Conventional and High Speed: Comparison

Characteristic	Existing Intercity Service	High Speed Rail Study Corridor
Speed	**Up to 100 mph** (160 km/h)	**Up to 186 mph** (300 km/h)
Journey Times	Similar to auto, with ~70% on-time performance	Significant improvement, competitive with auto and air; anticipated ~95% on-time performance
Alignment and Infrastructure	Shared Right-of-Way with Other Services Shared Station Stops Significant Curved Track Sections	Dedicated Right-of-Way Shared Station Stops Long Sections of Straight Track Dedicated Station Platforms at key locations
At-grade Crossings	At-Grade Crossings Permissible	100% Grade Separated Corridor
Technology and Equipment	Conventional Locomotive-hauled Rolling Stock Fixed Block Signaling	Specialized HSR Rolling Stock Electrification Advanced Train Control
Host Railway Interaction	**~75%** route distance is shared track Between Toronto – Quebec City	**Anticipated ~5%** route distance with shared tracks (TOR, MTL and QC city access)

Conceptual comparison for discussion only. Existing systems may differ in characteristics.

HSR Study: Overview

- In 2023, VIA HFR completed the *Preliminary Corridor HSR Assessment*, a study of a conceptual HSR system connecting Toronto, Ottawa, Montréal, and Québec City.

- The study was used to support a review of anticipated benefits for an HSR system, using examples and benchmarks from global systems.

- The output of the report was to provide indicative capital cost, operating cost estimates, journey times, ridership and revenue estimates for developing an HSR system.

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

[redacted]

HSR Study Corridor

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

[redacted]

HSR Study: Key Outcomes

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

[redacted]

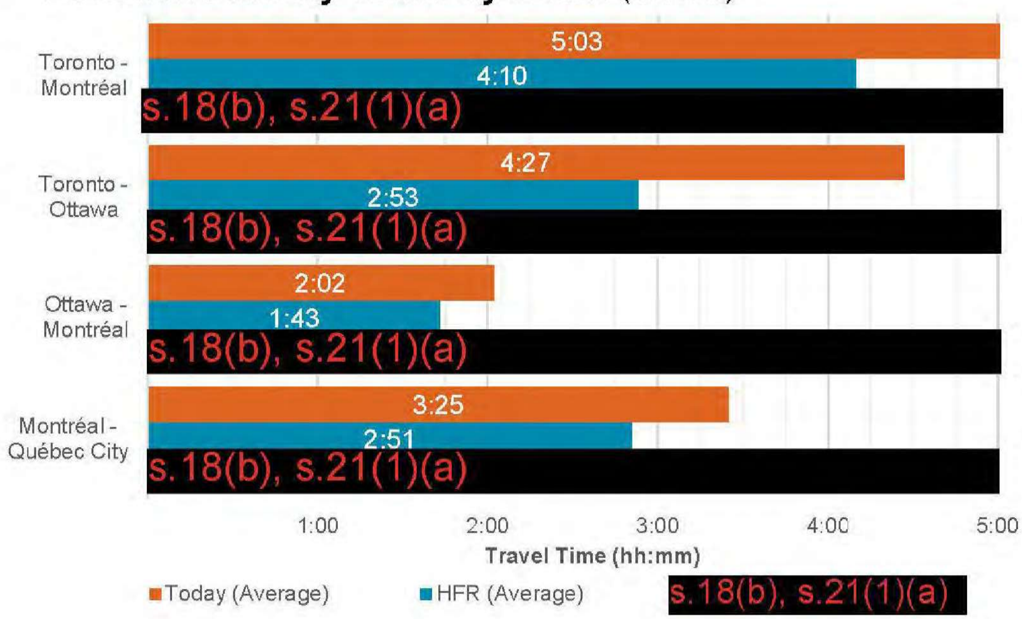
- HSR implementation, allowing for less than 3-hour journey times between TOR-MTL and 2-hour journey times between TOR-OTT and MTL-QC, enables significant rail demand, along with a significant modal shift from auto and air. The additional ridership benefits from shorter journey times are realized as revenue estimates in the assessment.

HSR Study: Journey Times & Ridership

HFR and HSR journey times are theoretical estimates based on average operating speeds benchmarked from intercity and high-speed rail projects. No rail simulation was conducted.

Ridership and revenue forecasts are initial indications of HSR benefits. Estimates are based on the forecasting framework developed by Steer for HFR.

Potential Journey Times by Route (hh:mm)*



[redacted] s.18(b), s.21(1)(a)

*Source: *Preliminary Corridor HSR Assessment (2023)*

Electrification Power Supply Overview

VIA HFR will be reliant on Hydro Quebec and Hydro One for electrification.
Greater design definition of power consumption details will be identified in Co-Dev Stages 2 and 3.

- The VIA-HFR project team has carried out a conceptual review of power consumption to support discussions with Hydro One and Hydro Quebec over the last 3 years.

- The level of high-level of analysis currently taken for the HFR project, in reference to the Base Case alignment, assumes: 850 km electrified network length with a traction power station every 50 km along the route; a projected power range of 30-40MVA.

- Under conceptual agreement, 1/3 of power is projected from Quebec Hydro, with the remaining from Hydro One.

Example: Traction Power Facility

Electrification Power Supply Overview

- Recognizing that a limited amount of design has been completed for the network, power consumption details are not currently available. Power consumption requirements on an electric railway will vary greatly on account of (and not limited to):

    1. Chosen alignment;
    2. Chosen equipment;
    3. Spacing of power facilities;
    4. Number and frequency of trains;
    5. Stations; and
    6. Non-Revenue Facilities.

- While preliminary stakeholder outreach has commenced with Hydro One, Hydro Quebec and the Ontario IESO (Independent Electricity System Operator), the Phase 1 connection request requirements cannot be met until the above is modelled under CoDev Stage 2.

Further Resources / Background Material

- **Preliminary Corridor HSR Assessment (2023)**

  This assessment informs an initial exploration for High Speed Rail between Toronto and Québec City, with indicative CAPEX, OPEX, ridership and revenue.

- **HFR Host 3rd Party Railways (H3R) De-Risking and De-Constraining Report (2022)**

  This report consolidates and assesses the information received to date from host railways on interfaces and requirements related to HFR. Operational and technical assessments are based on currently available facts and evidence, while also highlighting any currently unknown data / position of host railways.

CAPEX + OPEX: Class 5 Estimates

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

[redacted]

*Source: *Preliminary Corridor HSR Assessment (2023)*

HSR Study: Overview

The *Preliminary Corridor HSR Assessment* informs an initial exploration for High Speed Rail between Toronto and Québec City, with indicative Capital and Operating Costs, ridership and revenue.

- VIA HFR completed a preliminary assessment of a conceptual high speed rail (HSR) system connecting Toronto, Ottawa, Montréal, and Québec City.
- The Preliminary Corridor HSR Assessment provides an initial exploration of high speed rail systems and assesses, at a conceptual level, the potential level of investment and generated revenue Key elements of the scope of work requested by Transport Canada include:
  - Summarize contextual information and technical characteristics of high speed rail;
  - Review characteristics of international and North American HSR projects; and
  - Provide indicative capital cost, operating cost estimates, ridership, and revenue estimates for developing an HSR system based on project benchmarks.

Ridership Captured with HSR

HSR implementation, allowing for less than 3-hour journey times between T-M, enables significant additional modal shift from auto and air. Full corridor implementation for shorter/medium distance markets, such as M-Q, succeeds in attracting more people from auto.

In the HSR scenario for first year operations:

- Approximately [redacted] s.18(b), s.21(1)(a) of the future rail demand in the Québec City–Windsor Corridor is abstracted from other transport modes
- [redacted] s.18(b), s.21(1)(a) of ridership increase is from induced demand
- Modal shift to HSR comes predominantly from the auto markets

[redacted] s.18(b), s.21(1)(a)

[redacted] s.18(b), s.21(1)(a)

Note: Current forecasting framework cannot fully assess the potential of a transformational HSR proposition (e.g., willingness to pay and induced demand). Level of demand captured and induced is indicative.

HSR Operations and Lifecycle Costs

HSR lifecycle cost analysis represents the rehabilitation and replacement capital costs over the defined 40-year operating period for the infrastructure and rolling stock assets, mapped as a percentage of OPEX.

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

[redacted]

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

[redacted]

10/15/2025

***Source:** *Preliminary Corridor HSR Assessment (2023)*

Technical Considerations:
Specific to Intercity Passenger Rail Projects in Canada

Host Railway and 3rd Party Considerations

- Rail right-of-way ownership is primarily dominated by freight (CN, CP, QGRY, etc.) leading to:
  - Dependence on securing favourable Access and Operating Agreements
  - Desire to separate passenger operations from freight, passing tracks used today reduce on-time performance
  - Difficulty to electrify on host railway right-of-way s.20(1)(b), s.21(1)(b) [redacted] s.20(1)(b), s.21(1)(b)
- There are capacity restrictions and capability requirements for major stations:
  - Union Station requires further analysis and negotiations with Metrolinx to support frequencies during peak hours
  - Modifications will need to be made at multiple stations to support level boarding

Geographic Considerations

- Specific design considerations are required for safe operations in winter months:
  - Rolling stock specification that requires cold climate operations
  - Snow trenches, switch covers and heaters, to remove ice from operations interfaces
  - Advanced weather monitoring systems to accurately measure track conditions and maximum permissible speeds.

