

HYPERLOOP: CONNECTING THE GREAT LAKES MEGAREGION

Grace Gallucci
Executive Director
Northeast Ohio Areawide Coordinating Agency

Carrie Cooper
Deputy Director, Transit
Illinois Department of Transportation

CMAP Transportation Committee
February 21, 2020



NOACA

Metropolitan Planning Organization (MPO) for Greater Cleveland (largest in Ohio)

2.1 million population

5 counties: 166 cities, villages & towns



Regional Planning Agency Host/Chair: Vibrant NEO 2040

3.8 million population

12 counties: 7 legacy cities, 1200 political jurisdictions



NOACA STRATEGIC PLAN AND VISION STATEMENT

NOACA will **STRENGTHEN** regional cohesion, **PRESERVE** existing infrastructure, and **BUILD** a sustainable multimodal transportation system to **SUPPORT** economic development and **ENHANCE** quality of life in Northeast Ohio.



TRANSPORTATION TECHNOLOGIES

The Road to Innovation

Transportation technology refers to tools and machines used to solve problems or improve conditions in respect to the movement of people and goods. It also includes infrastructure such as roads, rail tracks, bridges, tunnels, parking areas, ports and airports.



WHAT'S CURRENTLY UNDER DEVELOPMENT IN OUR REGION?

- Autonomous Vehicles
- Advanced Transportation Management Systems
- Electric Vehicles and Charging Stations
- Hyperloop Systems



HyperloopTT System

Hyperloop brings airplane speeds to ground level, safely. Passengers and cargo capsules will hover through a network of low-pressure tubes between cities, transforming travel time from hours to minutes.

• HYPERLOOP IS •

A new mode of transport that will revolutionize travel by connecting people and goods with unprecedented

SPEED

SAFETY

EFFICIENCY

BACKGROUND



<https://www.youtube.com/watch?v=uwm3qvFWVRU>



imagine

BACKGROUND

- NOACA and Hyperloop Transportation Technologies (HTT) formed an official Public Private Partnership (P3) on February 26, 2018
- Announced Great Lakes Hyperloop starting with a feasibility study from Cleveland to Chicago.
 - Alternatives/Routes
 - Technical & Financial Assessment
 - Total cost of the study - \$1.2 M
 - NOACA (50%) - \$600 K
 - HTT (50%) - \$600 K
 - Added Pittsburgh in June 2019

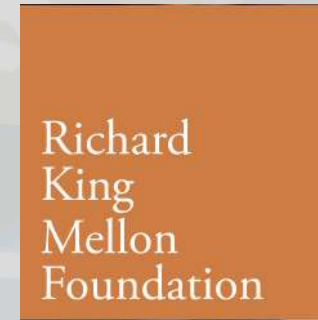


GREAT LAKES
HYPERLOOP

HYPERLOOP
TRANSPORTATION TECHNOLOGIES

PARTNERS

Feasibility Study Funding Partners



HYPERLOOP
TRANSPORTATION TECHNOLOGIES



PARTNERS

Hyperloop Collaborators



IDOT: Chicago leader

- **Interagency agreement**
 - Cooperation and Data Sharing
- **Facilitator for Chicago partners**
 - Chicago TAC Communications
 - Meeting logistics

Technical Advisory Committee (TAC)

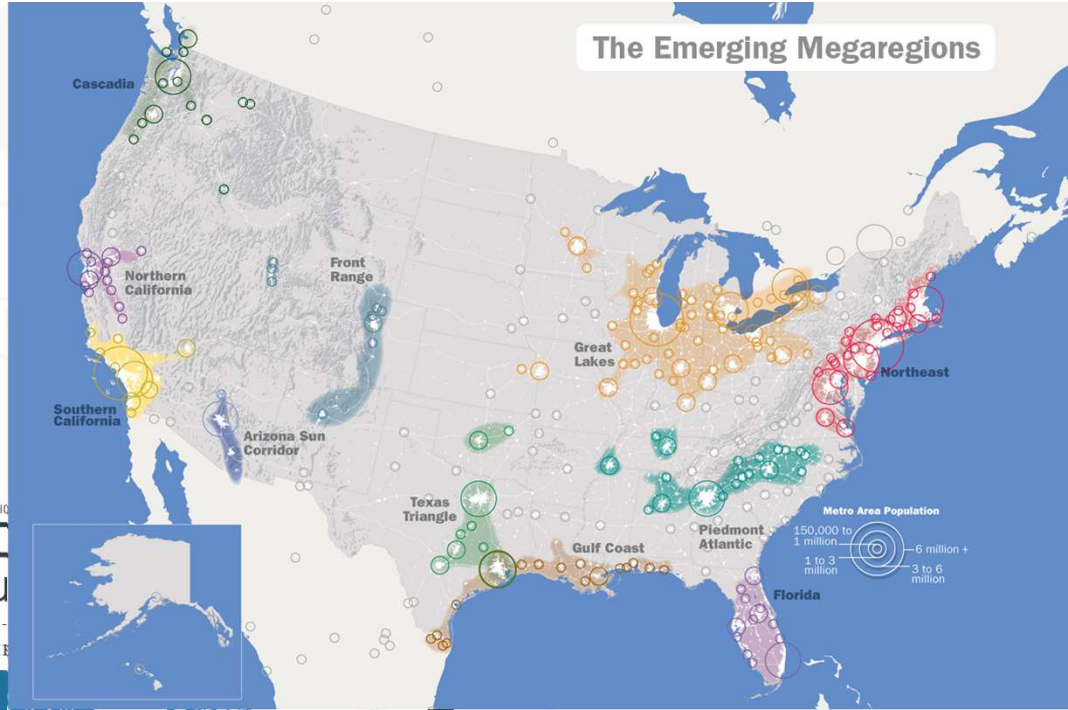
- **Local**
 - City, County, Transit Agency, MPO
- **State**
 - DOT, Tollway
- **Federal**
 - FHWA, Amtrak, NETT Council
- **Other**
 - Railroads



