



110

Hyperloop

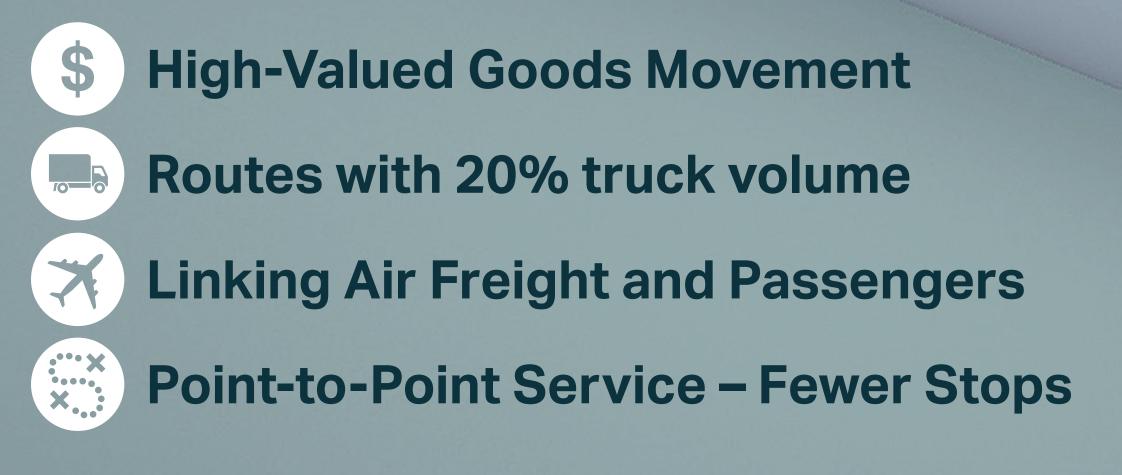


Introduction

High speed transport innovation is advancing around the world and while hyperloop is still in testing and proving phases, AECOM is leading the way to help our clients understand the potential and to support the industry to push boundaries and stretch into uncharted territory.

Imagine traveling at airline speeds for the price of a bus ticket. AECOM is the only engineering company in the world to have planned, designed and constructed Hyperloop projects. Now we're studying how the new high-speed transportation technology could efficiently transport goods between the ports, major transit hubs and inland distribution centers around the world.





hyperloop one

PASSENGER CARGO VEHICLE

AUTONOMOUS CONTROL PLATFORM

LOW-PRESSURE TUBE

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ELECTRO-MAGNETIC PROPULSION

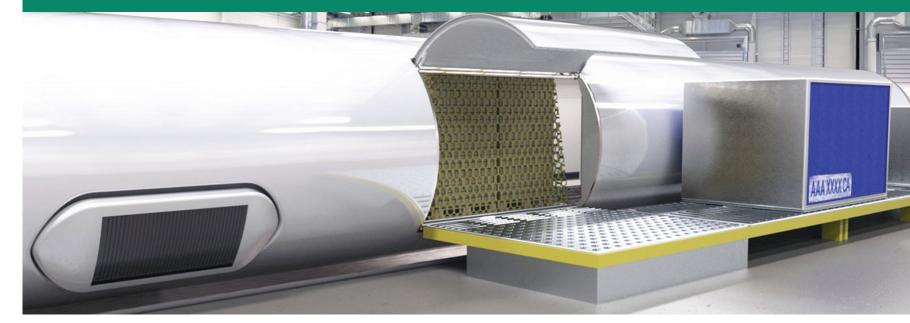
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MAGNETIC LEVITATION



Hyperloop drivers

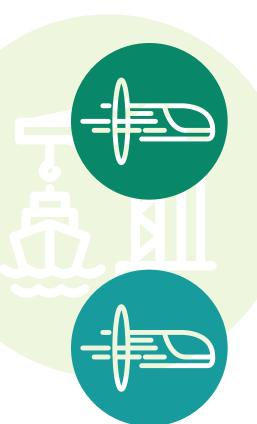




AECOM Hyperloop Projects



AECOM is the only infrastructure company in the world to have planned, designed and constructed Hyperloop projects