GH - Please use a common font throughout –
- 36pt Headings
- 20pt Regular
- Resolved - MB

Technical Briefing

High Speed Rail and Conventional Intercity Systems | September 2023

Government of Canada Gouvernement du Canada

Canada

Contents

- Differences between Conventional Intercity Rail and High-Speed Rail systems.
- Highlights from Preliminary HSR study.
- Update on power requirements to support electrification.

Intercity Overview

HSR Study

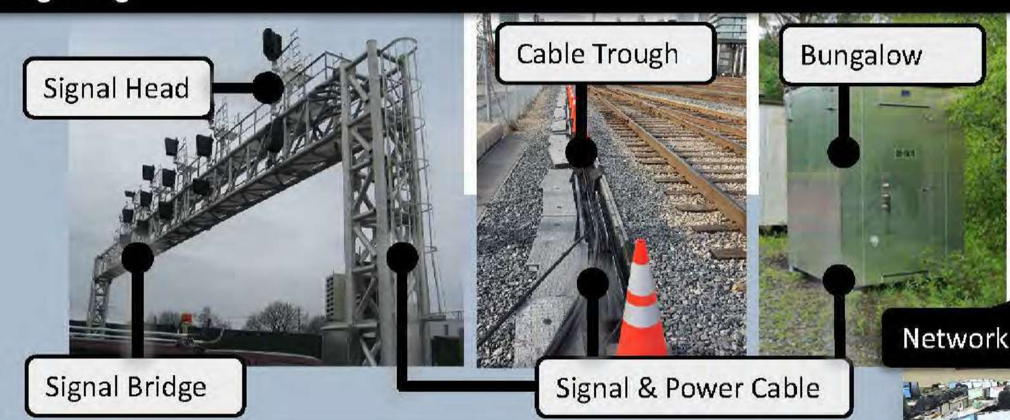
Hydro Update

An Overview of Railway Components:

Track

Track Switching

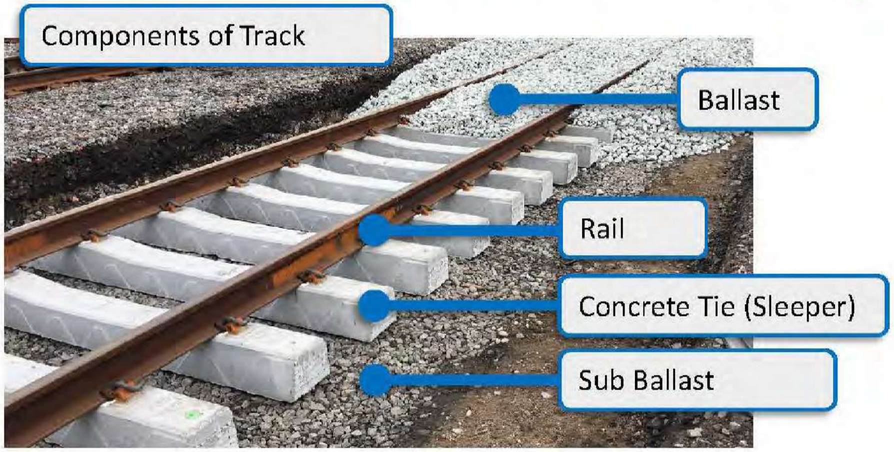
Signaling

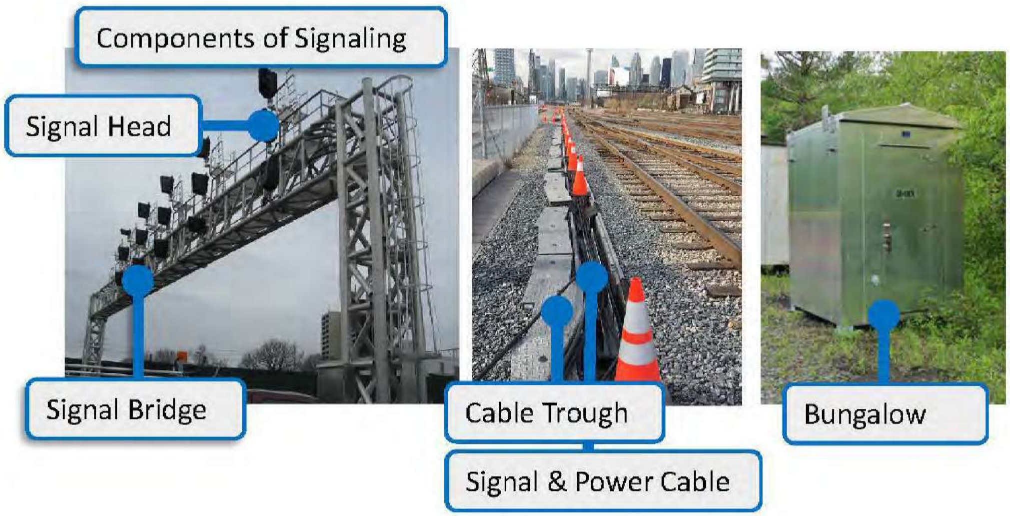


Electrification

Note: System configurations and components will vary. Content is an introductory non-exhaustive review of local applications.

An Overview of Railway Components:





High Speed Rail Systems

- High speed rail projects are rolling out at pace worldwide, bringing unique challenges that expand the frontiers of engineering.

Passenger Rail Systems

- Passenger rail systems serve specific transportation needs within urban, regional and intercity settings.
- Technical analyses of City stops, route alignment, journey time, and ridership, amongst other considerations, set the key constraints for a technical analysis of the passenger system.
- High speed rail projects are rolling out at pace worldwide, bringing unique challenges that expand the frontiers of engineering.

Light Rail Systems (LRT)
Urban
TTC Toronto; Ottawa LRT; Montreal REM
Quebec City Tramway

Commuter Rail System
Suburban-to-Urban Centre
Metrolinx Toronto
EXO Montreal

Intercity Rail System
Urban Centre -to- Urban Centre
VIA Rail Canada ; Amtrak USA

High Speed Rail System
Urban Centre-to-Urban Centre
HS1 UK ; TGV France ; ICE Germany

GH - Please include some stats such a tph, pax per hour,

Intercity Rail: Definitions

Conventional Intercity Rail:
Long-distance rail services between communities. In Canada, VIA Rail operates on tracks shared with freight between Windsor-Quebec City at speeds of up to 160 km/h. In the United States, Amtrak operates [redacted] s.21(1)(a)

High Speed Rail:
The International Union of Railways (UIC) defines high speed rail as systems of rolling stock and infrastructure which regularly operate at or above 250 km/h on new (dedicated) tracks, or 200 km/h on existing (shared) tracks.

Rail Speeds and related Classes with Transport Canada and Federal Railroad Administration regulations:

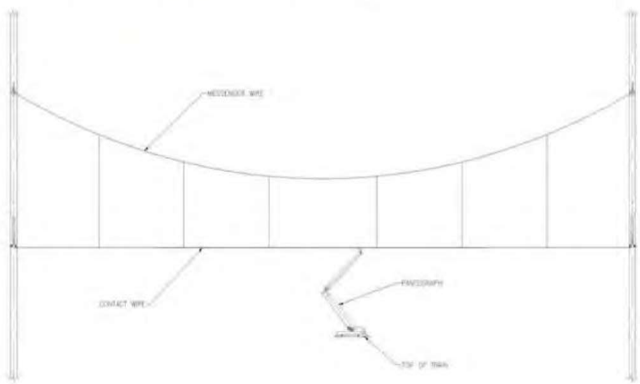
Track type	Freight	Passenger	Regulations
Class 3	40 mph (64 km/h)	60 mph (97 km/h)	Transport Canada
Class 4	60 mph (97 km/h)	80 mph (129 km/h)	Transport Canada
Class 5	80 mph (129 km/h)	100 mph (160 km/h)	Transport Canada
Class 6	110 mph (177 km/h)		FRA
Class 7	125 mph (200 km/h)		FRA
Class 8	160 mph (258 km/h)		FRA
Class 9	200 mph (320 km/h)		FRA

TrenItalia High Speed Train with Commercial Speed of 360km/h.
Milan to Rome, Italy

