Historically, the public transportation infrastructure within the corridor has focused on a local need rather than being considering as a fully integrated transportation system which meets the first mile-last mile, local, intercity and international travel needs for passengers. A key missing link has been a frequent and resilient intercity rail service which consistently performs to on-time arrival and departure expectations. HFR is planned to bring greater connectivity across the region by serving new communities, regions and integrating HFR to other transportation modes.

[redacted]

s. 18(a)
s. 18(b)
s. 18(d)


*Figure 13 Proposed VIA network map with HFR*

Through the Option 2 alignment currently being considered, HFR is planned to provide intercity rail services to more communities, such as Peterborough, which has a population of 84,000, and Trois-Rivières, which has a population of 137,000. By serving and connecting to new communities and regions, HFR enables greater connectivity between people and places across the HFR corridor. HFR is planned to also benefit the communities across the Southwestern Ontario region, including London, Sarnia, and Windsor. With a connection through Toronto, HFR lowers the overall journey times and increases options to travel through to Ottawa, Montréal and Québec City.

HFR is planned to strengthen the intercity service offering and complement the existing passenger rail services that would continue to operate in the corridor. With key interchanges between HFR and other forms of transportation in the region (Table 9), HFR can be the foundation of a sustainable transportation system that connects with local and regional transit networks and increase overall accessibility and attractiveness of HFR to a wider population.



[redacted]

[6] REM (proposed)

[7] Québec City Tramway (proposed)

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

HFR will also provide rail connections between city centers and airport hubs to deliver improved connectivity and access to longer-distance markets for both residents and visitors to Canada. HFR will provide two new connections to airports in the Corridor, connections to Québec City Jean-Lesage International Airport, and Montréal-Trudeau International Airport (Table 10). Additionally, HFR will indirectly connect to other airports in the Corridor through connections to the greater transport network.

*Table 10 Journey times to from stations to major airports*

| City (Station) | Annual Air Passengers | Journey Time to Airport (min) | | |
|---|---|---|---|---|
| | | Car* | Public Transit* | HFR |
| Montréal (Gare Centrale) | 20,305,106 | 20-30 | 40 | 17 |
| Québec City (Gare Du Palais) | 1,774,871 | 20-30 | 70 | 13 |

*represents pm peak hour journey times from station to airport. Source: Google maps

## 6.3. Reducing greenhouse gases and supporting sustainability

The HFR project presents an opportunity for Canada to start to restore the social, economic, and environmental balance for intercity travel in the corridor. It further supports the Government initiative for Canada to be net-zero by 2050 while also contributing towards the priorities outlined in the Federal Sustainable Development Strategy. Thus, HFR would not only benefit Ontario and Quebec, but would also help Canada as a whole to meet the overall targets for reducing emissions.

Through electrification of the alignment, HFR would further support the reduction of greenhouse gas emissions. HFR with a bi-mode trainset (i.e., which can operate both in electric and non-electric sections of the alignment) would provide significantly lower average emissions per train (Figure 14). Preliminary findings indicate that over 30 years, HFR with bi-mode could provide a [redacted] tonnes reduction of CO2 equivalents compared to a business-as usual scenario with today's existing fleet of diesel trains. This reduction is based on approximately 90% electrification of the alignment; current alignment proposals suggest that full electrification would create operational and maintenance constraints for host railways on certain segments of the shared corridors. Greenhouse gas emissions could be further reduced should HFR be able to achieve 100% electrification across the alignment. The HFR reference vehicle with its Tier 4 diesel technology could bring a [redacted] tonne reduction of CO2 equivalents as compared to a business-as-usual scenario with today's existing fleet of diesel trains – it would however continue to emit pollutants.

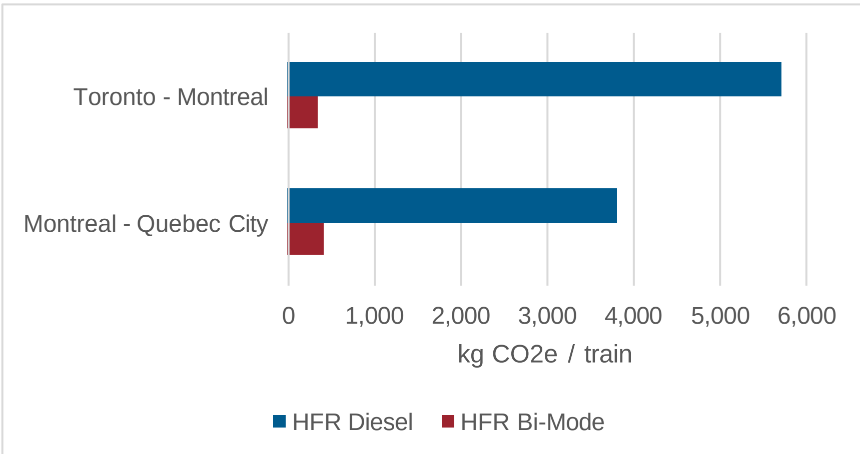


*Figure 14 Average emissions per HFR train by route*

HFR is planned to support Canada's sustainable development priorities by delivering climate resilient infrastructure and by avoiding adverse effects on the natural environment. This will contribute towards the priorities outlined in the 2019-2022 Federal Sustainable Development Strategy which includes:

- Greening government – HFR is currently planned to reduce greenhouse gas emissions emitted when compared to business-as-usual operations; electrification has greater potential for greenhouse gas reductions
- Modern and resilient infrastructure – HFR is an opportunity to improve the resilience of existing rail infrastructure and can be designed to be resilient to the impacts of climate change.
- Safe and healthy communities – HFR is planned to encourage modal shift from driving and flying to rail, which lowers air pollution emissions, noise, and number of passenger vehicle collisions.
- Healthy wildlife populations and pristine lakes and rivers – The planning for HFR will consider avoiding or reducing potential adverse effects on the natural environment, where reasonably possible. Where adverse effects cannot be avoided, mitigation measures will be identified through the Impact Assessment for the project.



## 6.4. Supporting economic growth

HFR is an investment in Canada's economy by improving productivity, supporting tourism, encouraging transit-oriented development, connecting major business, manufacturing, and finance centres, and creating jobs across the Corridor.

Increase regional productivity – HFR is planned to serve the most populous region of all Canada, which contributes to over 40% of the national GDP.[8] By 2043, an additional five million people,

[8] Statistics Canada – Table 36-10-0468-01

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

an increase of 21% from 2020, will call Quebec and Ontario home,[9] necessitating investment in sustainable intercity transport to support growth and economic activity. HFR can support regional productivity by making it easier to travel across the major communities, regions and through connecting the major cities in the Corridor. – enabling more productive time while traveling, connecting hubs of economic activity and linking many of the region's largest centres of higher education.

Supporting tourism – Tourism is Canada's largest service industry and represents two percent of the national GDP.[10] Both Toronto and Montréal account for two of the three top-earning tourism regions in the country.[11] With faster and more reliable service between cities, HFR could support increased tourism across the Corridor. Decreasing travel time results in rail becoming a more viable option for leisure travel and in particular for tourists planning to visit multiple Canadian cities, which would in turn, promote further tourism across the region, including destinations that are currently less travelled.

Transit-oriented development – The proposed HFR alignment allows for new rail stations and transit hubs. These stations present opportunities for transit-oriented development (TOD) integrated within new communities, and cities. There are potential opportunities to use available lands at or adjacent to HFR infrastructure for TOD that integrates new residential, mixed use and/or commercial development with rail. The JPO has not explored or financially evaluated opportunities; however, potential TOD opportunities could be explored through the project or by third-parties at or adjacent to the corridor.

Creating Jobs – HFR is an important investment for Canada, in the order of magnitude of [redacted] for the diesel option and [redacted] for the electric option. This investment is planned to generate economic activity and job creation in various sectors that span the entire project lifecycle from pre-procurement activities to operations and maintenance. Over the entire lifecycle of the project, HFR would create new jobs and opportunities for Canadians during the design, construction, and operation & maintenance phases of the project. HFR could generate between [redacted] total annual equivalent jobs (for electrification) or [redacted] total annual equivalent jobs (for diesel) over the construction period.[12]



[9] Statistics Canada (2019). Population Projections for Canada (2018 to 2068), Provinces and Territories (2018 to 2043) (91-520-X). Available at: https://www150.statcan.gc.ca/n1/pub/91-520-x/2019001/sect03-eng.htm
[10] Statistics Canada – Table 24-10-0042-01
[11] Statistics Canada – Visitor travel survey 2019 https://www150.statcan.gc.ca/n1/daily-quotidien/190827/dq190827a-eng.htm
[12] Refer to the Economic Case Section 7

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s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

## 6.5. Promoting a competitive marketplace

HFR provides a more competitive travel mode, providing passengers with more options and greater flexibility for intercity travel between Toronto and Québec City. Reducing travel times and transforming the passenger experience makes HFR an attractive alternative for intercity travel, [redacted]

[redacted]

## 6.6. Advancing the public interest

HFR is planned to advance the public interest by achieving better passenger, economic, and environmental outcomes. HFR also supports the public interest by enabling safer intercity journeys, respecting Indigenous interests, optimizing financial commitment from Government, and aligning with Provincial priorities.

- Respecting Indigenous interests: The JPO is progressing the Crown's duty to consult by facilitating enhanced relationships with Indigenous stakeholders and communities. The focus alignment is not proposed on reserve lands. However, many segments of the alignment cross Indigenous Traditional Territories and Treaty Areas. Some sections of the alignment also cross Land Claims Areas currently in negotiation with the provincial and federal governments.
- Enabling safer intercity journeys: HFR is planned to deliver new infrastructure, new rolling stock, and modern rail systems that will enable safer intercity rail journeys with greater segregation between passenger and freight operations, including the implementation of enhanced train control following an approach set out by Transport Canada for this technology.

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[redacted]

- Reducing impact of motor vehicle collisions: HFR is planned to reduce the overall vehicle kilometres travelled on highways between Toronto and Québec City, and in turn, reduce the impact of motor vehicle collisions on human life and society.
- Minimizing risk and financial commitment: Existing VIA intercity services in the Windsor – Québec City corridor require an annual subsidy of $140-150 million. HFR is planned to attract ridership and increase revenue; further work will focus on the risk borne by the public and private sectors with the objective of lowering the overall on-going financial commitment from Government.
- Aligning with Ontario's priorities[14] – HFR aligns with the Ministry of Transportation's focus on these key priorities:
  - Improving the transit experience: with new infrastructure that serves communities and regions across the province;
  - Promoting a multi-modal transportation network: that supports the province's economic competitiveness by strengthening connections between intercity rail and local transit; and
  - Keeping Ontario's roads safe and reliable: by promoting travel alternatives to cars and lowering overall congestion on Ontario's roads.
- Aligning with Quebec's priorities[15] – HFR aligns with the objectives in Quebec's Integrated Mobility Policy including:
  - Bringing mobility to serve the public and improving road safety through journey time reductions and providing an alternative to cars for intercity travel;
  - Creating mobility with a smaller carbon footprint through modal shifts reducing petroleum consumption and reducing GHG emissions; and
  - Using mobility to support a stronger economy by reducing costs associated with congestion.



[14] Ministry of Transportation Key Priorities: https://www.ontario.ca/page/published-plans-and-annual-reports-2019-2020-ministry-transportation
[15] Quebec's Integrated Mobility Policy: https://www.transports.gouv.qc.ca/en/Documents/PMD.pdf

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# 7. Economic Case

## 7.1. Introduction

This section sets out the status of the economic appraisal for the HFR project. Two options in respect of propulsion technology are appraised to date, the HFR Diesel Option, with 100% diesel traction, and the HFR Electric (Bi-Mode) option, wherethemajority of the traction is electric.

## 7.2. Economic Appraisal Assumptions

The economic appraisal makes use of assumptions and parameters such as the social discount rate, value of time, and value of external impacts, which are taken from a combination of Metrolinx and MTQ guidance. Input data that supports this analysis is based on the ridership and revenue forecasts completed on the [redacted] alignment (i.e., [redacted]

Outputs in this section are presented as the economic benefit and costs (in present value terms) totaled over a 30 year evaluation period[16]. Results in this section related to economic benefits and ridership are presented as a range of [redacted]

## 7.3. Costs

Costs to deliver the HFR project are divided into two categories:

- Capital Costs (Capex) arefixed one-time costs incurred during the development and construction of the project.
- Operating and Maintenance Costs (Opex) are ongoing costs required to operate the service, provide day to day maintenance and complete major rehabilitations throughout the lifecycle of the project.

Within the economic appraisalconducted, costs are presented as incremental to a business-as-usual scenario, representing the additional cost as a result of the HFR project. The Capex and Opex for the project evaluated over a 30-year period are set out as present values (in 2020 prices) in Table 11.

*Table 11: Total incremental capex and opex over a 30-year evaluation period*

| PV Billions of 2020 CAD | Diesel | Electric |
|---|---|---|
| Incremental Capex | [redacted] | |
| Incremental Opex | | |
| **Total Incremental Costs** | | |

[16] It is important to note that the incremental benefit and operational costs associated with HFR would continue beyond the initial 30-year period noted here. .

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## 7.4. User Impacts

User Impacts are a key area of analysis for transport investments. They represent how the investment will improve the social welfare of the users of the transport network. This includes existing users of VIA rail who will continue with HFR, those who are currently making journeys in the corridor by other modes, who will switch to HFR, and new users who will travel (or existing users who will travel more) as a result of HFR. The primary user impacts are the monetized journey time savings forexisting and new users who benefit from faster HFR journeys compared to today's service offering. Table 12 summarizes current estimates for user impacts over a 30-year evaluation period.

*Table 12: User impacts over a 30-year evaluation period*

| PV Billions of 2020 CAD | Diesel | Electric |
|---|---|---|
| Total Journey Time Benefits | [redacted] | |

## 7.5. External (Societal) Impacts

Every auto and airplane trip taken can contribute negative impacts to society through emissions or injuries and deaths that can occur from accidents. These impacts are called external impacts, or the 'social cost of transport.'

External impacts are estimated through the mode choice changes generated by the proposed investment. The external impacts have been calculated for the main monetized externalities:

1. Unperceived Automobile Operating Costs savings – or the costs of driving not taken into account when choosing how to make a journey
2. Decongestion Benefits – calculated through the removal of cars from the road
3. Road Safety Benefits – related to the reduction of car collisions from lower distances travelled by car
4. GHG changes – through reduced driving, flights, and changes in traction power

*Table 13: External impacts over a 30-year evaluation period*

| PV Billions of 2020 CAD | Diesel | Electric |
|---|---|---|
| Unperceived auto cost | [redacted] | |
| GHG Reductions | | |
| Decongestion Benefits | | |
| Road Safety Benefits | | |
| **Total External Benefits** | | |

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s. 21(1)(b)

## 7.6. Other Impacts

Two additional benefits were calculated as part of the Impact Analysis:

- The Resource Correction – which accounts for the transfer of fare paid from new HFR users to the operator, and is included as the incremental revenue from new users
- Agglomeration – or the measure of economic benefit from businesses being better connected

These impacts are relatively new to Canadian economic appraisal; the resulting benefits and benefit-cost ratio (BCR) have been reported both with and without these values.

*Table 14: Other impacts over a 30-year evaluation period*

| PV Billions of 2020 CAD | Diesel | Electric |
|---|---|---|
| Resource Correction | [redacted] | |
| Agglomeration Benefits | | |
| Total Other Impacts | | |

## 7.7. Jobs Created

HFR is expected to create jobs during the construction period. While typically not considered as a monetized benefit within economic appraisal, the number of jobs is presented here as a supplemental economic impact of investing in HFR. Two numbers have been calculated based on the overall capital cost and Canadian/US benchmarks for therate of direct jobs[17] per dollar of capital investment:

- The Change in Annual Equivalent Jobs – the average number of jobs the project will support during each year of construction
- The Maximum in one year – or the number in the year of highest spend

*Table 15: Number of direct jobs created during HFR construction*

| PV Billions of 2020 CAD | Diesel | Electric |
|---|---|---|
| Annual Equivalent Jobs | [redacted] | |
| Maximum Jobs in one year | | |

[17] Job estimates presented here are based on the capital costs, and only include direct construction jobs. This does not include the supply chain, or operations and maintenance employment.

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## 7.8. Impact Results

The total benefits and costs evaluated over a 30-year period are compared to generate a benefit-cost ratio for the project. An expanded BCR is presented which include other impacts (e.g., resource correction and agglomeration). Table 16 shows the overall impact results for the two options:

*Table 16: Total benefits and costs over a 30-year evaluation period*

| PV Billions of 2020 CAD | Diesel | Electric |
|---|---|---|
| Journey Time benefits | [redacted] | |
| Total External Benefit | | |
| Total Incremental Costs | | |
| **Benefits to Costs Ratio (BCR)** | | |
| Total Other Impacts | | |
| **Expanded BCR** | | |

The results of the Economic Case are preliminary and reflect the current progress on the focus alignment. Further design and analysis by the JPO will refine these results further.

These results should be reviewed in the context of the Project's Strategic and Financial Cases, which presents a wide range of strategic and policy objectives that can be supported by the Project.

## 8. Procurement Case

Ov erview

Selecting an optimal delivery method is one of the most important decisions made by the public sector when procuring infrastructure projects. For the VIA HFR Project, the JPO has the mandate to thoroughly assess two implementable procurement options (DBFM and DBFOM) for the Project.

The associated procurement research workstream involves 4 stages.

- Step A: Overview of procurement options (Completed)
- Step B: Case studies to support procurement options (Completed)
- Step C: Shortlist of procurement options with HFR overlay (Completed)
- Step D: Final analysis of the shortlisted options (Completed)

This section addresses materials intended for the Step C deliverables and provides the range of [redacted] procurement options that would be best suited to deliver the HFR Project. [redacted]

Baseline Assumptions for all Procurement Options.

[redacted]

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[redacted]

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[redacted]

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[redacted]

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[redacted]

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## 9.2. Journey Times and Indicative Timetables

### 9.2.1. HFR Schedule

The HFR project will provide improved service and more choice leading to increased ridership from 4.8 million trips in 2019 increasing to [redacted] trips post ramp-up (2034) and [redacted] trips per year at the end of the initial 30 years of operations (2059).

HFR will enable faster journey times between Toronto, Ottawa, Montréal, and Québec City with an alignment that provides journey times better than current services. With the planned services on HFR passengers will be able to travel between:

- Toronto and Ottawa in less than [redacted];
- Toronto and Montréal in approximately [redacted];
- Ottawa and Montréal in [redacted] minutes; and
- Montréal and Québec City in [redacted]

*Table 29 Existing VIA and future HFR travel times between major routes*

| Segment | Jan 2020 VIA Average Journey Times | HFR – Average Journey Times | Jan 2020 VIA Fastest Journey Time | HFR – Fastest Journey Time |
|---|---|---|---|---|
| Toronto - Montréal | 5:03 | [redacted] | 4:49 | [redacted] |
| Toronto – Ottawa | 4:27 | | 4:05 | |
| Ottawa – Montréal | 2:02 | | 1:50 | |
| Montréal – Québec City | 3:24 | | 3:11 | |

The JPO developed indicative opening day timetables based on the Option 2 alignment and reference vehicle. These timetables were used as a key input into the development of the ridership and revenue forecasts. The indicative opening day timetables were developed with a strategic focus to improve the passenger experience. Key benefits of the HFR timetable include:

- Higher frequency and faster journey times combine to provide the traveler market with an attractive schedule.
- Schedule allows for daily round trips between key city pairs, ideal for commuter & business markets.
  - One train a day from Toronto to Montréal arriving before 9am.
- As demand for the service increase, additional departures will fill out holes in schedule to create a true hourly service.