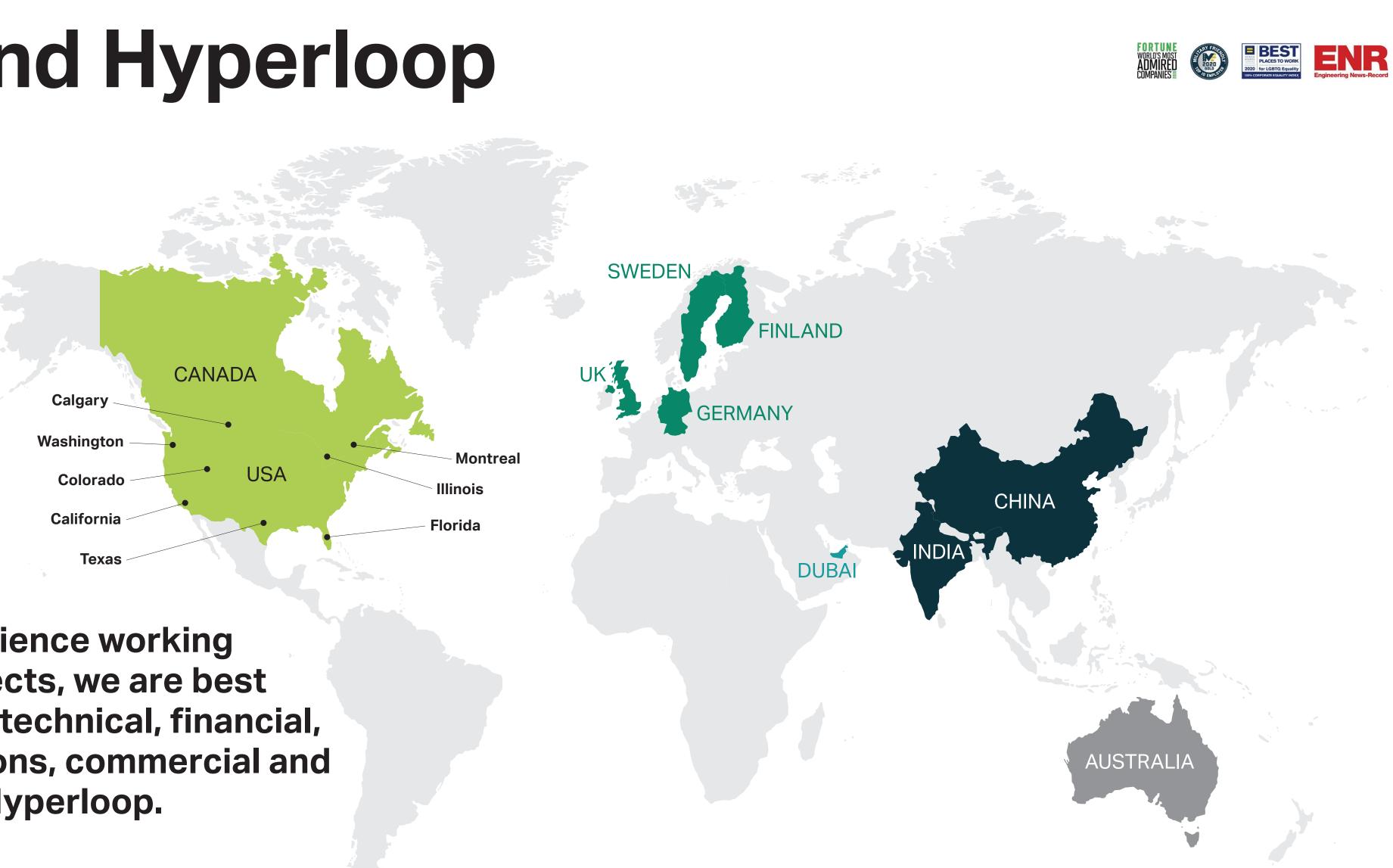
- Elon Musk's SpaceX has selected AECOM, one of the world's largest construction and design firms, to build its Hyperloop test track on 2016
- **AECOM** served as the overall **Program** Manager, Design, and Construction Manager for the 4,200 foot long Space-X Test Track in Hawthorne, CA



Our Global team of engineers and construction management professionals bring world class expertise on a variety of unique and first of xxx??