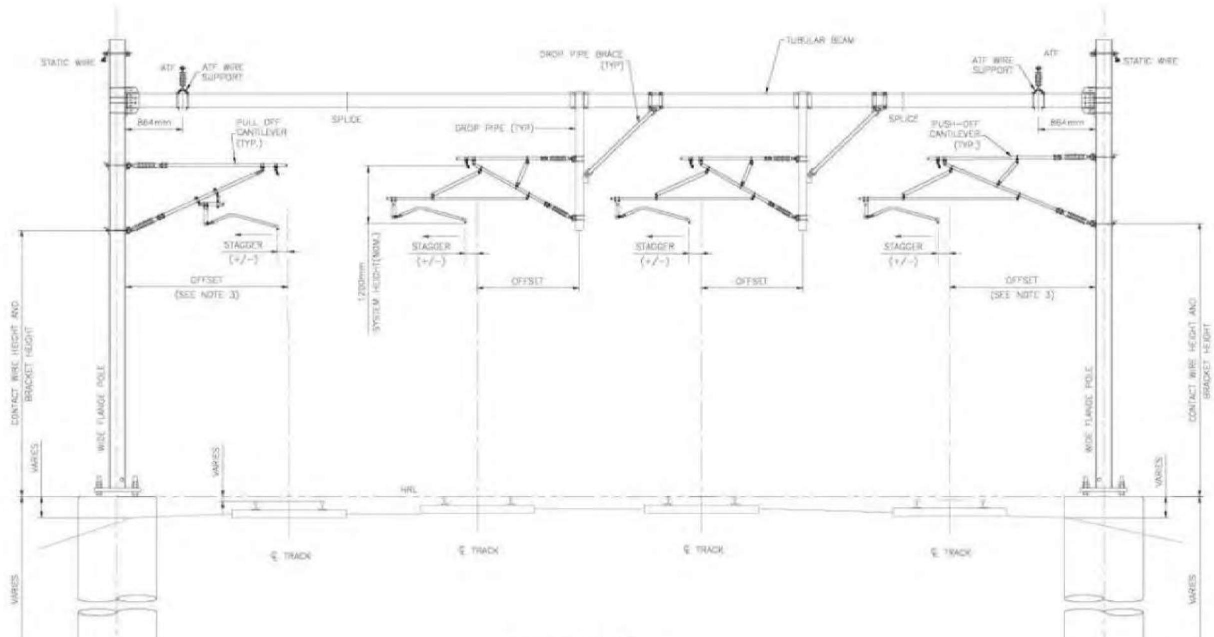
Comparison between conventional and high speed (quantitative)

- Signalling systems
- Cost per km
- Power draw
- Staffing
- Segregation
- Fencing
- Geometry
- Typical cross sections
- Tph
- Etc…

Figure 3-9: Typical OCS Contact Wire, Messenger Wire and Pantograph



PANTOGRAPH LOOKING ACROSS TRACK



TYPICAL PORTAL

aerodynamic impacts of high-speed rail movements

balancing speed, ware and safety

Challenges with Operation

Challenges with Platform Heights

Conventional vs. High Speed

Characteristic	Existing Via Rail Service	High Speed Rail Study Corridor
Speed	**Up to 100 mph** (160 km/h)	**Up to 186 mph** (300 km/h)
Journey Times	Similar to auto, with ~70% on-time performance ? tpd	Significant improvement, competitive with air; anticipated ~95% on-time performance, ? tpd
Alignment and Infrastructure	Shared Right-of-Way with Other Services Shared Station Stops Significant Curved Track Sections	Dedicated Right-of-Way Shared Station Stops Long Sections of Straight Track - rephrase Dedicated Station Platforms at key locations
At-grade Crossings	At-Grade Crossings Permissible	100% Grade Separated Corridor
Technology and Equipment	Conventional Locomotive-hauled Rolling Stock Fixed Block Signaling No train protection	Specialized HSR Rolling Stock Electrification Advanced Train Control
Host Railway Interaction	**~75%** route distance is shared track Between Toronto – Quebec City	**Anticipated ~5%** route distance with shared tracks (TOR, MTL and QC city access)

Conceptual comparison for discussion only. Existing systems may differ in characteristics.

HSR Study: Overview

- In 2023, VIA HFR completed the *Preliminary Corridor HSR Assessment*, a study of a conceptual HSR system connecting Toronto, Ottawa, Montréal, and Québec City.

- The study was used to support a review of anticipated benefits for an HSR system, using examples and benchmarks [significant benchmarking is available] from global systems.

- The output of the report was indicative capital costs, operating cost estimates, journey times, ridership and revenue estimates for developing an HSR system.

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

[redacted]

HSR Study Corridor

[redacted]

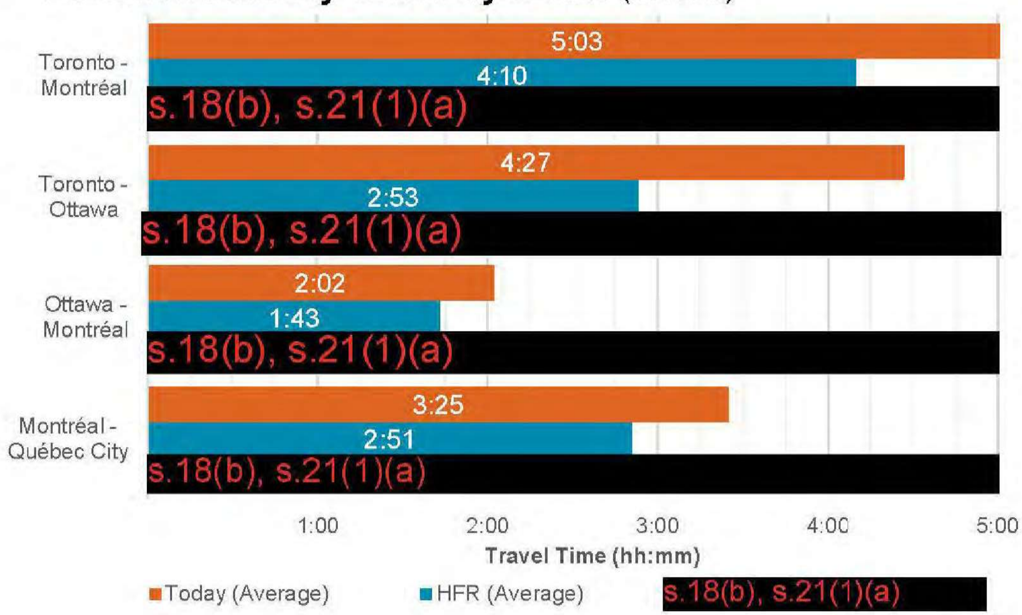
s.18(b), s.21(1)(a)

HSR Study: Journey Times & Ridership

HFR and HSR journey times are theoretical estimates based on average operating speeds benchmarked from intercity and high-speed rail projects. No rail simulation was conducted.

Ridership and revenue forecasts are initial indications of HSR benefits. Estimates are based on the forecasting framework developed for HFR.

Potential Journey Times by Route (hh:mm)*



[redacted] s.18(b), s.21(1)(a)

***Source:** *Preliminary Corridor HSR Assessment (2023)*

Format slide

CAPEX + OPEX: Class 5 Estimates

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

[redacted]

*Source: *Preliminary Corridor HSR Assessment (2023)*

Electrification Power Supply Overview

VIA HFR will be reliant on Hydro Quebec and Hydro One for electrification.
Greater design definition of power consumption details will be identified in Co-Dev Stages 2 and 3.

- The VIA-HFR project team has carried out a conceptual review of power consumption to support discussions with Hydro One and Hydro Quebec over the last 3 years.

- The level of high-level of analysis currently taken for the HFR project, in reference to the Base Case alignment, assumes: 850 km electrified network length with a traction power station every 50 km along the route; a projected power range of 30-40MVA.

- Under conceptual agreement, 1/3 of power is projected from Quebec Hydro, with the remaining from Hydro One.

Example: Traction Power Facility

Electrification Power Supply Overview

Hydro Update

- Recognizing that a limited amount of design has been completed for the network, power consumption details are not currently available. Power consumption requirements on an electric railway will vary greatly on account of (and not limited to):

    1. Chosen alignment;
    2. Chosen equipment;
    3. Spacing of power facilities;
    4. Number and frequency of trains;
    5. Stations; and
    6. Non-Revenue Facilities.

- While preliminary stakeholder outreach has commenced with Hydro One, Hydro Quebec and the Ontario IESO (Independent Electricity System Operator), the Phase 1 connection request requirements cannot be met until the above is modelled under CoDev Stage 2.
- Talk to Shona about IA implications

Further Resources / Background Material

Source Materials

- **Preliminary Corridor HSR Assessment (2023)**

  This assessment informs an initial exploration for High Speed Rail between Toronto and Québec City, with indicative CAPEX, OPEX, ridership and revenue.

- **HFR Host 3rd Party Railways (H3R)
  De-Risking and De-Constraining Report (2022)**

  This report consolidates and assesses the information received to date from host railways on interfaces and requirements related to HFR. Operational and technical assessments are based on currently available facts and evidence, while also highlighting any currently unknown data / position of host railways.

Technical Consideration: Hydro Power Supply

- Phased approach:
  - Hydro One (HONI) and Hydro-Quebec (HQ) have similar procedures to establish such a transmission level connection.

- 10-12 months — **Phase 0 –** Feasibility Study
- 1-3 months — **Phase 1 –** Connection Application
- 3-6 months — **Phase 2 –** Impact Assessments
- 4-8 month — **Phase 3 –** Connection Cost Estimate
- 1 or more months — **Phase 4 –** Connection Approval and Connection Cost Recovery Agreement (CCRA)
- 1-2 years — **Phase 5 –** Design and Build
- 1-2 months — **Phase 6 -** Commissioning

This process can take up to 3-4 years.