Indicative timetables are provided on the next page.

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s. 18(b)
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s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
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s. 21(1)(b)

## 9.3. Frequencies

[redacted]

[redacted]

Increasing the supply in order to accommodate as many passengers as forecasted will increase the size of the operations which will go on to drive operational costs, capital costs, lifecycle costs, and maintenance costs.

## 9.4. Ridership & Revenue

### 9.4.1. Introduction

This section sets out the status of the Ridership and Revenue forecasts forthe HFR project in the Québec City-Windsor corridor based on the forecasting framework dated October 12, 2020. The JPO is developing an investment grade ridership report at the time of this Project Status Report.

The forecasting framework for HFR builds upon an approach widely accepted throughout the transportation industry and commonly used to estimate potential demand for rail networks in the context of a brownfield infrastructure project.

As far as reasonably practical, the modelling framework developed produces forecasts for a range of inputs, situations and options that are internally consistent and coherent within the transport modelling and forecasting paradigm.

Forecast results for two options are presented as part of this report, the HFR Diesel Option, with 100% diesel traction, and the HFR Electric or Bi-Mode option, where majority of the traction is electric.

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

All ridership and revenue outputs in this section should be seen as sitting within a range [redacted] In addition, ridership and revenue forecasts presented here are unconstrained, and assume that sufficient capacity and high on-time performance can be achieved through infrastructure or commercial solutions. Further work is required by the JPO to optimizethe balance between supply, demand and costs.

### 9.4.2. Forecasts Results

Headline forecasts

Forecasting results indicate that the HFR Diesel Option has [redacted] more riders and generates [redacted] more revenue than the Business as Usual (BAU) scenario (i.e., existing riders if there is no HFR) during the first 30 years of operation of HFR. Electrification of the HFR project would generate [redacted] more riders and [redacted] more revenue compared to the Diesel option over the same period.

*Table 31: Cumulative ridership and revenue forecasts for the 2030-2059 evaluation period, in millions (rounded)*

| 2030-59 cumulative | BAU | HFR Diesel | HFR Electric |
|---|---|---|---|
| Total riders (millions) | [redacted] | | |
| Total revenue ($2019, in millions) | | | |

Source: [redacted]

Increases in HFR ridership and revenue have three fundamental sources: abstraction from other modes (car, air and inter-city bus), natural growth of the existing rail market and induced traffic.

Modal shift and induced demand

Modal shift comes mainly from air and auto market (Table 32 and Figure 32). The ridership composition of the Diesel and Electric option is comparable: 21% of the rail demand come from air travellers, 17% from car travellers, 1% from intercity bus users and 2 % from induced demand (i.e., new trips that would otherwise not have occurred) as a result of HFR.

*Table 32: Demand composition by mode for the 2030-2059 evaluation period, in millions (rounded)*

| 2030-59 cumulative | BAU | HFR Diesel | HFR Electric |
|---|---|---|---|
| Existing rail | 232 | [redacted] | |
| Capture from Car | - | | |
| Capture from Air | - | | |
| Capture from Bus | - | | |
| From induced | - | | |
| **Total riders (millions)** | **232** | | |

Source: [redacted]

---

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

Source: [redacted]

### Forecast results by rail segments

Table 33 below presents the cumulative ridership and revenue forecasts over 30-years across the full Québec City-Windsor corridor split by network rail segment. Upon opening, HFR attracts new demand (from capture and induced) and existing riders adopt the new services (migrating from the existing rail routes to the HFR routes) where appropriate to complete their journey. Over [redacted] % of the riders (~[redacted] % of the revenue) will use the HFR rail segments in both the Diesel and Electric cases. HFR T-O carries [redacted] % of the riders and is responsible for [redacted] % of the revenues. HFR T-M carries a similar level of riders and slightly larger share of the revenues ([redacted] %) (see Figure 33).

---

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)



[redacted]

*Figure 33: Ridership and revenue split (%) by rail segment for the 2030-2059 evaluation period*

Source: Steer analysis[28]

*Table 33: Cumulative ridership and revenue by rail segment for the 2030-2059 evaluation period, in millions (rounded)*

| Rail segment | Ridership (in millions) | | | Revenue ($2019, in millions) | | |
|---|---|---|---|---|---|---|
| | BAU | Diesel | Electric | BAU | Diesel | Electric |
| HFR T-O | [redacted] | | | | | |
| HFR O-M | | | | | | |
| HFR T-M | | | | | | |
| HFR M-Q | | | | | | |
| ***HFR sub-total*** | | | | | | |
| SWO | | | | | | |
| T-K | | | | | | |
| T-O | | | | | | |
| T-M | | | | | | |
| O-M | | | | | | |
| M-Q | | | | | | |
| **Total** | | | | | | |

Note: Figures may not sum due to rounding.

## High and low forecast results

A series of sensitivity tests that change one input in isolation at a time against the HFR Diesel option[29] have been undertaken to both demonstrate the level of responsiveness of the forecasts for HFR and indicate the likely envelope of uncertainty around the central case forecasts and a range of modelling factors. The sensitivity analysis informed the development of

[28] Same as footnote 25.

[29] Given that the diesel and electric scenarios are very similar, only a selected number of sensitivities were undertaken for the Electric option. The range of impacts on revenue and ridership is broadly comparable between the two options.

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

a high and low case for demand and revenue associated with the project. Results for both options are shown in Table 34.

*Table 34: Cumulative high and low ridership and revenue forecasts for the 2030-2059, in millions, diesel case (rounded)*

| 2030-59 cumulative | Base Case | High Case | Low Case |
|---|---|---|---|
| Total riders (millions) | [redacted] | | |
| Total revenue ($2019, in millions) | | | |

Source: Steer analysis[30]

*Table 35: Cumulative high and low ridership and revenue forecasts for the 2030-2059, in millions, electric case (rounded)*

| 2030-59 cumulative | Base Case | High Case | Low Case |
|---|---|---|---|
| Total riders (millions) | [redacted] | | |
| Total revenue ($2019, in millions) | | | |

Source: Steer analysis[31]



## 9.5. Operations & Maintenance Costs (OpEx)

An OpEx cost model was developed to produce cost profiles corresponding to the operations and maintenance costs for both HFR and local services. These vary based on three demand scenarios (including likely, low, and high demand ranges from sensitivity analysis), and two fuel options (diesel or electric traction). The model was built for a specific alignment and, as a result, inputs such as track lengths, demand, and service levels are specific to the modelled alignment.

The figures below present the total OpEx costs per annum. The total Diesel OpEx cost is [redacted] in 2030 under the likely demand scenario, with a range of [redacted]. The electrified scenario presents annual costs of [redacted] with a range of [redacted] to $[redacted].

[30] Same as footnote 25.

[31] Same as footnote 25.

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

The tables below summarize the results for the diesel and electrified scenarios. All results are presented following the low, likely, and high ridership demand scenarios assessed by the JPO.

*Table 36 Diesel OPEX costs for high, likely, and low demand scenarios (million CAD 2020)*

| | TOR - OTT - MTL | MTL – QUE |
|---|---|---|
| Annual Maintenance Costs (High) | [redacted] | |
| Annual Maintenance Costs (Likely) | | |
| Annual Maintenance Costs (Low) | | |
| Annual Operation Costs (High) | | |
| Annual Operation Costs (Likely) | | |
| Annual Operation Costs (Low) | | |
| 30-year Maintenance Costs (High) | | |
| 30-year Maintenance Costs (Likely) | | |
| 30-year Maintenance Costs (Low) | | |
| 30-year Operation Costs (High) | | |
| 30-year Operation Costs (Likely) | | |
| 30-year Operation Costs (Low) | | |

*Table 37 Electrified OPEX costs for high, likely, and low demand scenarios (million CAD 2020)*

| | TOR - OTT - MTL | MTL – QUE |
|---|---|---|
| Annual Maintenance Costs (High) | [redacted] | |
| Annual Maintenance Costs (Likely) | | |
| Annual Maintenance Costs (Low) | | |
| Annual Operation Costs (High) | | |
| Annual Operation Costs (Likely) | | |
| Annual Operation Costs (Low) | | |
| 30-year Maintenance Costs (High) | | |
| 30-year Maintenance Costs (Likely) | | |
| 30-year Maintenance Costs (Low) | | |
| 30-year Operation Costs (High) | | |
| 30-year Operation Costs (Likely) | | |
| 30-year Operation Costs (Low) | | |

The figures below present the breakdown for both diesel and electrified scenarios, showing the major cost categories.

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

*Figure 36: Composition of costs in 2030, Likely demand scenario, diesel*

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

*Figure 37: Composition of costs in 2030, Likely demand scenario, electrified*

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

## 9.6. Lifecycle Costs analysis (LCCA)

LCCA are intended to represent major capital replacement costs required throughout the lifecycle of the infrastructure asset. The period of analysis for HFR's LCCA was tied to the potential concession period (30 years). The same accuracy range applied to the CAPEX (i.e., [redacted] was applied to all developed life cycle costs.

The following table summarizes the 30-year total LCCA broken down by corridor segment (Toronto-Ottawa-Montréal, and Montréal-Québec City).

*Table 38 30-year total LCCA results (infrastructure, electrification, and trackwork) [values in million CAD 2020]*

| | TOR-OTT-MTL | MTL-QUE | Total TOR-MQ |
|---|---|---|---|
| Total 30-year Infrastructure (High) | [redacted] | | |
| Total 30-year Infrastructure (Likely) | | | |
| Total 30-year Infrastructure (Low) | | | |
| Total 30-year Trackwork (High) | | | |
| Total 30-year Trackwork (Likely) | | | |
| Total 30-year Trackwork (Low) | | | |
| Subtotal 30-year Infrast. & Trackwork (High) | | | |
| Subtotal 30-year Infrast. & Trackwork (Likely) | | | |
| Subtotal 30-year Infrast. & Trackwork (Low) | | | |
| Total 30-year Electrification (High) | | | |
| Total 30-year Electrification (Likely) | | | |
| Total 30-year Electrification (Low) | | | |
| Total 30-year including electrification (High) | | | |
| Total 30-year including electrification (Likely) | | | |
| Total 30-year including electrification (Low) | | | |

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

Rolling stock 30-year lifecycle costs are summarized in the table below both for a diesel scenario and an electrified scenario (i.e., including an electric powered car (EPC) car).

*Table 39 30-year total LCCA HFR Rolling Stock results (million CAD 2020)*

| | HFR Rolling stock (Extra Long Trainset) |
|---|---|
| Total 30-year HFR Diesel Rolling Stock (High) | [redacted] |
| Total 30-year HFR Diesel Rolling Stock (Likely) | |
| Total 30-year HFR Diesel Rolling Stock (Low) | |
| Total 30-year HFR additional EPC cars (High) | |
| Total 30-year HFR additional EPC cars (Likely) | |
| Total 30-year HFR additional EPC cars (Low) | |
| Total 30-year HFR including EPC Cars (High) | |
| Total 30-year HFR including EPC Cars (Likely) | |
| Total 30-year HFR including EPC Cars (Low) | |

The table below summarizes the BAU rolling stock (with Extra-Long trainsets) LCCA for the 30-year period of analysis, both for a diesel scenario and an electrified scenario (including EPC cars).

*Table 40 30-year total LCCA BAU Rolling Stock results (million CAD 2020)*

| | BAU Rolling stock (Extra Long Trainset) |
|---|---|
| Total 30-year BAU Diesel Rolling Stock (High) | [redacted] |
| Total 30-year BAU Diesel Rolling Stock (Likely) | |
| Total 30-year BAU Diesel Rolling Stock (Low) | |
| Total 30-year BAU additional EPC cars (High) | |
| Total 30-year BAU additional EPC cars (Likely) | |
| Total 30-year BAU additional EPC cars (Low) | |
| Total 30-year HFR including EPC Cars (High) | |
| Total 30-year HFR including EPC Cars (Likely) | |
| Total 30-year HFR including EPC Cars (Low) | |

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

### 9.8.3. Key Structuring Decisions and Assumptions

[redacted]

| | | |
|---|---|---|
| | Procurement Model | DBFM (availability) and DBFOM (availability & revenue) are shortlisted procurement models that need to be structured |
| | Level of Government Funding during Construction | Percentage of capital costs funded by Contracting Authority & the split between Construction Period Payments vs a lumpsum Substantial Completion Payment |
| | Target Bond Rating | Long Term Bond rating targeted for the VIA HFR Project to ensure bonds can be sold successfully as a broadly marketed transaction at Financial Close |
| a | **DSCR / Resiliency** | **Minimum DSCR and Resiliency required to be achieved to meet the targeted bond rating** |
| b | **Proportion of Debt vs. Equity** | **Minimum gearing required to be achieved to meet the targeted bond rating** |
| | **Market Capacity & Liquidity** | **Equity, long term and short term debt capacity / liquidity in the market** |
| a | Debt and Equity, Cost and Returns | Rates of return for equity and debt (short and long) |

These decisions will drive sizing of on-going subsidy required for capital repayment (if any)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

Structuring Decision 1 – Government Funding Amount

[redacted]

| VIA HFR - Procurement Model | DBFM (availability) | DBFOM (availability) | DBFOM (revenue) |
|---|---|---|---|
| Construction Funding (% of capital cost) | [redacted] | | |

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

*Figure 56* [redacted]

Cost to Government of Canada (Electric Option)

The following table provides a similar breakdown of the total project costs, however this table is organized by phase of the project in order to show the total government cost during construction and the total government cost during operations. [redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

| Categories of metrics for comparison | DBFM 2 | DBFOM 2 | DBFOM 3 Partial AP | DBFOM 3 Volume |
|---|---|---|---|---|
| **Funding and Financing Contribution** | [redacted] | | | |
| [redacted] | [redacted] | [redacted] | | |
| **Project Risk Transfer** | [redacted] | | | |
| [redacted] | [redacted] | [redacted] | | |
| **Project Subsidies** | [redacted] | | | |
| [redacted] | [redacted] | [redacted] | | |

[redacted]



[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

Cost to Government of Canada (Diesel Option)

The following table provides a similar breakdown of the total project costs, however this table is organized by phase of the project in order to show the total government cost during construction and the total government cost during operations. [redacted]

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

Key Metrics for Government of Canada (Diesel Option)

The below table summarizes the key financial structuring metrics and outputs shown in the Financial Structuring section. [redacted]

[redacted]

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

### 9.8.5. Financial Structuring Key Takeaways

The financial structuring work conducted by the JPO has resulted in the following list of key takeaways:

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

## 9.9. Procurement and Financial Structuring Next Steps

[redacted]



## 9.10. Framework for optimizations

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 18(d)

## 10. Deliverability and Operations Case

HFR requires an attractive service plan, along with infrastructure and facilities to support operations to attract and retain passengers throughout its concession period and beyond. Modern intercity rail systems require infrastructure, rolling stock and systems to support operations and to deliver on passenger expectations. The integration of HFR stations within the major cities are equally critical. These stations should be planned for seamless interchange with other modes, accessibility, and future growth in mind, whether through accommodating for service growth through shared host railway stations or dedicated HFR stations and city accesses.

Conceptual Service Plan

The HFR conceptual service plan provides the basis for the definition of the infrastructure, technology, and delivery strategies. The HFR concept includes new trains on a separate route between Toronto and Québec City with an attractive service proposition for passengers including additional frequencies, lower journey times, and improved on-time performance. HFR services are planned to increase frequencies on Toronto – Ottawa, Toronto – Montréal, Ottawa – Montréal, and Montréal – Québec City routes. HFR services will complement the existing local services in the Windsor - Québec City Corridor (Figure 64), although the frequencies and calling patterns on local services will be revised as a consequence of journey opportunities provided by HFR. Passengers may connect with local services (i.e., trains via Kingston and Drummondville, or trains to/from southwestern Ontario) at the major city stations.

[redacted]

*Figure 64: Map of existing Corridor services and planned HFR services*

The JPO assessed the number of round-trip frequencies and seats to define Service Levels that are required to accommodate forecasted HFR passenger demand. The project has used the diesel-powered Siemens Charger rolling stock (currently being procured by VIA as part of its Fleet Replacement Program) as a reference vehicle from which seat capacity and journey times can be assessed. Higher frequencies are required to accommodate the growth on Toronto – Ottawa and Toronto – Montréal routes. These service levels (presented in Section 9.3 and repeated in Table 41) provide initial parameters for the planning and design of the HFR system to accommodate operations over the thirty-year period. Final frequencies and required service

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

level changes will be determined after results are considered from the on-going optimization exercise.

*Table 41: HFR Service Levels: Planned frequencies and seats per train*

| HFR Service Levels | Service Level 1 | Service Level 2 | Service Level 3 |
|---|---|---|---|
| Time Frame | 2030-2034 | 2035-2044 | 2045-2059 |
| | [redacted] | | |
| Montréal – Toronto | | | |
| Toronto – Ottawa | | | |
| Ottawa – Montréal | | | |
| Montréal – Québec City | | | |
| | | | |
| Montréal – Toronto | | | |
| Toronto – Ottawa | | | |
| Ottawa – Montréal | | | |
| Montréal – Québec City | | | |

Indicative journey times estimates for HFR were advanced based on the Option 2 alignment and preliminary assumptions for dwell times, stopping patterns, and reference vehicle performance (i.e., maximum operating speed capped at 177kph (110 mph)). These journey times do not consider potential impacts or delays from host railway trains or services to on-time performance, and assumes that these can be achieved through further development of the City Accesses, intercity alignments and/or host railway access rights. Further work is required for the JPO to validate the target journey times including more detailed modelling of all HFR, local, commuter and freight movements within the corridor as the project progresses.

*Table 42: Journey times for key city pairs*

| Journey Time | HFR Fastest Journey Time | HFR Slowest Journey Time | HFR Average Journey Time |
|---|---|---|---|
| Toronto – Montréal | [redacted] | | |
| Toronto – Ottawa | | | |
| Ottawa – Montréal | | | |
| Montréal – Québec City | | | |

This Deliverability and Operations Case section covers the status of conceptual studies, due-diligence and analysis to date, along with the decision gate reviews required before the basis of design and pre-procurement activities – in particular reference concept design, procurement documentation and the Impact Assessment – can progress. This is a complex project with many interdependencies that need to be fully aligned with the overall project objectives.