AECOM and Hyperloop



With our team's experience working on 19 Hyperloop projects, we are best positioned to provide technical, financial, construction, operations, commercial and strategic aspects of Hyperloop.



AECOM Hyperloop Projects

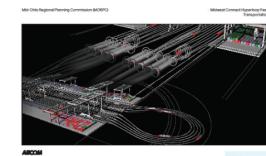
AECOM served as the overall **Program Manager, Design, and Construction Manager for the** 4,200 foot long Space-X Test Track in Hawthorne, California. Our Global team of engineers and construction management professionals bring world class expertise on a variety of unique and first of their kind infrastructure projects like Hyperloop



Hyperloop Experience











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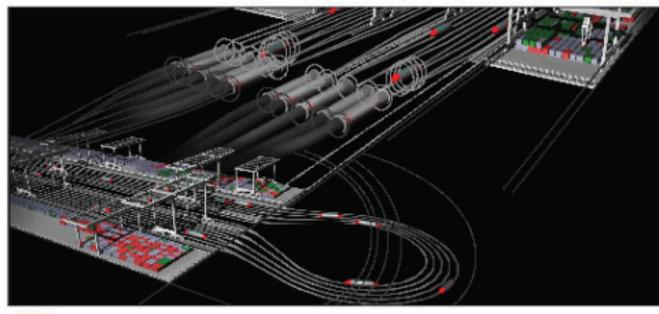
Connecting Hyperloop and Logistic hubs

Ports of Los Angeles and Long Beach Hyperloop One use hyperloop to transport goods/packages between logistic hubs. Transporting goods in a very quick and relative energy efficient way maybe benefits our major logistic clients already on the shorter term



Mid-Ohio Regional Planning Commission (MORPC)

Midwest Connect Hyperloop Feasibility Study Transportation Consultant



ABCOM

Ports of Los Angeles and Long Beach Hyperloop One Feasibility Study Los Angeles, CA

Cargo movement in the Southern California region is a critical transportation issue, as much of the cargo leaving the two major ports in the region, the Port of Los Angeles (POLA) and the Port of Long Beach (POLB), travel via freight truck on heavily congested roads. Truck traffic has major impacts to the Southern California transportation system; increasing congestion, accidents, and impacts to infrastructure maintenance. The Hyperloop One (H1) pre-feasibility report studied the opportunities, barriers, and wider economic benefits of integrating Hyperloop for cargo movement to reduce truck traffic in the region.

As the civil infrastructure lead on the project, the AECOM team, led by Philip Hadfield and Andrew Bui, worked with H1 to develop the Hyperloop study, and provided critical input into infrastructure design, freight movement operations, and critical stakeholder engagement to develop a preliminary design for the Hyperloop One cargo system. AECOM led development of this study and completed the following scope of work:

 Development of a VH1 technology overview and operational model, including a basis of design that defines the technology system including system geometric constraints, power requirements, acceleration constraints, equipment and labor requirements,

operational requirements, and rough order magnitude cost.

- Cargo logistics for the region, including identification of addressable market for the VH1 and current operational systems that would need to be integrated into the Hyperloop operational model.
- Demand/Market analysis to evaluate and estimate the future demand and market of the VH1 freight system based on market and potential induced demand
- Route evaluation and impact assessment based on VH1 technology requirements and required infrastructure needed for loading/unloading of cargo containers
- Stakeholder identification and engagement plan for strategic stakeholders based on the route analysis and business model
- Implementation plan for integration of the technology
- Value proposition of the corridor deployment including capital expenses. operational expenses, and wider economic benefits the system can bring.

The study was completed on time and on budget, and provided VH1 with a core understanding of infrastructure requirements for their cargo system and analysis and development of integration strategies for Southern California.

