Some Light Reading on Heavy Rail

Executive Summary

As of 2025, the State of Colorado is moving forward with two transformative passenger rail projects, both of which will require new trains and supporting infrastructure.

First, the **Mountain Rail** project plans to build on existing passenger rail service between Denver and Colorado's Western Slope by expanding access to Winter Park and Granby initially followed by future service to Steamboat Springs and Craig in the Yampa River Valley. The second is the **Front Range Passenger Rail (FRPR)** project, which will provide a new north/south train service connecting several of Colorado's highest-population cities from Fort Collins through Denver to Colorado Springs and Pueblo.

The decisions surrounding the types of trains being purchased or leased will have significant impacts on both projects. These choices will affect how convenient and reliable the services are when they launch, how easily they can grow in the future, and how cost-effective they will be to operate in the long-term.

The 'New Train for Colorado' concept envisions a modern fleet of fast, lightweight, and highly-efficient intercity passenger trains designed to connect towns and cities across the state with attractive and comfortable onboard amenities. Aligning on a single type of train would help Colorado save on procurement and maintenance costs while also enabling interoperability between the services should the need arise. Unfortunately, Colorado faces challenges in running a common spec due to incompatible existing rail infrastructure between Denver and that of the Mountains which will require thoughtful choices.

Greater Denver Transit advances that all measures be taken to build up to a single intercity passenger rail equipment standard over time that can successfully operate both up in the Mountains and down along the Front Range.

GDT's Detailed Guide to New Passenger Rail Equipment

When considering a rail expansion, there are several key choices and technical restrictions that narrow down what kinds of trains can be bought, leased, and operated.

In Colorado, as with most of the western US states, the vast majority of the track in consideration for new routes is owned by private freight rail companies. Infrastructure built along these rights-of-way is subject not only to state and federal regulations, but also the railroads themselves which apply their own standards which can be more restrictive. Most notably, the electrification that allows for conventional zero-emission fleets to operate is almost always deemed impracticable in the eyes of the freight railroads due to steep installation costs and additional operating restrictions imposed by the new infrastructure. Additionally, the trackside and station infrastructure required to offer level-boarding, the gold standard for accessibility for disabled riders, is both difficult and expensive to build next to active freight lines.

As a consequence of using the freight railroad owned right-of-way (ROW), unless a dedicated new track is built for a passenger-only rail service, the operator must be compliant with freight rail company operating requirements and either lease or purchase equipment that fits around these requirements. These sections of shared track between freight and passenger rail are called blended corridors, and they require careful planning and coordination.

Train Power Outline

How the train is powered is often the first consideration in differentiating what options are out there, especially for those interested in decarbonization. Here is a breakdown of the key terms for motive power in passenger rail:

1. Locomotive hauled train (LHT): A train consisting of one or more passenger cars hauled by a locomotive or set of coupled locomotives. This is considered the traditional train structure, and while it has fallen out of favor for passenger rail services outside of North America, it has remained in favor by freight rail companies globally, Amtrak, and most US state operators.

- **Locomotive (Loco)** - Also known as a motive power rail vehicle or prime mover, pulls a train set (also known as a consist) of passenger and/or freight rail cars. All modern locomotives are similar in that they are propelled by electric motors attached to each axle, but the way the power is supplied to those motors differs:
  - **Diesel Locomotive**: In the US, diesel-electric locomotives are by far the most common type where the electric motors are powered by onboard diesel generators. The Siemens Charger is an example of a modern diesel passenger rail locomotive that operates in North America and is currently the most popular passenger locomotive in production as of 2025.
  - **Electric Locomotive:** Less common in western states, power can also be supplied either by offboard energized wires from an overhead catenary system **(OCS)** which is collected by a device aboard the train called a pantograph or from an energized 3rd rail at track-level. The former is generally favored for moderate to longer-distance above-ground lines and the latter is often favored in underground subway designs where the tunnel geometry is more constrained. The Alstom ALP46 and the Siemens ACS-64, also known as the Amtrak Cities Sprinter, are examples of modern electric passenger locomotives that operate in North America.
  - **Dual-Mode Electro-diesel Locomotive:** Some locomotives possess an onboard diesel generator with the ability to switch to an overhead catenary system (OCS), a 3rd rail, or potentially onboard batteries (no battery units in production yet). These units are designed to operate over routes that have some limited, intermittent, or required electrification (tunnels, urban low-emissions zones, etc). The Alstom Traxx Passenger ALP45-DPA is an example of a modern dual-mode passenger locomotive that operates in North America.
  - **Battery Electric Locomotive:** These units get their electricity from onboard batteries. Current battery technology limits the range of these units but they have become more popular as battery technology improves. The onboard battery can be charged by a cable while stationary, an onboard pantograph collecting electricity from an OCS like an electric locomotive, or by generating power from the electric motors while dynamic braking. An example is the Wabtec FLXDrive heavy-haul locomotive.
  - **Hydrogen Locomotive**: These units get their electricity from onboard Hydrogen Fuel Cells with onboard Hydrogen storage. These units are not yet commercially available, operating only as prototypes that are still in the early stages of testing.