Technical Considerations: Typical Traction Power Facilities and OCS


Hydro Tap Facility


Traction Power Substation

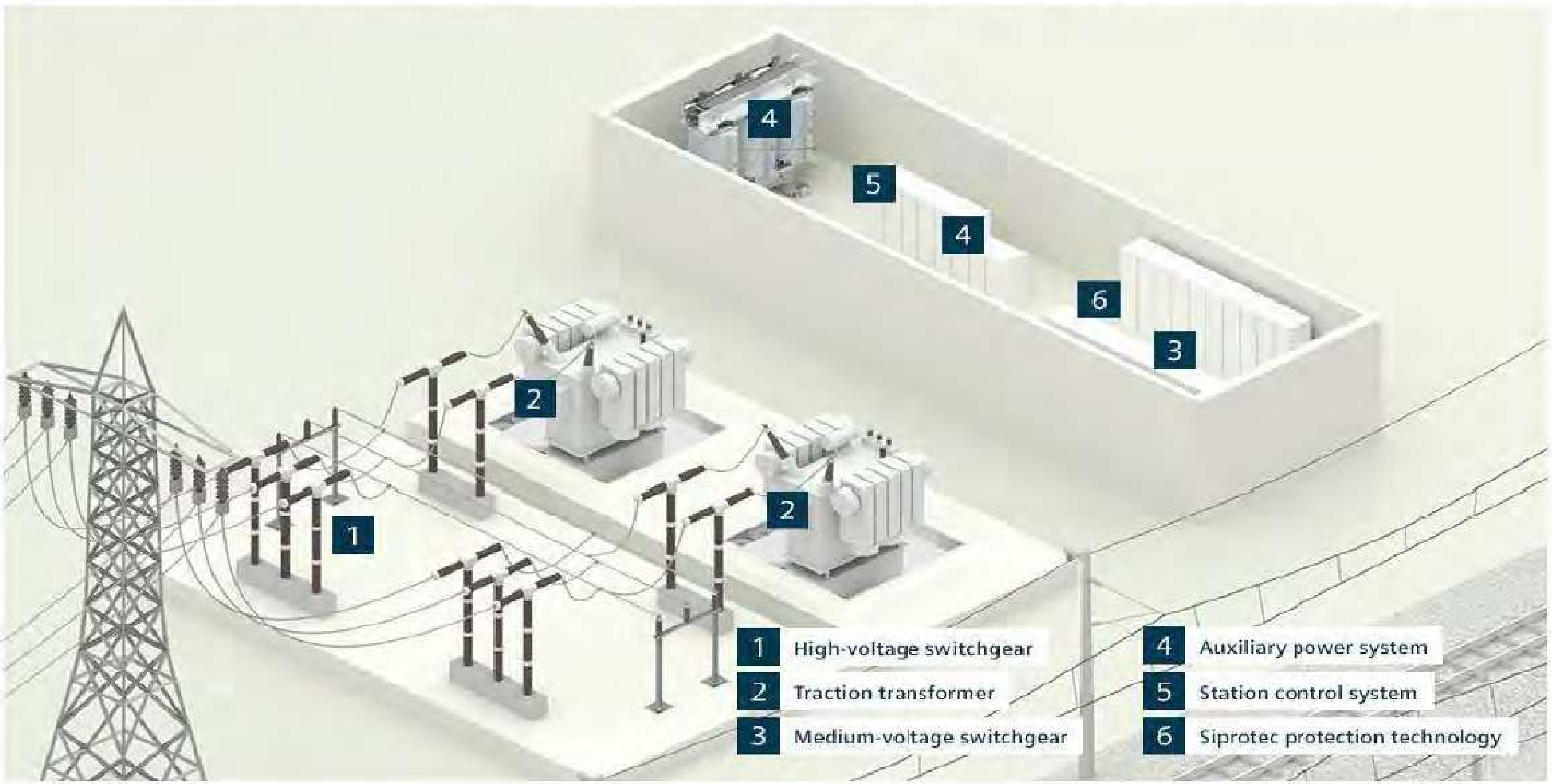
Traction Power Switching Station


Auto Transformer Feeding Station


OCS Portal Structure


OCS Pole Structure

Technical Considerations: Traction Power Substation



Connecting to Electrical Utility

Key Issue – Electrified Railroad Loading is Dynamic, Single Phase and Could Impact Power Quality of Utility System.

- Dynamic Load (i.e. large power swings to support train's start (and maybe stop) requires a strong electrical utility network to support.

- As a result, Electrical Utility will require Engineering Studies to evaluate their system and determine if changes are required

s.18(b), s.21(1)(a), s.20(1)(b)

[redacted]

Technical Considerations: Third party considerations

Early identification and involvement of Third-Parties will mitigate cost and schedule risks

- Utilities above, below, and adjacent to VIA HFR;
- Grounding and Bonding;
- Other railroad operators
  - Clearances and train interoperability;
  - Electromagnetic fields and electromagnetic interference (EMF/EMI);
  - Immunization of Signals and Communications;
- Joint development of Standard Operational Procedures, Maintenance, and Training

HSR Study: Key Outcomes

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

[redacted]

- HSR implementation, allowing for less than 3-hour journey times between TOR-MTL and 2-hour journey times between TOR-OTT and MTL-QC, enables significant rail demand, along with a significant modal shift from auto and air. The additional ridership benefits from shorter journey times are realized as revenue estimates in the assessment.

- Delete this slide and include details on the next slide

Technical Briefing

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Government of Canada Gouvernement du Canada

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Intercity Overview

HSR Study

Hydro Update

Classic Rail vs. HSR

What is High Speed Rail (HSR):

- "High-speed rail combines many different elements which constitute a "whole, integrated system": an infrastructure for new lines designed for speeds of **250 km/h and above; upgraded existing lines for speeds of up to 200 or even 220 km/h**, including interconnecting lines between high-speed sections;

  - its rolling stock, specially designed for train sets;
  - telecommunications,
  - signaling,
  - operating conditions and
  - equipment, etc.

- Technology is expected to have a major influence on infrastructure development over the next 20 years."
  - International Union of Railways (UIC)

Classic Intercity Rail Locomotive

North American
VIA Rail Canada

High Speed Rail Locomotive

European
ICE Germany

VIA Rail vs. World's Fastest High-Speed Trains (km/h)

VIA Rail operates on tracks shared with freight between Windsor-Quebec City at speeds of up to **160 km/h.**

When viewing these charts consider that performance is a measure of not just rolling stock, but a harmonization of rail systems that consider track geometry, vehicle loading, signaling technology, power, operational constraints, and environmental factors, etc.

General Note:
Source quote obtained from International Union of Railways (UIC):
Intercity and High-Speed | UIC - International union of railways
World's Fastest High Speed Trains Source Graphic:
Chart: The World's Fastest High-Speed Trains | Statista

VIA-BAU, HFR and HSR Overview

The table below provides comparative analysis using key railway performance measures, contrasting VIA-Business-as-Usual alongside projected HFR and HSR scenarios. Data for this analysis was collected from the HFR Business Case Update 2021 and Primary HSR Study 2023

