

High-Speed Rail in the U.S.

The Mega Project Delivery Perspective

May 2025



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Executive Summary

The United States is on the brink of transforming how it moves people, connects communities, and bolsters regional economies. After decades of cautious progress, existing rail services like Amtrak's Acela and Brightline Florida have demonstrated that there is increasing public appetite for faster, smarter, more efficient intercity transport. Such projects are creating a solid foundation on which to learn, build and move forward with increased confidence and certainty.

However, to realize high-speed rail's (HSR) full potential — a nationwide network connecting major population and economic centers - the U.S. must avoid the most common pitfalls that lead to ballooning costs, chronic delays and waning public support.

Fortunately, this is entirely possible. But, it requires more than just a rail plan. What's needed to make HSR successful in the U.S. is a bold, coordinated effort to transform how projects are delivered. Systematic program management — with the right structure, built-in accountability, transparent approach to financing, and a fully integrated team from start to finish — will turn unrealized ambition into a ground-breaking national achievement.

The good news? We don't have to start from scratch. By drawing on proven lessons from countries that have delivered HSR, the U.S. can bring speed, and scale to its own network.

The case for HSR is compelling. Rail transportation is the lifeblood of vibrant regions and cities. It not only drives economic growth, creates jobs, and strengthens supply chains — it also advances global sustainability and carbon reduction goals. Electrified HSR can cut emissions by up to 95%

compared to flying and generates ten times fewer emissions than cars.

And perhaps most appealingly, it improves quality of life. Per mile, rail is twenty times safer than driving. It also provides commuters with a faster, more affordable alternative to gridlocked roads and highways — increasing capacity across the broader transportation network and easing congestion.

When we consider other countries enjoying the social and economic benefits of HSR, the opportunity for the U.S. is clear. In just 15 years, China has delivered over 27,000 miles of high-speed lines. Europe has more than 5,000 miles, Japan over 1,800, and Russia 800. Meanwhile, the U.S. has yet to build a true high-speed line. With the right investment, America can leapfrog outdated systems and deliver a network designed for the future.

The U.S. High Speed Rail Association (USHSR) has proposed one approach, a 17,000-mile, four-phase national HSR network that would revolutionize the country's transportation landscape. This system is projected to create substantial employment opportunities, stimulate transit-oriented development, and drive economic growth.

And yet despite clear advantages, the U.S. has faced challenges in scaling up HSR. Funding has been inconsistent. Permitting is slow and fragmented. Land acquisition is often complex. Delivery systems — from institutional structures to on-the-ground capacity — have not evolved at the pace required. But these challenges can be overcome.

This white paper offers a comprehensive approach for successful HSR delivery in the U.S. It identifies what's held HSR back, and what's needed to propel it forward. It begins with the key **Enablers**, political will, funding, and institutional capacity. Success is contingent on sustained political, institutional and public support.

Next, the paper calls for bold **Reforms**, including faster permitting and streamlined land acquisition. These sections draw on insights from our expert contributors who, like us, want to see changes that will help deliver HSR and bolster connectivity throughout the U.S.

Finally, the paper addresses **Delivery**, with lessons learned from mega-projects around the world that tell us HSR can be delivered on time and on budget. The key is starting with the end in mind: laying out a shared vision and then designing an innovative and integrated delivery model that can manage the complexity with skill and efficiency.

The world's leading HSR systems in France, Japan, Spain, and beyond show us this is possible. Experienced contractors and delivery partners like Bechtel have helped translate policy ideas into viable, high-performing transit. By combining the shared knowledge and experience of governments, public bodies, and practitioners, this paper sets out a comprehensive path to delivering a world-class HSR system for Americans to connect, work and thrive for generations to come.

At a Glance

These catalysts highlight the key drivers of successful HSR delivery. Each is briefly introduced here and explored in greater depth later, with clear rationale and implementation guidance.

Enablers

1. Maintain a Long-Term Vision with Adaptive Phasing
2. Develop the Workforce and Operational Readiness Early
3. Drive Technological Innovation and Supply Chain Maturity
4. Political and Public Support
5. Secure Phased and Sustainable Funding

Reform

6. Enable Corridor-Based Delivery Through Regional Coordination
7. Streamline Permitting and Environmental Approvals
8. Accelerate Land Acquisition and Engage Communities
9. Standardize HSR Design Nationwide
10. Optimize HSR Development to Improve Efficiency

Delivery

11. Define Clear Project Objectives and Scope from the Start.
12. Integrate Delivery Functions Early
13. Foster a Collaborative Delivery Culture
14. Implement Advanced Project Controls
15. Employ Strategic Commercial Management
16. Master Complexity with Rigorous Integration Management
17. Finish Strong with No Surprises

Transforming the U.S.: A High-Speed Rail Revolution

Imagine America connected coast-to-coast by sleek high-speed trains moving at 220 mph. This bold vision for HSR could revolutionize how Americans live, work, and travel. More than transportation, it's a blueprint for national connectivity and prosperity, championed by advocates like the U.S. High-Speed Rail Association.

Picture a national network transforming distances into mere hours, connecting Chicago to Detroit or Los Angeles to San Francisco without the hassle of traffic or the limitations of air travel. HSR would bring urban and rural communities closer together, making jobs, education, healthcare, cultural, entertainment, sporting events, and family visits accessible like never before. HSR is also one of the safest ways to travel — Japan's Shinkansen, the world's first bullet train, has operated for over 60 years without a single passenger fatality.

HSR is a high-impact investment for the U.S. economy and infrastructure. Every \$1 billion invested generates 20,000 good-paying jobs — from engineering and construction to domestic train manufacturing — supporting American workers and supply chains.

Stations become magnets for private investment, spurring urban renewal, attracting employers, and unlocking growth in underserved regions. Experience from Europe and Japan shows that HSR

consistently delivers these outcomes, transforming station areas into vibrant economic hubs. For policymakers focused on economic strength, job creation, and smart growth, HSR is a proven catalyst.

Ambitious infrastructure has always defined America — from the Transcontinental Railroad to the Apollo missions. These efforts succeeded not because they were easy, but because the country committed to doing something bold. That same spirit still exists today.

Amtrak's Acela has captured 50% of the air-rail market share between Washington, D.C. and New York City — proof of public demand for faster trains. But Acela still doesn't meet the definition of HSR. It's constrained by legacy signaling systems and speed limits. Just imagine what a true high-speed line could deliver. Getting one up and running would be a pivotal moment — building public trust, driving adoption, and generating momentum nationwide.

As Bob Yaro, President of North Atlantic Rail Alliance, put it, *"...getting the first one of these schemes in the US up and running is going to be of critical importance. In 1938, the Pennsylvania Turnpike opened, and everybody saw this and said, 'Wow, I want one!'"*



"Ultimately, high-speed rail isn't just about offering consumers alternative and more efficient travel choices. It's about expanding choices, fostering innovation, and driving national progress — learning from past challenges to build a better, faster, more connected future."
Keith Sibley, Bechtel's Rail Program Director

The Economic Benefit of High-Speed Rail in the United States

HSR offers a compelling alternative to traditional intercity travel — reducing journey times, increasing reliability, and easing congestion on overcrowded highways and at airports. Many U.S. city pairs are ideally suited for HSR, with distances and demand profiles that make rail a viable and attractive option.

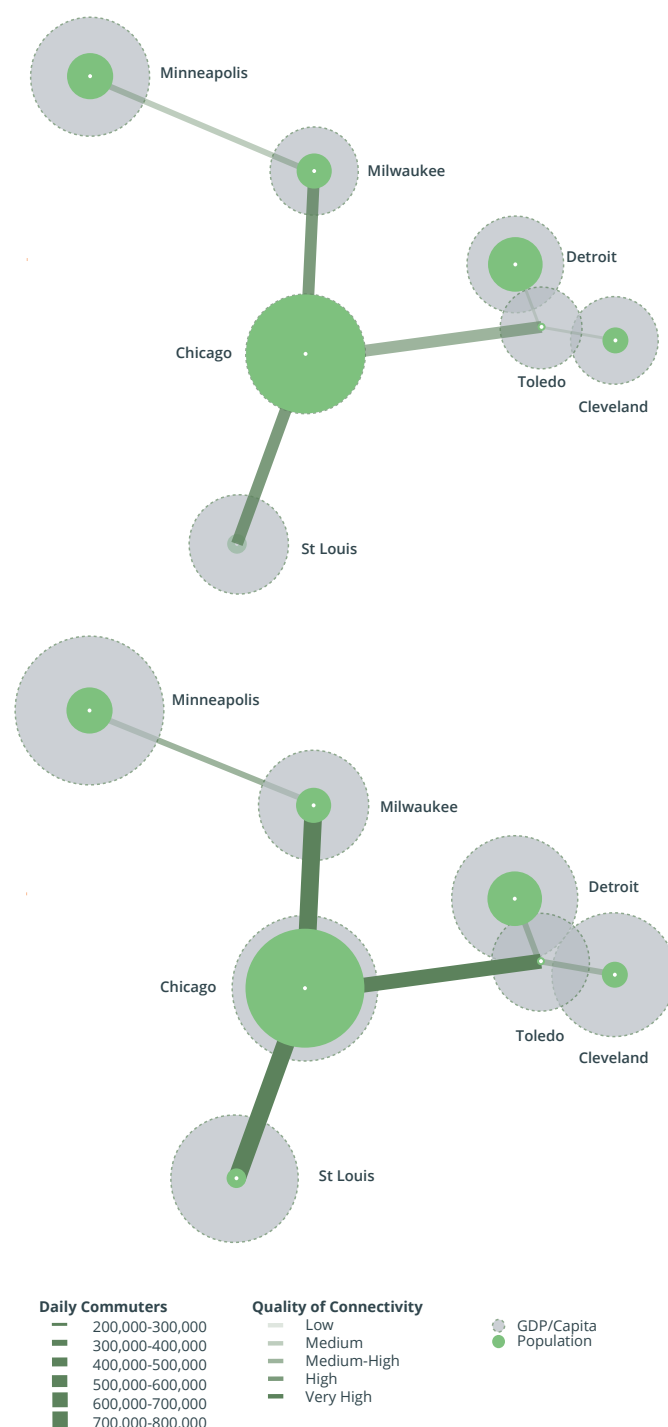
HSR is also widely recognized as a catalyst for real estate development and boosting house prices and land values. Brightline in Florida has been described as *“an old-fashioned real estate deal with a railroad attached.”* Investors see much of their return not from fares alone, but from the value created around stations: housing, offices, retail, and civic space that flourish with rail access.