The key next steps require formal confirmation of the overall project objectives such that the concept design of HFR can be advanced and aligned with them. These objectives would then

s. 18(a)
s. 18(b)
s. 18(d)
s. 21(1)(a)
s. 21(1)(b)

facilitate the formal initiation of the Impact Assessment, Concept of Operations, Basis of Design and advancement of strategies for host railway access, rolling stock requirements, and operations and maintenance.

## 10.1. Infrastructure

The achievement of the HFR conceptual service plan requires an alignment with infrastructure and capacity that meets the passenger and operational requirements for service. The current progress for defining infrastructure requirements for the project are summarized for city access, intercity alignment, stations and rail/road crossings in the following sub-sections.

### 10.1.1. City Access

The JPO was tasked with reviewing and assessing alignment options for access in Toronto, Montréal, and Québec City, where there is potential interface between HFR and other freight or regional transit operators. This section provides a summary of the current progress on City Access.

The focus to date has been on Toronto and Montréal, as they carry the most complex challenges with regards to bringing HFR to these major nodes - in particular, with regards to capacity, future proofing and on-time performance aspects through either shared track or station facilities owned and operated by others. Further assessment is required by the JPO to de-risk the City access along with defining the optimum solution that caters to the operational and performance needs of HFR. The JPO has initiated discussions with host railways (e.g., Metrolinx, Exo, CN, CP) on capacity and requirements for HFR to access Toronto Union Station, Montréal Gare Centrale, and Québec City Gare du Palais.

[redacted]

Toronto

The current HFR proposal assumes Toronto Union Station as a terminus station. The JPO has initiated discussions with Metrolinx to assess track and platform capacity to accommodate opening day and service level growth requirements for HFR. [redacted]

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 18(d)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

Montréal

The current HFR proposal assumes Gare Centrale as the main station in Montréal. The original proposal for High Frequency Rail considered a route through Mont Royal Tunnel to access the Montréal – Québec City intercity alignment. [redacted]

The JPO identified and assessed alternative options for the Montréal City Access towards Québec City including consideration of alternate stations and routes. [redacted]

[redacted]

In the current HFR proposal, all HFR trains to/from Gare Centrale use host railway (primarily CN) controlled tracks on the island of Montréal. Existing capacity on CN corridors in Montréal is a constraint. HFR operation on host railway infrastructure presents risks related to continued prioritization of freight movements versus passenger rail movement. CN is assessing capacity, infrastructure requirements, and capital cost for new infrastructure to enable HFR in its controlled right-of-way on behalf of the JPO. [redacted]

[redacted]

Québec City

The current HFR proposal assumes Gare du Palais as the terminus station in Québec City. Access to Gare du Palais uses CN-controlled right-of-way where freight trains have traffic priority. [redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

### 10.1.2. Intercity Alignment

The Intercity Alignment for the project has been advanced based on the Option 2 alignment. In general, the Option 2 alignment follows existing [redacted] or formerrail corridors. In places, tight curves have been replaced with smoother curves to permit a maximum speed of 201 kph (125 mph) (i.e., Class 7 track). It should be noted however that under the current regulations, the presence of numerous at-grade crossings and reference vehicle performance limits the maximum operating speed to 177 kph (110 mph) (discussed further in Section 10.1.4).

Current requirements for single or double track sections for HFR are based on the highest HFR frequencies within the 30-year period as assessed by the JPO. Higher levels of double track would increase the resiliency of the corridor for on-time performance and capacity for additional frequencies beyond the first 30 years.

Toronto – Ottawa – Montréal

The Toronto-Ottawa-Montréalsection (Figure 67) principally follows [redacted] With this alignment, it is currently envisaged that:

- Peterborough would be served by the HFR service, [redacted]
- The proposed alignment detours around [redacted]

[redacted]

The Toronto – Ottawa – Montréal section would currently require the rehabilitation and upgrade of existing tracks, together with the construction of new track along decommissioned and existing rail ROW. This alignment enables direct services between Toronto and Ottawa and between Toronto and Montréal. Current rough order of magnitude estimates[34] for infrastructure in this section inclusive of trackwork, structures, stations, and at-grade crossings,

---

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

but excluding land acquisition and host railway (e.g., MX,CN for city access and CP for the intercity route) costs ranges between $[redacted] and $[redacted].

[redacted]

Montréal – Québec City

The Montréal and Québec City section (Figure 68) follows the existing QGRY freight railway, through Trois-Rivières, on the north side of the St. Lawrence River. [redacted]

It is currently envisaged that:

- The corridor would be a mixture of lengths of single track and double track that would provide sufficient capacity to operate the proposed HFR timetable [redacted]
- In several locations, tracks will be reconfigured, to improve the safety of the HFR services and to reduce conflicts with freight traffic. This may result in grade separation or re-configured crossings where HFR has priority over freight traffic.

[redacted]

s. 18(a)
s. 18(b)
s. 18(d)
s. 21(1)(a)
s. 21(1)(b)

- A number of existing rail bridges will need to be reconstructed or rehabilitated to meet the needs of the HFR.

[redacted]

*Figure 68: Montréal - Québec City alignment and stations*

[redacted] At this time, the alignment should be considered preliminary and hence will be subject to future modifications to ensure that it fully aligns with the overall project objectives.

### 10.1.3. Stations

HFR is currently planned to serve a total of thirteen stations between Toronto and Québec City, which were shown in Figure 67 and Figure 68. There are currently ten stations between Toronto and Québec City that require improvements to meet the anticipated operational requirements of HFR. [redacted] The preliminary assessment of existing stations suggests that the following stations have a low likelihood of major impacts resulting from HFR: Ottawa, Alexandria and Québec City. The rough order-of-magnitude[36] capital costs associated with HFR stations ranges between $[redacted] and $[redacted]. The extent of work required for existing stations to achieve the anticipated HFR requirements is being assessed by the JPO. [redacted]

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[36] Costs are presented as total project costs as a range based on rough order of magnitude (Level 5) estimates, consistent with AACEi standard.

Dorval Hub

The JPO conducted a separate study to develop the existing Dorval station into an integrated transport hub with connections to Montréal Airport, Réseau Express Métropolitain (REM), and local bus services. This study explored a range of concepts and proposed solutions. The costs for an intermodal hub station are excluded from the current capital cost estimate for HFR. [redacted]

### 10.1.4. Road / Rail Crossings

There are a total of [redacted] road / rail crossings along the Option 2 alignment. The total number of crossings are summarized by section in Table 43.

*Table 43: Number of rail crossings by segment*

| Toronto-Ottawa- Montréal | Montréal-Québec City | Total Crossings |
|---|---|---|
| [redacted] | | |

Currently, the majority of roads cross the rail corridor at-grade (i.e., the road and rail are at the same level). With at-grade crossings there remains the risk of accidents between rail and road users, which is elevated by the higher speed and frequency of trains. Current regulations for at-grade crossings limit maximum train operating speeds to [redacted] kph ([redacted] mph) while traversing these crossings. Current journey times are based on a maximum operating speed of [redacted] kph ([redacted] mph).

Of the [redacted] total crossings, [redacted] are public crossings of major or minor roads. The current project costs assume that all public crossings will be upgraded with a full grade crossing warning system with lights, bell, and gates. Current rough order-of-magnitude[37] capital costs for crossings ranges between $[redacted] [redacted] and $[redacted] [redacted]. Private crossings will undergo safety and risk analysis, along with any regulatory compliance requirements. Given the very high number of private crossings, the JPO may consider combining adjacent crossings where reasonably practicable to reduce the total number of crossings.

In the next phase of the project, the JPO will conduct a full safety and risk assessment for crossings on the alignment. A full safety and risk analysis will be required to identify at-grade crossings that may need to be eliminated (i.e., through the closure of the crossing or the construction of a road bridge over the tracks), and those which may be managed through interventions such as warning systems and gates. Grade separations may be recommended taking into consideration benefits to safety, train journey times, local traffic impacts, capital investment, and operational requirements.



[37] Costs are presented as total project costs as a range based on rough order of magnitude (Level 5) estimates, consistent with AACEi standard.

s. 18(a)
s. 18(b)
s. 18(d)
s. 21(1)(a)
s. 21(1)(b)

## 10.2. Technology

The key technology elements to deliver and implement HFR include suitable rolling stock, electrification, and signaling and train control. The current progress for defining technology requirements for HFR are detailed in the following sub-sections.

### 10.2.1. Rolling Stock

The JPO is developing its rolling stock strategy and has assessed potential approaches to procure and maintain HFR rolling stock. Further assessment and de-risking are required in terms of rolling stock concept development that assesses the operational, performance, deliverability and customer requirements that supports HFR service needs.

Fleet Requirements for HFR

The passenger demands and the future operating conditions should dictate the rolling stock required for the HFR services.

[redacted]

Further due diligence and assessment is required to develop the most appropriate 'reference vehicle' that could address the operational, performance, deliverability, and customer requirements for HFR.

Rolling Stock Procurement Strategy

The JPO identified options for the procurement of the HFR rolling stock. The strategy for rolling stock procurement could be considered independently from the overall procurement model selected for the project [redacted] Alternatives exist for the Government of Canada to procure rolling stock or enable a potential Private Partner to offer rolling stock that meets the objectives of the project. The strategy is also affected by the definition of requirements for the HFR project, for example, intercity operating speeds for attractive journey times, use of dedicated passenger corridors versus using shared corridors or whether the route is completely, partly, or not electrified.

Next Steps

The JPO will continue the development of its rolling stock strategy along with verifying that rolling stock for HFR could be procured as part of [redacted] procurement model. Next steps include:

- Develop concept report for HFR rolling stock requirements, with focus on operational, performance, customer and deliverability requirements

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

- Further assess Siemens Charger applicability to HFR requirements including completion of the assessment on Siemens' contracts for implications of exercising the options for additional trains and the proposed concept bi-mode;
- Complete an assessment of the market for additional electrical bi-mode or diesel trains to operate HFR services discrete from existing local services.
- Recommend strategies for HFR rolling stock that that could be implementable through either DBFM and/or DBFOM.

### 10.2.2. Electrification

HFR is evaluated under two technology options: electric and diesel. This section discusses the benefits and the technical feasibility for delivering the HFR project with electrification.

Electrification of the HFR project brings considerable environmental benefits including reduced greenhouse gas, particulate matter, and nitrogen oxides emissions at the train source. At this stage of design, electrification of 90% of the current alignment including all sections [redacted]

Electrification requires additional investment in infrastructure and bi-mode trainsets [redacted] The additional infrastructure includes supply and distribution facilities to convert electric power to usable voltage for the overhead catenary system. Bi-mode trainsets that can operate on both electrified and non-electrified parts of the route would mitigate the constraint of host railways across the alignment under the scenario where the HFR alignment is not 100% electric.

The primary delivery considerations for electrification of the HFR alignment include:

- third-party coordination with utilities and freight rail operators;
- potential constraints with host railway access and interoperability negotiation (affecting interfacing infrastructure and potential electromagnetic interference – [redacted]
- regulatory provincial and federal requirements; and,
- potential implementation timeline challenges for electrical utility and supply capacity coordination.

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

### 10.2.3. Signaling and train control

Signaling systems control the movement of trains within the network and support the safe and optimum operation of HFR. The JPO conducted a preliminary evaluation of mature signaling technologies considering operational safety, interoperability, scalability and growth, and rolling stock compatibility. Through this assessment, a solution based on [redacted] that accommodates regulatory needs is recommended for HFR. This system is recommended because it is a safe, allows for optimum operations and uses a non-proprietary technology that has been proven globally for over two decades, is interoperable with other rail signaling systems, and can be tailored and scaled depending on track ownership and any existing controls. Modern signaling and train control systems require less physical wayside infrastructure across the route alignment which is a resiliency and maintenance advantage.

The Rail Association of Canada (RAC) is working with Transport Canada to define future Enhanced Train Control functionality requirements across Canada. HFR base functionality will be Automatic Train Protection (ATP), which is safety critical function that overrides human error, such as overspeed and passing red signals. On host railway networks, where HFR operates within a blended system, with host railways dispatching, currently CN and MX networks, there are three options:

[redacted]

## 10.3. Project Delivery

The JPO has initiated the planning of activities to support the overall delivery of the project including consideration of the Impact Assessment, land acquisition, host railway access rights, project timeline, and consultation. The following subsections summarize the work completed to date and next steps to advance the project towards delivery.

### 10.3.1. Impact Assessment

The JPO confirms that, based on the current design, the Project consists of an alignment that exceeds 50 km of New ROW as defined in the *Physical Activities Regulations*, triggering the requirement to enter the Impact Assessment Process. Once an alignment is confirmed, the Project will submit an Initial Project Description report and a Detailed Project description report after which Impact Assessment Agency of Canada (IAAC) will determine the requirements for

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

and Impact Assessment. It is predicted that IAAC will identify the need for a full Impact Assessment under the *Impact Assessment Act*.

Early desktop assessment, [redacted] identified medium risk impacts and zero high risk impacts to environmental, social, schedule and cost factors. Further desktop assessment and initial field verification of the Option 2 alignment was conducted to de-risk environmental concerns in specific locations and provide data for the Impact Assessment Initial Project Description, Study Plans, and Work Plans.

The JPO and the IAAC have begun informal early discussions regarding the upcoming Impact Assessment process for the Project. The next steps for the JPO will be to share the Initial Project Description (IPD) with IAAC and receive feedback to adjust the Initial Project Description (IPD). The topics include:

- Greenhouse gas definitions, methodology, calculations and reduction results;
- List of studies, current understanding of potential environmental effects;
- ROW snapshot with all infrastructure (including electrification) and order of magnitude information on such equipment and distances;
- IPD scope and incidental effects (requested by IAAC);
- Economic benefits, Purpose and Need per the Impact Assessment;
- Communications plan and strategy for Indigenous Consultation and Public Consultation (requested by IAAC);
- JPO and IAAC expectations for provincial engagement in a federal project.

Additional work that the JPO will progress to support the completion of the IPD and Detailed Project Description (DPD) include:

- Updating of legal advice and memos on the applicability of the *Impact Assessment Act*, provincial environmental regimes, and the Strategic Assessment of Climate Change;
- Review of the Permit Register with IAAC to confirm requirements and finalize down to the local/municipal level once final alignment and optimization is known; and
- Review of the Environmental Regulatory Inventory with IAAC to validate requirements.

JPO will initiate the formal Impact Assessment Process by filing an IPD. IAAC has advised that it requires two months to review the draft IPD and to share the document with Environment and Climate Change Canada and other regulators, notably energy regulators. [redacted]
The workshops with IAAC will review the scope of the Impact Assessment to understand the timeline. [redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

### 10.3.2. Land Acquisition

Land acquisition will be required to enable the HFR project. [redacted]

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

### 10.3.3. Host Railway Access Rights

Access rights to host railway infrastructure is a key de-risking element of the JPO mandate as all City Access proposals currently include the requirement to use host railway track infrastructure, as well as use of host railway right-of-way between Toronto and Montréal (i.e., [redacted]), and Montréal and Québec City (i.e., [redacted]). [redacted]

[redacted]

Existing Commercial Agreements

VIA Rail presently has in place commercial agreements providing for on-going access rights and negotiates infrastructuredevelopment as required through bespoke commercial arrangements. Within Canada, currently 97% of VIA's operations are on host railway infrastructure, who are responsible for train control. [redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

Next Steps

Work is ongoing to progress the legal framework for HFR, including the following activities:

- Progressing the Rail Regulatory Inventory including review of crashworthiness compliance;

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

- Assessing the options to transition JPO intellectual property at the expiry of the Joint Venture Agreement (i.e., to a Procurement Office, storage, or extended term for JPO).

### 10.3.4. Project Schedule

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 18.1(1)(d)
s. 21(1)(a)
s. 21(1)(b)

### 10.3.5. Public and Stakeholder Engagement

Public and stakeholder engagement for the current Option 2 alignment has not yet taken place. The JPO has undertaken a desktop review and stakeholder analysis to identify potential supporters, detractors, concerns and mitigations for the project.

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

Social acceptability risks are issues and concerns that have the potential to shift the level of support of key municipal stakeholders along the assessed alignment. These risks will require mitigation through communication, engagement or other technical/ engineering solutions. These risks were identified through the desktop review and stakeholder analysis, and are presented by province.

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

### 10.3.6. Indigenous Consultation

Indigenous communities in Ontario and Québec likely to have an interest in the establishment of HFR have been identified by the JPO. The JPO has undertaken a desktop review and stakeholder analysis to identify potential supporters, detractors, concerns and mitigations for the project. This preliminary analysis is based on feedback on the original alignment as much of the assessed alignment overlaps with the alignment presented in VIA's 2016 proposal, and available online information for each Indigenous community.

Results from this desktop analysis were also used to inform early discussions with identified Indigenous communities, which started in September 2020 through phone calls and emails. As of January 2021, 18 early discussion meetings having been scheduled or completed. These were key to enhancing preliminary results from the desktop review/ analysis. The JPO's goals for initiating early discussions were to:

- re-open dialogue and introduce the JPO and HFR Project;
- discuss the communities' interests and concerns;
- understand consultation protocols and/ or a desired level of engagement; and,
- hear from each community with regards to how they are managing and operating under COVID-19.

In consideration of the Crown's Duty to Consult and the anticipated requirements of an Impact Assessment process, a preliminary list of Indigenous communities has been identified for early discussions across Ontario and Québec and is shown in Table 46. This list will be updated with final list of Indigenous Groups approved by IAAC or with others who express an interest to be consulted with once public engagement starts.

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s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

Key comments, insights and questionsraised by Indigenouscommunities during early discussions

[redacted]

## 10.4. Operations and Maintenance

[redacted]

### 10.4.2. Existing Assets

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

## 10.5. Risk Management

The JPO developed a Risk Management methodology for the HFR project in accordance with best practice standards, such as ISO 31000 and published guidance from the Project Management Institute (PMI). The objective of the risk management approach is to identify, quantify, mitigate, and monitor the project risks throughout the project's lifecycle.

Through multiple discussions and workshops, the risks were identified, classified, the probability of each respective risk event occurring was assessed, risk owners were assigned, and response measures were proposed. All this information has been categorized into a project risk register, which will be in continuous update as the project evolves.

The following Table 47 summarizes the top risks identified at this stage of the Project and ranked using a qualitative score (1 to 5) applied to probability of occurrence and cost/schedule impacts. The subsequent Risk Score reflects the multiplication of the score applied to the probability and the score applied to the cost/schedule impacts. For the full list of identified risks, refer to the Risk Management Methodology report and the complete risk register developed to date.

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

## 11. Role of VIA

This section outlines the role of VIA and the public sector based on the various procurement options being considered for rail services in the Corridor.

In order to make an informed decision as to what should be the preferred procurement model retained by the Government of Canada (GoC) to maximize value for money for the Canadian taxpayers, clear visibility over the broader impacts, more specifically those related to the remaining role of VIA within the Corridor and the impacts on delivery of services outside of the Corridor have to be clearly understood and weighted in.