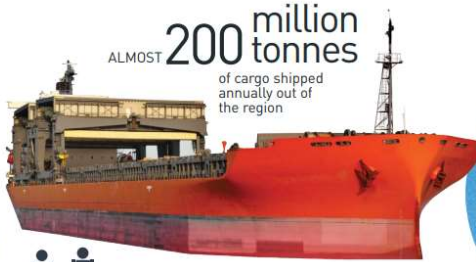




The Emerging Megaregions



EACH YEAR, THE GREAT LAKES-ST. LAWRENCE REGION contributes roughly **USD \$232 billion** to Canada-U.S. trade



Less than 1% of the waters of the Great Lakes is renewed annually

BY PRECIPITATION, SURFACE WATER RUNOFF, AND INFLOW FROM GROUNDWATER SOURCES

THE REGION OF R&D in the U.S. & Canada



The Great Lakes-St. Lawrence Region has a GDP of USD **\$5 trillion** (non-farm economy)



THE GREAT LAKES CONTAIN ABOUT **20%** of the world's surface freshwater supply

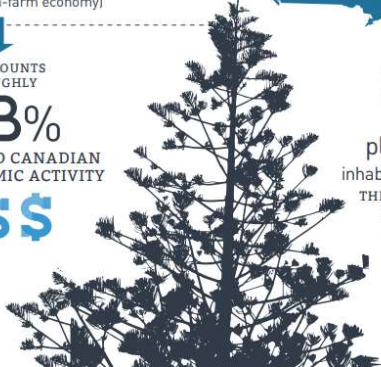
HOME TO **105 million** people,

THE REGION SUPPLIES **46 million** JOBS

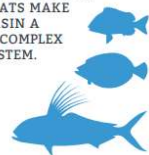
OR NEARLY **30%** of the combined U.S. & Canadian workforce.

THIS ACCOUNTS FOR ROUGHLY **28%** OF COMBINED CANADIAN & U.S. ECONOMIC ACTIVITY

\$\$\$



MORE THAN **3,500** species of plants & animals inhabit the Great Lakes basin. THE VARIETIES OF WILDLIFE AND HABITATS MAKE THE BASIN A UNIQUE & COMPLEX ECOSYSTEM.



“Where You Build Dreams”

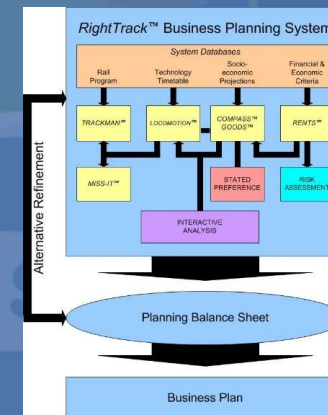
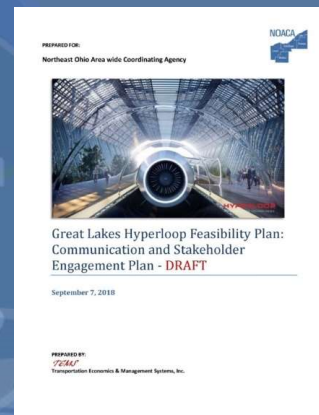
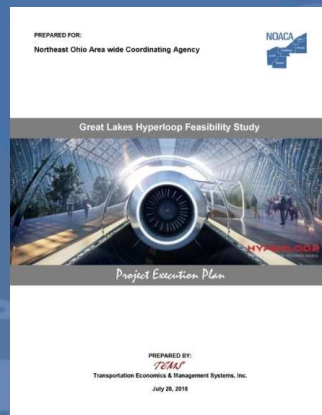


https://www.youtube.com/watch?v=YMKstW3B_IA&feature=youtu.be



PHASE 1: PROJECT OBJECTIVES AND ORGANIZATION

- Project Execution Plan
- Communications and Stakeholder Engagement Plan
- Business Planning Process

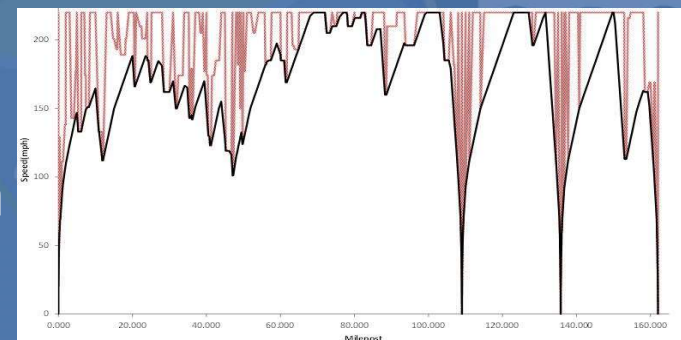


PHASE 2: SITE RECONNAISSANCE AND PRELIMINARY ROUTE ANALYSIS



TRACKMAN™ will identify the capital costs for each route.