The U.S. is well-positioned to harness this potential. It benefits from high state capacity, strong per capita income, and land markets that reward good urban connectivity — all key factors for generating both farebox revenue and broader economic uplift. With smart planning, HSR can drive dense, walkable housing and commercial development around stations and anchor regional growth in a way that highways and airports rarely do.

The benefits ripple far beyond transport. Road congestion costs the U.S. economy an estimated \$140 billion annually in lost productivity, while tens of thousands of lives are lost each year on highways. HSR offers a safer, cleaner, and more efficient alternative — relieving road networks and supporting more sustainable infrastructure planning for the long term.

With focused investment, strategic coordination, and a long-term commitment, the U.S. can turn HSR into a transformative force — unlocking mobility, economic value, and quality of life for generations to come.

Improving GDP per Capita through transit connectivity: before and after HSR



Enablers

Delivering HSR in the United States is a generational opportunity — and it will depend on getting a core set of enablers right:

- Strong political support,
- Widespread public and community support,
- Sustainable, long-term funding,
- A skilled and future-ready workforce,
- Advanced, reliable technology, and
- A resilient, domestic supply chain capable of scaling with demand.

Just as important, a modern planning and environmental permitting framework is essential — one that enables timely, coordinated decisions without compromising environmental integrity. This is covered in detail in the Reform section of the report, where we outline the specific improvements needed to make permitting work for HSR. Together, these enablers form the foundation for delivering HSR at the pace and scale the country needs.

Sustained Political Support

Infrastructure on this scale requires decades of continuity, from funding authorizations and regulatory reforms through to project delivery.

Presidential sponsorship would elevate these efforts further — as shown throughout American history. Washington supported early roads and canals to unify the young nation. Jefferson backed the National Road to open the western frontier. Lincoln signed the Pacific Railway Act to build the Transcontinental Railroad and bind the Union. Eisenhower launched the Interstate Highway System to boost economic growth. Kennedy set a bold national goal to land on the moon, driving innovation and global leadership.

Each of these initiatives was transformational — proving that when presidential vision aligns with public need and political will, the nation can achieve the extraordinary.

Public Support: The Foundation for Success

Across polls, a clear majority of Americans say they'd use HSR if available — and they support investment to make it happen. One national survey found that 74% of rural voters backed efforts to build a stronger passenger rail network.

While public enthusiasm is vital, translating it into lasting change requires more than goodwill alone.

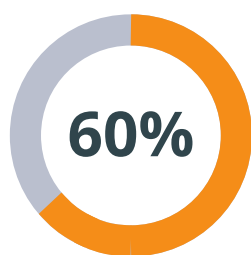
Advocacy groups like the USHSR are leading the charge — publishing bold vision maps, lobbying for a national HSR authority and trust fund, and making the case that HSR is as American as the Eisenhower Interstate Highway Program of the 1950s and 1960s.

Broad-based coalition building is key. That means clearly emphasizing what it means and what benefits it brings to key stakeholders, e.g.:

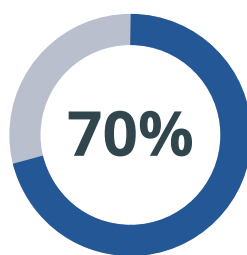
- **Communities:** Articulating the benefits to the broad spectrum of communities along the route(s)
- **Labor Unions:** High-quality jobs and skilled workforce development
- **Business Groups:** Growth around stations and new market opportunities
- **Regional Planners:** For smart city-to-city connections and access to more housing options
- **Environmental Advocates:** For cleaner travel and reduced emissions
- **Private Investors:** Making a compelling case for stable, long-term returns to mobilize private capital through subsidized financing and PPPs

Each of these constituencies brings influence — and together, they can make HSR not just a progressive ideal, but a national imperative.

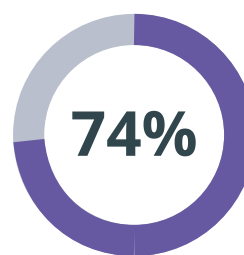
The % of the Population Supporting High-Speed Rail



National US
Newsweek (Redfield & Wilton)
2024 Data



Texas Dallas-Houston Corridor
Guardian (via Texas Central surveys) 2024 Data



US Rural Areas
Rail Passengers Association
(Change Research) 2021 Data



We are proud to have stepped in as the private sector sponsor of the Texas high-speed rail. We agree with Secretary Duffy that this project should be led by the private sector, and we will be proud to take it forward. This project is shovel-ready and will create significant new jobs and economic growth for Texas as part of President Trump's efforts to boost the U.S. economy."

John Kleinheinz, President and CEO of Kleinheinz Capital Partners



Paying for High-Speed Rail

Rail projects are capital-intensive, with long-lived infrastructure that can operate for over a century once built. While construction takes years, the benefits accrue over generations. Most projects can't recover both capital and operating costs through user fees alone, so their "bankability" depends on aligning upfront investment with reliable income — whether from fares or broader public funding. Without serious investment, projects stall before they start.

Funding vs. Financing: Why the Difference Matters

These two terms are often used interchangeably, but they refer to distinct concepts — and both are essential to delivering HSR.

A useful way to think about the difference is through a familiar example:

- **Funding** is like income — the revenue used to cover ongoing costs, such as fares, taxes, or government grants.

- **Financing** is like a mortgage — it provides upfront capital now, based on expected future income, and is repaid over time.

Both are needed to build and sustain a high-performing system. Recognizing the distinction helps ensure better planning, clearer decisions, and faster delivery.

A Smarter Funding Model – Local to Federal

The answer could be a creative blended approach that combines federal leadership, state contributions, private capital, and innovative tools.

1) Federal Leadership with Dedicated Funding

Delivering HSR at scale requires consistent, long-term investment — not one-off grants or short-term programs. Other major transportation modes in the U.S. benefit from stable funding streams: the Federal Highway Trust Fund, for example, is backed by the federal gas tax and has underpinned road expansion for decades. HSR lacks a comparable foundation.

Establishing a dedicated HSR trust fund could be a game changer. While any new funding mechanism would require congressional approval and careful stakeholder engagement, even modest, steady investment — for example, \$5 billion per year — could unlock critical progress on priority corridors. There are different ways this could be achieved. Some proposals have included reallocating a portion of existing revenues, such as the gas tax, or exploring targeted surcharges on short-haul flights, where rail offers a viable alternative. These approaches aren't without controversy and would need to be structured to ensure fairness, transparency, and broad public support. The core principle is clear: a stable funding base is essential to move HSR from pilot to program — and to give states, regions, and the private sector the confidence to commit.

Alongside the powerful financing tools offered by the U.S. Department of Transportation and the Build America Bureau, there are two key instruments particularly relevant for HSR projects.

Private Activity Bonds “PABs” enable private sponsors to tap into the tax-exempt municipal bond market, accessing its deep liquidity and competitive interest rates. Since interest earned on these bonds is tax-free, lenders accept lower rates, passing on the savings to the project issuer. PABs are a unique financial tool, available only for projects that serve the public interest — transportation infrastructure clearly qualifies. However, access to PABs is not guaranteed. Because they reduce federal tax revenue, Congress must authorize a national volume cap through surface transportation legislation. The most recent authorization, under the 2021 Infrastructure Investment and Jobs Act (IIJA), set a limit of \$30 billion.

Federally Subsidized Loans: TIFIA and RRIF
Through the Build America Bureau, USDOT offers direct loans via the TIFIA (Transportation Infrastructure Finance and Innovation Act) and RRIF (Railroad Rehabilitation and Improvement Financing) programs. These loans are exceptionally attractive to borrowers, offering:

- Interest rates set at U.S. Treasury rates plus one basis point
- Repayment periods of up to 75 years
- Flexible, sculpted payment profiles

These terms make the debt as affordable as possible. Borrowers should aim to ensure their project is compliant with RRIF or TIFIA requirements and maximize the use of these programs in their capital stack.

However, federal loans come with limitations. Because they are provided at below-market rates, they reduce federal interest income. To offset this and manage risk, Congress allocates a capped amount of “credit subsidy” through surface transportation legislation. The most recent such allocation was under the 2021 IIJA. While there is no hard cap on total loan volume, the budget authority acts as a practical ceiling.

Access to RRIF and TIFIA financing is highly valuable but inherently limited. Large HSR proposals may quickly deplete the available credit authority, particularly if several megaprojects are seeking support simultaneously. To improve the chances of securing these loans, projects will need robust preparation, strong alignment with national transportation and infrastructure priorities, and early, proactive engagement with USDOT and Federal Railroad Administration (FRA) to ensure eligibility and competitiveness within the constrained funding envelope.

2) State and Local Skin in the Game

Stable public funding is essential to attract private partners and ensure delivery. While private capital can and should play a role, international experience — and recent U.S. lessons — show that large-scale rail infrastructure requires strong public commitment, particularly in the early phases.