- **Passenger Car -** Single, unpowered train car designed to carry passengers and passenger amenities that is pulled by a locomotive.
  - **Coach Car:** Passenger cars that can be coupled together and traversed by riders on board from other cars on both ends. Coaches are usually dedicated to standard passenger seats, but can feature some local amenities including luggage storage, bicycle storage, and bathrooms.
  - **Special-use cars:** Passenger cars can be dedicated to amenities, and include baggage cars that store larger bulk luggage, lounge cars with larger windows for sightseeing, cafe cars that

sell snacks and drinks, dining cars that serve meals, and sleeper cars that include berths/bunks for overnight journeys. Like coaches, special-use cars can almost always be coupled to all other cars, and be traversed internally by riders from one car to another.

- **Cab Car:** Passenger cars which can be connected to the rest of the train from one end with the other side dedicated to a crew-only control station capable of controlling the locomotive on the opposite end of the train. This allows the train to run in reverse, with the operator facing forward in the direction of travel. Modern cab cars are reinforced structurally to protect the crews and passengers in the case of a collision with an object on the tracks.

2. Multiple Unit (MU) trains: A train consisting of multiple cars (sometimes semi-permanently coupled depending on model), with an operator cab on either end and multiple cars containing electric motors for propulsion.

- **EMU** - Electric-multiple units: Zero-local-emission train set powered by overhead wires or 3rd rail. These are most common in Europe and Northeast Asia, and since the 2000's, have become the most popular design for high-speed trains. In the US, conventional EMUs can be seen operating in Denver and Philadelphia on RTD's "Commuter Rail" and SEPTA's "Regional Rail" networks with the Hyundai Rotem Silverliner V (now discontinued) along with the Bay Area's CalTrain double-decker KISS equipment manufactured by Stalder (still in production).
- **DMU** - Diesel-electric multiple units: Established alternative to a traditional diesel locomotive-hauled train. These contain one or multiple smaller diesel engines or generators, and are almost always quieter and more fuel efficient than a contemporary diesel locomotive. Examples include Tren Maya in Mexico by Alstom under their X'Trapolis platform, Stadler's FLIRT used by TEXRail, the Nippon Sharyo's DMU used on SMART in Northern California (out of production), and the Colorado Railcar DMU (now discontinued) that can operate in a train of all DMU equipment or can be combined with a regular locomotive hauled train to assist the diesel locomotive.
- **EDMU/BMU** - Electro-diesel multiple units: Hybrid version of a DMU where a diesel engine and a battery and/or pantograph work together to power the train. The battery is charged either by the onboard diesel generator, offboard electricity when operating under a wire, plugging in with a cable when paused at a station, or by using regenerative braking to generate electricity from the electric motors. This design incorporates hybrid vehicle technology including in-motion charging, regenerative braking, and switching between power modes while the vehicle is in-motion. (Ex: Stadler's bi-mode FLIRT, but this has yet to be produced in the United States).
- **BEMU** - Battery-electric multiple units: Experimental semi-permanently coupled train set capable of zero-local-emission operations being powered entirely by battery power, though sometimes can be capable of overhead electrical power as well for in-motion charging – soon to be tested in California on CalTrain's southmost segment (Ex: Stalder developing first major US variant for CalTrain as part of their KISS platform).
- **HEMU/ZEMU** - Hydrogen-electric multiple units: Emerging alternative for a zero-local-emission passenger rail solution for non-electrified track powered by Hydrogen fuel (Ex: Stalder developing first major US variant to be operated in Southern California).

The Tradeoffs: LHTs vs. MUs

The MU design has become the modern standard for passenger rail in almost all markets outside of North America because of the built-in efficiencies of the design. The distributed power system allows for passenger trains to have less total weight compared to LHTs which causes less wear on the track, requires fewer total axles, proportionally less maintenance per train, and materially faster acceleration/deceleration. Most contemporary MU passenger trains are equipped with onboard batteries, meaning that it is possible to save energy with regenerative braking that uses the kinetic energy of the train to charge batteries or generate energy back into overhead lines. The distributed power design also offers redundancy where if one powered section has a problem, the rest of the train can usually offer enough tractive power to complete the journey.

The main immediate downside with MUs is equipment availability in North America. MUs had a slower start in North America as did modern passenger rail equipment generally, and while many companies have and continue to offer electric EMUs targeting the more mature rail markets of the coasts, few offer the modern diesel-powered DMU/EDMUs which are more conducive to blended freight/passenger corridors where diesel will remain practical for some time to come. As of Spring 2025, only 1 of the 3 major passenger rail manufacturers in North America offer an FRA-compliant DMU/EDMU (the Stadler FLIRT), though this design does comply with the most stringent emissions regulations for diesel trains. There is virtually no secondhand market for MUs which is a significant challenge for any new services intending to be introduced quickly.

Unlike a LHT, if a mechanical defect is found on one unit of a semi-permanently coupled MU train that would require that unit to be out of service, the whole train must be removed from service until repaired. Damage / defects on one car that compel the removal of the whole set includes collisions with vehicles as well as trees and rocks which has a higher likelihood in the mountains of Colorado. Locomotive hauled trains have a significant advantage in this area where backup equipment can be staged and available in the event of a mechanical defect or collision, and switching it out mid-trip on the mainline would be possible.