Port of Los Angeles Services Prelinary feasibility study Project constraints rking closely with VH to co-develop technol identifying corridor needs, constraints, and opportunities Co-developing in strategy with VH Start date August, 2016 **Completion date** lovember, 2016 Schedule variance oject delivered on tim Cost management \$412,000 roject delivered on budge **Key contact details** Josh Raycroft, VH1 PM Harbor Department PO Box 191 San Pedro, California 90733 (219) 218-4203 raycroft@hyperloop-one.co Key staff Andrew Bul, PE Deputy project manager Mark Sleeon, PE Planning, simulation analysis Philip Hadfield, PE Project manager Ahmad Abdel-Karlm, PhD, PE Structures lead Sponsor feedback on uality of service ECOM allowed the team to better quantify opportunities

barriers, and wider economic benefits of the Hy system for freight movement In Southern California. ---Josh Raycroft



CDOT RoadX Program Management, Colorado, USA

AECOM partnered with CDOT to submit a proposal to the Hyperloop Global Challenge in 2016. Later in 2017, the Rocky Mountain Hyperloop proposal was one of ten winning proposals and AECOM led the feasibility study to explore implementation potential for Hyperloop in Colorado

	UCTION			
1.1 0	/erview/Why this Study	3		
1.2 Pu	1.2 Purpose and Need For this report			
1.2.1	Purpose			
1.2.2	Need			
1.3 Ca	II to Action	4		
1.4 Re	view of Previous Transit Plans	5		
1.4.1	Rocky Mountain Rail Authority – High-Speed Rail Feasibility Study			
1.4.2	CDOT Interregional Connectivity Study			
1.4.3	CDOT Advanced Guideway System (AGS) Feasibility Study			
1.4.4	CDOT Statewide Transit Plan			
1.4.5	CDOT State Freight and Passenger Rail Plan			
1.4.6	Implications for High-Speed Rail and Other Rapid Speed Technologies	12		
POLICY	FRAMEWORK			
2.1 Ov	erall Implementation Framework			
2.2 Pla	anning and Environmental	23		
221	Planning			
222	National Environmental Policy Act (NEPA)			
2.2.3	Agencies with Potential Purview over High-Speed Rail			
2.2.4	NEPA Streamlining			
2.3 Sa	fety Certification			
2.3.1	Federal Railroad Administration Safety Certification	31		
2.4 Go	overnance & Policy			
2.4.1	System Governance	37		
2.4.2	Station Governance			
2.4.3	Transit-Oriented Development			
2.4.4	Station Governance Structures			
2.5 Pr	oject Delivery Strategy			
2.6 Fir	nancial and Legal			
2.6.1	Funding and Financing			
2.6.2	Public Funding Sources			
2.6.3	Service or Asset-Related Revenue-Generating Funding Mechanisms			
2.6.4	Partnerships with Utilities or Other Providers			
2.6.5	Public Innovative Financing			
266	Private Financing Mechanisms			

3 TECHNOLOGY OVERVIEW 65 3.1 Inter-City: Hyperloop 66 3.1.1 Overview of the Technology 66 3.1.2 Vehicles 67 3.1.3 Status of Development 68 3.1.4 Potential for Technology in Colorado 70 3.2 Intra-City: Arrivo 71

State Benefits and Opportunities Study for Rapid Speed Travel in Colorado

AECOM

Prepared for

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CDOT RoadX Program Management, Colorado, USA

The Colorado Department of Transportation (CDOT) RoadX program recognizes that 21st-century technology and ingenuity are critical to solving modern infrastructure problems. AECOM was selected to serve in a program management role to advance technology and innovations from proof of concept through demonstration and implementation. We helped to incubate ideas, study feasibility, accelerate design, and highlight partnership opportunities for our clients. Through this program we stay in tune with the latest smart technology trends being developed by the private sector and implemented by public agencies.

Summary of Projects:

Hyperloop Feasibility Study

AECOM partnered with CDOT to submit a proposal to the Hyperloop Global Challenge in 2016. Later in 2017, the Rocky Mountain Hyperloop proposal was one of ten winning proposals and AECOM led the feasibility study to explore implementation potential for Hyperloop in Colorado.

Arrivo Feasibility Study

AECOM performed the feasibility study and near-term implementation plan for both a test track and expanded network system to implement the Arrivo automated and high-speed technology for auto, transit, and freight mobility in the Denver metropolitan area.