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

## 11.1. Role of Public Sector [redacted]

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

## [redacted] Role of Public Sector under [redacted]

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

## [redacted] Role of Public Sector under [redacted]

[redacted]

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

[redacted]

# 12. Communication Plan

## 12.1. Communication Plan Overview

Communication and engagement plans have been developed to guide engagement with Canadians and Indigenous groups and peoples on one of the most important transportation projects in recent memory. The objectives for these plans are to:

- Identify, describe and connect with those people who are interested in or may be impacted by the establishment of HFR, including Indigenous peoples and groups; with a goal of achieving social acceptability of the project.
- Inform, consult, involve or collaborate with as many people/ organizations as possible on selected elements of the project.
- Participate in de-risking process through public participation and Indigenous engagement activities.
- Use the principles and best practices of IAP2 to make HFR an exemplary project in terms of public participation and social acceptability.

Our approach to communicating with and involving people will reflect best practices in terms of public and Indigenous engagement, including themanagement of expectations and needs of those listed in Sections 9.3.5 - *Public Stakeholder Engagement*, and 9.3.6 - *Indigenous Consultation*. Through the implementation of our plans, we intend to raise awareness and build enthusiasm for the HFR project, gain support of, as well as mitigate issues and address concerns raised by, those in proximity to the route, and maximize participation of target audiences in engagement activities and meet the regulatory requirements of IAAC. As part of the JPO's de-risking activities, we will also provide key messages to spokespersons and partners so as to remain in control of the narrativeand ensure that consistent information is provided to those interested.

Provided below is a high-level overview of the information included in communication and engagement plans.

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

*Table 54: Communication plan activities by project phase*

| Phase | Activities |
|---|---|
| **Pre-announcement** from the Government of Canada | 1. Development of communication materials, tools, digital and media strategies, KPIs and dashboard with alignment of the ministers' offices<br>2. Development of holding statements and approach for media inquiries and leaks<br>3. Local stakeholder/interest mapping and list of priorities and concerns, to inform engagement strategies, including Indigenous peoples<br>4. [redacted]<br>5. Spokesperson/Subject Matter Experts media training, including media request procedure dry run<br>6. Ongoing early discussions with identified Indigenous communities<br>7. Contributing to de-risking the project by monitoring and managing emerging and real-time issues |
| Government of Canada **Announcement** (and following weeks) | 8. Proactive and reactive media relations, both national and local, aligned with ministers' offices.<br>9. Stakeholder and Indigenous relations<br>10. Media monitoring, including social media, and reporting<br>11. Update of local stakeholder mapping and list of priorities and concerns, including Indigenous peoples |
| **Post-announcement** from the Government of Canada | Ongoing communications, including issues monitoring and management, proactive and reactive media relations (both national and local), stakeholder and Indigenous community relations, social media management and implementation of the engagement plan, including communication and engagement activities required for the Impact Assessment. |

To effectively engage Canadians, including Indigenous peoples, and fulfil the requirements of the Impact Assessment process, the JPO will use the IAP2 Spectrum of Public Participation for public engagement. This system was designed to help select the appropriate level of participation to involve the public in any public participation process; and can also be used as a starting point to help define an appropriate level of involvement from Indigenous communities. This is a decisions-based process, which consists of five key pillars: INFORM, CONSULT, INVOLVE, COLLABORATE and EMPOWER. We will focus on the first four.

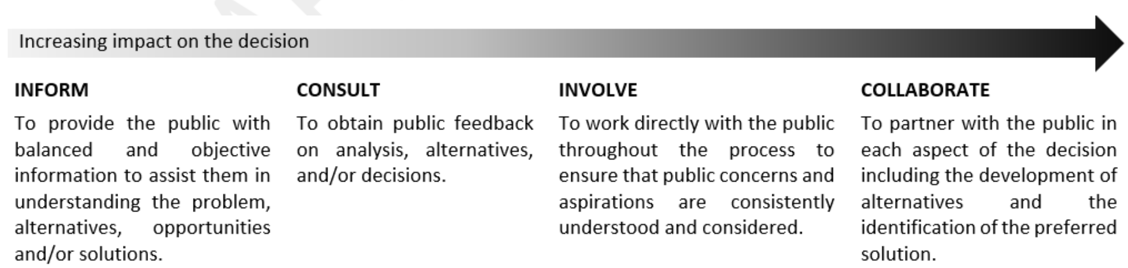


*Figure 77: IAP2 Spectrum of Public Participation*

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s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

Key Elements for a Successful Engagement Program:

Advanced media briefings: While we recommend inviting media to the public engagement sessions, we also propose organizing separate media briefings beforehand. This will provide an opportunity for journalists to speak directly with the JPO ahead of public sessions.

Spokespeople: Along with the primary communications spokesperson, the JPO recommends having subject matter experts trained and available as secondary spokespeople for every engagement session.

Align public engagement with community events: It would be beneficial for a JPO Project lead to virtually attend town halls, present to city/town councils and other municipal bodies, and engage with community-based organizations and associations, when invited to do so.

Indigenous Communities engagement: Align timing of Indigenous communities engagement with Project milestones and planned public engagement events.

Third-party advocates: In hotspot communities, the JPO will review an approach to activating advocates for the HFR project along the route.

## 12.2. Sequence of the Engagement Strategy

**Sequence of the engagement strategy**

| |
|---|
| Pre-announcement from the Government of Canada |
| **Major stakeholders:** We recommend contacting major stakeholders immediately in advance of the Government of Canada announcement to help in gaining their support (e.g., Major cities' chambers of commerce, provincial and national organizations, major transportation agencies, etc.).<br>**Indigenous Leaders**: Assuming Government of Canada approval, contact will also be made with Indigenous leaders to relay similar information to that shared with major public stakeholders. |
| Government of Canada Announcement (and following weeks) |
| **Local government officials**: At this stage, gaining support from local government officials is key. |
| **General meetings**: Right after the announcement, we suggest engaging in public information sessions (virtual) for all Canadians, both in English and in French, to raise awareness and to gather insight to early concerns/ interests in HFR (to strengthen the stakeholder map) and answer questions. At these events, we want to inform on the plans and benefits of HFR, listen to understand preliminary concerns or questions people might have about its establishment, and confirm that we will continue to engage throughout the planning process.<br>**Follow-up with Indigenous Communities:** In follow-up to early discussions (and, if approved, pre-Announcement reach-out), we will meet with Indigenous communities to introduce the project and the selected alignment that will be included in the Initial Project Description (IPD), review general Impact Assessment timelines and discuss opportunities to become engaged. |
| [redacted] |
| **First round of public consultations:** It will be a great opportunity to consult with local communities (along the route) on how we will consult, and on which decisions will be made in their area. At this stage, we want to demonstrate that we are aware of impacts the HFR will have on the communities and that we will keep in touch in the coming months. |
| Post-announcement from the Government of Canada |
| **Second Round of Public Engagement/Participation on Specific Issues in Local Communities and Indigenous Communities:** This step is where we will dig deeper in every location and either *inform, consult, involve and collaborate* with communities, based on the decisions that need to be made in those locations. |
| **Third round of public engagement participation sessions:** If necessary, based on issues in each locality and if the local population asks for a specific topic. |

[END OF PROJECT STATUS REPORT]

# Indicative Economic Assessment
# VIA HFR versus HSR

Ministerial Briefing to

The Honorable Catherine McKenna, Minister of Infrastructure and Communities

and The Honorable Marc Garneau, Minister of Transport

October **X,** 2020

Note to Reader: This presentation is based on indicative, high-level, general information that was available to the QMOT team within the allotted timeframe as directed by JPO.



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# Pur ose of the Presentation

- The purpose of this presentation is to:
  - Provide information on High Speed Rail systems and their use around the world; and,
  - To provide comparisons between HSR and HFR along key metrics
- It is organized in four parts to cover the following themes:
  1. Definitions
  2. HSR Key Considerations and Metrics
  3. HSR Operations in Winter
  4. HSR and HFR Comparison
- Appendices A, B, and C provide additional information on HSR systems around the world, HSR and HFR technical requirements, and summary references

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# 1.1. Definitions: High Frequency Rail (HFR) and High Speed Rail (HSR

## High Speed Rail (HSR)

- Various definitions exist for **HSR.**(https:l/uic.orglcomlenews/596-high-speed/article/the-definition-of-high-speed-rail?page=thickbox_enews)
  - UK East Coast Main Line (ECML) and West Coast Main Line (WCML) (200 km/h (125 mph))
  - Acela service on Northeast Corridor (NEC) (241 km/h (150 mph))
  - HS2 (300 km/h (186mph))
- For the purposes of this presentation, HSR is defined as:
  - Rail service that combines technologies to operate at increased maximum allowable speed of 300 km/h or greater

## High Frequency Rail (HFR)

- Conventional intercity rail service that includes dedicated and shared right of way (ROW) with priority assigned to passenger service and tracks to increase the number of trips, reduce trip times, and improve the reliability of service between the major cities of Toronto, Ottawa, Montreal and Quebec operating at up to 177 km/h (110 mph) with design speed of 200 km/h (125 mph). *Source: VIA HFR Technical note,* https:llcorpo.viarail.ca/en/projects-infrastructure/



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# 2.1. HSR Stren thens Economic Benefits

| Benefits | Description |
|---|---|
| **Accessibility** | HSR time savings enables workers to move about the mega-region faster and more freely. |
| **Reliability** | Greater frequencies, fewer delays,.better on-time performance than cars and airplanes. |
| **Connectivity** | Increased labour mobility and expanded commuter should give employers access to larger pools of skilled workers and employees access to more job options. |
| **Spatial Agglomeration** | Firms benefit from locating in closer proximity to other complementary firms and make use of the accessibility to activities and skilled labor resulting in regional productivity growth. |
| **Reduced Road and Airport Congestion** | Reduced long-distance auto trips, further alleviating highway congestion.<br>Competitive alternative to air, reduces congestion at capacity constrained airports, possibility to defer investment in secondary airports in Montreal and Toronto. |
| **Reduced Greenhouse Gas Emissions and Improved Air Quality** | Electrified HSR service reduces GHG emissions from trains compared to diesel-powered HFR. Reduced auto and air trips further reduce transportation sector carbon footprint. |
| **Energ,y Sovereignty** | Clean electricity sources available along the corridor to reduce dependency on imported fossil fuels. |



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s. 18(a)
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s. 21(1)(a)
s. 21(1)(b)

## 2.2 HSR Benchmark CAPEX

CAPEX costs vary based on:

- Labour market
- Construction materials
- Engineering Complexities
- System design
- Geography
- Civil works
- Structures requirements

**HSR Benchmark Cost (2020 CAD $/km)**

[redacted]

High Speed Rail Project

**Note: not all systems within the table are in operation (e.g. systems in North America)**

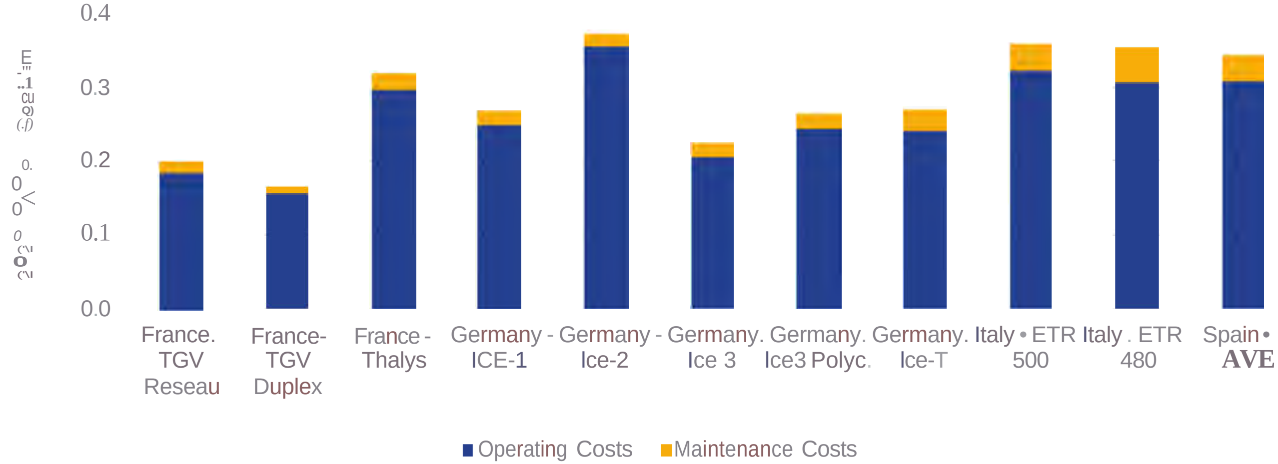
# 2.3. HSR Benchmark - Indicative OPEX

**O&M costs vary based on:**

- **Rolling stock technology**
- **Corridor length**
- **Seat capacity**
- **Ridership levels**
- **Service frequency**
- **Energy prices**
- **Labour costs**

**HSR O&M Benchmark Costs**

**Average = $0.285/seat-km**




***Sources: QMOT Analysis based on Economic Analysis of High Speed Rail in Europe (Fundaci6n Banco Bilbao Vizcaya Argentaria (Fundaci6n BBVA), 2009). Based on actual operating costs.***



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s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

# 2.4. City Access Factors to Consider for HSR

- Key Elements include:

[redacted]



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# 2.5. Success Factors: Where HSR Works Best

Strong transit connections (LRT, subway, commuter rail, etc.)

Optimal HSR corridor length (i.e. distance between economic centers)

City pairs:

- Large metropolitan area and city populations
- Large metropolitan area GDP
- Megaregion (considers population density and urban form)
- Collaborating economic sectors

s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

# 2.6. Selected HSR S stems: Ke Metrics

| Project / Location | Capital cost (2020 CAD) | Cost per track km (2020 CAD) | Population of cities served - combined (2016)[1] | GDP of cities served – combined (2016 CAD)[1] | Total length (km) of project |
|---|---|---|---|---|---|
| | | **Existing HSR Systems in Operation** | | | |
| **France-LGV Sud-Est (Paris/Lyon)** | $9.3 billon | $22 Million | 15 million | $1.4 billion | 425 |
| **Spain-AVE (Madrid-Barcelona)** | $32.9 billion | $53 million | 12 million | $740 million | 621 |
| **UK-High Speed 1 (HS1) (London - Channel Tunnel)** | $26.1 billion | $237 million | 12 million (London only) | $1.2 billion (London only) | 109 |
| **Japan-Sanyo Shinkansen (Osaka-Fukuoka)** | $6.8 billliion | $11 million | 20 million | | 626 |
| **Taiwan-High Speed Rail (Taipei-Kaohsiung)** | $90.1 billion | $257 million | | | 350 |
| | | **Proposed HSR Systems (Not in Operation)** | | | |
| **USA-California HSR Phase 1 (San Francisco-Los Angeles)** | $107 billion | $128 million | 24 million | $2.6 billion | 836 |
| **USA-Texas High-Speed Train (Dallas-Houston)** | $24.3 billion | $64 million | 14 million | $1.2 billion | 380 |

[redacted]

- (1) Gombined population of cities served and combined GDP of cii'ies served based only on cities identified under "ProjecULocation", unless otherwise noted..
- (2) Note: Planning for thiis proposed HSR system has not moved ahead.

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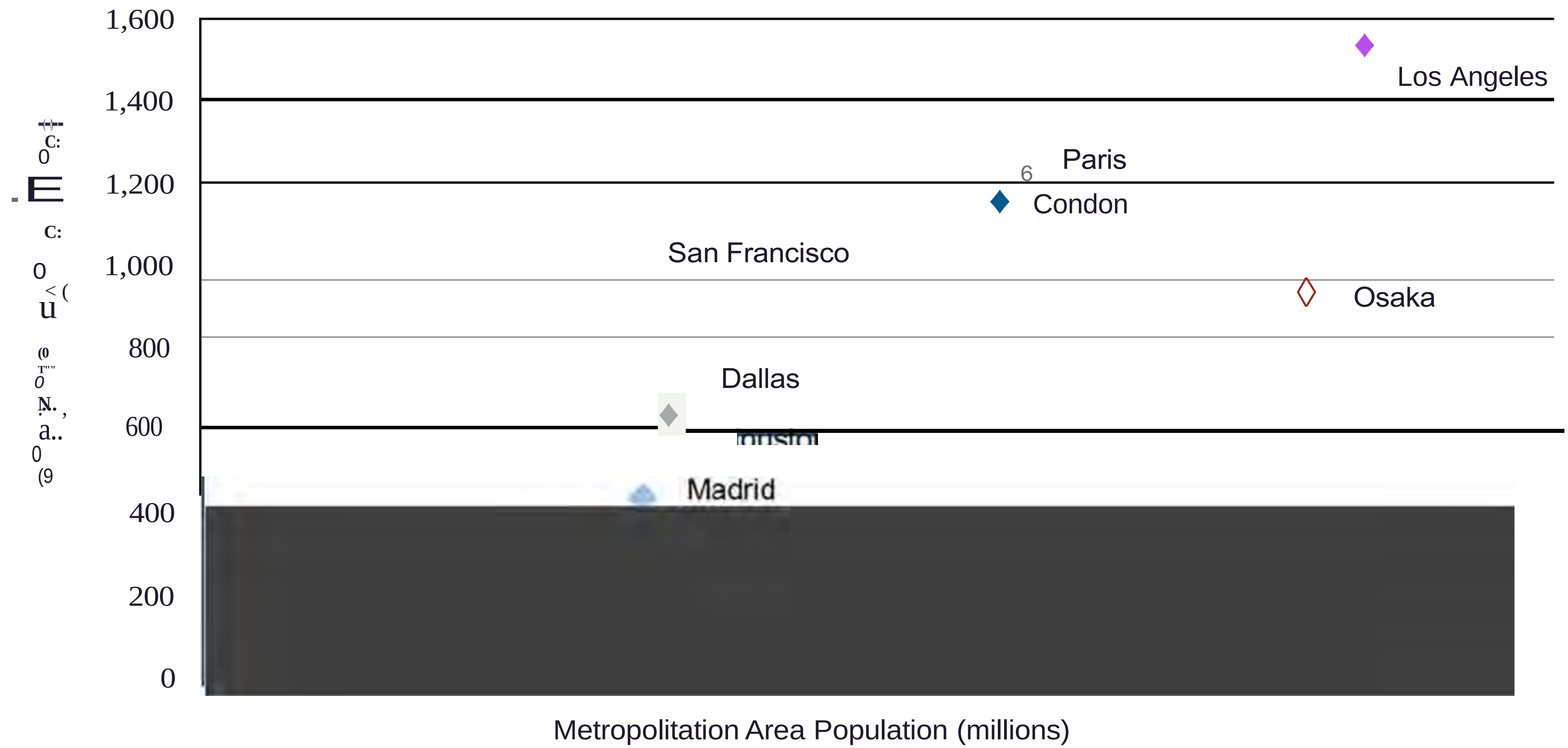
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

# 2.7. GDP to Population Ratio

*S.ample fiS CilLes and Eole otial C aoadLan..Markats n J*




(1) The cities identified in the scatter plot are a small sample of cities that are served by HSR and excludes the Asian market (aside from Osaka).