For LHTs, the traditional locomotive-hauled train design has other benefits as well. First, locomotives are readily available with a very large second-hand market (unlike second hand passenger car equipment which is in more limited supply).

Diesel locomotives have become less polluting in recent years. Newer environmental regulations from the US and Canadian Federal Governments (which can be made even more stringent by state/provincial governments) either prefer or require compliance with emissions standards which pushes passenger operators toward new locomotives, but not always. There are two manufacturers offering passenger locomotives that comply with the latest environmental regulations (Tier 4) and there are multiple other companies that can rebuild older freight and passenger locomotives to be compliant as well.

The LHT design is more familiar to American railroaders. There is a common preference that American railroaders have for the LHT design where there is a perceived resilience that comes from the cars being detachable. If one section of the train has a mechanical defect, it can be removed, and the rest of the train can carry on its way, unlike an MU which would require the whole train to be out of service.

The major disadvantages of locomotive-hauled trains are the heavier weight which means more wear on the track, more drag that burns more fuel, more axles which require more maintenance per train, and inferior acceleration/deceleration performance. Platform space is also a consideration, especially at stations with shorter platforms designed for MUs, the locomotive can add “dead space” to the train where precious platform space cannot be used to board passengers.

GDT believes that the MU design will become more common in the United States over time due to the inherent efficiencies already offered. That said, we acknowledge that the Mountain Rail standards are being pulled in multiple directions between what equipment is available, what local railroaders have experience with, and what is practical in the current operating environment. GDT still hopes that CDOT can establish a common equipment standard that enables future fleets to be seamlessly moved between mountain and urban corridors.

Fleet Restrictions from Grade Crossings and Signal Systems

When railroad tracks intersect with a busy road at-grade, grade-crossing infrastructure is required to protect pedestrians and vehicles. On major roads, an approaching train activates warning lights and lowers physical gates to block traffic, temporarily halting vehicles to prevent collisions. This activation process, known as shunting, relies on the train completing an electrical circuit through the rails.

Freight railroad grade-crossings in the U.S. were designed primarily with long, heavy freight trains in mind: trains that naturally provide strong, consistent electrical contact with the rails. In contrast, passenger trains - especially lightweight multiple units (MUs), including legacy equipment like Budd Rail Diesel Cars (RDCs) or contemporary European-designed MUs - can be shorter, lighter, and critically have fewer axles to complete the circuit.

These differences can lead to inconsistent activation not only of grade-crossing signals but also of the wayside signaling systems used to control train movements. To mitigate this, freight railroads often require train sets to meet a minimum number of axles, typically in the mid-teens, to ensure proper electrical detection. This limits the viability of short MU configurations of less than 5 cars on shared freight corridors, often pushing operators toward locomotive-hauled trains or longer MU consists, which in turn may require longer platforms and increased costs even if the extra cars are only there to satisfy shunting requirements.

Railway Envelope Outline

The Track Gauge describes the specification for the distance between the rails, and is a basic design element that determines compatibility of rail equipment.

In the United States, the overwhelming majority of railroads in operation run on Standard Gauge tracks with rails that are 4’ 8.5” apart (1,435 mm). This gauge is the most popular in the world, with the overwhelming majority of modern equipment being built to Standard Gauge specifications. Minor exceptions in the United States exist, most visibly in Colorado with the 3’ Narrow Gauge tourist railroads operating in two mountainous areas that are mostly disconnected from the national network. The US Narrow Gauge standard is 3’ (914.4mm) between the rails, but this design fell out of favor in the early 20th Century for nearly all freight and passenger rail that aspired to be connected to the national network.

Track gauge is rarely a challenge in terms of modern equipment compatibility, but there is another design spec that presents a much greater challenge for passenger railroads: the width and floor height of the trains themselves.

The Loading Gauge is the design specification focused on the width and height of train cars to be able to pass down a stretch of track without any collision. The loading gauge can differ by route - usually, the vertical clearance varies more than the width, as pieces of legacy infrastructure such as tunnels and overpasses can restrict the height of modern equipment, usually for freight cars which tend to be the tallest over the rails.

While nearly all modern passenger cars can physically fit and operate over freight tracks, the wider freight spec means that many types of freight cars cannot be operated along legacy passenger tracks like those of the Northeast Corridor because they would collide with platforms.

The height of both the (a) platform and (b) the floor of rail vehicles might be the single most challenging design element for North American passenger trains because there is no single standard.