States, in particular, can play a leading role. Just as they collect their own gas taxes to fund state DOT projects, states could establish dedicated revenue streams for HSR. In many cases, federal funding programs require state matches — not only

to share cost, but to reinforce commitment and alignment.

There is also room for creativity in how these state contributions are structured. For example, California’s Proposition 1A authorizes the issuance of bonds backed by projected revenues from the state’s Cap-and-Trade program, administered by the California Air Resources Board (CARB). This approach reflects how innovative financing tools can be used to secure long-term public investment.

Another funding source that is growing in popularity, and necessity, is value capture from TOD (Transit Oriented Development) or other monetization of the right of way. One method of financing this type of value capture is via TIF districts, which allow the borrower to identify a portion of future property taxes associated with urban development as a funding source that could be utilized in HSR delivery. (Going back to the residential mortgage analogy, this is akin to getting a mortgage based on tenant income for a home that’s not built yet. Just because it’s speculative doesn’t mean it’s not financeable.)

3) Smart Public-Private Partnerships (PPPs)

Pure private funding for HSR is rare, but public-private partnerships (P3s) can mobilize capital and bring project delivery and operational expertise. Bechtel Enterprises, Senior Development Director, David Blaisdell, explains, *“The key is to allocate risk appropriately and collaboratively between the private*

consortium and the public sector to optimize cost, delivery, and long-term performance.”

There is significant private capital available for railway infrastructure, but private investors are generally unwilling to shoulder the political and permitting risks alone. Without clear government leadership and sovereign investment, many private entities will hesitate to engage — particularly when navigating uncertain regulatory processes.

While some projects — such as Brightline West, whose recent bond issue was significantly oversubscribed, reflecting strong investor confidence — have progressed without government-backed revenue guarantees, many still benefit from public support mechanisms. Tools like availability payments, first-loss protection, or value capture agreements can help manage early-stage risks, particularly when passenger revenues are uncertain. These commitments can give private investors the confidence to participate and secure financing. In return, private partners bring innovation, commercial discipline, and a long-term focus on operational efficiency, including value creation through real estate and station development.

P3 models have been implemented across the rail sector in North America, Europe, Australia, and parts of Asia and Latin America — each adapted to the specific financial and institutional context of the corridor.

Quick Guide: Federal Financing Tools for High-Speed Rail

Tool	What It Does	Who It’s For	Key Benefits	Considerations
Private Activity Bonds (PABs)	Tax-exempt bonds for private sponsors	Projects with public benefit (e.g., rail infrastructure)	Access to low-cost capital via municipal bond market	Subject to Congressional cap (\$30B as of IIJA 2017); no guarantee of full allocation
Federal Subsidized Loans (TIFIA & RRIF)	Direct federal loans with favorable terms	Public or private project sponsors	Treasury-rate interest, sculpted repayments, up to 75-year terms	Must meet program requirements; strong candidate projects encouraged to apply

Workforce: Building Capacity for High-Speed Rail

At the heart of HSR readiness is people. America simply doesn't yet have a large, specialized workforce trained to build, run, and maintain 220 mph railways — because America has never had one. This gap spans the full lifecycle of delivery, from early-stage construction to long-term operations.

It includes everything from civil works, systems installation, and track construction to driver training, maintenance protocols, business models, safety systems, and service planning.

The workforce gap spans all roles:

- 67% of HSR jobs will go to workers with high school or less — electricians, welders, equipment operators, track layers
- 19% will require some college or technical degrees — signal techs, foremen, technicians
- 14% will require bachelor's degrees or more — engineers, systems integrators, operations managers

For every engineer, you need dozens of skilled tradespeople. That means vocational training, pre-apprenticeship programs, and on-the-job experience are just as vital as university degrees. It also means preparing the workforce not only to operate HSR but to physically build the infrastructure to the demanding specifications it requires.

And with 20,000 jobs created per \$1 billion invested in HSR, we'll need tens of thousands of new workers — fast.

Unions and labor alliances will be essential partners in making that happen. The High-Speed Rail Labor Coalition, representing 160,000 railroad workers, has already shown its impact — playing a pivotal role in advocating for funding for both Brightline West and California High-Speed Rail. Their continued leadership and coordination across crafts will be critical in scaling up the workforce nationwide.

Likewise, the California Building Trades have been a steadfast and influential advocate for California's project, ensuring union jobs and training opportunities remain central to its success. Their continued involvement will be essential to delivering HSR in a way that uplifts American workers and communities — both in construction and in long-term operations.

Training the Next Generation

The work has begun — but it's just the beginning:

- Penn State Altoona offers the nation's only dedicated 4-year rail engineering degree
- University of Illinois and Michigan Tech are expanding rail-specific course offerings
- The International Union of Operating Engineers' training center in Crosby, Texas, now includes a program specifically focused on HSR.
- Community colleges are developing HSR-relevant curricula in areas like signaling, rolling stock maintenance, and systems engineering



20,000
JOBS CREATED PER
\$1 BN
INVESTED

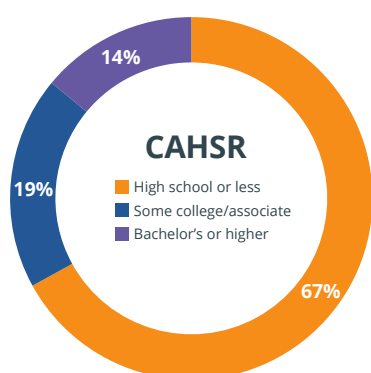
One standout is the High-Speed Rail Construction Skills Training Center in Selma, California — a 16-week pre-apprenticeship program launched by California HSR Association in partnership with local building trades and colleges. It recruits veterans, at-risk youth, and underrepresented groups for high-quality jobs in rail construction.

Programs like Selma and Tunnelling and Underground Construction Academy in the UK, show what's possible. These centers aren't just about building skills — they create pathways to

economic mobility and long-term employment. Every HSR corridor could embed similar training facilities into its delivery model from the outset.

Unions and contractors will also be vital. Apprenticeship programs must evolve to include HSR content: 25-kV electrification, slab track installation, trainset diagnostics, and more. Many core skills already exist in adjacent trades — electricians, mechanics, linemen — but targeted upskilling will be essential.

Workforce Education Distribution



The Talent Gap: Engineers and Builders Wanted

Behind every high-speed train is a small army of rare, highly in demand specialists: designers, systems integrators, signal engineers, power technicians, and construction managers. Right now, the U.S. doesn't have enough of them. The tenure of HSR projects provides the opportunity to plan, evolve and develop this talent pool for the future.

American engineers are skilled — but most haven't worked on a high-speed corridor. That's why California brought in European consultants to support design and systems integration. That knowledge transfer is working and needs to scale. Over time, we'll grow our own experts, but only if early projects succeed and invest in training.

Standards are another unlock: as American Railway Engineering and Maintenance-of-Way Association (AREMA) and Federal Railroad Administration

(FRA) collaborate on high-speed track and systems guidelines, pulling from international best practices, designers and contractors will finally have a U.S. reference point to work from.

And every project that moves forward — California, Brightline West, North East Corridor upgrades — becomes a training ground for engineers, managers, and manufacturers. That's how readiness grows.



Crossrail Tunnelling and Underground Construction Academy & Apprenticeship Scheme

A valuable international example from the UK is the Tunnelling and Underground Construction Academy (TUCA) in London that was established to up-skill the industry. Managed by Bechtel, TUCA opened in 2011 as a state-of-the-art facility aimed at providing specialist technical skills for the Crossrail project and future infrastructure projects, creating a lasting legacy for the UK construction industry. Bechtel's Deputy Chief Engineer, Elias Sahyoun said,

"Over seven years, TUCA trained more than 20,000 people, in parallel with over 1000 apprentices trained on Crossrail."

While UK-based, TUCA and the Crossrail apprentice scheme offers a proven model of how to leave a lasting legacy of expertise and workforce capacity — a model the U.S. can draw from in building its own high-speed rail capabilities.

Leveraging Emerging Technologies: Smarter, Faster, Safer High-Speed Rail

Technology will be the cornerstone of building and operating HSR in the U.S. To create a cutting-edge rail network, adoption of emerging technologies is crucial. The application of emerging technologies offers potential to accelerate delivery, enhance safety, and create a better passenger experience.

- **Digital Engineering:** Through Building Information Modeling (BIM) every project detail is digitally constructed first, significantly reducing construction errors, conflicts, rework, and associated costs. While digital twins dynamic digital replicas of physical rail systems — continuously integrate real-time data from drones, sensors, and laser scans.
- **Automation and Robotics:** Robotics and automation in tracklaying and construction, as demonstrated in countries like China and the UK, can drastically shorten timelines and improve safety on construction sites.
- **Extended Reality (XR):** Augmented Reality (AR) and Virtual Reality (VR) are transforming workforce training and quality assurance. AR provides onsite technicians immediate access to critical information, while VR simulation training prepares personnel efficiently for real-world challenges. International industry leaders such as Alstom already utilize XR, underscoring the urgency for U.S. rail to integrate these innovations.
- **Artificial Intelligence (AI):** Predictive analytics, powered by AI, will ensure optimal resource allocation, enhance safety, and proactively address potential issues during construction and operation.
- **Smart infrastructure and predictive maintenance,** powered by sensors and analytics, shift rail maintenance from reactive to proactive. Network Rail UK's use of intelligent infrastructure significantly reduces disruptions and extends asset longevity. Additionally, autonomous drones and inspection robots enhance safety and efficiency by continuously monitoring infrastructure, thus minimizing manual inspections.
- **Sustainable by Design:** New tools can also shrink our carbon footprint. Electrification powered by renewables, as seen in California and Belgium, eliminates diesel emissions. Graphene-enhanced concrete and geopolymer materials reduce embodied carbon. Smart infrastructure adapts to climate stress, increasing resilience over decades of use.
- **Reimagining the Passenger Experience:** Mobility-as-a-Service (MaaS) platforms integrate ticketing, trip planning, and real-time alerts in a single app. Technologies such as contactless biometric systems expedite station access, exemplified by Japan's facial recognition gates. Internet of Things sensors and personalized digital services onboard further enhance comfort and convenience, with particular attention to accessibility to ensure inclusive benefits.
- **Cybersecurity: Protecting What We Build:** As rail networks increasingly digitize, cybersecurity becomes paramount. Protecting passenger data, safeguarding operational technology, and responding effectively to incidents require robust measures. AI-powered monitoring, proactive "security by design," and vigilant vendor management are essential to securing operational integrity and public confidence.
- **Offsite systems integration facilities.** Mega rail projects are technology integration projects just as much as they are heavy civil programs.