- HSR system is in operation (Paris, Lyon, Barcelona, Madrid, London, and Osaka);
- HSR system is not in operation (San Francisco, Los Angeles, Dallas, and Houston) and;
- Potential canaclian Markets (Quebec City, Ottawa, Montreal, and Toronto).

Soorce: https://stcis.oecd.org'

# 2.8. HSR Profitabili

- HSR line developments generally consider a fuller analysis of direct and wider economic benefits than purely operating profitability.
- HSR capital infrastructure has been provided by Governments to operators at a written down value (e.g. HS1 UK, Japan).
- Many HSR lines operate within wider rail systems (ownership) making underlying operating profitability difficult to analyze.
- The examples of HSR systems covering operating costs through farebox and other income was identified below.
- QMOT selected three of the JR companies as examples: JR West, Central, and East.
- The following table outlines the year-end profits as of March 31, 2019.

| JR Company | Approximate Profit (1) | | |
|---|---|---|---|
| | 2019 Yen | 2019 CAD (Converted)(2) | 2020 CAD (Escalated)(3) |
| **JR West** | ¥107.8 billion | $1.2 billion | $1.3 billion |
| **JR Central** | ¥445,037 billion (Referred to as "Net Income") | $5.3 billion | $5.4 billion |
| **JR East** | ¥297.3 billion | $3.5 billion | $3.6 billion |

- (1) Note that this reflects profits company-wide and not only for Shinkansen revenue service.
- (2) Conversion rate of 1 Japanese Yen= 0.01199 CAD assumed.
- (3) Escallation rate of 3% per year assumed.



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s. 18(b)
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s. 18(a)
s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

# 3.1. HSR O eralions in Winter: Ke Considerations

- QMOT was unable to identify an HSR system that operates at 300km/h (186 mph) in -30 degrees Celsius conditions.

- However, information was found on rail systems operating between 200-250km/h (125-155 mph) in extreme cold conditions. It is worth noting[1] that rail systems tend to reduce operating speeds at certain temperatures such as -30 degrees Celsius.

- In general, some of the risks and important implications of operating HSR and conventional rail systems in low temperatures and snow include[1] but may not be limited to:
  - Broken rail, broken rail detection, and train detection;
  - Malfunctioning and freezing of switches;
  - Malfunctioning of brakes on rolling stock;
  - Freezing and short-circuiting of signals and other controls and communications systems and;
  - Freezing of overhead catenary system (OCS) power lines.

- Kloow (2011) examined rail operations between 200-250 km/h (125-155 mph) in winter climates with a focus on Sweden. They noted that above 250 km/h (155 mph), winter-related issues involving components such as disc brakes, pantographs, snow clearing, and ballast pick-up become more severe the higher the operating speed.

- Specific consideration to providing special facilities such as for snow removal and special spare train sets storage at strategic locations are also incorporated into the design of the rail system to allow the operator to respond to such cold weather conditions.

Sources: https://www.hsrail.org/cold-weather-passenger-traiins;http://gronataget.se/upload/TR1O_2011.pdf; and https://uic.org/IMG/pdf/raiiladapt_final_report.pdf

# 3.2. Example Systems

The following are examples of HSR/higher-speed rail operating in climates at -30 degrees Celsius or lower:

- China: The only HSR line that was identified to operate in a climate colder than -30 degrees Celsius was the Harbin-Dalian high-speed train, which began operations in 2012. It is located in northeastern China where temperatures range between 40 to -40 degrees Celsius. While the service has a maximum operating, speed of 350 km/h (217 mph) in the summer, the maximum operating speed reduces to 250 km/h (155 mph) in the winter.
  - Some key considerations of this line include having facilities for snow and ice removal and train sets specially designed for the corridor.
  - As well, to operate HSR in extremely cold regions of the country, the China Railway Design Corporation (CRDC) developed technologies related to civil works (such as anti-freeze tunnel technology}, electrical and mechanical systems (such as for OCS ice-melting), and operation and safety facilities (such as various monitoring systems).

- Russia: The Moscow-St. Petersburg "Sapsan" train was designed to operate in -50 degree Celsius conditions. The service mostly operates at 200 km/h (125 mph) but does reach 250km/h (155 mph) along the route.

Source: htlps://www.hsrail.org/cold-weather-passenger-trains: https://e . . . .orglwiki/Harbin% 0 - 0 3Dalian high-speed railway: https://rusmania.com/lransporVsapsan-high-speed-train: and ht! s://uic. df/railada I final report.pdf



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s. 21(1)(b)

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s. 18(a)
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s. 18(a)
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s. 21(1)(a)
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s. 18(b)
s. 21(1)(a)
s. 21(1)(b)

# List of Appendices

# Appendix A: Selected HSR Systems

# Rail Networks with High Speed Rail Across the Globe

European Railway Networks
Source: Bernese Media


Railway Network in China
Source: Wikipedia


Railway Network in Japan
Source: Hisagi


Taiwan High Speed Rail
Source: World of Maps

Railway Network in South Korea
Source: KTX

Note: The maps reflect multiple systems operating at various speeds

# Selected HSR S stems: Notes

- The following slides present selected HSR systems in Europe, Asia, and North America.
  - The European and Asian systems are in operation.
  - Systems were selected based on maximum operating speed to the current study.
  - The HSR systems for North America are in planning and/or construction phases.
  - The Quebec City-Windsor Corridor system was added per JPO request.

- The following assumptions were made for the selected HSR systems:
  - Escalation 3% per year
  - Escalation 1.5% for Japan
  - End year 2020
  - Currency exchange 1 USO = 1.4 CAD
  - Currency exchange 1 Pound= 1.71 CAD
  - Currency exchange 1 NTD = 0.045 CAD
  - Currency exchange 1 Euro = 1.56 CAD
  - Location factors vary for each country

- Unavailable information is noted on its respective slide.

- Where information was not available but comparable values were identified, the applicable parameters were included.

- Some selected HSR systems included several references, refer to "Summary References" in Appendix C for full list.

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# TGV: France HSR Network
# LGV Sud-Est: Paris-Lyon HSR Line

| | Path to HSR | | | |
|---|---|---|---|---|
| **Owner(s) / Operator(s)** | Project background | Nature of project (greenfield, upgrade, etc.) | **Regulatory Approvals** | **Business Case Characteristics - Financing** |
| **Owner and operator:** SNCF (French National Railways)<br>• Stat owned | Sud-Est was first HSR line in Europe. Alleviated rail congestion.<br><br>Country-wide HSR network expanded from there, focusing on:<br>• City size/demand<br>• Congestion<br>• Profitability | Country-wide TGV network uses mixed infrastructure:<br>**Separate HSR Lines**<br>• Used for longer distances<br>• 37% o f network are HSR-dedicated lines<br>**Conventional Lines**<br>• Used for approach to large cities<br>• High-speed trains can operate on conventional lines | Subject to "Napoleonic tradition" under Roman law, not common law<br>• Legislative and executive authorities had the power<br>• "Declaration of public utility": expropriated land to build LGV<br>• Allowed for quicker implementation of TGV network | Overall, the TGV network started with the most viable lines and were financed based on profitability.<br><br>Sud-Est was financed 100% by SNCF. The line had the following rates of return:<br>• 15% fiinancial<br>• 30% social |

Source: https://en.wikipedia.org/wiki/LGY_Sud-Est;
https://www.itf-oecd.org/sites/default/files/docs/dp201326.pdf ;
https://reader.elsevier.com/reader/sd/pii/S2352146517307214?token=7E2FF14E4A75E95245DA89A6DD47CE3F8867B50 F507005537 AC7DBD92533223F96 4245580571732085318C59E848D928;
High-Speed Rail: Lessons for Poliicy Makers from Experiences Abroad (Barcelona Report); and
High-Speed Rail: International Lessons for U.S. Policy Makers



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# France - LGV Sud-Est Paris-Lyon)

| Construction | | | Operations | | | Ridership | |
|---|---|---|---|---|---|---|---|
| Capital cost (CAD) | Timeline | Cost per track km (2020 CAD) | First operational year | Annual operating costs (CAD) | Example ticket price (2020 CAD) | Annual ridership | Revenue (CAD) |
| $4.0 billion (1983) $9.3 billon (2020) | 1975 (approved), 1975-1983 (construction) | $22 million | 1981 (part), 1983 (full) | $18,700,000 (2002) $31,790,000 (2020) of single track HSR maintenance cost (country-wide) | $82.97 (one-way) | 44.4 million in 2017 | $13 billion in 2019 (SNCF high speed and conventional long distance) |

| Network/Service | | | | | | |
|---|---|---|---|---|---|---|
| Average operating speed (km/h) | Max. operating speed (km/h) | Total length (km) of project | Headways / trip time (express) | Number of stations | Distances between stations (km) | **Geography/Terrain** |
| 220 | 300 (260 during first operational year) | 425 | Headway not available; approximately 2 hours | 4 | 142 (calculated average) | Flat; some mountains and hills surrounding Lyon |

## Assumptions (Based on Arup Report):

Escalation factor = 111% (base year = 1983)
Location factor = 1.10
Operating cost (excludes compounded escalation value)= $44,000 X [1+(18 years X 0.03)] X 1.1

## Major Communities Served:

Paris: Metropolitan Area Population (2016): 13 million; City Density: 20,000/km$^2$
Lyon: Metropolitan Area Population (2016): 2 million; City Density: 11,000/km$^2$

Source: Several, including High-Speed Rail: Lessons for Policy Makers from Experiences Abroad (Barcelona R port); Economic Analysis of High Speed Rail in Europe (BBVA, 2009); For additional references refer to summary references i1tems 9, 14, 50, 54, 55, 59, 62, 64, 65, 69, 72, 75, 97, 99 and 119 (see Appendix C for details}.



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# S ain-AVE Madrid-Barcelona

AVE: Spain's HSR Service

| Path to HSR | | | | |
|---|---|---|---|---|
| Owner(s) / Operator(s) | Project background | Nature of project (greenfield, upgrade, etc.) | Regulatory Approvals | Business Case Characteristics - Financing |
| **Infrastructure owner:** ADIF AV<br>• State-owned<br><br>**0 perator:** Renfe Operadora<br>• State-owned | Planning commenced in the 1980's.<br><br>First HSR line **(Madrid-**Seville) opened in 1992<br>• Implemented to improve economic development in Southern Spain<br><br>HSR country-wide development stemmed years later. | Separate, country-wide HSR networl<.<br><br>The Madrid-Barcelona HSR extends to France. The line sections include:<br>Madrid-Lleida (2003)<br>• Lleida-Tarragona (2006)<br>Tarragona-Barcelona (2008)<br>Figueres (Spain)-Perpignan (France) (2010)<br>Barcelona-Figueres (2013) | The following are the regulatory considerations for the full line:<br><br>Regulatory Agencies:<br>Ministry of Development<br>• Ministry of Environment<br><br>Legal and regulatory environment:<br>• The European System of Accounts SEC-95<br>• Spanish public contracts law 24/2011<br>• *Real Decreto* 12/2011 (public contract legislation)<br><br>Events impacting the project:<br>• The Infrastructure and Transport Plan of the Spanish Government<br>• Law of Railway Sector 39/2003 (17 November) | Madrid-Barcelona-France financed by:<br>• Spanish Government<br>• EU Cohesion Fund<br>• TEN-T (Trans-European Transport Network)<br>• European Investment Bank (EIB) loans |

Source: htt ://www.me a- ro·ect.eu/assets/ex /resources/Hi h S eed Rail-Madridi-Barcelona-French-frontier. df; High-Speed Rail: Lessons for Policy Makers from Experiences Abroad (Barcelona Report); https://www.sciencedirect.com/science/article/pii/S2352146517307214; and https://en.wikipedia.org/wiki/Madrid%E2%80%93Barcelona high-speed rail line



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# .Spain - AVE (Madrid-Barcelona)

| Construction | | | Operations | | | Ridership | |
|---|---|---|---|---|---|---|---|
| Capital cost (CAD) | Timeline | Cost per track km (2020 CAD) | First operational year | Annual operating costs (2020 CAD) | Example ticket price (2020 CAD) | Annual ridership | Revenue (CAD) |
| $14.9 billion (2007)<br>$32.9 billion (2020) | 1993 (tender)<br>1995 (construction began)<br>Base year 2007 | $53 million | 2003 and 2006 (part), 2008 (full) | $32,292,000 (2002)<br>$78,867,000 (2020) Single track maintenance cost | $133.78 (one-way) | 8.7 million in 2017 (Madrid-Barcelona-France) | $6 billion in 2018 (Renfe's entire network rev.) |

## Network/Service

| Average operating speed (km/h) | Max. operating speed (km/h) | Total length (km) of project | Headways/ trip time (express) | Number of stations | Distances between stations (km) | Geography/Terrain |
|---|---|---|---|---|---|---|
| 236 | 300 | 621 | Headway not available; approximately 2:30 hours | 7 | 104 (calculated average) | Vari1ed; hilly regions and lowland. Madrid-Barcelona-France: 255 viaducts and bridges (581km) and 83 tunnels **(86 km).** |

## Assumptions (Based on Arup Report):

Escalation factor = 39% (base year = 2007)
Location factor = 1.59
Operating cost (excludes compounded escalation value)= $52,000 X [1+(18 years X 0.03)) X 1.59

## Major Communities Served:

Madrid: Metropolitan Area Populatiion (2016): 7 million; City Density: 5,300/km$^2$
Barcelona: Metropolitan Area Population (2016): 5 million; City Density: 16,000 people/km$^2$

Source: Several, including: High-Speed Rail: Lessons for Policy Mak,ers from Experiences Abroad (Barcelona Report) ; http://www.mega-project.eu/assets/e /resources/Hligh_Speed_Rail-Madrid-Barcelona-French-frontier.pdf ; for additional references refer to summary references items 2, 9, 14, 54, 60, 63, 66, 67, 73, 97, 116, and 119 (see Appendix C for details)



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# UK - High Speed 1 (London-Chann,el Tunnel)

## Path to HSR

| Owner(s) / Operator(s) | Project background | Nature of project (greenfield, upgrade, etc.) | Regulatory Approvals | Business Case Characteristics - Financing |
|---|---|---|---|---|
| Owner/Operator: HS1 Ltd<br>• Until 2040<br>• Private sector<br>• **O&M** Contractor: Network Rail (High Speed)<br><br>**Mainline Operators:**<br>**Domestic service:** London South Eastern Railway (LSER)<br>**International service:** Eurostar<br><br>HS1 Ltd. also services East Midlands Railway, Thameslink, and freight operator. | • Connect the UK with the rest of Europe quicker and more reliably<br>• Develop new commuter service<br>• Improve rail capacity<br>• Economic developmernt | **Section 1**: open countryside with bridge crossings, etc.<br>**Section 2:** urban setting, mostly tunnels<br><br>Double track and mixed traffic:<br>• High speed passenger and commuter trains; freight trains<br><br>60% of project is in existing transportation corridors<br>25% of the route is tunnelled | **Channel Tunnel Rail Lillk Act 1996:** provided for the project to be implemented. Also outlined a private sector entity would build, maintain, and operate it.<br><br>**Channel Tunnel Rail Link (Supplementary Provisions)** Act 2008: Updated the Act to support the 2009 restructuring and sale.<br><br>Additional applicable legislation to HS1:<br>• Parts of Railways Acts of 1993 and 2005, Railways and Transport Safety Act 2003, and secondary legislation<br><br>HS1 Ltd. Is the Infrastructure Manager under Rail Regulation 2016. | **Initially:** Private Fiinance Initiative (PFI)<br>**After restructuring:** Public Private Partnership (P3)<br><br>Financed through government grants and government guaranteed private finance.<br><br>The private company "London Continental Railways" (LCR) was to finance, build, and operate the project.<br>• Restructured in 1998 and 2002 due to financial difficulties from low Eurostar UK revenue forecasts<br>• Was purchased by the government in 2009<br><br>Overall, the public sector became more involved in the project than anticipated. |

Source: Several, including: https://highspeed1.co.uk/about-us;
https://www.systra.com/en-project/high-speed-1-hsr-link-between-london-and-the-channel-tunnel;
for additional references refer to summary references items 9, 52, 58, and 109-111 (see Appendix C for details).

# UK - High Speed 1 (HSl) (London-Channel Tunnel)

| Capital cost (CAD) | Construction: Timeline | Cost per track km (2020 CAD) | Operations: First operational year | Annual operating costs (CAD) | Example ticket price (2020 CAD) | Ridership: Annual ridership | Revenue (2020 CAD) |
|---|---|---|---|---|---|---|---|
| $18.9 billion (2007)<br>$26.1 billion (2020) | 1996 (contract award),<br>1998-2003 (section 1 construction),<br>2000-2007 (section 2 construction) | $237 million | International: 2003 (part), 2007 (full)<br>Domestic: 2009 | $407 million (2013)<br>$493 million (2020) | $59.114 | 20 million (2016) | $1 billion (calculated) |

**Network/Service**

| Average operating speed (km/h) | **Max.** operating speed (km/h) | Total length (km) of project | Headways/ trip time (express) | Number of stations | Distances between stations (km) | **Geography/Terrain** |
|---|---|---|---|---|---|---|
| Not available | International: 300<br>Domestic: 230 | 109 | Domestic: 80+ daily trips per direction; 37 minutes | 4 | 36 (calculated average) | Rolling terrain and farmland; 117 bridges, 26.5km of tunnels, and 6km of viaducts |

## Assumptions (Based on Arup Report):

Escalation factor = 39% (base year = 2007)
Location factor= 1.00
Operating cost (excludes compounded escalation value) = $407 million X [1+(7 years X 0.03)] X 1.0

## Major Communities Served:

London: Metropolitan Area Population (2016): 12 million; City Density: 5,666/km$^2$

Souroe: Several!, including: https://www.ice.org.uk/what-is-civil-engineeringlwhat-do-civil-engineers-dolhigh-speed-one-and-st-pancras-station ; http://researchbriefings.files.parliament.uk/documents/SN00267/SND0267.pdf ; for additiional references refer to summary references items 52, 56, 57, 61, 68, 71, 74, 76, 97, 108 and 119 (see Appendix C for details).

# Ja an - San o Shinkansen Osaka-Fukuoka

## Path to HSR

### Owner(s) / Operator(s)

In 1.987, Japanese National Railways (JNR) separated and became private.

Sanyo Shinkansen is owned and operated by West Japan Ra.ilway Company (JR West).

### Project background

Country-wide HSR network developed to support all regions, as a result of:

- Rapidly growing economy
- Loss of population to certain areas

First global HSR was the Tokai:do Shinkansen (Tokyo-Osaka), opened in 1964.