Smart Powered Lanes

AECOM partnered with SELECT (research center for sustainable electrified transportation) to complete a feasibility study and implementation plan for Wireless Dynamic Electric Charging referred to as Smart Powered Lanes. This study reviewed several use case applications near Denver International Airport.

Statewide Rapid Speed Benefits Study

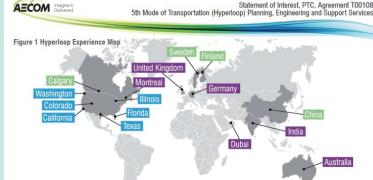
This feasibility study evaluated the various framework elements for implementation of emerging rapid speed technologies and systems in transportation, including NEPA, safety certification, procurement, financial and governance considerations. The study included high level evaluation of new high-speed transit such as Hyperloop, high speed automated highway, underground concepts, and elevated personal rapid transit.

Project	Overall Satisfaction	Technical Expertise	Client Comments	Colorado Department of Transportation Reviewer
CDOT RoadX Program Management	10 of 10	10 of 10	They have provided quality service and have educated us on new items. Innovative approach to things.	Lisa Streisfeld Lisa.streisfeld@state.co.us +1 303.757.9876



Pennsylvania Turnpike Commission (PTC): 5th Mode of **Transportation (Hyperloop) Evaluation Study**

This project aims to study the impact Hyperloop technology may have on a route connecting the major Pennsylvania cities of Pittsburgh, Harrisburg, Philadelphia and Wilkes-Barre/Scranton



discuss with the Commissions key goals and the

schedule of the study, identify key dates and output

. Create/Implement Stakeholder Plan – Under this task, the AECOM Team believes in an approach that combine

ducation, scenario planning, project inreach/outrea

Education begins with reviewing the technology and other studies occurring throughout the world. The AECOM Team has experience on 19 different Hyperloop technology projects (Refer to Figure 1

perloop Experience Map for Project Locations), an

vill lead discussions on how to perform an analysis

scuss lessons learned from current studies, and

<u>Scenario Planning</u> – Using information from the previo ask, the AECOM Team will propose five (5) potential

ographic locations for Hyperloop. These may includ

no-build. Phila.-Harrisburg-Pittsburgh. I-80. PhilaPo

etermine the goals and KPIs of this project.

inancial modeling and costing.

er Rail Environmental Study

Beach Hyperloop Freight Study

easibility Study-Hyperloop Alternative

oop Study (ARRIVO)

easibility Analysis

ack Design-Build

to Orlando Route

Houston Route

Liverpool Route

u to Chennai Route

eal to Toronto Route Study

Study, Cheyenne-Pueblo Route

AECOM Imagine it Delivered

Statement of Interest, PTC, Agreement T00100 5th Mode of Transportation (Hyperloop) Planning, Engineering and Support Services

The AECOM Team is comprised of AECOM Technical Services (AECOM), Transportation Economics & Management Systems, Inc. (TEMS), KPMG and Rybin: Engineering (contributed DEF) in Pengukania), Wa ana Engineering, (a certified DBE in Pennsylvania). We are pleased to submit this SOI to the Pennsylvania Turnpik nmission (the Commission).

With our Team's experience working on 19 Hyperloop projects, we are best positioned to provide technical, finan construction, operations, commercial and strategic aspect of this study. In addition, our Team's focus on economic impact analysis, as well as data and analytics, provides ne Commission with the most in-depth experience and nowledge of any other Hyperloop team.

ne Commission is a key transportation provider in the mmonwealth that operates 512 miles of roadway. roviding a vital link in mobility, economic growth and nerce within the Commonwealth. While providing thi stained service in a safe, reliable, customer valued wa end the Com supports, such as Hyperloop, that present a unique oportunity to determine how the Commission and the ommonwealth can examine the advancement of mobility and growth through this new technology.

part of the development of House Resolution HR-1057, COM was contacted by State representative personnel to fer Hyperloop technical information that reflects industry rminology. We disclose this in the spirit of transparency as AECOM is an active leader in Hyperloop technology and roject development throughout the world