Platform/Floor Height: There are currently three platform height standards in North America:

- **HF**: high-floor: 51" floor trains, often served by 48"-51" platforms, as seen on the Northeast Corridor and all planned high speed rail stations. HF trains are usually designed with a level floor above the wheels where on a single-deck train, passengers can traverse the full train without going up or down stairs. When the height of the platform is equivalent to the height of the train floor, riders benefit from level-boarding with riders in mobility devices able to board without employee assistance under their own power. This is rare in the western US however because Class I freight railroads prohibit platforms directly adjacent to their tracks taller than 8" to avoid risk of any collision from wider freight cars. In order to be placed along Class I freight lines, HF platforms require a dedicated passenger-only siding to be built. However, when high-floor trains call at low 8" platforms which are most common in the west and midwest, riders in mobility devices board either via a "high block" that is placed on the platform that is set back several feet from the tracks that is bridged with a manually-placed ramp or must be carried via manually-operated lifts. Both of these alternatives require human assistance to board riders in mobility devices and increase dwell time (the time spent while the vehicle is stopped for boarding and alighting passengers) along with the likelihood of human error in disrupting the boarding process for disabled riders. When level-boarding is not available, operational complexity increases.
- **LF** - low-floor: 24" floor trains, usually served by 8" platforms with gaps bridged by manually-operated lifts or manually-placed ramps. Equivalent 24" platforms are extremely rare, and so far have only been attempted on sections of dedicated passenger track located far away from the Northeast Corridor (UTA's FrontRunner in the Salt Lake City metro area runs on dedicated track with 24" platforms). 24" platforms are too high above the top of the rail for any Class I freight company spec, so level-boarding for 24" trains on blended corridors also requires dedicated station sidings. Alternatives to level-boarding at LF platforms carry almost the same cost and operational penalty required for level-boarding at the 51" HF spec: either high blocks with bridge ramps and/or mechanical lifts. As a result, this specification suffers similar drawbacks seen with 51" HF cars in bridging down to 8" platforms.
- **VLF** - Very low-floor: 18" floor trains are usually served by 8" platforms with gaps that must be bridged by manually-operated lifts or manually-placed ramps that require human assistance to operate in order to board riders in mobility devices (18" platforms are extremely rare). The advantage of the 18" floor over the 24" floor is that ramps can be placed reaching down to an 8" platform without the need for a high block. The very-low-floor height also offers hypothetical advantages over both the 24" and 51" floor specs for future fleets that could be equipped with auto-extending gap fillers to bridge down to 8" platforms. While no VLF fleets with auto-extending ramps are in service yet today in the US, this is the only known solution for serving 8" platforms that allows riders in mobility devices to board and disembark without employee assistance.

The floor height of a railcar matters a lot because it must be compatible with the platform height and configuration of the stations being served on the route. If a new rail service is planned to call at an existing rail station, the vehicle floors must be as high but hopefully not higher than the existing platforms along the route. If the floor height is more than 5/8ths of an inch higher than the platform height, special accommodations must be made for riders in mobility devices that can add significant inconvenience to those riders and also add complexity to operations.

Why does North America have three different platform / floor standards?

In North America, the original standard for passenger cars was for floors that were 51” above the top of the rail, what is today referred to as “high-floor”. This was the height required to clear the traditional rail wheels, and allow passengers to cross between train cars without needing to climb steps on either end of the car. However, for passengers to board with ease, this required equivalent “high” platforms be built next to the tracks of equal 51” height. The cost involved in building those platforms meant that only mid-sized and larger stations got such platforms - it was still common that when trains called in rural areas, passengers would need to climb steps to disembark the train. On the west coast even in the major cities, while high-floor trains were the standard for the first half of the 20th century, almost no stations actually built high-floor platforms. West of the Mississippi in general, the norm was for travelers to climb up via a combination of a stool on the ground and steps on the train in order to board trains which was impossible for many riders with disabilities to do without assistance.

The second North American floor height came in the 1950’s with the advent of Budd’s Hi-Level cars which were double-decker train cars that had very low-floors at only 18” above the top of the rail. This design offered more convenient loading from suburban and rural stations that often had no platform at all. An accessibility downside however, mainly impacting longer trips, was how the spec required riders to climb steps in order to pass from one car to another. This meant that riders in mobility devices would be confined to the car they boarded in for the duration of the journey.

The third North American floor height came in the 1970’s with the advent of the Canadian Bombardier BiLevel coach with floors at 24” above the top of the rail which was roughly aligned with the standard floors of Central European railroads. This design would prove exceedingly popular, with commuter railroads all across the west of North America adopting them over the 1980’s and 1990’s. By this time, 8” platforms were becoming prevalent across the Western US as they did not conflict with the increasingly wide loading gauge of freight rail equipment which could pass through passenger stations without any preparation or modification. This meant that riders needed to step up from either ground level or the 8” platform up to 18” Superliner height or the 24” BiLevel height in order to board trains. So by the end of the 1980’s, North America had three different floor heights for passenger trains.