### Nature of project (greenfield, upgrade, etc.)

New Shinkansen Line called Sanyo Shinkansen

- Extension of coun1ry-wide network
- Connected to Tokaido Shinkansen (Tokyo-Osaka)

Two Sanyo Shinkansen phases:

- Shin-Osaka-Okayama, opened in 1972
- Okayama-Hakata (Fukuoka),opened in 1975

### Regulatory Approvals

**National Shinkansen Railway Construction Law**

- Approved May 1970
- Outlines definitions, objectives of the network, and procedures

### Business Case Characteristics - Financing

Project built by the Japan Railway Construction Public Corporation (JRCPC), which was created by the government.

Construction cost funding:

JNR (public at the time)
Government's treasury investment and loan fund
Borrowed funds from the private sector

Source: http://www.omegacentre.bartlett.ucl.ac.uk/wp-contenVuploads/2014/12/JAPAN_SHINKANSEN_PROFILE.pdf ;
https://en.wikipedia.org/wiki/San%27y%C5%8D_Shinkansen;
ht1ps://www.westjr.eo.jp/global/en/about-us/history/; and
https://www.jrailpass.com/blogVtokaido-shinkansen-jr-pass



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# Ja an - San o Shinkansen Osaka-Fukuoka

| Capital cost (CAD) | Construction<br>Timeline | Cost per track km (2020 CAD) | Operations<br>First operational year | Annual operating costs (2020 CAD) | Example ticket price (2020 CAD) | Ridership<br>Annual ridership | Revenue (CAD) |
|---|---|---|---|---|---|---|---|
| $4.1 billion (1975)<br>$6.8 billion (2020) | 1965 (authorized),<br>1967 (construction began}-1975 | $11 million (nominal) (calculated) | 1972 (part), 1975 (full) | Not available | $191.79 | 85 million in 2018 (JR West Shinkansen) | $19 billion in 2019 (JR West Operating Revenue) (converted) |

**Network/Service**

| Average operating speed (km/h) | Max. operating speed (km/h) | Total length (km) of project | Headways/ trip time (express) | Number of stations | Distances between stations (km) | **Geography/Terrain** |
|---|---|---|---|---|---|---|
| 210* | 300 | 626 | Var,ies; 2.5 hours | 19 | 35 (calculated average) | Mountainous; joins two islands |

*Average operating speed Tokaido Shinkansen (Tokyo-Osaka}

## Assumptions:

Escalation factor = 68% (base year = 1975)
Location factor= 0.99

## Major Communities Served:

Osaka: Metropolitan Area Population (2016): 17 million
Fukuoka: Metropolitan Area Population (2016): 3 million; City Density: 4,600/km$^2$

Source: Several, including: High-Speed Rail: Lessons **for** Policy Makers frnm Experliences Abroad (Barcelona Report) ; http//www.omegacentre.bartlett.ucl acuklwp-contenUuploads/2014/12/JAPAN_SHINKANSEN_PROFILE.pdf ; for additional references refer to summary references items 14, 54, 78, 81-86, 88, 89, 97 and 119 (see Appendix C for details)

# Taiwan- !High Speed Rail (Taipei-Kaohsiun

| Owner(s) / Operator(s) | Path to HSR<br>Project background | Nature of project (greenfield, upgrade, etc.) | Regulatory Approvals | Business Case Characteristics - Financing |
|---|---|---|---|---|
| **Owner/Operator:** Taiwan High Speed Rail Corporation (THSRC) | Proj;ect allows for business travel between Taipei and Kaohsiung with a distance of 350 km in 90 minutes and builds on economic development along the route.<br><br>Project was initially planned to be public sector. Due to increased public fiscal burdens, the Legislative Yuan withdrew the budget allocated to the HSR Project and decided on a Design-Built-Operate-Maintain-Transfer (DBOMT) procurement. | Greenfield | Taiwan Ministry of Transportation and Communications (MOTC) | Privately financed by Taiwan High Speed Rail Corporation (THSRC) with some government subsidy (P3)<br><br>DBOMT<br><br>THSRC has a concession to finance, construct, and operate the HSR for a period of 35 years and a concession for HSR station area development for a period of 50 years. |

Source: https:/fen.thsrc com.tw/ArticleContent/50fa391b-09a7-4728-98e7-Bb7901a795d8

# Taiwan - Hiigh Speed Rail (Taipei-Kaohsiun

| Construction | | Operations | | | | Ridership | |
|---|---|---|---|---|---|---|---|
| Capital cost (CAD) | Timeline | Cost per track km (2020 CAD) | First operational year | Annual operating costs (2020 CAD) | Example ticket price (2020 CAD) | Annual ridership | Revenue (2020 CAD) |
| $23.1 billion (2005)<br>$90.1 billion (2020) | 1998 - Contract award<br>2005 - Construction complete<br>2007 - Full operation | $257 million | 2007 | $1.16 billion (2019)<br>$3.1 billion (2020) | $68.64 | 67.4 million in 2019 | $2.1 billion |

| Network/Service | | | | | | |
|---|---|---|---|---|---|---|
| Average operating speed (km/h) | Max. operating speed (km/h) | Total length (km) of project | Headways / trip time (express) | Number of stations | Distances between stations (km) | **Geography/Terrain** |
| Not available | 300 | 350 | 6 trains/hr (NB)<br>7 trains/hr (SB)/ 1:30 | 12 | 32 | Varied terrain<br>Approximately 73% of line runs on viaducts and 18% is in tunnels. |

## Assumptions:

Escalation factor = 45% (base year = 2005)

Location factor= 2.69

Operating cost ,(excludes compounded escalation value)= $1.16 biillion X [1+(1 years X 0.03)] X 2.69

## Major Communities Served:

Taipei City: Population: 2.65 million; Density: 9,700/km$^2$

Taichung: Population: 2.82 million; Urban Densiity: 5,400/km$^2$

Kaohsiung: Population: 2.77 millilion; Urban Density: 7,100/km$^2$

Source: Several, including: https://inta-aivn.org/images/assets/inta33/chiu_inta33_the_bo.texperience_of_taiwans_high_speed_rail_construction_project.pdf ; https://www.thsrc.eom.tw/event/lnvestorRelations/ShareholdersMeeting/2019_amial_report_EN.pdf ; for additional ref,erences refer to summary references items 91, 92, 94, 95, 96, 98 and 119 (see Appendix C for details).



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# USA - California HSR Phase 1 (Sain Francisco-Los Angeles)

**Path to HSR**

| Owner(s) / Operator(s) | Project background | Nature of project (greenfield, upgrade, etc.) | Regulatory Approvals | Business Case Characteristics - Financing |
|---|---|---|---|---|
| Contracting authority: California High-Speed Rail (CHSR) | Key points:<br>• **1981:** HSR first considered at the state-level<br>• **Mid-1990's:** increased transportation congestion (air, raiil, and road) motivates planning<br>• **1996:** report by the state's Intercity High-Speed Rail Commission determined HSR would be feasible. | Majority of project anticipated to be built along existing transportation corridors (rail and road)<br>• E.g. San Francisco to San Jose "blended system" between the HSR and Caltrain<br><br>Project separated into ten sections: geographic, environmental, and economics | **California's High-Speed Rail Act (1996):** created the high-speed rail authority that would begin planning for the project.<br><br>**Environmental planning:**<br>**Tier** 1: broad program<br>• 2 of 2 documents completed (2005 and 2008/2012)<br>**Tier 2::** individual projects<br>• 3 of 10 Phase 1 documents are completed<br>• For reference, environmental review and permitting took 4 and 5 years, for Merced to Fresno and Fresno to Bakersfield, respectively. | Funding **Sources**<br>**Federal:**<br>• American Recovery and Reinvestment Act (ARRA) and Fiscal Year 2010 (FY10) Transportation, Housing and Urban Development funds<br>• Total: $5 billion (2020 CAD)<br>**State:**<br>• Cap-and-Trade (received and future) and Proposition 1A bond funds<br>• Total: $24-28 billion (2020 CAD)<br><br>Total available funds: **$29-32** bilHon **(2020 CAD)**<br>(as of December 31, 2019)<br><br>Civil construction procured under multiple design build contracts; not integrated. |

Sources: Several, including httlPs://hsr.ca.gov/docs/about/business_plans/2020_Business_Plan.pdf;
HSR-CIB Case Studies;
for additional references refer to summary references items 33, 34, 39, 104, 105, 106, 107 (see Appendix C for details}.

# USA - California HSR Phase 1 (Sain Francisco-Los Angieles)

| Capital cost (CAD) | Construction: Timeline | Construction: Cost per track km (2020 CAD) | Operations: First operational year | Operations: Annual operating costs (CAD) | Operations: Example ticket price (2020 CAD) | Ridership: Annual ridership | Revenue (CAD) |
|---|---|---|---|---|---|---|---|
| $107 billion (2020) | 2009-2013/2014/in progress (environmental review), 2015 (construction began)- in progress | $128 million | 2031 (part) 2033 (full} | $1.4 billion (2034) (converted)* | Varies | 27.8 million {2034)* | $2.2 billion (2034, converted)* |

**Network/Service**

| Planned operating speed (km/h) | Max. operating speed (km/h) | Total length (km) of project | Headways / trip time (express) | Number of stations | Distances between stations (km) | **Geography/Terrain** |
|---|---|---|---|---|---|---|
| Not available | 354 | 836 | Headways not available; 2:40 | 15 | 60 (calculated average) | Var,ious; mountains and valleys |

*Based on 2034 medium forecasts

## Assumptions:

Escalation factor= 15% (base year= 2015)
Location factor= 0.87

## Major Communities Served:

San Francisco: Metropolitan Area Population (2016): 7 million; City Density: 7,255/km$^2$
Los Angeles: Metropolitan Area Population (2016): 18 million; City Density: 3,276/km$^2$

Source: Several, including https://hsr.ca.gov/docs/about/business_plans/2020_Business_Plan.pdf; https://www.permits.performance.gov/permitting-projects/california-high-speed-rail-progam-fresno-bakersffield-project-section ; for additional references refer to summary references items 34, 38, 39, 40, 41, 46, 47, 48 and 119 (see Appendix C for details)..



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# USA -Texas High-S eed Train Dallas-Houston

## Path to HSR

### Owner(s) / Operator(s)

Projec1being developed by Texas Central

### Project background

**HSR in Texas, pre-project:**
- **1987:** HSR planning at the state-level began
- **1989:** report by the Texas Turnpike Authority determined HSR would be feasible (under certain conditions)
- **1989-1995:** Texas High-Speed Rail Authority created and then abolished, respectively

Motivation for this project:
- Road congestion increasing on 1-45
- Additional time required for air travel

### Nature of project (greenfield, upgrade, etc.)

Utility corridor a.s the feasible alternative.

Project would require:
- Double tracks
- **Closed system:** dedicated ROW

### Regulatory Approvals

Regulatory approva.l process led by the Federal Railroad Administration (FRA)
- Includes 12+ federal and state agenc,ies

**Key step:** Final Environmental Impact Statement published in 2020
- Took 6 years to produce
  Allows for: permits to be finalized, the Record of Decision, and for construction to begin

### Business Case Characteristics - Financing

The project is private and for-pro it..

Market-led approach
- Funded by investors and entrepreneurs
- No grants from the US Government or State of Texas
- Would have no operational subsidy once in service

Sources: Several, including https://legacy.lib.utexas.edu/taro/tslac/20071/tsl-20071.html ;
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for add:itional references refer to summary references items 36, 102, and 103 (see Appendix C for details).

# USA -Texas High-S eed Train Dallas-Houston

| Construction | | | Operations | | | Ridership | |
|---|---|---|---|---|---|---|---|
| Capital cost (CAD) | Timeline | Cost per track km (2020 CAD) | First operational year | Annual operating costs (2020 CAD) | Example ticket price (2020 CAD) | Annual ridership | Revenue (2020 CAD) |
| $24.3 billion (2020) | 2014 (environmental review and permitting started)- ongoing | $64 million (calculated) | Not available | Not available | Varies | 6 million in 2029 | Not available |

| Network/Service | | | | | | |
|---|---|---|---|---|---|---|
| Planned operating speed(km/h) | Max. operating speed (km/h) | Total length (km) of project | Headways/ trip time (express) | Number of stations | Distances between stations (km) | **Geography/Terrain** |
| 300 (planned) | 330 | 380 | 30 minutes peak, 1 hour off-peak; 90 minutes | 3 | 190 (calculated average) | Rolling terrain |

## Assumptions:

Escalation factor= 0% (base year= 2020)
Location factor= 0.87

## Major Communities Served:

Dallas: Metropolitan Area Population (2016): 7 million; City Density: 1,527/km$^2$
Houston: Metropolitan Area Population (2016): 7 million; City Density: 1,398/km$^2$

Source: Several, including httpsllwww.texascentral.com/factsl ; https:llwww.pennits.performance.gov/permitting-projects/dallas-houston-high-speed-raill ; for additional references refer to summary references items 35, 37, 42, 43, 49 and 11g (see Appendix C for details).



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# Appendix B: HSR and HFR Technical Considerations

# Comparison of Technical Requirements
## Track Cross Section

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# Comparison of Technical Requirements Track Desi_n

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# Allignment - Curves & Track Geometry

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***End of the Ministerial Briefing Deck***

The following slides are supporting documents and appendices.

Note: some slides located in the first half of the deck (for the Ministerial Briefing) are also located in the second half of the deck {supporting documents and appendices) to keep applicable information grouped together.



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# 1.1. Executive Summa

- HFR is being designed to accommodate operating speeds of 110 mph and build criteria of 125 mph where feasible
- Velocity of 186 mph (300 km/h) is typical of what are generally considered to be true high speed trains (HSTs) operating on European and Asian HSR systems
- High Speed Rail requires electrification.
- Modern high speed railways are built to have very long sections of straight or only slightly curved track - horizontal curves
- Modern high speed railways are built to have inflections in gradient that are sufficiently mild that passengers do not notice the changes and it has low impact on infrastructure - vertical curves

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# 1.1. Executive Summa Continued

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- Key items that would be impacted are:
  - Curves and Track Geometry
  - Track Cross-Section Design
  - Track Design
  - Structures
  - Traction Power Supply
  - Train Control and Communications
  - Grade Separated and Dedicated Right of Way
  - Maintenance
  - Cost to Build

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# 4. HSR Profitability and Factors for Success

# 4.204. Success Factors: Where HSR Works

Strong transit connections (LRT, subway, commuter rail, etc.)

Optimal HSR corridor length (i.e. distance between economic centers)

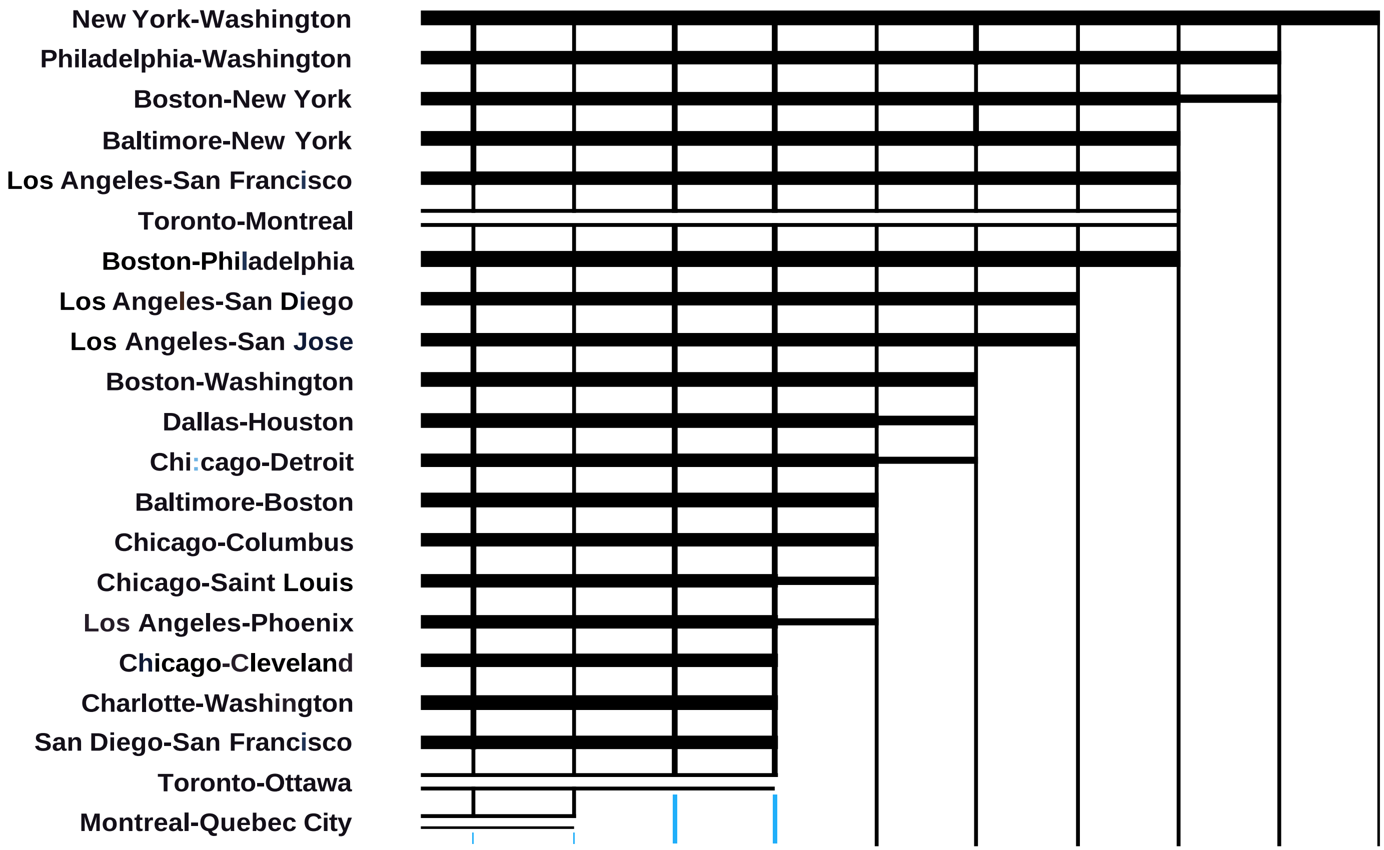
City pairs:

- Large metropolitan area and city populations
- Large metropolitan area GDP
- Megaregion (considers population density and urban form)
- Collaborating economic sectors

# 4.205. Success Factors: Where HSR Works

- America 2050 developed a tool for assessing which potential HSR corridors would have the greatest demand and evaluated 27,000 US city pairs
- Sample calculation suggests Toronto-Montreal would rank 6th in North America

- **Need to consider:**
  - Strong transit connections (LRT, subway, commuter rail, etc.)
  - Length of HSR corridor (i.e. distance between economic centers)
  - City pairs:
    - Metropolitan area and city populations
    - Metropolitan area GDP
    - Megaregion (considers population density and urban form)
    - Collaborating economic sectors



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s. 21(1)(a)
s. 21(1)(b)

# Selected HSR S stems - Summa

| Project / Location | Capital cost (2020 CAD) | Cost per track km (2020 CAD) | First Operational Year | **Total length (km) of project** |
|---|---|---|---|---|
| **Existing HSR Systems in Operation** | | | | |
| France-LGV Sud-Est (Paris/Lyon) | $9.3 lbillon | $22 Million | 1981 (part),<br>1983 (full) | 425 |
| Spain-AVE (Madrid-Barcelona) | $32.9 billion | $53 million | 2003 and 2006 (part),<br>2008 (full) | 621 |
| UK-High Speed 1 (HS1)<br>(London - Channel Tunnel) | $26.1 billion | $237 million | International:<br>2003 (part), 2007 (full)<br>Domestic: 2009 | 109 |
| Japan-Sanyo Shinkansen (Osaka-Fukuoka) | $6.8 billion | $11 million | 1972 (part),<br>1975 (full) | 626 |
| Taiwan-High Speed Raiil (Taipei-Kaohsiung) | $90.1 billion | $257 million | 2007 | 350 |
| **Proposed HSR Systems (Not in Operation)** | | | | |
| USA-California HSR Phase 1 (San Francisco-Los Angeles) | $107 billion | $128 million | Planned<br>2031 (part)<br>2033 (full) | 836 |
| USA-Texas High-Speed Train (Dallas-Houston) | $24.3 billion | $64 million | Not available | 380 |

[redacted]

1[1]lNote: Planning for this proposed HSR system has not moved ahead.