Hyperloop is an emerging technology under development Hyperiodop is an emerging technology under development and research over the past five years that has generated an immense amount of excitement. The technology aims to study a 5th mode of transportation: an ultra-high speed, autonomous, frictionless and direct transport system that combines the speed of air travel with the access and ease of ground transportation. While the technology has not yet commercially deployed, several commercial compani cluding SpaceX, Hyperloop Transportation Technologies TT) and Virgin Hyperloop One (VH1), formed to advance ology, study the impact and deploy test tracks. This project aims to study the impact Hyperloop technology nay have on a route connecting the major Pennsylvania cities f Pittsburgh, Harrisburg, Philadelphia and Wilkes-Barre/ cranton. This concept can have an immense impact on the ealth of Pennsylvania, the existing transportation

systems and the economy of the entire State. Our Team stands that while this technology is still in its infancy there is sufficient information and te geographical barriers, social and economic opportunitie barriers, and impacts on the existing Per sportation system

Approach Our Team's approach is to follow a systems engineering strategy to cost-effectively develop a study that answer the ollowing questions:

- What is Hyperloo What is the Commonwealth's Vision for Hyperloop How will Hyperloop impact the Commonwealth (if built
- or not built)? • Where are the most feasible locations to build?
- What will be the economic impacts?
- What type of funding is available/necessary How much would Hyperloop cost to build, operate and
- What key partnership should the Common
- to advance Hyperloop

How should the Commo 1. Within 10 business days from the NTP, the AECOM Team will meet with the Commission to identify the key stakeholders within and outside the agency. Suggeste stakeholders would include PennDOT, the Governor's Office, the office of State Representative Aaron Kaufe (HR-1057 Bill sponsor), region-specific MPOs and the AECOM Team. During this coordination, we will

ev to MelbourneRoute VH1 Germany Study- Hamburg to Berlin Route

The following are our references for global Hyperloop relevant projects. Mid-Ohio Regional Planning Commission (MORPC) Hyperloop Dina López T: 614.233.4149 E: dlopez@morpc.org

public transportation benefits (regional mobility, time savings, and congestion impacts), and assessing schedule of the study, identify key dates and output/ outcomes in the overall project schedule. This early establishment of a effective stakeholder group will directly determine the overall success of the project and provide a comprehensive and context sensitive study. We anticipate this stage to be completed within 30 days after NTD potential integration with the Northeast corridor. Partner Rybinski Engineering will evaluate traffic impacts by using large-scale traffic data and data visualization tools develop roadway performance measure

evelop Costs - Based on input from the above stakeholder meetings, the AECOM Team will develop CapEx and OpEx model for the Commission. Project Inreach/Outreach - An important part of This project in teach of the public of the public of the public apprised of how the Commission is progressing. The AECOM Team will work with the Commission to levelop a public information strategy and info

dissemination plan (Technical Memorandum/white papers) and graphic-intense brochures that can be ered via social media and more traditional outlets Final Report - A draft and final report, summarizing all of the above approach topics, will be created and lied to the stakeholders for review. The AECON feam will also provide an Executive Level briefing via a PowerPoint presentation. This presentation can then e used for future meetings in which the Commissio nation about the project and the next step:

o Lehigh Valley, or a stop at 30th Street Station in Philadelphia along the Northeast rail corridor. To lead this effort, and be the project's single point of contact, AECOM has chosen **Dan Corey**, **PE**, as **Project Manager**. Dan, who is located in the Philadelphia, PA, office, is a registered Professional Engineer in good standing in the Commonwealth of Penneylvania and has over 24 ve Determine Financial Analysis/Economic and Traffic Impact – AECOM Team members KPMG and TEMS wi maximizing Federal and State funds; local developme benefits (jobs, income, property values, tax base) of ground transportation service for the Commonwealth ealth of Pennsylvania and has over 24 years

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Colorado VH1 Hyperloop Study