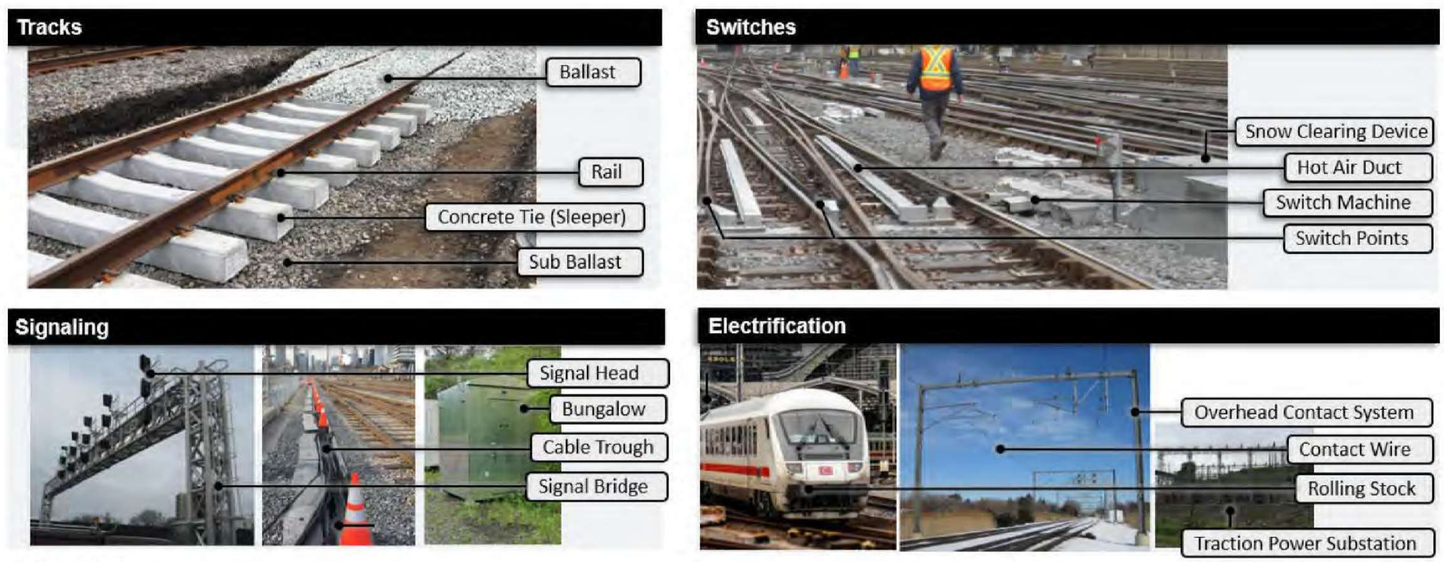
Characteristic	Existing Via Rail BAU Service	High Frequency Rail Business Case	Preliminary High Speed Rail Study
Operations:			
Speed	**Up to 160 km/h** (100mph)	Up to **201km/h** (125mph)	**Up to 300 km/h** (186mph)
Journey Times (ex.Tor-Mon)	s.18(b), s.21(1)(a) [redacted]		
On-Time Performance	~67% (2019)	~95% (Assumed)	~95%
Trains Per Day	24 (2023)	52 (2044)	72 (2039)
Ridership (40yr Period)	s.18(b), s.21(1)(a) [redacted]		
Host Railway Interface	Shared Right-of-Way	Shared Right-of-Way (Assumed)	Dedicated Right-of-Way (Assumed)
Stations:			
Station Stops	Shared	Shared	Shared
Station Platform Heights	Mixed (49" 25" 5")	Mixed (49" 25" 5")	Level Boarding (Assumed)
Technology:			
Rolling Stock	Deisel Locomotive-Hauled	Bi-Modal (Assumed)	Electric Multiple Unit (Assumed)
Signaling	Fixed Block Signaling	Advanced Train Control	Advanced Train Control
Electrification	No	Yes (93% Assumed)	Yes (Assumed)
Design:			
Alignment	More Track Curves Permitted	More Track Curves Permitted	Less Track Curves Permitted
Grade Crossings	Permitted	Permitted	Not Permitted

s.18(b), s.21(1)(a) [redacted]

s.18(b), s.21(1)(a) [redacted]

Technical Considerations:

- During Co-Development, the project development partner will need to assess a collection of available railway technologies and through a process of systems engineering, demonstrate compliance against with the project requirements.
- The railway must be designed as an integrated system balancing efficiency, safety, and reliability to achieve a stated performance outcome.
- A non-exhaustive, but foundational depiction of common railway elements is provided as introduction to railway terminology



General Note:
System configurations and components will vary. Content is an introductory non-exhaustive review of local applications, excluding electrification. For general education only.

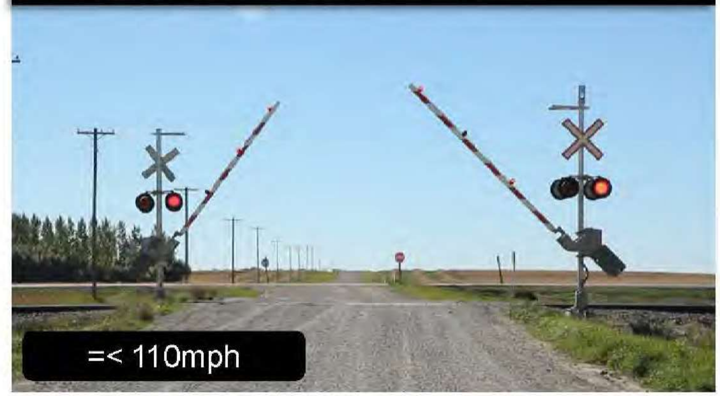
Regulatory Considerations:

- The legislative framework under the ***Railway Safety Act*** includes regulations, rules, and engineering standards that all have equal force of law.
- Rail Speeds and related Classes with Transport Canada and Federal Railroad Administration regulations:

Track Type	Freight	Passenger	Regulations
Class 3	40 mph (64 km/h)	60 mph (97 km/h)	Transport Canada
Class 4	60 mph (97 km/h)	80 mph (129 km/h)	Transport Canada
Class 5	80 mph (129 km/h)	100 mph (160 km/h)	Transport Canada
Class 6	110 mph (177 km/h)		FRA
Class 7	125 mph (200 km/h)		FRA
Class 8	160 mph (258 km/h)		FRA
Class 9	200 mph (320 km/h)		FRA

- Transport Canada does not currently have regulations or standards that address all areas of safety for operations above 95 mph (maximum speed for track class 5).
- **Transport Canada's regulations on grade crossings require grade separation for railway design speeds above 177 km/h (110 mph);** the current maximum operating speed through grade crossings is 100mph.

Example Signalized Grade Crossing



Example West Toronto Diamond Grade Separation

Credit Source Information to HFR Safety Workstream: HFR Safety Guidance Document

HSR Study and Global Benchmarking

HSR Study Background:

- In 2023, VIA HFR completed the Preliminary Corridor HSR Assessment, a study of a conceptual HSR system connecting Toronto, Ottawa, Montréal, and Québec City.
- The output of the report was indicative capital costs, operating cost estimates, journey times, ridership and revenue estimates for developing an HSR system.

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

[redacted]

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

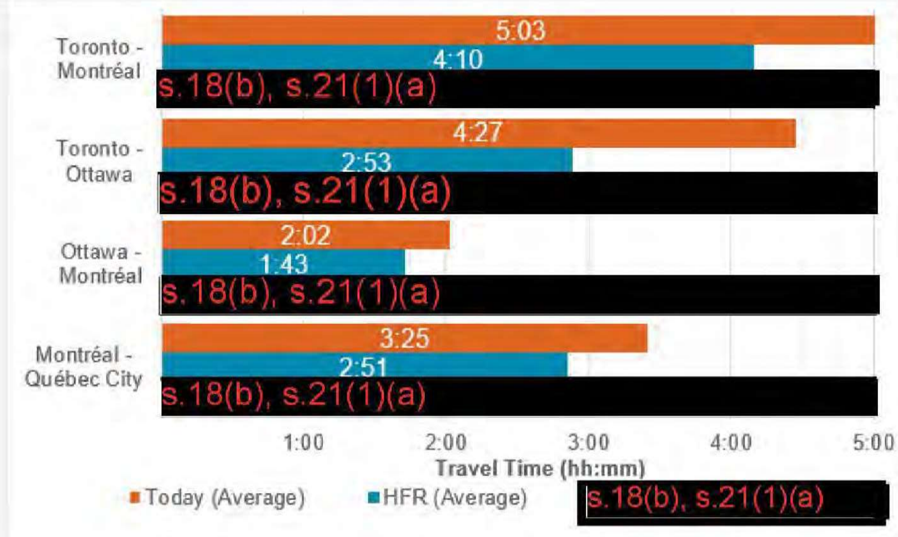
[redacted]

Journey Times

Base Assumptions

- **Rolling Stock:** This analysis assumes the typical characteristics of an electric multiple unit (EMU) train that can achieve speeds up to 300km/h (186mph).
- **Stopping Patterns:** Two different service types have been assumed – Express Service and Stopping Service.
- **Station Stops:** HSR is assumed to serve existing city center stations in Toronto-Ottawa-Montréal-Québec City, as well as secondary city stations within the major cities.
- **Station Dwells:** Assumes 2-minutes excluding Dorval which assumes 3-minutes.
- **Average Speed:** Based on international intercity and HSR benchmarks, it is assumed that the average operating speeds would be approximately 80-85% of the maximum permissible speed.
- **Simulation Modeling:** Spreadsheet analysis only.
- **Host Railway Conflicts:** None assumed. No model or data to support.

Potential Journey Times by Route (hh:mm)*



Ridership and Revenue

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

[redacted]

HSR Study: Capital Expenditure

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

[redacted]

Ridership and Revenue Compared

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

Total 40-year operating period	BAU Scenario (Today)	HFR Scenario	HSR scenario
Total revenue (billion CAD 2022)	[redacted]	[redacted]	[redacted]
Revenue Increment to BAU	[redacted]	[redacted]	[redacted]
Farebox revenue	[redacted]	[redacted]	[redacted]
Onboard ancillary revenue	[redacted]	[redacted]	[redacted]
Total Riders (million)	[redacted]	[redacted]	[redacted]
Ridership Increment to BAU	[redacted]	[redacted]	[redacted]

Electrification Power Supply Overview

Hydro Update

- The VIA-HFR project team has carried out a conceptual review of power consumption to support discussions with Hydro One and Hydro Quebec over the last 3 years.

- The level of high-level of analysis currently taken for the HFR project, in reference to the Base Case alignment, assumes: 850 km electrified network length with a traction power station every 50 km along the route; a projected power range of 30-40MVA.

- Under conceptual agreement, 1/3 of power is projected from Quebec Hydro, with the remaining from Hydro One.