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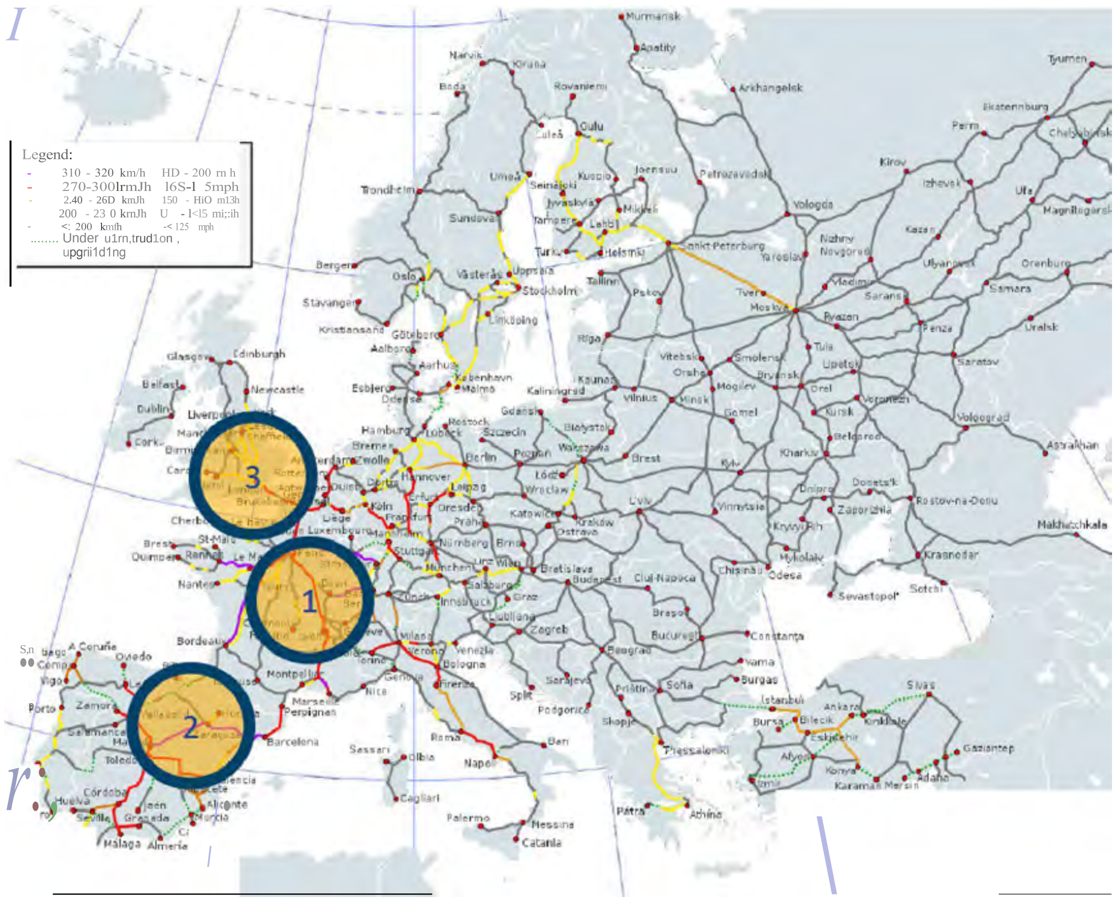
# Euro e

1. **France** - LGV Sud-Est (Paris-Lyon)

2. **Spain** -AVE (Madrid-Barcelona)

3. **United Kingdom** - High Speed 1 (London-Channel Tunnel)




*Note: Selected projects are in operation and have a maximum operating speed of 300 km/h*

Map Source: https://en.wikiipedia.org/wiki/High-speed_rail

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# TGV: France HSR Network
# LGV Sud-Est: Paris-Lyon HSR Line

| | Path to HSR | | | |
|---|---|---|---|---|
| **Owner(s) / Operator(s)** | Project background | Nature of project (greenfield, upgrade, etc.) | **Regulatory Approvals** | **Business Case Characteristics - Financing** |
| **Owner and operator:** SNCF (French National Railways)<br>• Stat owned | Sud-Est was first HSR line in Europe. Alleviated rail congestion.<br><br>Country-wide HSR network expanded from there, focusing on:<br>• City size/demand<br>• Congestion<br>• Profitability | Country-wide TGV network uses mixed infrastructure:<br>**Separate HSR Lines**<br>• Used for longer distances<br>• 37% o·f network are HSR-dedicated lines<br>**Conventional Lines**<br>• Used for approach to large cities<br>• High-speed trains can operate on conventional lines | Subject to "Napoleonic tradition" under Roman law, not common law<br>• Legislative and executive authorities had the power<br>• "Declaration of public utility": expropriated land to build LGV<br>• Allowed for quicker implementatio-of TGV network | Overall, the TGV network started with the most viable lines and were financed based on profitability.<br><br>Sud-Est was financed 100% by SNCF. The line had the following rates of return:<br>• 15% fiinancial<br>• 30% social |

Source: https://en.wikipedia.org/wiki/LGY_Sud-Est;
https://www.itf-oecd.org/sites/default/files/docs/dp201326.pdf ;
https://reader.elsevier.com/reader/sd/pii/S2352146517307214?token=7E2FF14E4A75E95245DA89A6DD47CE3F8867B50 F507005537 AC7DBD92533223F96 4245580571732085318C59E848D928;
High-Speed Rail: Lessons for Poliicy Makers from Experiences Abroad (Barcelona Report); and
High-Speed Rail: International Lessons for U.S. Policy Makers

# France - LGV Sud-Est Paris-Lyon)

| Capital cost (CAD) | Construction Timeline | Cost per track km (2020 CAD) | First operational year | Operations Annual operating costs (CAD) | Example ticket price (2020 CAD) | Ridership Annual ridership | Revenue (CAD) |
|---|---|---|---|---|---|---|---|
| $4.0 billion (1983) $9.3 billon (2020) | 1975 (approved), 1975-1983 (construction) | $22 million | 1981 (part), 1983 (full) | $18,700,000 (2002) $31,790,000 (2020) of single track HSR maintenance cost (country-wide) | $82.97 (one-way) | 44.4 million in 2017 | $13 billion in 2019 (SNCF high speed and conventional long distance) |

**Network/Service**

| Average operating speed (km/h) | Max. operating speed (km/h) | Total length (km) of project | Headways / trip time (express) | Number of stations | Distances between stations (km) | Geography/Terrain |
|---|---|---|---|---|---|---|
| 220 | 300 (260 during first operational year) | 425 | Headway not available; approximately 2 hours | 4 | 142 (calculated average) | Flat; some mountains and hills surrounding Lyon |

## Assumptions (Based on Arup Report):

Escalation factor = 111% (base year = 1983)
Location factor = 1.10
Operating cost (excludes compounded escalation value)= $44,000 X [1+(18 years X 0.03)] X 1.1

## Major Communities Served:

Paris: Metropolitan Area Population (2016): 13 million; City Density: 20,000/km$^2$
Lyon: Metropolitan Area Population (2016): 2 million; City Density: 11,000/km$^2$

Source: Several, including High-Speed Rail: Lessons for Policy Makers from Experiences Abroad (Barcelona R port); Economic Analysis of High Speed Rail in Europe (BBVA, 2009); For additional references refer to summary references items 9, 14, 50, 54, 55, 59, 62, 64, 65, 69, 72, 75, 97, 99 and 119 (see Appendix G for details).



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# S ain-AVE Madrid-Barcelona

## AVE: Spain's HSR Service

### Path to HSR

| Owner(s) / Operator(s) | Project background | Nature of project (greenfield, upgrade, etc.) | Regulatory Approvals | Business Case Characteristics - Financing |
|---|---|---|---|---|
| **Infrastructure owner:** ADIF AV<br>• State-owned<br><br>**0 perator:** Renfe Operadora<br>• State-owned | Planning commenced in the 1980's.<br><br>First HSR line **(Madrid-**Seville) opened in 1992<br>• Implemented to improve economic development in Southern Spain<br><br>HSR country-wide development stemmed years later. | Separate, country-wide HSR networl<.<br><br>The Madrid-Barcelona HSR extends to France. The line sections include:<br>Madrid-Lleida (2003)<br>• Lleida-Tarragona (2006)<br>Tarragona-Barcelona (2008)<br>Figueres (Spain)-Perpignan (France) (2010)<br>Barcelona-Figueres (2013) | The following are the regulatory considerations for the full line:<br><br>Regulatory Agencies:<br>Ministry of Development<br>• Ministry of Environment<br><br>Legal and regulatory environment:<br>• The European System of Accounts SEC-95<br>• Spanish public contracts law 24/2011<br>• *Real Decreto* 12/2011 (public contract legislation)<br><br>Events impacting the project:<br>• The Infrastructure and Transport Plan of the Spanish Government<br>• Law of Railway Sector 39/2003 (17 November) | Madrid-Barcelona-France financed by:<br>• Spanish Government<br>• EU Cohesion Fund<br>• TEN-T (Trans-European Transport Network)<br>• European Investment Bank (EIB) loans |

Source: htt ://www.me a- ro·ect.eu/assets/ex /resources/Hi h S eed Rail-Madridi-Barcelona-French-frontier. df; High-Speed Rail: Lessons for Policy Makers from Experiences Abroad (Barcelona Report); https://www.sciencedirect.com/science/article/pii/S2352146517307214; and https://en.wikipedia.org/wiki/Madrid%E2%80%93Barcelona high-speed rail line



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# .Spain - AVE (Madrid-Barcelona)

| Construction | | | Operations | | | Ridership | |
|---|---|---|---|---|---|---|---|
| Capital cost (CAD) | Timeline | Cost per track km (2020 CAD) | First operational year | Annual operating costs (2020 CAD) | Example ticket price (2020 CAD) | Annual ridership 8.7 million in 2017 (Madrid-Barcelona-France) | Revenue (CAD) |
| $14.9 billion (2007) $32.9 billion (2020) | 1993 (tender) 1995 (construction began) Base year 2007 | $53 million | 2003 and 2006 (part), 2008 (full) | $32,292,000 (2002) $78,867,000 (2020) Single track maintenance cost | $133..78 (one-way) | | $6 billion in 2018 (Renfe's entire network rev.) |

## Network/Service

| Average operating speed (km/h) | Max. operating speed (km/h) | Total length (km) of project | Headways/ trip time (express) | Number of stations | Distances between stations (km) | Geography/Terrain |
|---|---|---|---|---|---|---|
| 236 | 300 | 621 | Headway not available; approximately 2:30 hours | 7 | 104 (calculated average) | Vari1ed; hilly regions and lowland. Madrid-Barcelona-France: 255 viaducts and bridges (581km) and 83 tunnels **(86 km).** |

## Assumptions (Based on Arup Report):

Escalation factor = 39% (base year = 2007)
Location factor = 1.59
Operating cost (excludes compounded escalation value)= $52,000 X [1+(18 years X 0.03)) X 1.59

## Major Communities Served:

Madrid: Metropolitan Area Populatiion (2016): 7 million; City Density: 5,300/km$^2$
Barcelona: Metropolitan Area Population (2016): 5 million; City Density: 16,000 people/km$^2$

Source: Several, including: High-Speed Rail: Lessons for Policy Mak,ers from Experiences Abroad (Barcelona Report) ; http://www.mega-project.eu/assets/e /resources/Hligh_Speed_Rail-Madrid-Barcelona-French-frontier.pdf ; for additional references refer to summary references items 2, 9, 14, 54, 60, 63, 66, 67, 73, 97, 116, and 119 (see Appendix G for details).



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# UK - High Speed 1 (London-Chann,el Tunnel)

## Path to HSR

### Owner(s) / Operator(s)

Owner/Operator: HS1 Ltd

- Until 2040
- Private sector
- **O&M** Contractor: Network Rail (High Speed)

**Mainline Operators:**
**Domestic service:** London South Eastern Railway (LSER)
**International service:** Eurostar

HS1 Ltd. also services East Midlands Railway, Thameslink, and freight operator.

### Project background

- Connect the UK with the rest of Europe quicker and more reliably
- Develop new commuter service
- Improve rail capacity
- Economic developmernt

### Nature of project (greenfield, upgrade, etc.)

**Section 1**: open countryside with bridge crossings, etc.
**Section 2:** urban setting, mostly tunnels

Double track and mixed traffic:

- High speed passenger and commuter trains; freight trains

60% of project is in existing transportation corridors
25% of the route is tunnelled

### Regulatory Approvals

**Channel Tunnel Rail Lillk Act 1996:** provided for the project to be implemented. Also outlined a private sector entity would build, maintain, and operate it.

**Channel Tunnel Rail Link (Supplementary Provisions)** Act 2008: Updated the Act to support the 2009 restructuring and sale.

Additional applicable legislation to HS1:

- Parts of Railways Acts of 1993 and 2005, Railways and Transport Safety Act 2003, and secondary legislation

HS1 Ltd. Is the Infrastructure Manager under Rail Regulation 2016.

### Business Case Characteristics - Financing

**Initially:** Private Fiinance Initiative (PFI)
**After restructuring:** Public Private Partnership (P3)

Financed through government grants and government guaranteed private finance.

The private company "London Continental Railways" (LCR) was to finance, build, and operate the project.

- Restructured in 1998 and 2002 due to financial difficulties from low Eurostar UK revenue forecasts
- Was purchased by the government in 2009

Overall, the public sector became more involved in the project than anticipated.

Source: Several, including: https://highspeed1.co.uk/about-us;
https://www.systra.com/en-project/high-speed-1-hsr-link-between-london-and-the-channel-tunnel;
for additional references refer to summary references items 9, 52, 58, and 109-111 (see Appendix G for details).

# UK - High Speed 1 (HSl) (London-Channel Tunnel)

| Capital cost (CAD) | Construction: Timeline | Cost per track km (2020 CAD) | Operations: First operational year | Annual operating costs (CAD) | Example ticket price (2020 CAD) | Ridership: Annual ridership | Revenue (2020 CAD) |
|---|---|---|---|---|---|---|---|
| $18.9 billion (2007) $26.1 billion (2020) | 1996 (contract award), 1998-2003 (section 1 construction), 2000-2007 (section 2 construction) | $237 million | International: 2003 (part), 2007 (full) Domestic: 2009 | $407 million (2013) $493 million (2020) | $59.114 | 20 million (2016) | $1 billion (calculated) |

**Network/Service**

| Average operating speed (km/h) | **Max.** operating speed (km/h) | Total length (km) of project | Headways/ trip time (express) | Number of stations | Distances between stations (km) | **Geography/Terrain** |
|---|---|---|---|---|---|---|
| Not available | International: 300 Domestic: 230 | 109 | Domestic: 80+ daily trips per direction; 37 minutes | 4 | 36 (calculated average) | Rolling terrain and farmland; 117 bridges, 26.5km of tunnels, and 6km of viaducts |

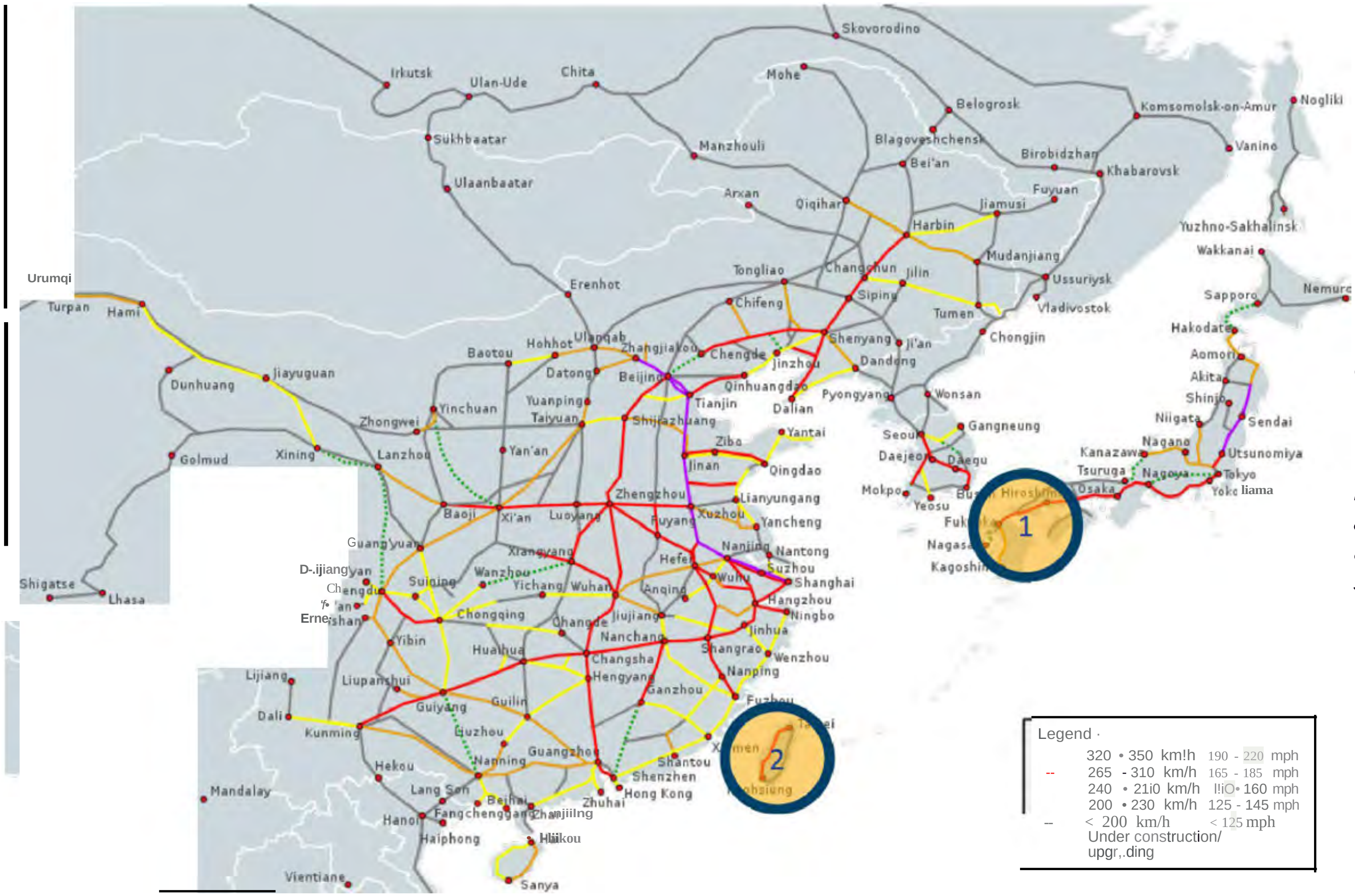
## Assumptions (Based on Arup Report):

Escalation factor = 39% (base year = 2007)
Location factor= 1.00
Operating cost (excludes compounded escalation value) = $407 million X [1+(7 years X 0.03)] X 1.0

## Major Communities Served:

London: Metropolitan Area Population (2016): 12 million; City Density: 5,666/km$^2$

Souroe: Several!, including: https://www.ice.org.uk/what-is-civil-engineeringlwhat-do-civil-engineers-dolhigh-speed-one-and-st-pancras-station ; http://researchbriefings.files.parliament.uk/documents/SN00267/SND0267.pdf ; for additiional references refer to summary references items 52, 56, 57, 61, 68, 71, 74, 76, 97, 108 and 119 (see Appendix G for details).