TRACKMAN™ and LOCOMOTION™ will assess the speed of Hyperloop technology along different routes.



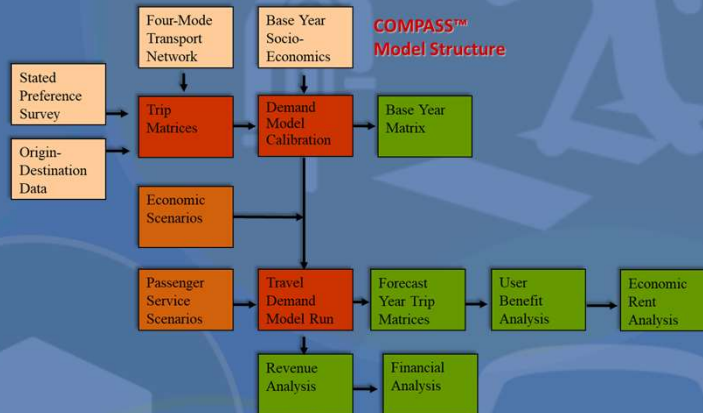
- Evaluate each route alternative
- Identify and analyze possible station locations
- Identify local traffic impact

PHASE 3: TECHNICAL AND FINANCIAL FEASIBILITY

Financial Analysis

Thousands of 2006 \$	Total to 2040	2012	2013	2014	2015	2016	2017
Revenues							
Ticket Revenue	\$1,080,230	\$13,567	\$25,107	\$28,659	\$29,422	\$30,185	\$30,948
On Board Services	\$86,418	\$1,085	\$2,009	\$2,293	\$2,354	\$2,415	\$2,476
Express Parcel Service (Net Rev)	\$54,011	\$678	\$1,255	\$1,433	\$1,471	\$1,509	\$1,547
Total Revenues	\$1,220,660	\$15,331	\$28,371	\$32,385	\$33,247	\$34,109	\$34,971
Train Operating Expenses							
Energy and Fuel	\$75,081	\$2,013	\$2,013	\$2,013	\$2,013	\$2,013	\$2,013
Train Equipment Maintenance	\$204,890	\$5,494	\$5,494	\$5,494	\$5,494	\$5,494	\$5,494
Train Crew	\$96,367	\$3,323	\$3,323	\$3,323	\$3,323	\$3,323	\$3,323
On Board Services	\$80,631	\$1,833	\$2,295	\$2,437	\$2,467	\$2,498	\$2,528
Service Administration	\$147,171	\$5,075	\$5,075	\$5,075	\$5,075	\$5,075	\$5,075
Total Train Operating Expenses	\$604,139	\$17,738	\$18,200	\$18,342	\$18,372	\$18,403	\$18,434
Other Operating Expenses							
Track & ROW Maintenance	\$114,663	\$3,954	\$3,954	\$3,954	\$3,954	\$3,954	\$3,954
Station Costs	\$40,547	\$1,398	\$1,398	\$1,398	\$1,398	\$1,398	\$1,398
Sales & Marketing	\$51,009	\$643	\$1,190	\$1,358	\$1,394	\$1,429	\$1,465
Insurance Liability	\$43,345	\$549	\$1,015	\$1,158	\$1,188	\$1,218	\$1,248
Total Other Operating Expenses	\$249,564	\$6,544	\$7,557	\$7,868	\$7,934	\$7,999	\$8,065
Total Operating Expenses	\$853,703	\$24,283	\$25,757	\$26,210	\$26,306	\$26,402	\$26,498
Cash Flow From Operations	\$366,957	(\$8,952)	\$2,614	\$6,175	\$6,941	\$7,707	\$8,473
Operating Ratio	1.43	0.63	1.10	1.24	1.26	1.29	1.32

Market Analysis



Land Use Development



Cost Benefit Analysis

Benefits	Billions in 1998 dollars
MWRRS User Benefits	
Consumer Surplus (e.g., time savings expressed as dollars)	\$6.4
System Revenues	\$6.8
Other Mode User Benefits	
Airport Congestion Relief	0.7
Highway Congestion Relief	1.3
Resource Benefits	
Air Carrier Operating Cost Reductions	0.4
Emission Reductions	0.3
Total Benefits	\$15.9
Costs	
Capital	\$4.1
Financing	0.2
Operating and Maintenance	5.0
Total Costs	\$9.3
Ratio of Benefits to Costs	1.7



PHASE 4: PROJECT DEVELOPMENT COST AND SCHEDULE

- Determine next steps
 - Environmental Impact Analysis
 - Preliminary engineering
 - Economic analysis