Taking a High-Speed train instead of a short flight could lower your emissions by up to 95%

The technology exists. The global case studies are clear. Elias Sahyoun, Bechtel's Deputy Chief



"High-speed rail is more than a transportation project — it's a job creation engine that puts skilled union workers to work building, operating, and maintaining a modern, world-class system." **Larry I. Willis, former President of the Transportation Trades Department of the American Federation of Labor and Congress of Industrial Organizations**

Engineer, goes on to say, *“By embedding innovation from the start — not as an add-on — the U.S. can leapfrog decades of incrementalism. The result: faster builds, better jobs, safer systems, and a future-ready rail network.”*

Technical and Supply Chain Readiness: Building What We’ve Never Built Before

HSR requires more than just upgrading existing systems — it demands new, precise engineering for speeds of 220 mph. While the U.S. has the civil works expertise, building the necessary technical capacity for HSR presents unique challenges. This section covers the gaps we need to address, the role of technology in streamlining delivery, and how we can leverage both U.S. and international expertise to build a robust domestic HSR industry.

The following are the key technical features essential for creating a world-class HSR system:

Precision Track & Infrastructure: High-speed trains demand ultra-straight, ultra-smooth track — far beyond freight rail standards. This means continuously welded rail, tight alignment tolerances, and a rock-solid foundation to withstand 200+ mph speeds. The FRA defines five technical levels of rail, from conventional rail (Level 1) to maglev (Level 5). Most U.S. mainline track operates at Level 1—60 mph for freight and 80 mph for passenger. Only limited sections of the Northeast Corridor (Acela, up to 150 mph) and Brightline Florida (up to 120 mph) qualify as Level 2. The FRA currently has no certified HSR (Level 3+) in operation. For U.S. railroads, this level of precision sets a new bar for both engineering and maintenance.

Electrification Gap: Most U.S. rail corridors aren’t electrified, outside a few legacy lines.

Chris Enoch, Bechtel’s Global Rail Sector Lead explains that *“only 2% of the U.S. rail network is currently electrified, compared to 40% in the UK and 70% in China. That means limited U.S. domestic capacity to deliver overhead catenary systems, substations, and high-voltage infrastructure.”*

Traditionally, full electrification has been seen as essential for HSR. However, new technologies are beginning to reshape that assumption. Railways worldwide are now exploring advanced onboard battery systems that allow trains to operate on partially electrified routes — drawing power from overhead lines where available and switching to stored battery power in non-electrified segments. Germany and the UK are progressing with battery-electric and hybrid train trials on regional routes, highlighting the potential of these technologies. As they advance, battery-assisted solutions could offer U.S. projects added flexibility — especially for phased delivery or environmentally sensitive areas. While full electrification remains the standard for HSR, partial electrification with onboard energy storage may help reduce costs and speed up implementation.

Advanced Signaling & Train Control: HSR relies on continuous, automated signaling — like Europe’s European Train Control System or Japan’s Automatic Train Control — to run safely at full speed with tight spacing between trains. U.S. systems like Positive Train Control cap out around 125 mph. To go faster, we’ll need to adopt international tech and train up local expertise — something already underway on projects like Brightline West.

Next-Gen Rolling Stock: There are currently no U.S.-built trains in operation capable of 200+ mph — but that’s beginning to change. Brightline West has ordered its new “American Pioneer 220” trains from Siemens, which will be built at a new facility in Horseheads, New York starting in 2026. While the new Acela hits 160 mph and is assembled by Alstom, these Siemens trains mark a significant step toward domestic high-speed manufacturing. The good news: global manufacturers are ready to build here — if there’s a steady pipeline of orders. Long-term commitment from U.S. policymakers is the key to unlocking and sustaining domestic production.

The U.S. Readiness Gap

The U.S. rail network is currently mostly 20th-century freight lines with aging infrastructure, built for 79 mph service. As a result, there's a clear technical readiness gap when it comes to building HSR from the ground up. Baking in systems thinking is a key lesson we've learned from many rail programs and helped distill in "Embracing a Systems Approach to Infrastructure Delivery: Key Insights from the Institute of Civil Engineers – Mission Critical Elements"

Technology Can Help

Modern tools can streamline various phases of HSR projects, including land acquisition and project tracking:

- **GIS for Route Planning:** Using geographic information systems to minimize impact and identify the best alignments.
- **Project Management Software:** Tracking parcels, timelines, and legal actions in real-time, with dashboards that highlight risks early in the process.

Civil Works: Ready to Go

Here's the good news: more than 70% of HSR capital costs go into core civil construction — and that's an area where U.S. firms already excel. American contractors have delivered complex transit systems, highway megaprojects, and major airport terminals. We know how to move earth, bore tunnels, build bridges, and pour concrete — and HSR builds on those strengths.

A 220-mph train bridge is still a bridge — but it demands new design criteria, tighter tolerances, and a more specialized delivery approach. The technical expertise exists, but engineers must now apply it with a deep understanding of HSR requirements. The challenge is scaling that capability to meet the specific demands of this mode.

Buy America: Prioritizing U.S. Jobs and Innovation

Buy America provisions have long been a cornerstone of federally funded rail projects, directing taxpayer dollars to U.S. jobs and industries. But for HSR, they present a challenge, many critical components aren't yet manufactured domestically. Navigating this risk will require alignment with both global and emerging U.S. supply chains. A pragmatic approach can unlock progress now while advancing long-term economic goals.



Offsite Systems Integration Facilities

- With industry partners, Bechtel has increasingly managed the implementation of innovative offsite systems integration facilities on a number of international projects.
- Using hardware and software configurations from multiple contractors, These facilities have been key to trouble shooting defects early and resulting in an overall reduction in defects found on site, which ultimately lead to improvements in on site testing productivity.
- They can also serve as a training and familiarization facility for operational staff in later project stages, demonstrating a strong business case for its investment.

Building a U.S. Rail Industry That Works

The U.S. cannot afford to approach HSR with business-as-usual costs. As Bob Yaro points out, *“we’re paying 4–5 times as much... as the rest of the world”* for rail infrastructure today. To close that gap, America must not only streamline delivery but also cultivate a domestic rail supply chain. If the U.S. makes a long-term commitment to HSR, Yaro argues, industries will grow here to supply steel, concrete, and rolling stock — reducing reliance on imports and creating sustained American manufacturing jobs.

The Strategy for Building a Robust U.S. Rail Industry

The plan is straightforward and focused on long-term growth:

- **Start with what we need:** Allow early HSR projects to source international components, filling the immediate gaps in U.S. manufacturing.
- **Pair imports with knowledge transfer:** Use international technology and expertise as a steppingstone to build U.S. capacity over time, while proactively supporting a shift to domestic production.
- **Support suppliers in the U.S.:** Encourage manufacturers like Siemens, Alstom, and Hitachi to build production lines in the U.S. by creating a stable, predictable pipeline of orders. These companies have already expressed interest, with Siemens building low-speed trainsets in California and Stadler assembling trains in Utah. With the right government signals, they can scale up faster.

What This Means for Early Projects

The first few U.S. HSR lines will understandably rely on global technology and expertise to bridge the gap. However, it’s crucial to approach this transition strategically:

- **Localization with global technical talent:** Leveraging international expertise in rail delivery, while simultaneously building U.S. capacity and developing local talent
- **Smart waivers:** Using waivers judiciously to ensure the fastest possible build-out, while providing the foundation for future domestic manufacturing; e.g. in 2020, the FRA granted Texas Central a Rule of Particular Applicability approving Shinkansen technology for its Dallas–Houston line — demonstrating how smart, tailored waivers can enable global systems while supporting future U.S. capabilities.
- **Investing in standards and training:** By creating robust industry standards and training programs, you can prevent reinventing the wheel on every project, enabling a smoother transition to domestic manufacturing.
- **Building confidence through long-term commitment:** Industry needs certainty and a steady stream of projects to scale up production. By committing to a reliable, long-term pipeline of HSR work, you can provide the stability needed to build a thriving U.S. rail ecosystem.

Just as countries like Japan and France spent decades developing their own HSR industries, the U.S. can compress that timeline with the right commitment to partnerships, smart policy, and sustained investment. Now is the time to build that foundation — and to do so in a way that prioritizes U.S. jobs and industry growth for the future.



Tim envisions high-speed rail as a once-in-a-generation transformative infrastructure that should be accessible and beneficial to as many people as possible. He believes that high-speed rail will transform regions, opening up new housing, employment, and business opportunities, thereby contributing significantly to regional economic development and community connectivity.

Tim Parker, CEO Australian High-Speed Rail Authority

Enablers Summary

Maintain a Long-Term Vision with Adaptive Phasing

Implement a national HSR masterplan that lays out a series of achievable phases toward a connected network. Remain flexible by adapting each phase based on real-world lessons and technological advances, while keeping the ultimate vision of nationwide HSR connectivity as the guiding star.