In 1990, the Americans with Disabilities Act (ADA) regulation was passed that set into motion a legal preference for designs allowing riders in mobility devices to board transit vehicles without employee assistance. At the time, the only major railroads already operating with level-boarding that did not usually require employee assistance were those trains with high-floor passenger cars being loaded from high-platforms which were found in the East and select Midwest cities. The common 8” platforms did not offer level-boarding to any floor-specification. Various approaches to close the gap have been attempted with manually-placed ramps that connect 24” low-floor trains to set-back 24” high-blocks being most common, nested tracks-within-tracks called gauntlet tracks that add a few inches of clearance (enough for some but not all freight cars to pass on the outer pair of rails), and most recently new auto-extending gap fillers from 51” high-floor passenger cars to set-back 51” platforms as seen on Florida’s Brightline. These gap-extenders on HF passenger trains that allow for platforms to be set back far enough to allow most types of freight trains to pass through stations (Brightline on the Florida East Coast Railway (FEC)) is promising, but has so far not been replicated. Meanwhile, Class I freight companies have so far refused to adopt either gauntlet tracks or set-back 51” platforms under the justification they add potential points of failure as well as added costs to maintain the track. In practice, upstart passenger services interested in adding level-boarding passenger service to freight corridors must pay for dedicated passenger-only sidings with platforms that match the floor-height of passenger trains. The only known viable alternative that can promise boarding without assistance from VLF platforms is with a future, yet-unbuilt specification of 18” inch very low-floor cars that adopt auto-extending ramp technology that can bridge down to the 8” platforms.

On blended corridors with Class I freight railroads, level-boarding has so far never happened. Existing designs without level-boarding were effectively grandfathered-in, and to date, while level-boarding is the preference of the Federal Railroad Administration (FRA), it is only required in-practice on new systems that build dedicated passenger track. To date, all new train services introduced on freight tracks have so far been successful in claiming exemptions from offering level-boarding and boarding without assistance with mitigation from ramps and lifts being accepted. Disability advocacy groups have pushed back on this exemption, sowing doubt that these exemptions will be granted indefinitely.

Riders with disabilities on these systems require the assistance of passenger rail staff paying close attention to their needs, and constantly monitoring which riders need the manual ramps or electric lifts operated and when those riders need such support to avoid missing the intended points of boarding/disembarkment. Many experiences are recorded of disabled riders being forgotten/ignored during journeys where they are prevented from boarding, disembarking, and navigating across trains under their own power as the ADA had intended. Thus, there is still more work to be done in order to bring the in-practice passenger rail experience for disabled riders into line with the intended equal access promised by the ADA.

The Platform Height Question in Colorado

This question matters a lot at **Denver Union Station:** Colorado's largest passenger rail hub. Denver Union Station has 8 tracks capable of receiving heavy rail trains and effectively no room to add tracks without substantial and unreasonable costs. All tracks are owned by the Regional Transportation District (RTD), but are contracted out to two different parties with two standards offered:

- 6 tracks are served by 51" high platforms which are used on the 4 lines of RTD's Commuter Rail network (3 of the 4 lines are not operated by RTD, but by a 3rd party contractor called Denver Transit Operators (DTO)). These tracks feature level-boarding at all doors where riders in mobility devices can seamlessly board trains at any door without assistance. These tracks were built to the same specification of the Amtrak and northeast commuter train services like MARC, SEPTA and New Jersey Transit (NJT) and are technically capable of receiving any trains that operate there. However, these 6 tracks are incompatible with any and all 24" low-floor or 18" very low-floor trains. Specifically, no 24" Bombardier BiLevel/Stadler FLIRT or 18" Amtrak Superliner (Amtrak's only train car operating in Colorado as of 2025) trains can board from these 6 tracks.

- 2 tracks are served by 8" very low platforms that can receive very low, low, and high-floor trains, but boarding is not seamless for riders in mobility devices. These tracks are leased to Amtrak, with special high-blocks in place on Track 4 (not on Track 5) that can bridge to the very-low 18" floor trains. Mechanical lifts are required for boarding 24" low-floor and 51" high-floor trains on either track. Unless a Superliner happens to be parked at precisely the right spot to access the high blocks on track 4, riders in mobility devices require employee assistance on these tracks in order to board.

In addition to the two platform heights, there are multiple lengths of platforms at DUS. The two low-floor platforms allow for the longest trains, which currently serve Amtrak's long-distance California Zephyr and state-sponsored Winter Park Express routes along with the luxury Rocky Mountaineer/Canyon Spirit. The six high-floor tracks used by RTD have a wide range of lengths, supporting boarding for between 4 and 9 cars, with the first (Track 1) and last (Track 8) being the longest.

Intercity passenger rail services are expected to be longer than 4 cars (5-8 cars). It is possible to board longer MU trains of 5 cars or more at 4-car platforms, but LHTs physically cannot as the operator of the locomotive cannot pass through the train and must step out from the cab which requires platform space. Thus, LHT's cannot "stick out" from beyond the platforms as the crew would be unable to exit and conduct turn-around duties. This is another advantage for MUs at space-constrained stations as crews can usually pass through the full train including the crew compartments on both ends, but boarding longer MUs from short platforms can add complexity to the boarding process for passengers as many riders are required to pass through additional cars once aboard to find an available/assigned seat.

At DUS, Track 1 hosts RTD's flagship A Line service to Denver International Airport (DEN) which is unlikely to be moved due to its perceived importance/popularity, so Tracks 6-8 are currently the prime candidates for any new state-supported intercity passenger rail service like Front Range Passenger Rail that targets higher frequencies. With Platform 8 long enough to board 6 cars directly, the optimal configuration would be having either a 6-car MU with the next alternative being an LHT configuration with 4 coaches and 1 cab car that carries passengers.