CLEVELAND TO CHICAGO

Route	Distance (miles)	Travel Time (minutes)	Top Speed (mph)	Average Speed (mph)
Option 1	315	31:52	760	593
Option 2	330	47:18	700	439
Option 3	337	36:38	700	554

CLEVELAND TO PITTSBURGH

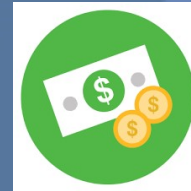
Route	Distance (miles)	Travel Time (minutes)	Top Speed (mph)	Average Speed (mph)
Option 1	139	24:04	525	339
Option 2	142	18:58	525	447



2025-2050 REGIONAL ECONOMIC IMPACT



Employment Growth
> 900,000 Jobs



Increased Income
\$46.7 Billion



Property Value Increase
\$74.8 Billion



Expanded Tax Base
\$12.7 Billion

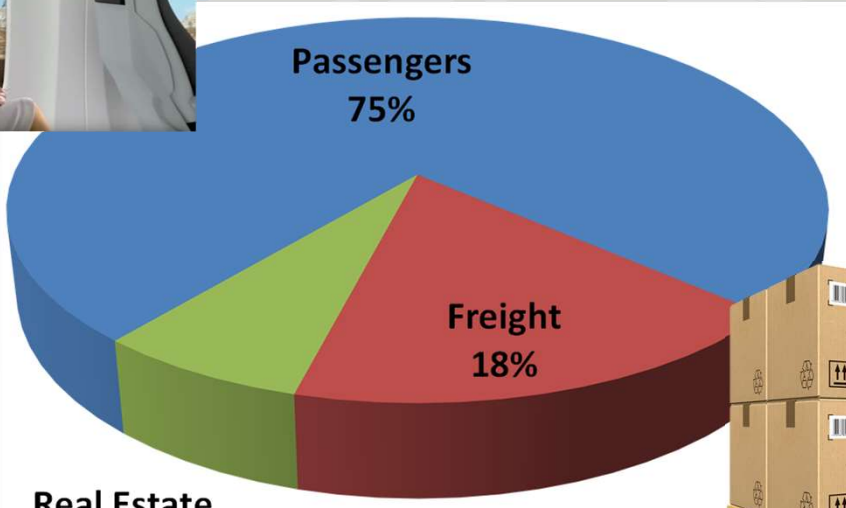


SUSTAINABILITY

- CO₂ emissions reduced by 143 million tons



2022 TOTAL PASSENGER AND FREIGHT REVENUE BY SOURCE

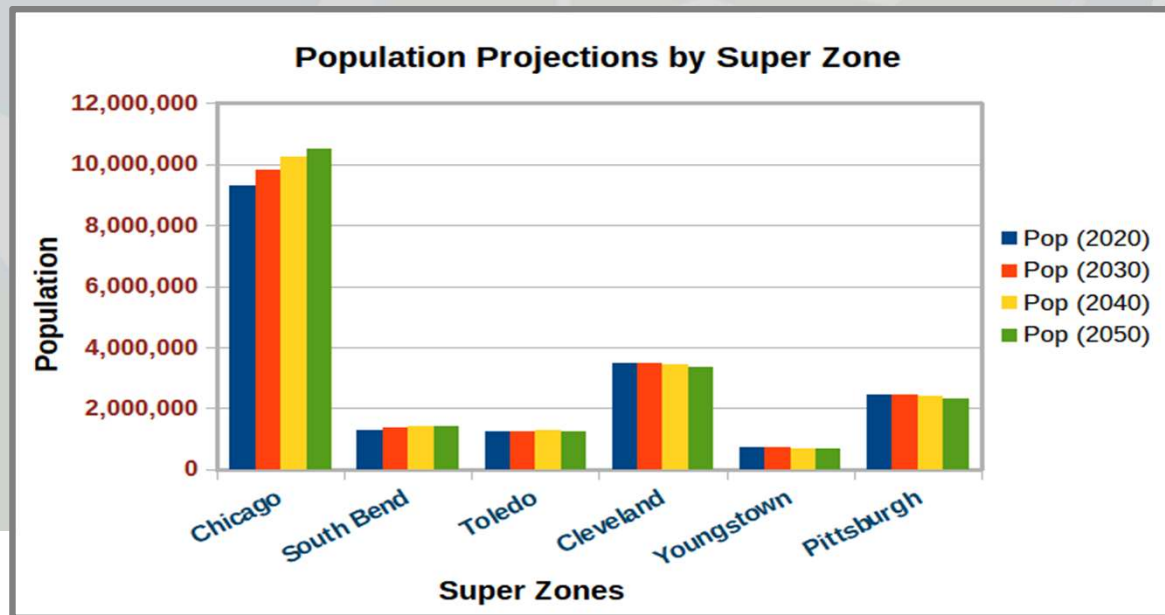


Forecast is for the Chicago-Cleveland-Pittsburgh Toll Road Option

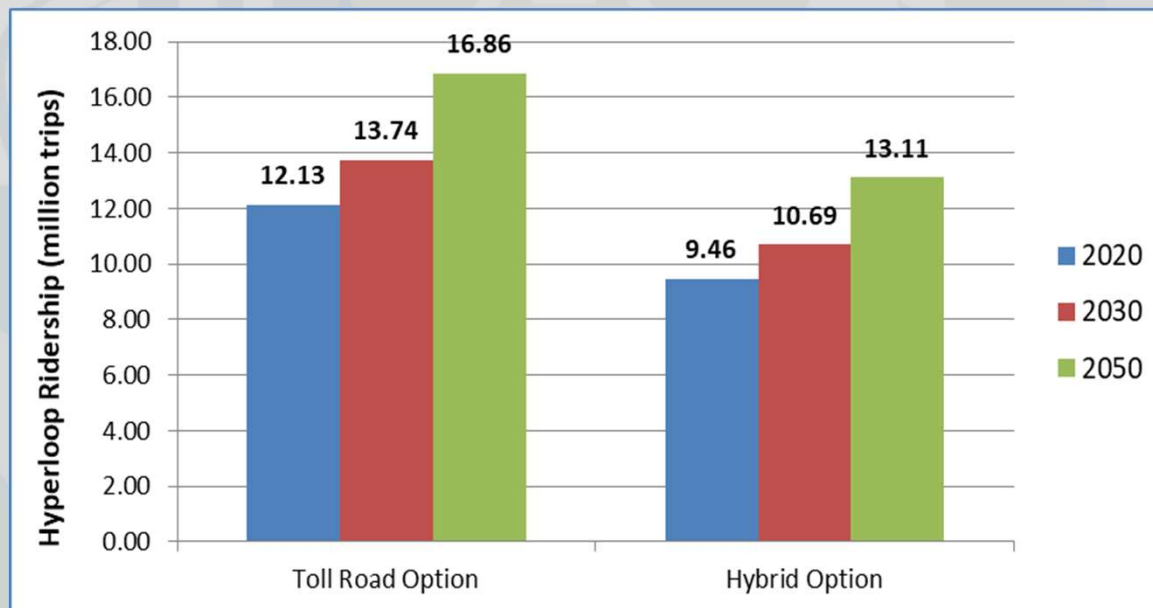