1. **Japan** - Sanyo Shinkansen (Osaka-Fukuoka)

2. **Taiwan** - High Speed **Rail** (Taipei-Kaohsiung)

*Note: Selected projects are in operation and have a maximum operating speed of 300 km/h*

Map Source: https://en.wikipedia.org/wiki/High-speed_rail



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# Ja an - San o Shinkansen Osaka-Fukuoka

## Path to HSR

### Owner(s) / Operator(s)

In 1.987, Japanese National Railways (JNR) separated and became private.

Sanyo Shinkansen is owned and operated by West Japan Ra.ilway Company (JR West).

### Project background

Country-wide HSR network developed to support all regions, as a result of:

- Rapidly growing economy
- Loss of population to certain areas

First global HSR was the Tokai:do Shinkansen (Tokyo-Osaka), opened in 1964.

### Nature of project (greenfield, upgrade, etc.)

New Shinkansen Line called Sanyo Shinkansen

- Extension of coun1ry-wide network
- Connected to Tokaido Shinkansen (Tokyo-Osaka)

Two Sanyo Shinkansen phases:

- Shin-Osaka-Okayama, opened in 1972
- Okayama-Hakata (Fukuoka),opened in 1975

### Regulatory Approvals

**National Shinkansen Railway Construction Law**

- Approved May 1970
- Outlines definitions, objectives of the network, and procedures

### Business Case Characteristics - Financing

Project built by the Japan Railway Construction Public Corporation (JRCPC), which was created by the government.

Construction cost funding:

JNR (public at the time)
Government's treasury investment and loan fund
Borrowed funds from the private sector

Source: http://www.omegacentre.bartlett.ucl.ac.uk/wp-contenVuploads/2014/12/JAPAN_SHINKANSEN_PROFILE.pdf ; https://en.wikipedia.org/wiki/San%27y%C5%8D_Shinkansen; ht1ps://www.westjr.eo.jp/global/en/about-us/history/; and https://www.jrailpass.com/blogVtokaido-shinkansen-jr-pass



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# Ja an - San o Shinkansen Osaka-Fukuoka

| | Construction | | Operations | | | Ridership | |
|---|---|---|---|---|---|---|---|
| Capital cost (CAD) | Timeline | Cost per track km (2020 CAD) | First operational year | Annual operating costs (2020 CAD) | Example ticket price (2020 CAD) | Annual ridership | Revenue (CAD) |
| $4.1 billion (1975) $6.8 billion (2020) | 1965 (authorized), 1967 (construction began}-1975 | $11 million (nominal) (calculated) | 1972 (part), 1975 (full) | Not available | $191.79 | 85 million in 2018 (JR West Shinkansen) | $19 billion in 2019 (JR West Operating Revenue) (converted) |

| Network/Service | | | | | | |
|---|---|---|---|---|---|---|
| Average operating speed (km/h) | Max. operating speed (km/h) | Total length (km) of project | Headways/ trip time (express) | Number of stations | Distances between stations (km) | **Geography/Terrain** |
| 210* | 300 | 626 | Var,ies; 2.5 hours | 19 | 35 (calculated average) | Mountainous; joins two islands |

*Average operating speed Tokaido Shinkansen (Tokyo-Osaka}

## Assumptions:

Escalation factor = 68% (base year = 1975)
Location factor= 0.99

## Major Communities Served:

Osaka: Metropolitan Area Population (2016): 17 million
Fukuoka: Metropolitan Area Population (2016): 3 million; City Density: 4,600/km$^2$

Source: Several, including: High-Speed Rail: Lessons **for** Policy Makers frnm Experiences Abroad (Barcelona Report) ; http//www omegacentre.bartlett.ucl acuklwp-contenUuploads/2014/12/JAPAN_SHINKANSEN_PROFILE.pdf ; for additional references refer to summary references items 14, 54, 78, 81-86, 88, 89, 97 and 119 (see Appendix G for details)



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# Taiwan- High Speed Rail (Taipei-Kaohsiun

**Path to HSR**

| **Owner(s) / Operator(s)** | Project background | Nature of project (greenfield, upgrade, etc.) | **Regulatory Approvals** | **Business Case Characteristics - Financing** |
|---|---|---|---|---|
| **Owner/Operator:** Taiwan High Speed Rail Corporation (THSRC) | Proj;ect allows for business travel between Taipei and Kaohsiung with a distance of 350 km in 90 minutes and builds on economic development along the route.<br><br>Project was initially planned to be public sector. Due to increased public fiscal burdens, the Legislative Yuan withdrew the budget allocated to the HSR Project and decided on a Design-Built-Operate-Maintain-Transfer (DBOMT) procurement. | Greenfield | Taiwan Ministry of Transportation and Communications (MOTC) | Privately financed by Taiwan High Speed Rail Corporation (THSRC) with some government subsidy (P3)<br><br>DBOMT<br><br>THSRC has a concession to finance, construct, and operate the HSR for a period of 35 years and a concession for HSR station area development for a period of 50 years. |

Source: https:/fen.thsrc com.tw/ArticleContent/50fa391b-09a7-4728-98e7-Bb7901a795d8

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# Taiwan - Hiigh Speed Rail (Taipei-Kaohsiun

| Construction | | | Operations | | | Ridership | |
|---|---|---|---|---|---|---|---|
| Capital cost (CAD) | Timeline | Cost per track km (2020 CAD) | First operational year | Annual operating costs (2020 CAD) | Example ticket price (2020 CAD) | Annual ridership | Revenue (2020 CAD) |
| $23.1 billion (2005)<br>$90.1 billion (2020) | 1998 - Contract award<br>2005 - Construction complete<br>2007 - Full operation | $257 million | 2007 | $1.16 billion (2019)<br>$3.1 billion (2020) | $68.64 | 67.4 million in 2019 | $2.1 billion |

| Network/Service | | | | | | |
|---|---|---|---|---|---|---|
| Average operating speed (km/h) | Max. operating speed (km/h) | Total length (km) of project | Headways / trip time (express) | Number of stations | Distances between stations (km) | **Geography/Terrain** |
| Not available | 300 | 350 | 6 trains/hr (NB)<br>7 trains/hr (SB)/ 1:30 | 12 | 32 | Varied terrain<br>Approximately 73% of line runs on viaducts and 18% is in tunnels. |

## Assumptions:

Escalation factor = 45% (base year = 2005)
Location factor= 2.69
Operating cost ,(excludes compounded escalation value)= $1.16 biillion X [1+(1 years X 0.03)] X 2.69

## Major Communities Served:

Taipei City: Population: 2.65 million; Density: 9,700/km²
Taichung: Population: 2.82 million; Urban Densiity: 5,400/km²
Kaohsiung: Population: 2.77 milllion; Urban Density: 7,100/km²

Source: Several, including: https://inta-aivn.org/images/assets/inta33/chiu_inta33_the_bo.texperience_of_taiwans_high_speed_rail_construction_project.pdf ; https://www.thsrc.eom.tw/event/InvestorRelations/ShareholdersMeeting/2019_amial_report_EN.pdf ;
for additional ref,erences refer to summary references items 91, 92, 94, 95, 96, 98 and 119 (see Appendix G **for** details).



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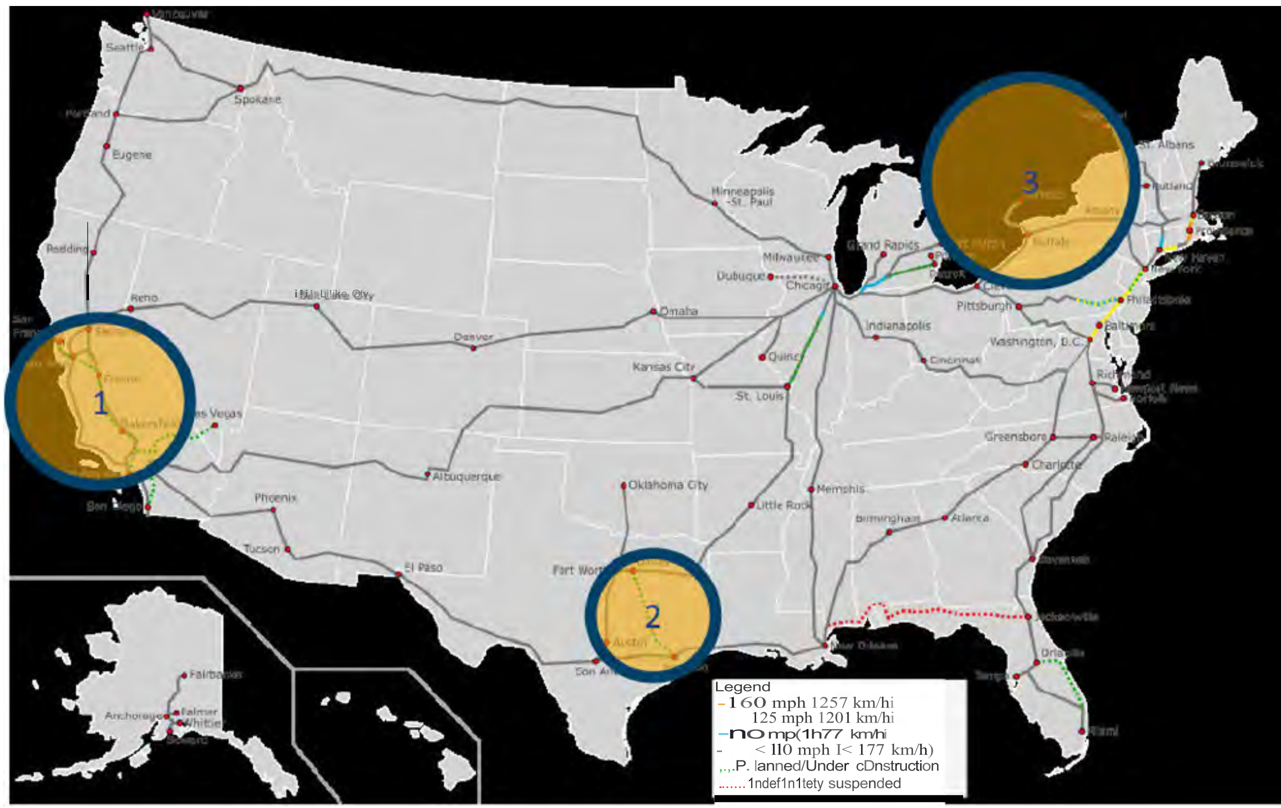
# North America

1. **USA-**
   California HSR Phase 1 (San Francisco - Los Angeles)

2. **USA** - Texas High-Speed Train (Dallas - Houston)

3. **Canada** - Quebec City - Windsor Corridor




*Note:*
*Selected projects are either currently being constructed or in planning phases*

# USA - California HSR Phase 1 (Sain Francisco-Los Angeles)

## Path to HSR

### Owner(s) / Operator(s)

Contracting authority: California High-Speed Rail (CHSR)

### Project background

Key points:

- **1981:** HSR first considered at the state-level
- **Mid-1990's:** increased transportation congestion (air, raiil, and road) motivates planning
- **1996:** report by the state's Intercity High-Speed Rail Commission determined HSR would be feasible.

### Nature of project (greenfield, upgrade, etc.)

Majority of project anticipated to be built along existing transportation corridors (rail and road)

- E.g. San Francisco to San Jose "blended system" between the HSR and Caltrain

Project separated into ten sections: geographic, environmental, and economics

### Regulatory Approvals

**California's High-Speed Rail Act (1996):** created the high-speed rail authority that would begin planning for the project.

**Environmental planning:**

**Tier** 1: broad program

- 2 of 2 documents completed (2005 and 2008/2012)

**Tier 2::** individual projects

- 3 of 10 Phase 1 documents are completed
- For reference, environmental review and permitting took 4 and 5 years, for Merced to Fresno and Fresno to Bakersfield, respectively.

### Business Case Characteristics - Financing

Funding **Sources**

**Federal:**

- American Recovery and Reinvestment Act (ARRA) and Fiscal Year 2010 (FY10) Transportation, Housing and Urban Development funds
- Total: $5 billion (2020 CAD)

**State:**

- Cap-and-Trade (received and future) and Proposition 1A bond funds
- Total: $24-28 billion (2020 CAD)

Total available funds: **$29-32** bilHon **(2020 CAD)**
(as of December 31, 2019)

Civil construction procured under multiple design build contracts; not integrated.

Sources: Several, including httlPs://hsr.ca.gov/docs/about/business_plans/2020_Business_Plan.pdf;
HSR-CIB Case Studies;
for additional references refer to summary references items 33, 34, 39, 104, 105, 106, 107 (see Appendix G for details).



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# USA - California HSR Phase 1 (San Francisco-Los Angeles)

| Construction | | | Operations | | | Ridership | |
|---|---|---|---|---|---|---|---|
| Capital cost (CAD) | Timeline | Cost per track km (2020 CAD) | First operational year | Annual operating costs (CAD) | Example ticket price (2020 CAD) | Annual ridership | Revenue (CAD) |
| $107 billion (2020) | 2009-2013/2014/in progress (environmental review), 2015 (construction began)- in progress | $128 million | 2031 (part) 2033 (full} | $1.4 billion (2034) (converted)* | Varies | 27.8 million {2034)* | $2.2 billion (2034, converted)* |

| Network/Service | | | | | | |
|---|---|---|---|---|---|---|
| Planned operating speed (km/h) | Max. operating speed (km/h) | Total length (km) of project | Headways / trip time (express) | Number of stations | Distances between stations (km) | **Geography/Terrain** |
| Not available | 354 | 836 | Headways not available; 2:40 | 15 | 60 (calculated average) | Various; mountains and valleys |

*Based on 2034 medium forecasts

## Assumptions:

Escalation factor= 15% (base year= 2015)
Location factor= 0.87

## Major Communities Served:

San Francisco: Metropolitan Area Population (2016): 7 million; City Density: 7,255/km$^2$
Los Angeles: Metropolitan Area Population (2016): 18 million; City Density: 3,276/km$^2$

Source: Several, including https://hsr.ca.gov/docs/about/business_plans/2020_Business_Plan.pdf; https://www.permits.performance.gov/permitting-projects/california-high-speed-rail-progam-fresno-bakersffield-project-section ; for additional references refer to summary references items 34, 38, 39, 40, 41, 46, 47, 48 and 119 (see Appendix G for details).

# USA -Texas High-S eed Train Dallas-Houston

## Path to HSR

### Owner(s) / Operator(s)

Projec1being developed by Texas Central

### Project background

**HSR in Texas, pre-project:**

- **1987:** HSR planning at the state-level began
- **1989:** report by the Texas Turnpike Authority determined HSR would be feasible (under certain conditions)
- **1989-1995:** Texas High-Speed Rail Authority created and then abolished, respectively

Motivation for this project:

- Road congestion increasing on 1-45
- Additional time required for air travel

### Nature of project (greenfield, upgrade, etc.)

Utility corridor a.s the feasible alternative.

Project would require:

- Double tracks
- **Closed system:** dedicated ROW

### Regulatory Approvals

Regulatory approva.l process led by the Federal Railroad Administration (FRA)

- Includes 12+ federal and state agenc,ies

**Key step:** Final Environmental Impact Statement published in 2020

- Took 6 years to produce
  Allows for: permits to be finalized, the Record of Decision, and for construction to begin

### Business Case Characteristics - Financing

The project is private and for-pro it..

Market-led approach

- Funded by investors and entrepreneurs
- No grants from the US Government or State of Texas
- Would have no operational subsidy once in service

Sources: Several, including https://legacy.lib.utexas.edu/taro/tslac/20071/tsl-20071.html ; https://railroads.dot.gov/elibrnry/dallas-houston-high-speed-rail-project-corridor-altematives-analysis-technical-report ; for add:itional references refer to summary references items 36, 102, and 103 (see Appendix G for details).

# USA -Texas High-S eed Train Dallas-Houston

| Capital cost (CAD) | Construction: Timeline | Construction: Cost per track km (2020 CAD) | Operations: First operational year | Operations: Annual operating costs (2020 CAD) | Operations: Example ticket price (2020 CAD) | Ridership: Annual ridership | Ridership: Revenue (2020 CAD) |
|---|---|---|---|---|---|---|---|
| $24.3 billion (2020) | 2014 (environmental review and permitting started)- ongoing | $64 million (calculated) | Not available | Not available | Varies | 6 million in 2029 | Not available |

| Network/Service: Planned operating speed(km/h) | Max. operating speed (km/h) | Total length (km) of project | Headways/ trip time (express) | Number of stations | Distances between stations (km) | Geography/Terrain |
|---|---|---|---|---|---|---|
| 300 (planned) | 330 | 380 | 30 minutes peak, 1 hour off-peak; 90 minutes | 3 | 190 (calculated average) | Rolling terrain |

**Assumptions:**

Escalation factor= 0% (base year= 2020)

Location factor= 0.87

**Major Communities Served:**

Dallas: Metropolitan Area Population (2016): 7 million; City Density: 1,527/km$^2$

Houston: Metropolitan Area Population (2016): 7 million; City Density: 1,398/km$^2$

Source: Several, including httpsllwww.texascentral.com/factsl ; https:llwww.pennits.performance.gov/permitting-projects/dallas-houston-high-speed-raill ; for additional references refer to summary references items 35, 37, 42, 43, 49 and 11g (see Appendix G for details).

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