SpaceX Hyperloop Test Track Florence Li T: 408.203.2072

E: Florence.Li@SpaceX.com

Amy Ford T: 303.757.9362

E: amy.ford@state.co.us

longest Hyperloop Test Track. Andrew is an industry leader the State who has coordinated and collaborated with many of the ommercial Hyperloop companies and has worked closely AECOM - With over 1200 tra our four (4) offices across the Commonwealth, AECON brings a strong history of working with the Commissio on technology projects (since 1999), as well as having under do 10 clobel Wardenewsche Theorem with infrastructure owners on identifying and guantifying the wealth, AECOM enefits and impacts of the potential technology deployment. Supporting Dan and Andrew is a team of planners, engineers and economists, with either recent, relevant Hyperloop worked on 19 global Hyperloop projects. These include the MORPC (Chicago/Columbus/Pittsburgh) feasibility study xperience and/or Commission experience. They include: where AECOM is the lead consultant (See Figure 2: Relevan Peter Vorhees serves as AECOM's Project Manager for the lyperloop Experience). We will leverage large s MORPC Hyperloop Feasibility Study and AECOM supported nation that has been gathered about the The Hyperiod piterative for the passenger rail environmental study. Peter will bring intimate knowledge of the Chicago to Pittsburgh route, which may have impacts and implications that should be considered for this study. Coordination with anies, plus leverage previou reports completed by the tear his team will be important in understanding the macro view of how Hyperloop may impact the entire region, including the state of Pennsylvania. Lincoln James will lead the economics model for the team Lincoln is the lead economist for the MORPC and Rocky Mountain Hyperloop projects, responsible for the deliver of the project's economic benefit analysis, evaluation of economic development opportunities, land use growth scenarios assessment and wider economic benefit analys (WEBS).

Assisting Lincoln on the economic model will be **Alexande Metcalf, PhD,** who developed the business cases for the ton-Calgary Hyperloop business cases MORPC and Edmo as well as Andy Garbutt who heads KPMG's infrastructure advisory team in the U.S. Andy is lead partner in charge o supporting VH1 and has overseen all the KPMG work that has been undertaken in the U.S. and has acted as global coordinator for the international projects. 3

AECOM Imagine it. Delivered.

Statement of Interest, PTC, Agreement T00108 5th Mode of Transportation (Hyperloop) Planning, Engineering and Support Services

Beyond these strategy points, AECOM also has the advantage of being technology and developer agnostic Our team has worked with several Hyperloop compani cluding The Boring Company, SpaceX, Virgin Hyperloop One, Arrivo and Hyperloop Transportation Technologies, a One, Arrivo and Hyperioop Transportation recrimologies, at we have no formal relationship with any of the technology developers. This allows us to bring an unbiased analysis of all the technologies available, and more importantly, a grounded approach to deal with the benefits and impacts o the technology's integration into a transportation system. Transportation Economics & Management Systems, Inc (TEMS) has been in existence since 1989, and is widely ccepted as one of the foremost ground transportation lanning firms in North America. Alex Metcalf leads the EMS staff that is made up of economists, statisticians, planners and system analysts, all of whom have special passenger and freight ground transportation planning he practice is built around four areas of transportation consultation: Demand and revenue forecasting; Operations route and cost analysis; Economic impact assessment; Financial analysis and business plan development. TEMS has conducted more than 100 passenger and high-speed ra feasibility and business plan studies, as well as the MORPC feasibility study and the Edmonton-Calgary Hyperloop. KPMG - KPMG is a professional service company that

mploys 207,050 people and has three lines of services

separate Hyperloop projects (Pune-Munika india; Finlan Sweden; Hong Kong, China; and Northern United Kingdo Since 2015, they have held a Master Services Agreement with Virgin Hyperloop One (VH1) to provide commercial

and financial advisor services. KPMG has been advising

of the Commonwealth's transportation needs/network. Th

employ 1,500 people in Pennsylvania out of 3 offices and have more than 80 professionals in Harrisburg, advising

Rybinski Engineering – Formed in 2012, Rybinski Engineering is a certified woman-owned Disadvantag Business Enterprise in Pennsylvania that brings

h Mode of Transportation (Hyperloop) Planning, Engineering and

nmonwealth agencies on a wide range of engagements

transportation engineering and data visualization experience

ennDOT on their P3 program and has a good understand

nancial audit, tax and advisory. KPMG has worked on 4

erience to this contracts and rojects, as well as rojects with the (as

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rnerstone of AECOM's com

9001:2008 Quality Management standard. delivering projects to the Com

Why the AECOM Team

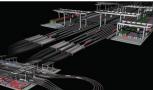
Experience. The AECOM Team has worked on over 19 global and similar Hyperloop projects and will bring this experience to the Commission.