CORRIDOR POPULATION PROJECTIONS

Super Zone ID	Super Zone Name	Super Zone State	Pop (2020)	Pop (2030)	Pop (2040)	Pop (2050)
1	Chicago	IL-IN	9,301,266	9,820,473	10,230,451	10,521,483
2	South Bend	IN-MI	1,290,356	1,353,305	1,400,188	1,429,671
3	Toledo	OH-MI	1,241,187	1,260,778	1,262,819	1,247,819
4	Cleveland	OH	3,491,093	3,494,427	3,450,766	3,363,592
5	Youngstown	OH-PA	737,815	722,874	697,442	662,946
6	Pittsburgh	PA	2,468,567	2,451,677	2,401,902	2,322,451
Grand Totals			18,530,284	19,103,534	19,443,569	19,547,962



HYPERLOOP RIDERSHIP FORECAST IN THE CLEVELAND-CHICAGO-PITTSBURGH CORRIDOR

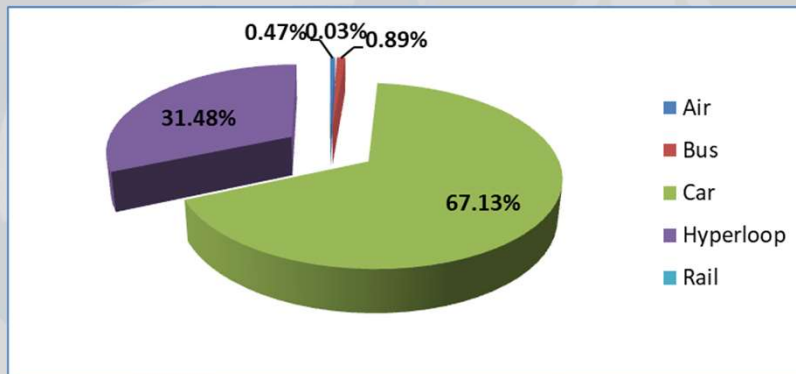


- Toll Road Option 3 intermediate stops (South Bend, Toledo, Youngstown)
- Hybrid Option 2 intermediate stops (Toledo, Youngstown)

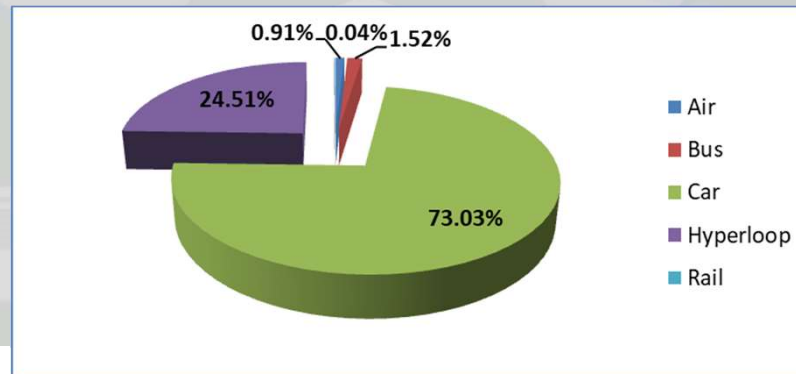


MODAL SHARES FOR EACH OPTION (2030)