Develop the Workforce and Operational Readiness Early

Begin training the future workforce well before the railway is finished. Launch specialized training programs and trial operations in advance so that qualified operators, maintenance crews, and operating protocols are in place, ensuring a smooth transition from construction to full service without last-minute surprises.

Drive Technological Innovation and Supply Chain Maturity

Close the HSR technology gap by developing domestic capabilities for HSR (e.g. precision track construction, electrification systems, advanced signaling, next-generation rolling stock). Leverage proven international expertise and commit to a steady pipeline of projects to encourage global manufacturers to localize production — building a robust U.S. supply chain ready to deliver a world-class HSR system.

Political and Public Support

Encourage broad political support and policy commitment that extends beyond election cycles. Identify cross-party champions and maintain transparent public communication about the project's benefits and progress, using early wins and visible milestones to sustain momentum and trust.

Secure Phased and Sustainable Funding

Commit to long-term funding through dedicated sources such as a federal HSR trust fund, supplemented by state, local, and private investments. Innovative financing tools (e.g. green bonds, value-capture, public-private partnerships) could be used to ensure the project has steady, predictable funding across all phases.





Reform

Delivering HSR isn't just about having a vision; it requires overcoming the barriers that have historically stalled progress — political, institutional, environmental, logistical, and more. In this section, we'll closely examine the reform needed to overcome these barriers, going deeper on the ones we find to be most crucial:

- Fragmented institutional efforts
- Inconsistent technical standards
- Delayed permitting
- Slow land acquisition

Coordinated Institutional Efforts

HSR in the U.S. requires coordinated action across federal, state, local, and private entities. The current system is fragmented, with no consistent mechanism to guide projects from planning through to operation. While the FRA plays a key role, its regulations remain oriented toward conventional rail and must evolve to support modern, high-speed systems and enable state-led delivery.

Readiness levels vary between states and appear to lack the institutional capacity to deliver largescale HSR projects independently. That said, several regions — including the Northeast, Midwest, and Texas — show strong potential and growing momentum.

Industry and advocacy groups are helping to unify the field by promoting technical standards, advancing research, and fostering shared learning. International examples, such as Société Nationale des Chemins de Fer in France and JR Group in Japan, demonstrate how integrated delivery systems can improve outcomes. While these models are centralized, the U.S. can adapt their principles in a way that respects its federal structure and state autonomy.

To address existing gaps, the U.S. could:

- Optimize FRA's HSR charter to be responsible for:
 - a. driving a consistent, prioritized national approach, including standards roadmap;

- b. active coordination and partnering with regional / state-led programs;
 - c. expediting planning, permit and approvals processes;
 - d. clearing the path for creative privately led development.
 - Strengthen partnerships with regional and state-led efforts.
 - Establish voluntary joint federal–state–community task forces to guide corridor development, ensure local input, and secure long-term support.
 - Encourage knowledge-sharing networks and collaboration with international peers to adopt best practices without duplicating effort.
 - Create incentives for states and communities that proactively support HSR, ensuring they are not only participants in the process but also beneficiaries.
- American Public Transit Association (APTA) convenes agencies and suppliers to share insights and align planning.
 - High-Speed Rail Alliance is building grassroots support for HSR with mayors and local volunteers around the country.
 - Universities and research centers are helping build the talent pipeline and drive innovation.
 - Consultants and contractors are delivering training programs to close skills gaps and build capacity where it's needed most.
 - Manufacturers and suppliers are investing in R&D and adapting proven global technologies to U.S. conditions.
 - International institutions (e.g., Institution of Civil Engineers, Institution of Engineering and Technology, Institute of Measurement and Control, International Organization for Standardization) are sharing tools and frameworks that can help streamline project development.

The foundational elements are already in place. With true partnership, states and regions could quickly establish or scale up HSR authorities that are locally grounded and nationally aligned.

Industry and advocacy groups are actively contributing to this ecosystem:

- USHSR is keeping HSR on the national agenda and advocating for supportive policy and funding.
- The High-Speed Rail Labor Coalition, representing 13 unions and over 160,000 workers, is preparing the workforce and promoting equitable labor standards.
- American Railway Engineering and Maintenance-of-Way Association, the U.S. rail engineering body, is advancing high-speed technical guidance across disciplines.

These contributors illustrate the potential for a more structured but locally responsive delivery model. In other countries, national rail operators take on full lifecycle accountability. While the U.S. requires a different approach, one that respects state leadership and community engagement, it can still benefit from those lessons — particularly the value of integrated planning, continuity, and local trust.

Today, the U.S. relies on fragmented partnerships and inconsistent processes. A more collaborative, regionally-led model — supported by federal coordination, not control — is essential to achieving a connected, HSR network that earns community support and reflects how Americans live, work, and travel.



Consistent Technical Standards

A key opportunity to accelerate U.S. HSR lies in establishing consistent technical standards. Unlike countries with mature HSR systems, the U.S. currently approaches each project independently, developing bespoke designs for track, electrification, signaling, and stations. This stems from a legacy regulatory framework built around freight and conventional rail, which until recently limited compatibility with proven high-speed trainsets from Europe and Asia. The FRA's 2018 introduction of Tier III safety standards marked an important step forward, opening the door to international rolling stock under performance-based criteria.

Still, the absence of standardized frameworks means longer design timelines, higher costs, and limited ability to replicate success across corridors. Each project faces the challenge of defining requirements from scratch, often navigating complex approvals and custom procurement. Without common templates, it's harder to share expertise, reuse designs, or leverage economies of scale in manufacturing and construction.

Recognizing what qualifies as “high-speed rail” is an important part of building a shared foundation. The internationally recognized definition, according to the International Union of Railways (UIC), sets the minimum operating speed at 250 km/h (155 mph) on new, purpose-built tracks and 200 km/h (124 mph) on upgraded existing tracks. While individual corridors may vary in speed depending on context and connectivity, these benchmarks offer a valuable reference point — helping to clarify the goals, expectations, and performance standards that define HSR across projects.

International experience offers valuable lessons. Countries like Spain, Japan, and France have built world-leading HSR networks by applying consistent specifications — reducing duplication, improving interoperability, and enabling faster delivery. The EU's harmonized Technical Standards for Interoperability and shared European Railway

Traffic Management System (ERTMS) signaling system show how coordinated standards can unlock seamless cross-border networks.

The U.S. has a real opportunity to apply the same logic. Developing a national HSR standards framework — covering key elements like track geometry, electrification, control systems, rolling stock, and station design — would provide a foundation for smarter, faster project delivery. With standardized reference models, agencies can shorten design cycles, streamline procurement, and improve coordination across regions and suppliers.

Consistency doesn't limit flexibility — it empowers delivery. By building on recent regulatory progress and working collaboratively toward a shared standards platform, the U.S. can turn HSR from a complex one-off into a repeatable, scalable infrastructure success.

Organizations like the International Union of Railways (UIC) can play an important role in this effort. As a global hub for rail standards and best practices, the UIC provides widely recognized technical guidelines for HSR development, drawing on decades of international experience. By engaging with the UIC and aligning with global benchmarks, the U.S. can fast-track the development of its own standards while ensuring interoperability and long-term global compatibility.

The bottom line: Funding and political will can create a HSR project, but enabling its delivery requires systemic reform to remove administrative friction. By streamlining permitting, strengthening institutional coordination, modernizing land acquisition, and standardizing technical requirements, the U.S. can transform HSR from an aspiration into an achievable, efficient, and scalable national asset. The opportunity is clear: align processes, empower delivery, and unlock the speed and certainty needed to build a world-class HSR network.

Streamlined Permitting

In the U.S., obtaining permission to build HSR can take longer than construction itself. Environmental permitting is a critical path for these massive projects, which span hundreds of miles, cross multiple jurisdictions, and require extensive reviews, regulations, and legal challenges.

The issue is delay by design. Any federally funded HSR project triggers the National Environmental Policy Act (NEPA), requiring a full Environmental Impact Statement (EIS). The average EIS takes four and a half years, though it's often longer. States add their own regulations, further complicating the process. Multi-state HSR projects face conflicting requirements with no central coordination.

A single HSR corridor may require approvals from the Army Corps of Engineers, U.S. Fish & Wildlife Service, state environmental agencies, tribal governments, and state historic preservation offices. Each step has its own process, and each can be litigated.

These delays drive up costs through inflation, extended overhead for contractors and agencies, and reduced investor and political confidence. Longer timelines mean higher total investment cost (TIC) due to increased overhead and higher total financing cost (TFC) from expensive last-minute funding. For example, the Caltrain electrification project in the Bay Area faced a 19-month delay for federal approval, pushing costs to six times higher per mile than similar projects abroad.

The longer the approval process, the greater the risk of HSR project failure. So in order to build HSR faster, we need to fix how we approve it.

5 Steps to Accelerate Permitting

1) Coordinate the process regionally, not centrally. In France, the single-step Déclaration d'Utilité Publique (DUP) integrates environmental and public interest reviews into one binding decision, with fast-tracked legal review. While the U.S. permitting system is different — there is still a path forward. For multistate corridors, regional HSR coordination councils or compacts could be established, bringing together state agencies, federal partners, and local stakeholders to streamline reviews without stripping state authority. The One Federal Decision (OFD) policy can support this coordination, but it isn't a cure-all: recent delays in Houston, despite OFD, show the need for additional tools. That's why the U.S. should consider an HSR-specific permitting fast-track, modelled after recent legislation for semiconductor facilities that streamlined NEPA requirements and accelerated approvals.

2) Set parameters for environmental reviews.

Oversized EIS documents are commonly written to defend against lawsuits, rather than inform decisions. Clear parameters — such as a set page length and required review within two years, focusing only on material impacts — would preserve rigor without unnecessary paperwork. As Chris Brady, Commonwealth Research Associates, points out said, *"Permitting processes need to have a shot clock, like many sports have found, to keep the action moving"*

3) Integrate environmental planning from the start.