DUS Track Platform Boarding Capacity (excluding a locomotive, assumes all cars carry passengers):

- Track 1: 9 cars (51" HF platform)
- Track 2: 4 cars (51" HF platform)
- Track 3: 4 cars (51" HF platform)
- Track 4: 11 cars (8" VLF platform)
- Track 5: 11 cars (8" VLF platform)
- Track 6: 4 cars (51" HF platform)
- Track 7: 4 cars (51" HF platform)
- Track 8: 6 cars (51" HF platform)

Rail Manufacturer Outline

In the 20th Century, the United States had a thriving domestic passenger equipment market with locomotives supplied by General Motors' Electro Motive Division (EMD) and General Electric (GE) and passenger cars manufactured by companies like Budd, Pullman and others. Today, none of these companies are major players in the manufacturing of passenger rail equipment. With the decline of US passenger rail in the 1960's - 1980's, nearly all domestic producers of passenger equipment went bankrupt or exited the market. Japanese firms such as Kawasaki and Nippon Sharyo then stepped into the breach, often producing cars based on original American designs.

The United States thereby lost all economies of scale for passenger rail equipment manufacturing, and also missed out on decades of rail equipment modernization and best practices with designs that were simultaneously being refined in Europe and Northeast Asia and adapted around digital systems. So far, no US company has caught up, but protectionist US Federal Buy America procurement requirements still forced US agencies to buy equipment that is manufactured in the United States. This paradox drove non-US firms with scale to enter the US market, set up shop, and produce the on-average heavier FRA-required specifications at great expense. This has inflated the cost of rail fleets in the US for decades.

As of 2025, only 3 companies are actively manufacturing heavy passenger rail equipment at scale that is approved by the Federal Railroad Administration (FRA).

- **Alstom (Incl. Legacy Bombardier and Adtranz):** offers the widest lineup of the 3 based on 1 single locomotive (the Traxx Passenger™ ALP45-DPA) program but two families of multiple-units and coaches that are available in low-floor and high-floor specs each with variations of single-level and multi-level coaches/cabs. Both families are marketed as including multiple-unit trains for

EMU/BEMU/HMU, but so far, there is no diesel DMU/EDMU offering being marketed that has FRA approval. Alstom has made DMUs for other countries, most recently with the X'Trapolis platform for Tren Maya in Mexico, but this is not being marketed to US customers and is likely not approved by the FRA. As of 2025, Alstom's only diesel offering for the US appears to be a single type of locomotive and a pair of legacy coach designs.

- Alstom US Passenger Rail Offering (Excl. High Speed Rail):
    - Traxx Passenger Locomotive ALP-45DPA (Passenger Tier 4 Diesel)
    - Adessia Family (High-floor), adapted from the Bombardier Multilevel III Coach (HF Double Deck) concept designed specifically for the North American market.
        - Adessia Stream™ EMU (HF Single Deck
        - Adessia Stream B™ BEMU (HF Single Deck)
        - Adessia Stream H™ HEMU (HF Single Deck)
        - Adessia Stream™ Coach (HF Single Deck)
        - Adessia Stream™ Cab Car (HF Single Deck)
        - Adessia Max™ EMU (HF Double Deck)
        - Adessia Max™ Coach (HF Double Deck)
        - Adessia Max™ Cab Car (HF Double Deck)
    - Coradia Family (Low-floor), adapted from the Bombardier BiLevel Coach (LF Double Deck), and derived from their European offering.
        - Coradia Stream™ EMU (LF)
        - Coradia Stream B™ BEMU (LF)
        - Coradia Stream H™ HEMU (LF)
        - Coradia Stream™ Coach (LF Single Deck)
        - Coradia Stream™ Cab Car (LF Single Deck)
        - Coradia Max™ EMU (LF Double Deck)
        - Coradia Max™ Coach (LF Double Deck)
        - Coradia Max™ Cab Car (LF Double Deck)

- **Siemens Mobility:** offers a narrow lineup with only one single locomotive family (the diesel ALC-42 Charger) alongside single-level high-floor passenger cars. While the ALC-42 platform can operate as a bi-mode locomotive (3rd rail variant offered along with OCS power via coupling the ALC-42E to an axillary tender), putting aside the electric-only high-speed rail platform, Siemens offers no conventional low-floor, multi-level, or multiple-unit fleet platform in the United States.
    - Siemens Passenger Offering (Excl. high-speed rail):
        - Charger Locomotive ALC-42E (Passenger Tier 4 Diesel)
        - Venture Coach (HF Single Floor)
        - Venture Cab Car (HF Single Deck
        - Airo Set (HF)
            - Charger Locomotive ALC-42E (Passenger Tier 4 Diesel)
            - Auxiliary Power Vehicle (APV)/Battery Car (HF Single Deck)
            - Venture Coach (HF Single Deck)
            - Venture Cab Car (HF Single Deck)

- **Stadler Rail:** offers a lineup of multiple-unit train designs that are currently low-floor-only in the United States for single level trains (the FLIRT platform) but offer a dual-platform height low-floor and high-floor spec for their multi-level trains (the KISS Platform). The single-level FLIRT platform has so far only been applied to shorter distance regional rail trains in North America, but an intercity veriant is underway. An experimental North American adaptation of Stadler's Norwegian intercity train called the FLIRTNEX is being developed. This is a bi-mode multiple unit design with distributed electric power that can run under OCS or be powered by a diesel generator housed in a quasi-locomotive at the front of the train, but is not the true prime mover even in diesel mode (provides 100% of the energy, but a fraction of the tractive effort comes from motors in the rest of the train in diesel mode). Platform height and extent of customization for North America are still unknown.