Toll Road Option



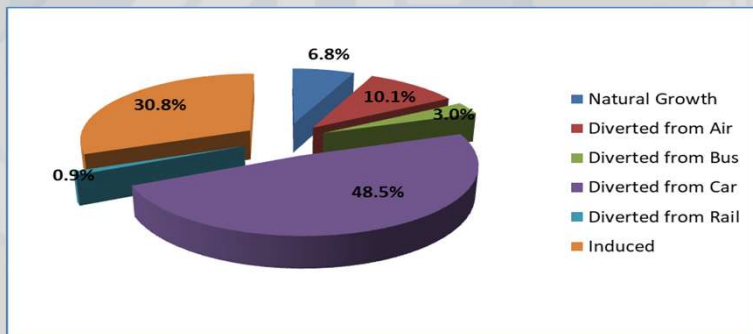
Hybrid Option



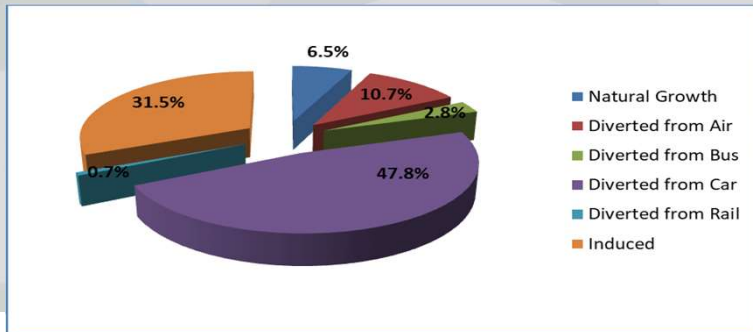
- Hyperloop obtains between 25 and 30 percent of the market

SOURCES OF HYPERLOOP TRIPS FOR EACH OPTION (2030)

Toll Road Option



Hybrid Option



Hyperloop has approximately 30 percent induced demand and 50 percent diverted from auto