- **Key Issue: Electrified Railroad Loading is Dynamic, Single Phase and Could Impact Power Quality of Utility System.**

- Prior to these Utility required Engineering Studies, VIA should determine the following:
  - Select trainset and assess its electrical characteristics (operating voltage limits, power consumption, etc.);
  - Select a perceived train operating schedule (that includes provisions for growth);
  - Define the design/operational characteristics for the Traction Electrification System;
  - Perform their own **Traction Power Load Flow Simulation**

Typical Hydro Transmission Level Connection Process

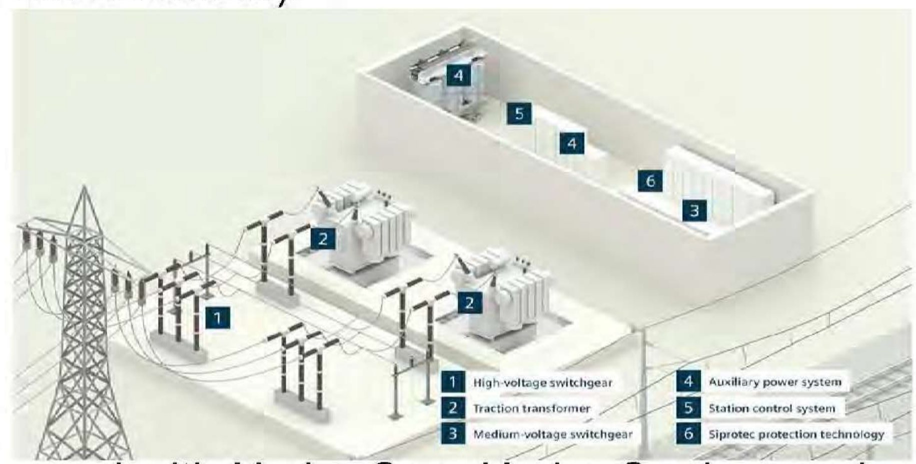
Typical Traction Power Arrangement

Electrification Power Supply Overview

Hydro Update

- Recognizing that a limited amount of design has been completed for the network, power consumption details are not currently available. Power consumption requirements on an electric railway will vary greatly on account of (and not limited to):

    1. Chosen alignment;
    2. Chosen equipment;
    3. Spacing of power facilities;
    4. Number and frequency of trains;
    5. Stations; and
    6. Non-Revenue Facilities.



- While preliminary stakeholder outreach has commenced with Hydro One, Hydro Quebec and the Ontario IESO (Independent Electricity System Operator), the Phase 1 connection request requirements cannot be met until the above is modelled under CoDev Stage 2.
- Talk to Shona about IA implications

Connecting to Electrical Utility

Key Issue – Electrified Railroad Loading is Dynamic, Single Phase and Could Impact Power Quality of Utility System.

- Dynamic Load (i.e. large power swings to support train's start (and maybe stop) requires a strong electrical utility network to support.
- As a result, Electrical Utility will require Engineering Studies to evaluate their system and determine if changes are required

s.18(b), s.20(1)(b), s.21(1)(a)

[redacted]

Base Case Route vs. Theoretical HSR

- Noise and Vibration
- Continuous Track Welds
- Winter Operations

Typical modern railway electrification systems use a 25 kilovolt (kV) alternating current (AC) and require traction power substations

piston effect which is the air forced through the tunnel by the train.

General Note:
Base Case Obtained from HFR De-Risking Report:
JPO_HFR_Project - HFR_H3RDeriskingReport_Interim Status Update_2021-11-17_.pdf - All Documents (sharepoint.com)

High Speed Rail Systems

- High speed rail projects are rolling out at pace worldwide, bringing unique challenges that expand the frontiers of engineering.

Comparison between conventional and high speed (quantitative)

- Signalling systems
- Cost per km
- Power draw
- Staffing
- Segregation
- Fencing
- Geometry
- Typical cross sections
- Tph
- Etc…

Implementation Plan
- Preparation of engineering plans
- Preparation of consultation material

Recommended Standards
- Jurisdictional review and recommended design fundamentals for HFR

Planning
- Corridor Planning Study
- Environmental Assessment Study

Design
- Development of engineering design standards for HFR through principles defined in SEMP

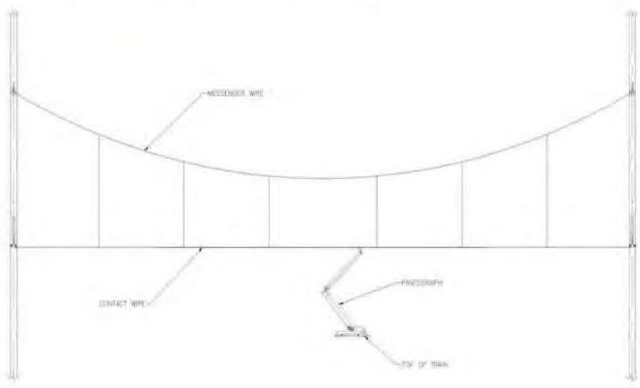
Consultations
- Engaging period with stakeholders and industry associations

Application
- Application to Federal Minister of Transport for assessment of HFR standards

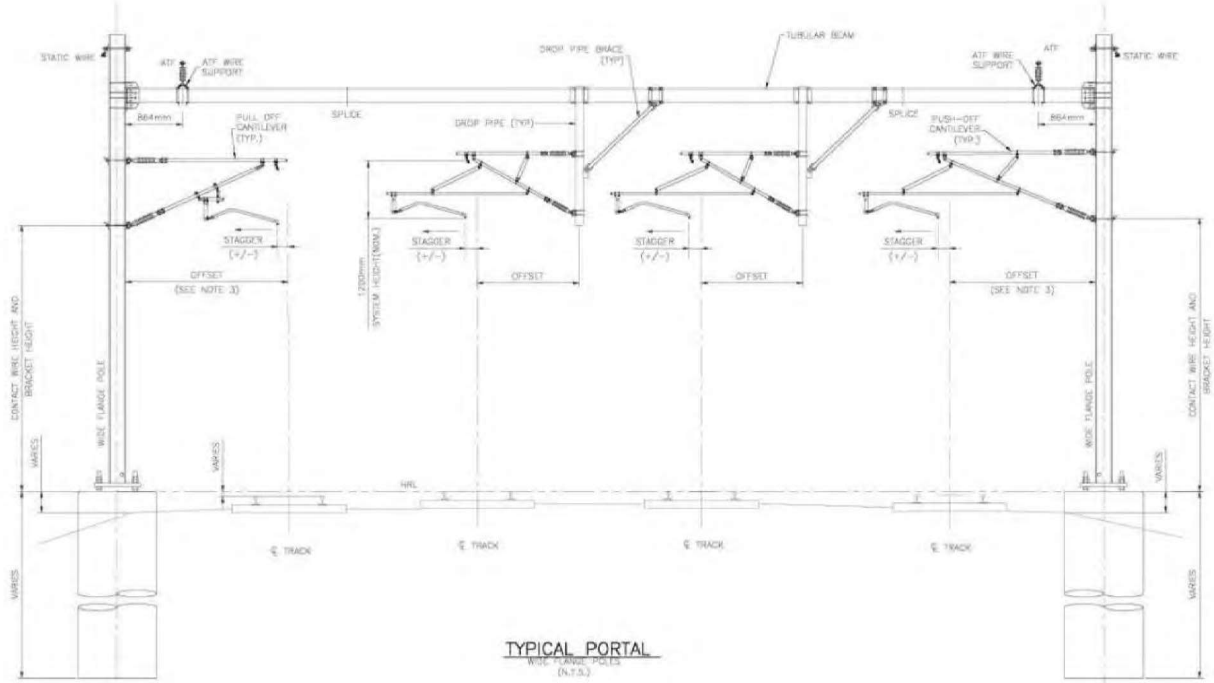
Approval
- Assessment period and Minister's approval of HFR standards (60 days)

Compliance
- Ongoing TC oversight for compliance with approved HFR standards

Figure 3-9: Typical OCS Contact Wire, Messenger Wire and Pantograph



PANTOGRAPH LOOKING ACROSS TRACK



aerodynamic impacts of high-speed rail movements

balancing speed, ware and safety

Challenges with Operation

Challenges with Platform Heights

Figure 3.2: Example EMU train used for HSR services.

A summary of the assumed train capacities is presented in Table 3.2. The trainsets shown in the table have a higher number of coaches and seat density compared to conventional intercity rolling stock currently used on the Québec City–Windsor Corridor.