- Stadler Passenger Rail Offering
  - KISS EMU (Dual LF/HF)
  - KISS BEMU (Dual LF/HF)
  - FLIRT EMU (LF)
  - FLIRT DMU (LF)
  - FLIRT EDMU (LF)
  - FLIRT BEMU (LF)
  - FLIRT HEMU (LF)
  - FLIRTNEX Norske Tog EMU (Floor TBD)
  - FLIRTNEX Norske Tog EDMU (Floor TBD)

In some cases, especially on scenic tourist railroads, locomotives built to a freight rail specification are used. There are currently two manufacturers that develop freight locomotives in compliance with the Tier 4 emission regulations specified by the Federal Railroad Administration (FRA).

- **Progress Rail by Caterpillar (Fmr. Electro Motive Diesel (EMD))**
  - SD70ACe-T4 Locomotive (Freight Tier 4 Diesel)
  - SD70ACe-T4 Hybrid/SD70H Locomotive (Freight Tier 4 Diesel)

- **Wabtec (Fmr. GE Transportation (GE))**
  - ET44AC Locomotive (Freight Tier 4 Diesel)
  - ET23DCM Rebuilt SD40-2 Locomotive (Freight Tier 4 Diesel)

Future Offering (Manufacturer TBD)

In the near future, there are a few notable request for proposal (RFP) specifications that are expected to bring new passenger rail offerings. The first is a successor for the Silverliner V EMU which will be bound for SEPTA on the Northeast Corridor and other lines in Pennsylvania (presumably called the Silverliner VI). The second, and pertinent to the mountain states, is a replacement for Amtrak's long-distance very low-floor VLF Superliner fleet. These are expected to be powered by a long-distance variant of the Siemens Charger (ALC-42), and will serve central Colorado on the Central Corridor between Denver and Grand Junction on the California Zephyr as well as southern Colorado's Raton Pass (La Junta and Trinidad) on the Southwest Chief. The Amtrak long distance spec of very-low-floor (VLF) height of 18" is not expected to change.

- Silverliner Successor for SEPTA (HF EMU)
- Superliner III Coach Successor (VLF Coach)
- Superliner III Sleeper Successor (VLF Double Deck, 104.5" Upper Deck)
- Superliner III Lounge Successor (VLF Double Deck, 104.5" Upper Deck)
- Superliner III Diner Successor (VLF Double Deck, 104.5" Upper Deck)

Out of Production (Recent)

In recent years, several modern makes and models have been either discontinued or have been taken out of production. Japanese Nippon Sharyo, Korean Hyundai Rotem, and Spanish CAF and Talgo each built trains, but exited from new heavy rail manufacturing in North America during the 2010's. Progress Rail and Webtech both developed Tier 4 compliant diesel passenger locomotives, but are both out of production as of the mid 2020's. This leaves Alstom and Siemens as the only firms manufacturing new Tier 4 complaint passenger diesel locomotives in North America.

- **Nippon Sharyo (Plant closed in 2018)**
  - "DMU-1" or "DMU Tier 4" DMU (HF)
- **Hyundai Rotem (Plant closed in 2018)**
  - Silverliner V EMU (HF)
  - BiLevel Coach (HF/LF)
  - BiLevel Cab Car (HF/LF)
- **CAF USA (Last heavy rail project accepted in 2010, completed in 2021)**
  - Viewliner II Baggage Car (HF)
  - Viewliner II Dining Car (HF)
  - Viewliner II Sleeper Car (HF)
  - Viewliner II Baggage-dormitory Car (HF)
- **Talgo (Plant closed in 2014)**
  - Talgo Series 8 Coach (LF)
  - Talgo Series 8 Cab (LF)
- **Progress Rail by Caterpillar (Fmr. Electro Motive Diesel (EMD))**
  - EMD F125 Locomotive (Passenger Tier 4 Diesel)
- **Wabtec (Fmr. GE Transportation (GE))**
  - MP54AC Locomotive (Passenger Tier 4 Diesel)

Key Takeaways for Colorado

1. **Colorado's near-term passenger rail expansion will operate on blended corridors:** With the exception of RTD's remaining FasTracks extensions in the Denver Metro Area, all new state services are expected to be introduced over private freight rail-owned corridors. It is vital that the State maintain strong working relationships with the private freight railroads, and be prepared to pay them to use and upgrade their tracks.