2022 FREIGHT REVENUE FORECAST



LTL Cargo
45%
4% growth per year



Express Parcel
42%
15% growth per year

Air Cargo
13%

5% growth per year



Forecast is for the Chicago-Cleveland-Pittsburgh Toll Road Option

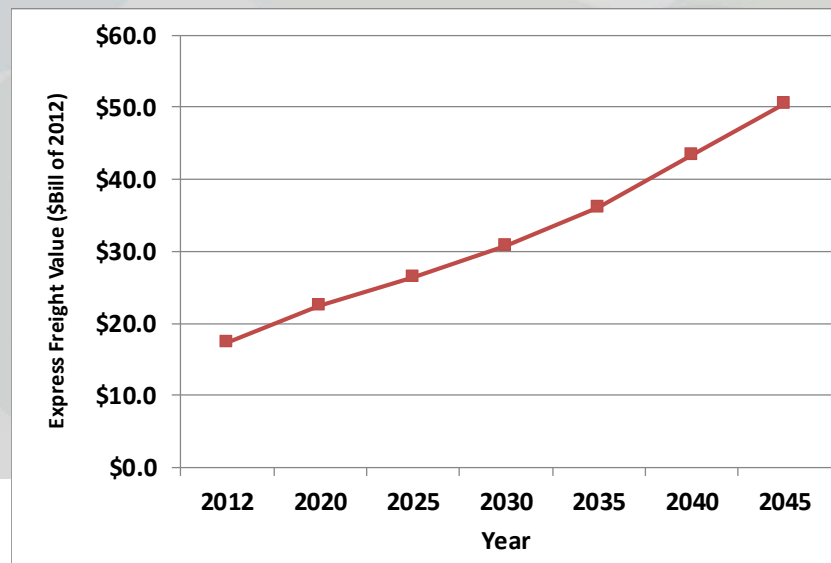


FREIGHT FORECAST GROWTH

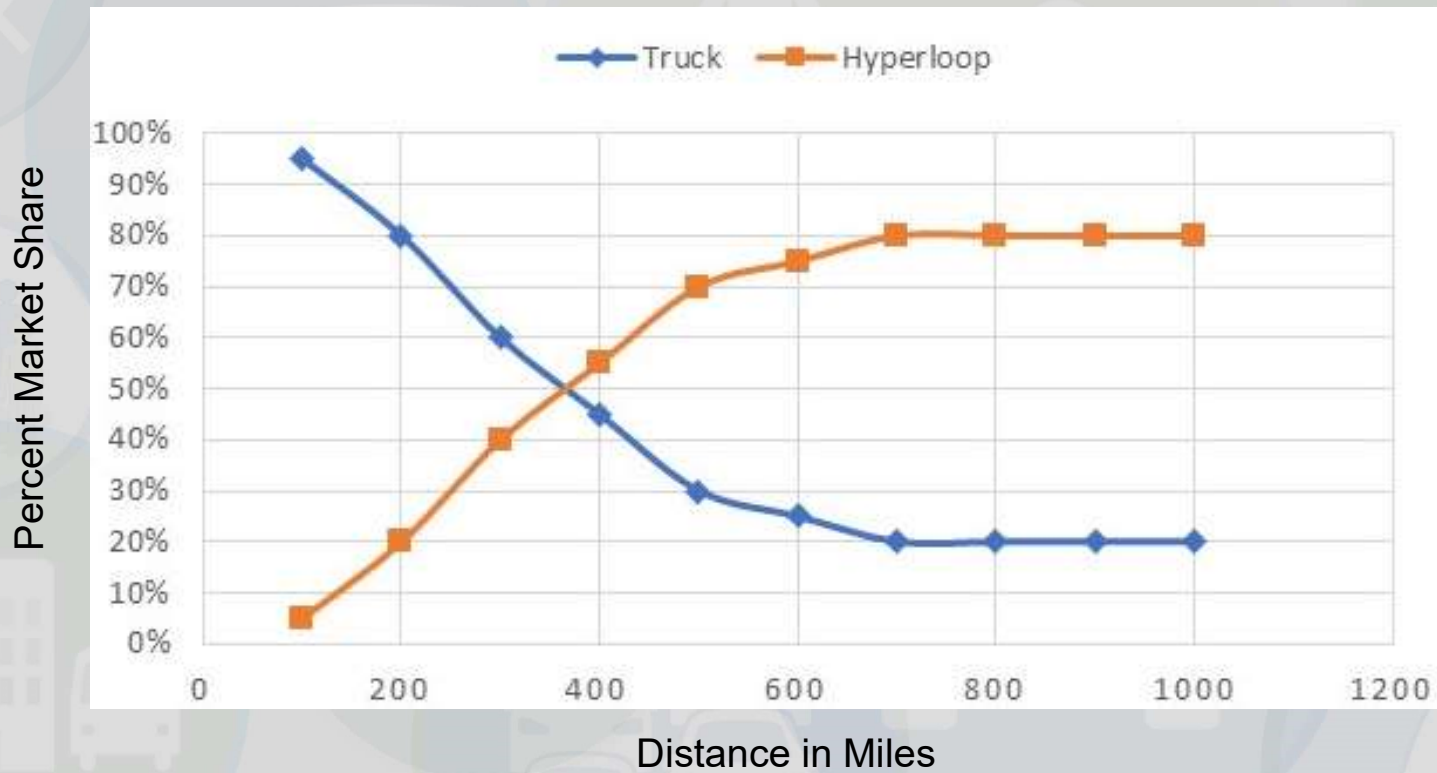
Cleveland-Chicago-Pittsburgh Growth – by Cargo Value

- Compound Rate of Growth = 3.2% over the 33-year period results in nearly tripling the freight market over the forecasted time frame.
- This is a very conservative rate of growth for some segments of the business, e.g. E-Commerce which is now growing at up to 15% per year but is still higher than the annual growth rates that are generally used for forecasting passenger traffic growth.

Forecasted Cargo Value by Year



TRUCK, HYPERLOOP MARKET SHARES



EXPRESS FREIGHT TOTAL MARKET

	Commodity	Value (\$ mill)	Tons (mill)	Avg \$/Pound
**	Mail	\$3,794.21	0.07	\$27.00
01	Live Animals/Fish	\$136.98	0.07	\$0.97
05	Meat/Seafood	\$770.75	0.12	\$3.17
20	Basic Chemicals	\$719.87	0.38	\$0.95
21	Pharmaceuticals	\$13,549.81	0.03	\$222.66
23	Chemical Products	\$1,806.85	0.60	\$1.52
30	Textiles/Leather	\$376.82	0.02	\$10.22
35	Electronics	\$8,070.25	0.26	\$15.42
38	Precision Instruments	\$2,616.03	0.03	\$42.28
08	Alc Beverages	\$0.52	0.00	\$2.66
09	Tob Products	\$0.02	0.00	\$0.67
29	Printed Materials	\$419.14	0.14	\$1.52
34	Machinery	\$8,172.14	0.46	\$8.88
43	Mixed Freight	\$2,913.91	0.57	\$2.55
	TOTAL	\$43,347.29	2.75	\$7.89

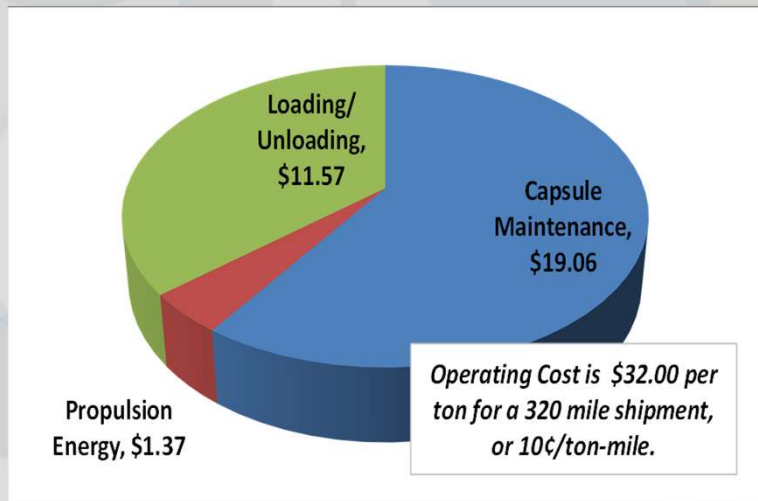
**** Mail is not actually a commodity in FAF-4, rather it is Mode #5**

Only the types of Express freight that are likely to move in Air Cargo or LTL trucking service were selected. This freight with an average value of \$7.89 per pound is clearly very high value. It will have a correspondingly high Value of Time and require expedited handling such as Hyperloop could provide.