Spain engages stakeholders early, adjusting alignments before filing an EIS to reduce downstream conflict. The FRA's Corridor ID program



"Streamlining permitting is foundational to high-speed rail success. The U.S. can accelerate approvals without sacrificing environmental integrity by adopting proven strategies from countries like France, Spain, and Japan — where projects are subject to rigorous, yet efficient, review. Their success stems from authority, focus, and speed."

Kash Qadeer, Bechtel's Global Rail Systems Lead

in the U.S. is a positive step in this direction, but it needs more funding and institutional support to ensure local and regional authorities are full participants.

4) Limit lawsuits without blocking justice.

In Europe, legal challenges are subject to strict timeframes and reviewed by expert courts. In the U.S., lawsuits can delay projects for years. The federal government could implement a 150-day statute of limitations for HSR-related NEPA lawsuits, designate federal appellate panels for these cases, and apply streamlined litigation rules — as already used for sports stadiums in California.

5) Invest in permitting capacity. The FRA needs more staff trained in HSR-specific environmental issues. Standardized templates, toolkits, and guidance can help each corridor avoid starting from scratch. California's Phase 1 approvals can serve as a foundation for a national reference model — adaptable, not prescriptive.

The bottom line: Permitting can often extend project schedules and therefore add cost. However, this does not have to be the norm. Creative best practice from other countries, who have managed to crack this challenging nut — in some case by shaving years off traditional permitting process timescales - are available to be leveraged by the U.S., without sacrificing standards for safety or environmental protections.

No Corridor, No Rail: Rethinking Land Acquisition for High-Speed Rail

HSR depends on securing land efficiently — yet in the U.S., this remains one of the biggest roadblocks. California's experience, with land acquisition still incomplete after more than a decade, highlights how fragmented ownership, legal delays, and local resistance can lead to costly and time-consuming gridlock.

In contrast, countries like Japan, France, and Spain treat landowners as partners while keeping projects

on schedule. The U.S. should move from a reactive, parcel-by-parcel approach to a proactive, corridor-first strategy.

Smart route planning can help. Alignments that follow existing public rights-of-way or transportation corridors can reduce the need to



UK High-Speed Rail Phase 2b - Stakeholder Management

In 2021 HS2 Ltd, with Bechtel acting as its development partner, successfully deposited the Phase 2b High-Speed Rail Bill for the route north between Crewe to Manchester to the UK's parliament.

The level of engagement undertaken by the Bechtel team as part of the development of the Phase 2b scheme included:

- Engagement with 79 utility companies for Phase 2b
- Liaison with over 400 farms on the Phase 2b route
- 1,000 of habitat and ecology surveys to establish the baseline
- 60 public events to support consultation
- Approximately 2,000 affected parties along the Phase 2b route (those whose land and/or property were impacted by permanent land take).
- 25,000 impacted stakeholders identified in the 'Book of Reference'
- Approximately 21,000 land parcels impacted

acquire private land. Brightline West, for example, routed much of its line through the I-15 highway median and public desert.

While such routes aren't always available, early consideration of land feasibility can save years of delay and millions in cost.

Even with optimal routing, many projects will still require complex private land acquisition — and today's system isn't set up to manage that well. Fully unlocking the potential of HSR will require a smarter, more streamlined approach to acquiring the land it needs. The following five strategies offer a blueprint for doing just that:

5 Strategies for Faster, Fairer Land Acquisition

1) Preserve Corridors Early

Land only gets more expensive over time. Future HSR routes should be identified and safeguarded from conflicting development through tools like land banking, option agreements, and advance acquisitions. These measures help preserve strategic alignments before real estate pressures or local land use decisions make them infeasible. Federal funding could support these proactive efforts.

2) Modernize Land Acquisition Approaches

Timely access to right-of-way is essential but must respect state authority and property rights. A federal "Corridor of National Interest" designation could support planning and coordination, without changing existing eminent domain laws. States can lead by using tools like early voluntary acquisition, corridor co-location, and, where appropriate, existing "quick-take" authority — always paired with transparent process and fair compensation.

3) Prioritize Fair and Respectful Compensation

Recognizing and valuing landowners' concerns is essential to building trust and avoiding conflict. Offering compensation that reflects not only market value but also the personal impact of land sales — such as providing 10–25% above market value — can encourage voluntary cooperation and reduce the emotional and financial strain of legal disputes.

In California, the High-Speed Rail Authority evolved its approach after hearing from communities — introducing above-market offers to better acknowledge landowner concerns and minimize the need for eminent domain proceedings.

Taking a people-first approach to acquisition fosters goodwill, eases transitions, and keeps projects moving forward with stronger public support.

4) Engage Communities and Deliver Local Benefits

Many land disputes stem from communities feeling they won't benefit. Projects could demonstrate clear value — offering infrastructure upgrades, noise barriers, local road improvements, and advisory councils that give residents a voice. The more we demonstrate the benefits of HSR to local communities the greater chance we have of winning their support.

5) Build Public Trust with Safeguards

Skepticism of eminent domain is understandable. Safeguards like reversion clauses (returning land if projects don't proceed), clear public benefit requirements, and well-planned relocation support can reassure communities that the process is fair, beneficial and transparent.



Reform Summary

Enable Corridor-Based Delivery Through Regional Coordination

Establish empowered corridor-specific delivery entities with clear end-to-end accountability — developed in partnership with states, local communities, and federal agencies. This approach builds on existing state leadership, ensures locally responsive implementation, and replaces fragmented oversight with structured coordination. Regional models ensure each corridor has a defined “owner” driving delivery forward — without imposing a top-down national authority.

Streamline Permitting and Environmental Approvals

Cut through red tape by introducing firm timelines and concurrent review processes for environmental permits. Front-load stakeholder engagement and coordinate across agencies early to surface issues and compress approval timelines from years to months.

Accelerate Land Acquisition and Engage Communities

Secure critical right-of-way corridors early via land banking and expedited eminent domain processes. Provide fair (even above-market) compensation and proactive community engagement to turn potential opponents into project advocates and avoid protracted land battles.

Standardize High-Speed Rail Design Nationwide

Develop a national framework of technical standards for track, electrification, signaling, rolling stock, and stations. Use consistent templates and reference models to streamline design, reduce duplication, accelerate procurement, and enable scalable, interoperable HSR delivery across corridors.

Optimize High-Speed Rail Development to Improve Efficiency

Focus on establishing a consistent national approach, actively coordinating with regional and state-led programs, expediting planning and approval processes, institutionalizing lessons and facilitating innovative privately led development.



Delivery

Program Management of an High-Speed Rail Project

A HSR network isn't delivered through blueprints and policy alone — it requires complex civil infrastructure, the integration of advanced systems, and coordinated teams executing with precision under a shared vision. In short: it demands a program management approach as sophisticated and high performing as the railway itself, spanning everything from earthworks and structures to digital control systems and operational readiness.

The following sections offer a comprehensive step-by-step guide for best-in-class program delivery.

Create a Compelling Vision & Define Program Objectives

It all starts with a bold, compelling, vision — one that clearly articulates project goals to stakeholders and end-users. It's a helpful exercise to start with the end in mind and tailor the narrative to the specific end-users or beneficiaries. For example, what does success look like for passengers, communities, schools, housing, operators and investors?

Below is a list of tips for establishing the vision and objectives:

Define Functional Requirements: Define what a safe, reliable, high-performance railway must achieve. Set service and performance targets (capacity, travel times, frequency), passenger experience goals (ridership and satisfaction), and sustainability objectives.

Keep Technology Simple and Purposeful:

More technology isn't always better. Choose proven technologies that enable your operational objectives without unnecessary complexity. The adage "just because you can, doesn't mean you should" rings especially true for rail schemes. The

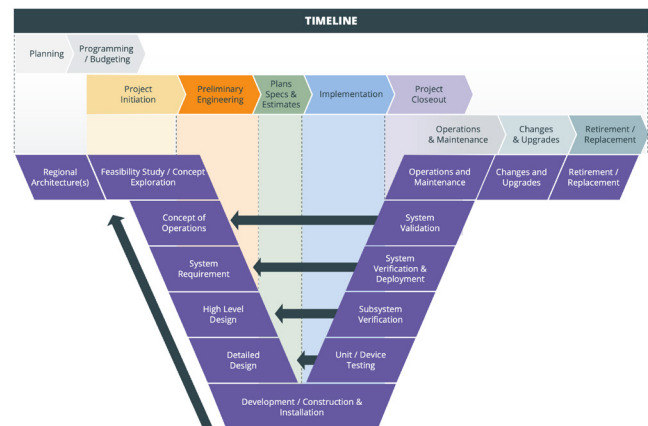


goal is to deliver a railway that's safe, reliable, maintainable, and fit for purpose — functional and appealing, but not complex for complexity's sake.

Embrace Innovative Delivery Methods:

Innovation is an important component of building the system. Embrace construction methods that can accelerate schedules and reduce risk, such as prefabrication, automation, and modular construction.

Develop a Full Lifecycle Perspective: Plan the railway's entire lifespan — from engineering to operations from day one. Keith Sibley, Bechtel's Rail Program Director, goes on to say, *"it's crucial to involve the people who will operate and maintain the system early in the design process. Likewise, engage experienced contractors early to improve designs, find cost-saving alternatives, forge early partnerships with suppliers, uncover green solutions, and minimize disruption."*



Select a Match-Fit Project Delivery Model

No two projects are the same. An owner must establish a delivery model that fits their project's unique context and circumstances. Start by assessing in-house strengths, gaps in experience or capacity, and risk tolerance.