Table 3.2: Representative high speed train capacities and weights

Train Length	Consist	Business Seats	Economy Seats	Total Seats	Train Weight (tonnes)
200 metres	8-car	124	436	560	517.0
275 metres	11-car	170	599	769	710.7
325 metres	13-car	201	708	909	840.0

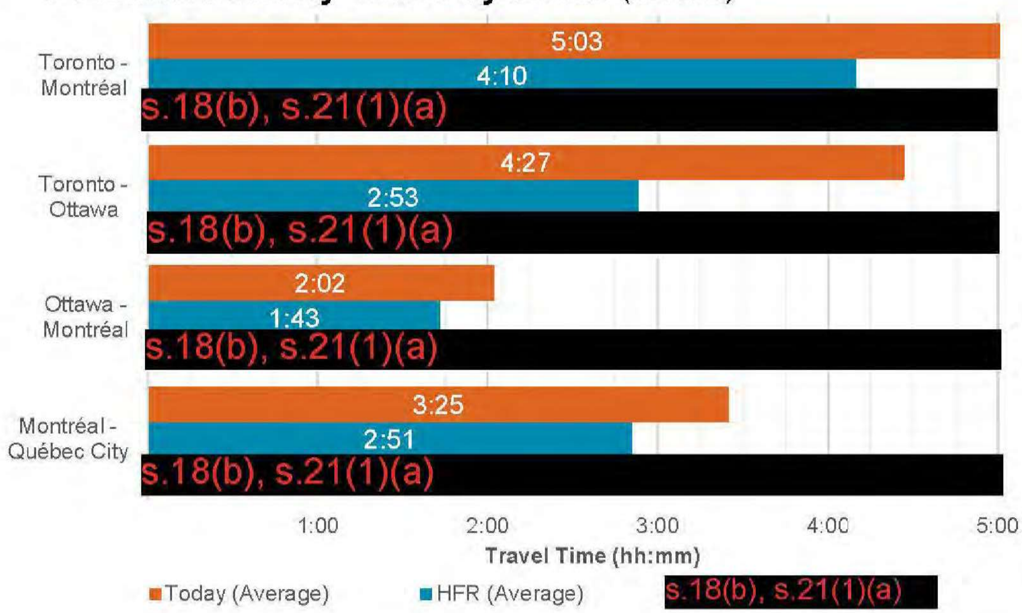
The values in Table 3.2 are representative values given the conceptual nature of this analysis. Seating capacities and train weights are subject to change, given further project definition and regulatory requirements.

HSR Study: Journey Times & Ridership

HFR and HSR journey times are theoretical estimates based on average operating speeds benchmarked from intercity and high-speed rail projects. No rail simulation was conducted.

Ridership and revenue forecasts are initial indications of HSR benefits. Estimates are based on the forecasting framework developed for HFR.

Potential Journey Times by Route (hh:mm)*



Aggregated HSR Ridership and Revenue (40-yr. period)*

***Source:** *Preliminary Corridor HSR Assessment (2023)*

Format slide

CAPEX + OPEX: Class 5 Estimates

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

[redacted]

*Source: *Preliminary Corridor HSR Assessment (2023)*

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

[redacted]

Further Resources / Background Material

Source Materials

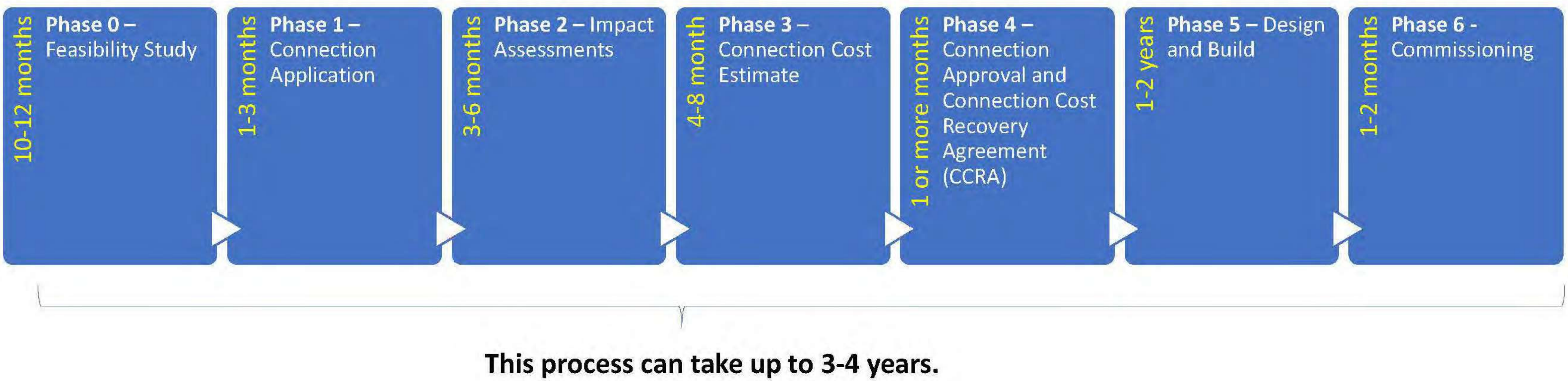
- **Preliminary Corridor HSR Assessment (2023)**

  This assessment informs an initial exploration for High Speed Rail between Toronto and Québec City, with indicative CAPEX, OPEX, ridership and revenue.

- **HFR Host 3rd Party Railways (H3R)**
  De-Risking and De-Constraining Report (2022)

  This report consolidates and assesses the information received to date from host railways on interfaces and requirements related to HFR. Operational and technical assessments are based on currently available facts and evidence, while also highlighting any currently unknown data / position of host railways.

Technical Consideration: Hydro Power Supply



HSR Study Corridor

HSR Study

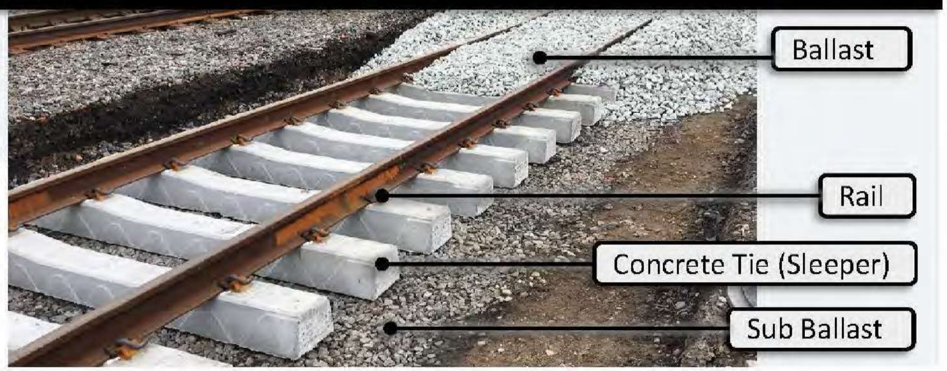
s.18(b), s.21(1)(a)

[redacted]

Introduction to Railway Components:

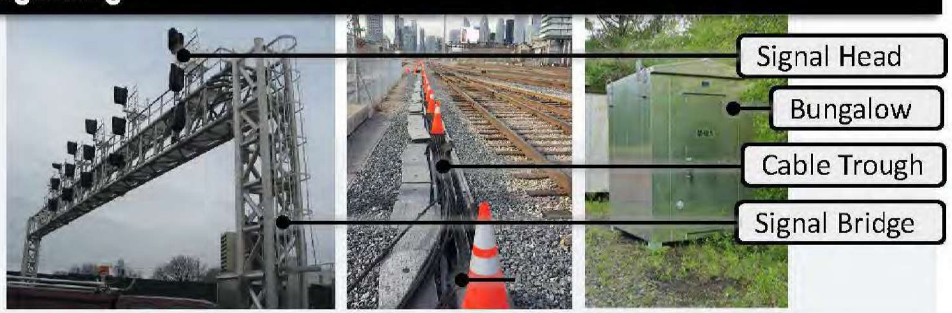
- Technical elements that form a railway must be designed as an integrated system balancing efficiency, safety, and reliability to achieve a stated performance outcome. The infrastructure below is often a subset component of these 4 railway facets:

Tracks

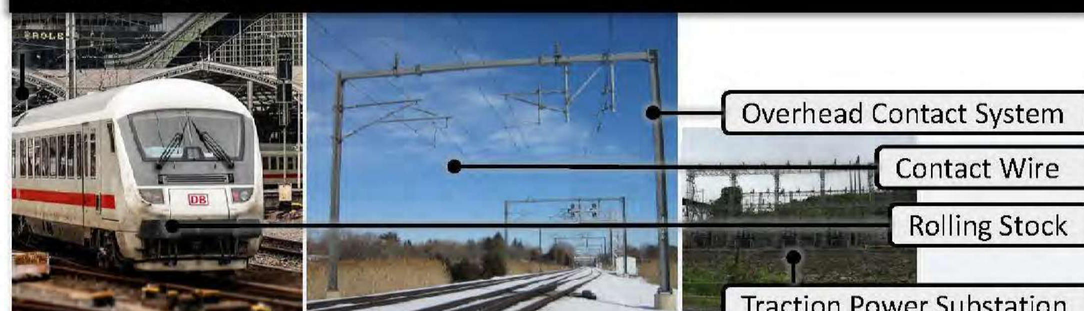


Switches

Signaling



Electrification



General Note:
System configurations and components will vary. Content is an introductory non-exhaustive review of local applications, excluding electrification. For general education only.