2. **100% off-wire zero emission technologies are not yet feasible for Colorado:** Aside from very short distances where batteries can be used and recharged quickly, diesel is the only practical means of propulsion up and down mountain grades in most parts of Colorado where trackage is owned by Class I freight railroads that are unlikely to permit overhead catenary systems (OCS). Battery and hydrogen technology are both promising, but currently require unfavorable operational, cost, and carbon compromises to execute within the foreseeable future across Colorado. The battery technology of today is heavily limited in range and grades, especially without any in-motion charging from intermittent electrification of overhead wires. Battery multiple units capable of being charged in-motion from OCS systems should be considered for shorter and flatter routes where green energy power sources are available, but will not be a fit for a statewide fleet. Hydrogen-powered rail is also not sufficiently mature for Colorado's conditions. Today, there is no environmentally-friendly hydrogen production within state

lines, and there is no path with funding to achieving an environmentally-friendly supply of hydrogen fuel for rail within state lines over the next 10 years. Even if green-produced hydrogen fuel can be found elsewhere, the hydrogen will need to be shipped in from other states, and the total cost in emissions will likely be higher than the alternative of simply using the lowest-emission diesel power.

3. **Dual-mode trains should be acquired.** Either electro-diesel multiple units (EDMUs) or dual-mode electro-diesel locomotives are the preferred propulsion for passenger rail in Colorado. For maximum flexibility and economies of scale, all fleets procured in Colorado should be able to to be powered by onboard diesel and overhead wires to allow for zero-emission operation when traveling into and out of the Denver Metro Area and any future electrification zones. Dual-mode trains fitted with pantographs will provide operational advantages at Denver Union Station which has exhaust/emission requirements under the station canopy. These restrictions prohibit diesel power from pulling trains into the station by the head (currently require time-consuming turnaround motions every time a diesel Amtrak train arrives at the station). Bi-mode fleets that can operate under electric power can enter and exit Denver Union Station without restriction, and offer the benefit of generating no emissions when idling over layovers in Denver Union Station. Thus, the lowest-emission, modern tier 4 compliant dual-mode diesel locomotives and electro-diesel multiple unit (EDMU) trains are preferred.

4. **If locomotive-hauled trains are operated, cab cars must be standard to every set**. The stub-end configuration of Denver Union Station and foreseen congestion of the throat tracks means that trains will need to be turned around quickly, so cab cars should be considered a core requirement for smooth operations.

5. **The state should set a path toward a permanent fleet of passenger cars with a standardized floor height at the 51" high-floor standard.** While the wide availability of 24" low-floor commuter cars on the secondhand market may make the acquisition of a low-floor fleet in the near term an attractive proposition, the high-floor infrastructure at Denver Union Station, Denver International Airport, and all new Amtrak equipment being high-floor provides a compelling case for the 51" high-floor standard to be adopted statewide in Colorado. If low-floor equipment is planned to be used initially, perhaps due to availability or financial considerations, there should be a clear path to replacement with a high-floor fleet that is compatible with RTD and Amtrak's intercity standard. While ADA high blocks and / or lifts will be required for the 8" very low-floor platforms allowed on blended freight corridors initially, it is vital that every planning effort be made to drive toward providing high-floor platforms (with associated dedicated track and / or station sidings) to achieve boarding without assistance at these stations in a 25 year timeline.

Key Takeaways for the Front Range

1. **Front Range Passenger Rail must operate with high-floor equipment:** Denver Union Station's stub-end track configuration when combined with the existing B Line infrastructure practically requires any frequent intercity services to operate with high-floor equipment compatible with the existing 51" platforms as to avoid captivity to the two low-floor tracks currently leased to Amtrak. The 2025 Alternatives Analysis from FRPR anticipates needing 2 platforms at Denver Union Station simultaneously. The most desirable morning slots on the two low-floor tracks are unavailable with the long-distance California Zephyr, Winter Park Express, and possible Mountain Rail services calling at these platforms. Each of these trains is expected to occupy platform space for up to an hour, and can also be delayed by freight trains in neighboring states. With the private Rocky Mountaineer/Canyon Spirit luxury train now also sharing the Amtrak tracks, the future outlook is for severely limited low-floor slot availability which advantages RTD's high-floor tracks 6-8 for FRPR (shared with the B and G Lines). Track 8 will likely make the most sense to be fully dedicated to FRPR as it has the longest high-floor platform at DUS that is directly accessible from the B Line corridor that FRPR and Joint Service are expected to share without requiring the complex maneuver to cross the congested DUS "throat tracks" shared by all trains going into and out of DUS.

2. **High-floor FRPR platforms will require dedicated station-sidings:** In order to offer boarding without assistance to either 24" low-floor or 51" high-floor vehicles, dedicated station sidings must be built that do not conflict with the freight rail loading gauge. Thus in consideration of the previous DUS infrastructure requiring 51" high-floor vehicles for level-boarding, station sidings with equivalent high-floor 51" platforms will be required.

3. **FRPR infrastructure must be built to be expanded:** especially on sections of track within the RTD District where frequent commuter-style service was promised, FRPR and RTD must partner to build station infrastructure that can be expanded in a future double, triple, or even quad-tracking scheme without needing to be replaced. Infrastructure must be built for the future to fit a 50+ year expansion timeline.