Ultimately, the adopted delivery model should promote end-to-end accountability and provide a strong “controlling mind” — or integrated leadership capable of overseeing all parts of the railway. Every scope element and contractor must reflect a unified program mission.

The spectrum of delivery models can range from fully outsourced to fully in-house, or a hybrid approach. The following outlines three commonly used models, each with different implications for accountability, integration, and risk management:

Partner-Led Delivery: The delivery partner is fully responsible for organizing, managing, and delivering the project — with the owner only providing oversight and strategic input.

Integrated Owner-Partner Team: The owner and a delivery partner form a joint organization and work as one integrated team, sharing responsibility, accountability, and authority. Combining the owner's strengths (e.g. local knowledge) with the partner's expertise, this model is a true partnership.

Owner-Managed with Augmented Staff: The owner builds and manages its own delivery

organization, retains full control, and brings in partner firms to supply key personnel or expert support to fill gaps.

There is no one-size-fits-all answer. However, many owners are gravitating toward collaborative models with experienced delivery partners. A partner with hands-on mega-project experience — designing, procuring, and constructing complex rail systems — can bring best practices and hard-earned lessons to any project.

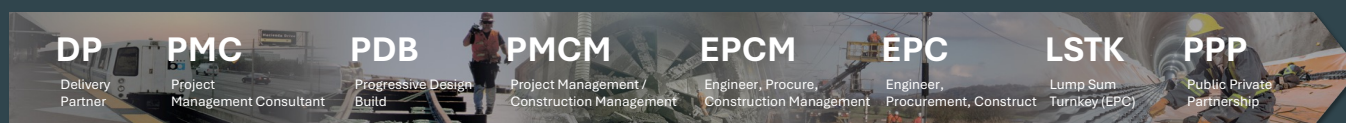
Whatever model is selected, structure the team like a single-purpose enterprise — with its own culture, processes, and tools. Define how decisions are made and how information flows between engineering, procurement, construction, and commissioning.

Additionally, give operators a seat at the table early, during design and procurement. Waiting until year nine of a ten-year build to figure out how to run the system is a recipe for chaos. Not only do operators flag issues others miss, they also consider other factors that impact infrastructure like train frequency, ticket sales and pricing, and maintenance windows. Operators need to shape design, workforce training, safety protocols, maintenance systems and customer experience.

With the right model and team in place, the project is set up to navigate the challenges ahead.

Project Delivery Models

Range of example contract models, that can be blended and tailored to optimize rail project delivery



Establish Project Execution Fundamentals

With the vision articulated and a delivery model in motion, the project's next step is to establish a solid foundation of scope, budget, schedule, and risk — the fundamentals that will guide execution. These project baselines should be reviewed by all stakeholders and monitored through robust project control mechanisms throughout the project lifecycle. A useful checklist of key delivery-focused deliverables is provided below:

Project Requirements Document	Create a definitive, verifiable, and unambiguous record of all functional and performance requirements the HSR system must meet (e.g. speed, capacity, frequency, reliability, and safety standards, as well as customer experience targets).
Scope Book & Delivery Matrix	Build out a comprehensive scope that defines every project element and outlines interfaces, particularly between civil works and subsystems. Meanwhile, a well-structured delivery matrix should link the work breakdown structure (WBS) to geographic sections and contract packages.
Project Execution Strategy	Develop a high-level project delivery plan that covers the approach to design, procurement, construction, testing and commissioning. It should address phasing (e.g. will segments open sequentially or at once?), procurement methods (design-build contracts, public-private partnerships, etc.), and special tactics (such as early works packages or geographic work splits).
Procurement Strategy	Determine how all contracts and purchases will be handled and integrated. Smart packaging of contracts, timing alignment and clear contractual boundaries are critical. For instance, bundling tightly linked systems into a single contract can reduce integration risk, while overly large contracts might limit competition. Identify schedule-critical items, and procure high-risk elements early.
Project Risk & Opportunities Register	Establish a register of all technical and external risks – and opportunities — from the start and continuously update it. Each risk should have an owner and a mitigation plan.
Baseline Budget	Have a bottom-up cost estimate for the entire program, including contingencies for risk. Break the budget down by work package and scope element so cost accountability is clear. This baseline budget becomes the yardstick for all future cost control.
Master Schedule	Plot out an integrated master schedule that charts the project from design to commissioning. It should have a sequence of activities, with critical paths that include major milestones.
Change Control Plan	Define a process for managing changes to scope, design, or baseline. The plan should require that any change from the approved baseline is evaluated and approved by the appropriate governance and recorded. This reduces scope creep and ensures changes are justified by the business case.
Community & Stakeholder Engagement	Draft a plan to engage local communities, businesses, and other stakeholders throughout the project. Outline public outreach efforts, feedback management, and measures to address local concerns.
Health & Safety Plan	Develop a comprehensive health, safety, and security plan that targets zero incidents. It should outline protections for workers and the public, enforcement of safety standards, and how a strong safety culture will be built across all contractors. The H&S plan should also include Design for Safety, including constructability, maintainability and operability considerations.

Build a Collaborative Delivery Culture

Processes and plans don't deliver projects — people do. To execute a HSR program, you need an aligned, high-performing team and a collaborative culture that's reinforced by project owners and delivery leaders.

Here are the key elements of a collaborative culture:

Empowered, High-Performing Teams: Set teams up for success by jointly developing goals and providing them with the authority to make decisions within their realm. Likewise, remove obstacles that prevent them from doing their best work. Everyone — whether a field engineer or a system tester — should feel a sense of mission and accountable for success.

Health, Safety & Wellbeing as Core Values: Safety is non-negotiable. Every team member should know that their wellbeing is the top priority. This also includes mental health and work-life balance. Leaders must lead by example: encourage reporting of hazards, reward safe behavior, and never ignore a potential problem.

Trust and Transparency: Trust fuels true collaboration. Leaders must be transparent — sharing challenges as openly as successes. When teams see support from the top, trust grows across the organization. Encourage candor: early issues are solvable; hidden ones risk failure.

Active Owner Engagement: The project owner sets the cultural tone. When the owner works with the delivery team and shows they are invested in the team's success — by actively participating in governance meetings, quickly fulfilling obligations, and championing the project's vision — it motivates everyone to go the extra mile.

For example, Bechtel emphasizes recruiting, developing, and empowering top talent, building well-structured teams, and enabling them with the right tools. But success comes when the entire

extended team works as one. This "One Team" approach includes the owner's staff, designers, contractors, suppliers, and eventual operators.

Building a collaborative culture is an ongoing effort. It starts on day one with how the team is formed and continues through every interaction.

Develop an Effective Commercial Approach

Major infrastructure programs often involve dozens of contracts, vendors and suppliers, each with their own scope, deliverables, motivations and commercial terms. An effective commercial strategy aligns every contractor's incentives with the overall project's success. Key considerations include:

Balance of Control and Risk Allocation: Commercial terms should balance risk and control — assigning risks to the parties best equipped to manage them. Overloading contractors with risk while retaining control can deter bids or inflate costs. Conversely, if contractors take on uncontrollable risks (e.g. bureaucratic approval delays), cost and schedule will suffer. Consider risk-sharing mechanisms like pain/gain arrangements or owner-provided insurance for certain risks.

Strategic Incentives: Craft contract incentives that reward the outcomes the project cares about. These might include schedule incentives, performance incentives (for meeting defined quality or safety targets), or shared savings arrangements to encourage cost efficiency. The key is to design incentive schemes that drive alignment around critical, integrated, project-wide milestones.

"Rules of the Relationship": Treat the contract as a framework for collaboration. If an issue arises, refer to the contract and project goals ("what did we agree and what serves the project best?") — before considering formal dispute processes.

Strategic Market Engagement: Plan a bidding schedule that avoids overwhelming contractors or inflates prices by releasing too many large contracts at once. Also, stagger major procurements to maintain competitive tension. If appropriate,

consider alternative delivery methods (e.g. public-private partnerships, design-build, alliancing).

When the commercial strategy is aligned with project objectives, every contractor and supplier is motivated to finish on time and on budget, and to deliver a railway that performs as intended.

Implement Project Control Tools to Manage Delivery

Large, complex projects are notorious for budget overruns and schedule delays. A HSR program is especially vulnerable if not carefully controlled. Avoid this by using robust project controls to track progress and prevent surprises — anchored in a single source of program-wide truth.

Core components of a strong project controls include:

Defined Baseline & Work Breakdown Structure:

Establish a clear baseline for scope, schedule, and budget — and rigorously manage against it. Organize the project into a work breakdown structure (WBS) to break it into manageable pieces and to track cost and schedule at various levels (project-wide, corridor, contract, task). Identify and map all interfaces between subsystems, civil scope, and contractual boundaries — and define how ownership will evolve over time.

Integrated Information Systems — One Source of Truth: Use an integrated project controls platform that links schedule, cost, risk, and reporting. Avoid disjointed spreadsheets and siloed data. Everyone should draw from the same data repository for status. Dashboards can be tailored for different audiences but all should pull from the same consistent data.

Rigorous Change Management: Enforce a formal change management process that is aligned and integrated with the overall project governance protocols. Every change request (design modification, added scope, schedule shift, etc.) should be evaluated for its impact on scope, cost, and time. A change control board

(with project, engineering, commercial, and owner representatives) should approve or reject changes based on clear criteria.

Meaningful Metrics & KPIs: Define key performance indicators that reflect project success factors — and measure and report them. Track metrics like schedule float burn (how quickly contingency is being used on the critical path), cost variance, design completion, field productivity rates, number of open engineering issues, and testing progress. Tie metrics to action — if a KPI moves in the wrong direction, it should trigger a response (e.g. a drop-in productivity prompts a deep dive into site issues).