Technical Considerations: Typical Traction Power Facilities and OCS

Hydro Tap Facility

Traction Power Substation

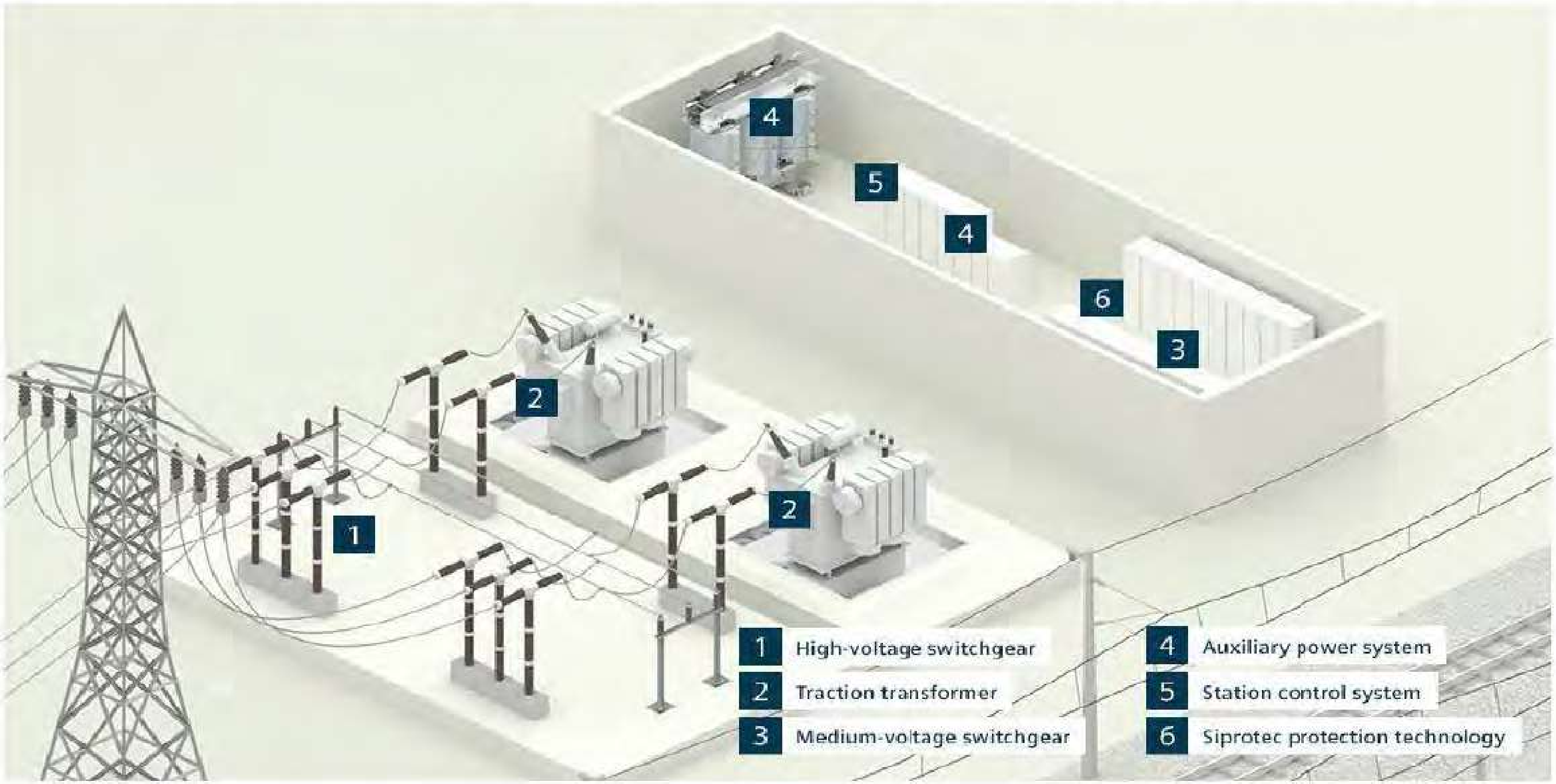
Traction Power Switching Station

Auto Transformer Feeding Station

OCS Portal Structure

OCS Pole Structure

Technical Considerations: Traction Power Substation



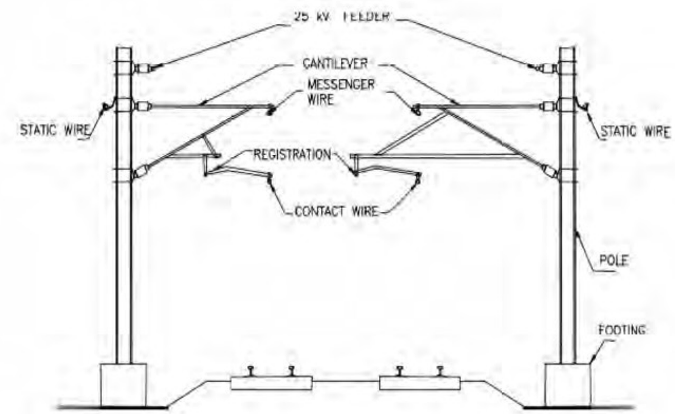
Technical Considerations: Third party considerations

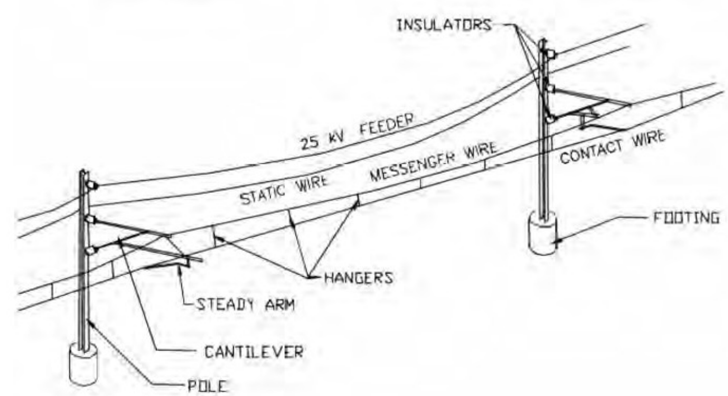
Early identification and involvement of Third-Parties will mitigate cost and schedule risks

- Utilities above, below, and adjacent to VIA HFR;
- Grounding and Bonding;
- Other railroad operators
  - Clearances and train interoperability;
  - Electromagnetic fields and electromagnetic interference (EMF/EMI);
  - Immunization of Signals and Communications;
- Joint development of Standard Operational Procedures, Maintenance, and Training

Electrified Railway: Overhead Contact System (OCS) Key Considerations

- OCS is supported by poles or portals installed on foundations;
- Energy is transmitted through the OCS contact, static and feeder wires
- Contact wire is set 4.5m to 7.5m above ToR).
- OCS design is based on:
  - alignment;
  - Type of rolling stock;
  - Train operation;
  - Climatic conditions:
    - temperature range.
    - wind,
    - ice,
    - altitude and pollution.





QMOT Partnership

Technical Considerations: Third party considerations

Early identification and involvement of Third-Parties will mitigate cost and schedule risks

- Utilities above, below, and adjacent to VIA HFR;
- Grounding and Bonding;
- Other railroad operators
  - Clearances and train interoperability;
  - Electromagnetic fields and electromagnetic interference (EMF/EMI);
  - Immunization of Signals and Communications;
- Joint development of Standard Operational Procedures, Maintenance, and Training

HSR Study: Key Outcomes

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

[redacted]

- HSR implementation, allowing for less than 3-hour journey times between TOR-MTL and 2-hour journey times between TOR-OTT and MTL-QC, enables significant rail demand, along with a significant modal shift from auto and air. The additional ridership benefits from shorter journey times are realized as revenue estimates in the assessment.

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Passenger Rail Systems

- Technical analyses of City stops, route alignment, journey time, and ridership, amongst other considerations, set the key constraints for a technical analysis of the passenger system.

- High-speed rail combines many different elements which constitute a "whole, integrated system": an infrastructure for new lines designed for speeds of 250 km/h and above; upgraded existing lines for speeds of up to 200 or even 220 km/h, including interconnecting lines between high-speed sections; its rolling stock, especially designed specifically for train sets; telecommunications, signalling, operating conditions and equipment, etc. Technology is expected to have a major influence on infrastructure development over the next 20 years.

- High speed rail projects are rolling out at pace worldwide, bringing unique challenges that expand the frontiers of engineering.

Light Rail Systems (LRT)
Urban
TTC Toronto; Ottawa LRT; Montreal REM
Quebec City Tramway

Commuter Rail System
Suburban-to-Urban Centre
Metrolinx Toronto
EXO Montreal

Intercity Rail System
Urban Centre -to- Urban Centre
VIA Rail Canada ; Amtrak USA

High Speed Rail System
Urban Centre-to-Urban Centre
HS1 UK ; TGV France ; ICE Germany

GH - Please include some stats such a tph, pax per hour,

Technical Briefing

High Speed Rail and Conventional Intercity Systems | September 2023



Government of Canada Gouvernement du Canada

Canada

Contents

- Differences between Conventional Intercity Rail and High-Speed Rail systems.
- Highlights from Preliminary HSR study.
- Update on power requirements to support electrification.

Intercity Overview

HSR Study

Hydro Update