Technical Understanding. Our Team knows and stands the Co nd program needs. AECOM and our Team have bee Ily involved with the design and deplo technologies along the Commission's Right-of-Way since 2001 and with PennDOT since the mid-1990's. Experienced Project Manager. Dan Corey has been working with the Commission on their ITS and technical



vironmental impact work and are well known to the Commission for their environmental permit and studies assignments

The AECOM Team has conducted more studies, planning, engineering design and construction of the technology than any other firm, which gives us the unique ability to valuate the benefits and impacts this system will have



to moving goods from PhilaPort to the Lehigh Valley.

open-end contract, project manager Dan Corey exceeds t 10% DB goal with a current participation of 13.3%.

4 QA/QC/Work Quality/Cost Control/Ability to Meet

An effective, well planned and well executed Quality Assurance/Quality Control (QA/QC) Program is anothe mitment to excellence. Th AECOM Team will use the AECOM QA/QC Program Plan as the framework for a project-specific QA/QC plan. The project specific Q/QC Plan will be submitted to the Commission for review within 30 days from NTP. The purpose of the QA/QC Program Plan is to establish procedures to provide quality in the sector is a stablish procedures to provide quality in the sector is a stablish procedure to provide quality in the sect the professional services performed by the AECOM Team. Each team member will be required to follow AECOM's QA/ QC program. AECOM's commitment to quality is further ated by the company's certification to the ISO

As a Project Manager, Dan Corey has a strong record o mission on time and within udget. Due to the depth of the AECOM, should the need arise, we have the unique ability to provide additional resources to meet the schedule deadlines and budgetary limits agreed to on this project.

with the commission of the rechnologies and ns for over 17 years. From technologies and -bid-build projects, to design-build and P3s, Dan tands how to implement the Commission's vision







Pennsylvania Hyperloop

DRAFT REPORT

June 2020



Image: Virgin Hyperloop One





Mid-Ohio Regional Planning Commission (MORPC): Hyperloop Feasibility Study, Chicago-Columbus-Pittsburgh corridor

In 2018, MORPC launched the Rapid Speed Transportation Initiative (RSTI), which is exploring better and faster connections for goods and passengers between Columbus (Ohio), Chicago (Illinois) and Pittsburgh (Pennsylvania). Project value: \$300,000

The RSTI has to date has included two studies: the Midwest Connect Hyperloop Feasibility Study (with AECOM as prime consultant) and Environmental Impact Statements (EI5) Elements for passenger rail and hyperloop in the corridor (supported by AECOM). The studies have identified candidate locations for high-capacity passenger multimodal and freight intermodal connectivity throughout the corridor. The Hyperloop Feasibility Study was developed collaboratively with Virgin Hyperloop One (VH0) and assumes the use of proprietary VHO hyperloop technology.

A key RSTI vision is to identify an initial research and demonstration segment within the project corridor meeting the objectives of the project sponsors and VHO. AECOM's role in the study included a technology overview, an analysis of potential alignments, demand and economic analysis, regulatory framework, conclusions regarding feasibility and a framework for NEPA analysis. The analysis concluded that the project can potentially convey goods and passengers throughout the entire 500-mile Chicago-to-Pittsburgh corridor within one hour, increase total corridor travel by more than 50%, and add \$300 billion to the regional economy over 30 years. The study concluded in November 2019.





About AECOM

AECOM is built to deliver a better world. We design, build, finance and operate infrastructure assets for governments, businesses and organizations in more than 150 countries. As a fully integrated firm, we connect knowledge and experience across our global network of experts to help clients solve their most complex challenges. From high-performance buildings and infrastructure, to resilient communities and environments, to stable and secure nations, our work is transformative, differentiated and vital. A Fortune 500 firm, AECOM had revenue of approximately \$18.2 billion during fiscal year 2017. See how we deliver what others can only imagine at aecom.com and @AECOM.



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