UK's HS1 – Under Budget Delivery through Robust Project Controls

UK's High-Speed 1 (HS1) was completed with a \$128 million underrun, achieved through robust use of Bechtel's project control tools, innovative contract packaging, effective use of construction contracts, strategic realignment of goals, Six Sigma, e-auctioning, and comprehensive budget management. Key tools included: Progress and performance control systems; Cost/Time Trend and forecasting and Quantitative Risk Analysis.

"It is not often you can announce, for a major infrastructure project, that it came in on time and on budget!"

**The Right Honorable Sir Tony Blair KG,
Former Prime Minister of the United Kingdom**

Integrated Risk Management: Link the risk register to the controls system. High risks should have response plans reflected in the schedule and cost contingencies. For example, if there's a risk of delay in environmental permitting, build some buffer into the schedule and put the team on alert to expedite that process if needed. Revisit the risk register regularly (e.g. monthly) in light of progress data – some risks will retire, and new ones will appear.

Bechtel's Operations Director, Bill Tucker, says, *"At its core, project controls is about doing the basics well. Modern digital tools can help immensely, but only if they are integrated into a unified platform."*

Master the Complexity, Organize, Integrate

High-speed rail systems must integrate civil structures, tracks, power systems, signaling, communications, rolling stock, and software into one harmonious whole.

Advances in technology improve capabilities, but also introduce challenges: evolving standards, obsolete components, and more interfaces to manage than ever before. The only way to conquer this complexity is through rigorous, end-to-end integration.

Here is a list of best practices:

Manage Interfaces Proactively: Chris Enoch, Bechtel's Head of Global Rail says, *"One of the biggest threats in a project of this scale is managing and aligning the thousands of technical interfaces at play, over time – the handoff points where one team's work, or sub-systems, connects to another's. To avoid things falling through the cracks, create a project delivery matrix that clearly identifies every interface. Bechtel's Project Delivery Matrix maps every interface, so ownership and accountability are clear, from start to finish, across every works package."*

Be Proactive about Maintenance: HSR systems are unforgiving. Miss a crack in a rail weld or slack in a catenary tensioner, and you

risk serious disruption. You need purpose-built HSR maintenance depots, daily inspections and standardized, real-time condition monitoring. Track recording cars and fixed sensors should monitor track geometry 24/7, and maintenance of way crews will need HSR-specific training (ideally learned from peers abroad).

Promote Lifecycle Maintenance: Furthermore, lifecycle maintenance should be embedded in the business model. That means public-private partnership contracts that include performance-based maintenance, public operators setting aside a percentage of revenue for long-term renewal, and clear standards for ride quality, availability, and safety.

Integrate at Every Phase: Plan a full integration process with clear stages for design, system integration, testing, and commissioning. Agree on a streamlined project governance process that clearly defines roles, responsibilities, and accountabilities — and includes clear pathways for fast-track escalation and decision-making. Hold regular cross-discipline design reviews and use a gated process to manage design maturity. During construction, schedule joint inspections at interface points. As completion nears, execute a structured testing and commissioning plan that progressively integrates subsystems and test components. Then run trial trains on completed track to test the whole system.

Civil and Systems Focus: Civil works dominate rail megaproject budgets and early focus — but systems like signaling, electrification, and train control can lead to major downstream delays if not proactively planned and managed concurrently with the civil works.

Integrate systems planning from day one. Track design, procurement, and interfaces alongside construction. Civil builds the canvas, but systems bring it to life — they must move in sync.

HSR projects require vigilant integration management at every step. The complexity can be mastered, but only through structured coordination and a mindset that the entire railway is one system.

Fortunately, the industry is replete with lessons from past projects about integration (from other rail lines and analogous large systems like airports and power plants). The key is to apply those lessons going forward.

Finish Strong with No Surprises

As the project nears the finish line, the challenge becomes knitting millions of individual assets into a single, smoothly operating railroad. The last 10% of a mega-project often carries more complexity than the first 90%. Nowhere is this more true than in HSR. The industry has a tendency to dramatically underestimate the level of complexity required at the project's back-end.

The goal should be that when the ribbon is cut, everything works as it should and the owner/operator is fully prepared to take over. Achieving this requires meticulous planning and follow-through on several fronts.

To ensure you finish strong, take the following steps:

Develop an Operational Readiness Plan: In parallel with construction, the operations team should conduct training on the new systems, run trial operations, and hold emergency drills before the public ever boards a train. Finishing the project isn't just about assets — it's about the people and processes to run those assets.

Complete Documentation & Approvals: An HSR system won't be handed over until a mountain of paperwork is signed off — and this documentation is vital, not just bureaucracy. It includes as-

built drawings, asset registers, operations and maintenance manuals, warranty documents, safety certifications and regulatory approvals, and environmental compliance records. Plan the handover documentation early.

Governance to the End: As completion nears, maintain strong governance and rigor — don't assume it's all downhill after construction. Hold daily or weekly readiness meetings involving top leadership to quickly remove blockers. Consider a "war room" approach in the last phase: Bring together key people to complete punch list items, and track progress hour by hour if needed. And as the hoardings come down, ensure the team understands that new safety risks will emerge that need to be identified and managed.

Be Local: Ensure the project is grounded in and connected to the communities it impacts. Communicate how the project invests in local communities, and actively identify opportunities for local employment, training, and economic participation. Local support is a critical success factor — being seen as part of the community, not just building through it, builds long-term goodwill and momentum.

Stay True to the Vision: Often years pass between the initial vision and the finish line, and fatigue can set in. Remind everyone why this project matters — a transformative rail service for the public. Reiterate the project objectives and outcomes that were set at the beginning. This reinforces the collaborative ethos — we're all in this together to deliver something great.



"In the end, finishing strong means delivering not just the physical railroad, but launching a safe and reliable service on day one. All systems tested, all staff trained, and all paperwork signed off — so the new high-speed train runs safely and on time, with the only surprise for riders being how transformative a 220 mph journey can be!"

Jacob Mumm, Bechtel's Global General Manager Public Infrastructure



Delivery Summary

Define Clear Project Objectives and Scope from the Start

Establish definitive requirements, performance targets, and scope boundaries upfront. Early clarity on “what success looks like” prevents costly mid-course changes and keeps all stakeholders aligned on the goal. Identify, stress-test, and manage the program’s many interfaces, with clear definitions of interactions, ownership, and handoffs.

Integrate Delivery Functions Early

Conduct an honest capability assessment to choose the right delivery model (e.g. an integrated joint team or empowered delivery partner) and mobilize it early. Unite designers, builders, and operators into one team with clearly defined roles and shared objectives to reduce interfaces and integration risks from day one.

Foster a Collaborative Delivery Culture

Cultivate a “One Team” ethos across stakeholders, community groups, delivery organizations, and supply chain partners. Build high-performing teams that are empowered to make decisions, share information transparently, and solve problems together — with the project owner actively engaged — so that everyone is working toward shared goals rather than in silos.

Implement Advanced Project Controls

Deploy an integrated program control platform that serves as a single source of truth for cost, schedule, risk, and scope status in real time. Enforce disciplined change control and risk management throughout to reduce scope creep, budget overruns, and schedule slippage.

Employ Strategic Commercial Management

Align procurement strategy, contract terms, and risk allocation with the project’s objectives and complexity. Use creative fair risk-sharing and incentive structures to foster collaboration and innovation among contractors, so all parties focus on delivering success.

Master Complexity with Rigorous Integration Management

Actively manage technical interfaces and system integration from day one with a detailed interface management plan. Conduct continuous integration reviews and joint testing of components to catch incompatibilities early and prevent costly late-stage surprises.

Finish Strong with No Surprises

Plan for the final stages (testing, commissioning, safety certification, and handover) from the very beginning. As the project nears completion, intensify oversight and decision-making to quickly resolve any issues, ensuring the system is safe, vetted, and operational on opening day.



Conclusion

The case for HSR is clear: it offers faster, safer, and cleaner travel; boosts regional economies and job creation; and builds a more connected nation with thriving cities and communities—creating growth, opportunity, and consumer choice. After decades of ambition but hesitant steps, now is the time to prioritize HSR systems that will transform how people live and move, dramatically increasing connectivity between cities and regions.

The ambition of this paper is to help unlock the opportunity. With three clear areas for focus: Enablers, Reform, and Delivery, HSR can go from aspiration to reality. First, the U.S. needs to figure out how to secure, fair, stable, long-term funding and streamline cumbersome permitting and land acquisition processes that have long stifled progress. It will also need to boost institutional capacity and skilled team development at every level — federal, state, regional, and local — to manage the complexity of HSR delivery. International expertise and private-sector innovation could be harnessed to bring in proven ideas and additional capital. Finally, a phased rollout strategy will allow early successes to build public trust, confidence and momentum for the broader network.

Even with these enablers in place, a robust delivery-focused mindset is essential for success. HSR must be approached as a coordinated, integrated program — one that emphasizes partnership, shared accountability, and integrated planning across jurisdictions. This means empowering corridor-level delivery entities with the tools, talent, and authority to drive results; implementing rigorous program controls for cost, schedule, and risk; and aligning every contract and team with the goal of timely, on-budget delivery.

The good news is that America does not need to reinvent the wheel — proven playbooks from world-class HSR systems in Europe, Asia and the Middle East can be adapted and leveraged. By grounding our strategy in these global best practices and tailoring them to local conditions, we can deliver HSR efficiently and effectively.

As a nation, the U.S. has accomplished bold, remarkable infrastructure feats — from the transcontinental railroad to the interstate highways. This can be done again. Through the concerted efforts of our industry, government policymakers, investors — both public and private — public bodies, and local communities, we can deliver an ambitious vision for a nationwide HSR network — leaving a legacy that future generations will be proud of.

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