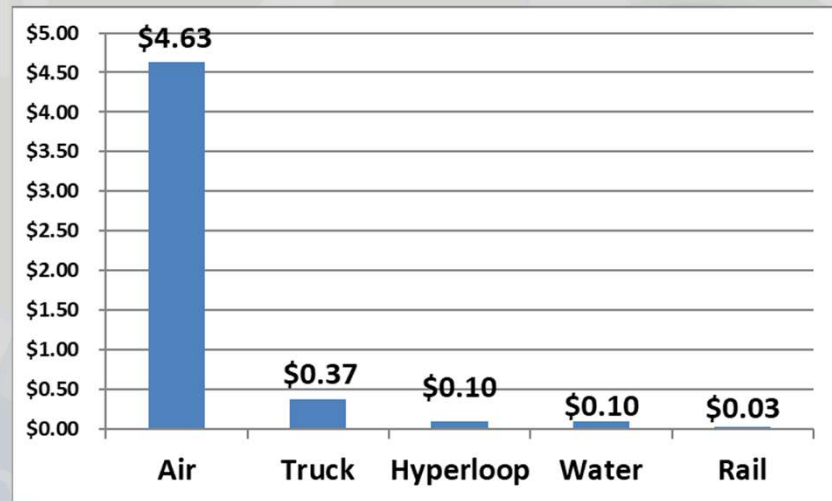


FREIGHT OPERATION COSTS

Estimated Hyperloop Operating Cost Per Ton-Mile:
320 Miles Cleveland to Chicago



Benchmark Cost per Ton-Mile for Four
Shipping Modes



Hyperloop is very competitive with Air, Truck and Water



FINANCIAL ANALYSIS

Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility   Achieving Increased Mobility



COST BENEFIT RESULTS

Discount Rate	3.0%	7.0%
Benefits to Users		
Passenger Consumer Surplus	\$43,177.81	\$21,635.41
Freight Consumer Surplus	\$17,310.09	\$7,734.58
Total User Benefits	\$60,487.90	\$29,370.00
Benefits to Public at Large		
Env + Resource (Air)	\$4,327.52	\$1,933.65
Env + Resource (Auto)	\$4,005.88	\$2,013.60
Freight Envir. Benefit	\$5,826.74	\$2,928.87
Total Public at Large Benefits	\$14,160.15	\$6,876.11
Total Benefits	\$74,648.05	\$36,246.11
Costs		
Passenger Op Cost	\$8,392.09	\$4,245.16
Air Cargo Op Cost	\$291.19	\$130.75
LTL Cargo Op Cost	\$1,136.28	\$525.23
Capital Cost	\$24,128.14	\$21,444.12
Total Costs	\$33,947.70	\$26,345.25
Benefits Less Costs	\$40,700.35	\$9,900.86
Benefit/Cost Ratio	2.20	1.38
Passenger-Only Benefit/Cost Ratio	1.58	1.00



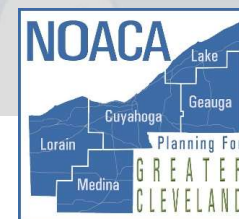
EMPLOYMENT IMPACT

Station Name	Employment Improvement (man year) 2025~2050
Chicago, IL	425,628
South Bend, IN	67,755
Toledo, OH	64,306
Cleveland, OH	191,097
Youngstown, OH	36,592
Pittsburgh, PA	146,367
Total	931,745



INCOME IMPACT

Station Name	Income Improvement 2025~2050 (billion \$)
Chicago, IL	21.6
South Bend, IN	3.5
Toledo, OH	3.2
Cleveland, OH	9.8
Youngstown, OH	1.9
Pittsburgh, PA	7.6
Total	47.6



LOCAL TAX IMPROVEMENT

Station Name	Local Tax Improvement 2025~2050 (million \$)
Chicago, IL	919
South Bend, IN	150
Toledo, OH	136
Cleveland, OH	418
Youngstown, OH	79
Pittsburgh, PA	319
Total	2,021



PROPERTY VALUE IMPROVEMENT BY STATION COVERAGE AREA (DEVELOPMENT)

Station Name	Property Value Improvement 2020~2050 (billion \$)
Chicago, IL	27.1
Midway Airport, IL	6.9
South Bend, IN	5.5
Toledo, OH	5.2
Cleveland, OH	15.3
Youngstown, OH	3.0
Pittsburgh, PA	11.9
Total	74.8

- Hyperloop with an average speeds of 400 to 600 mph, brings massive transit oriented development (TOD) to station areas



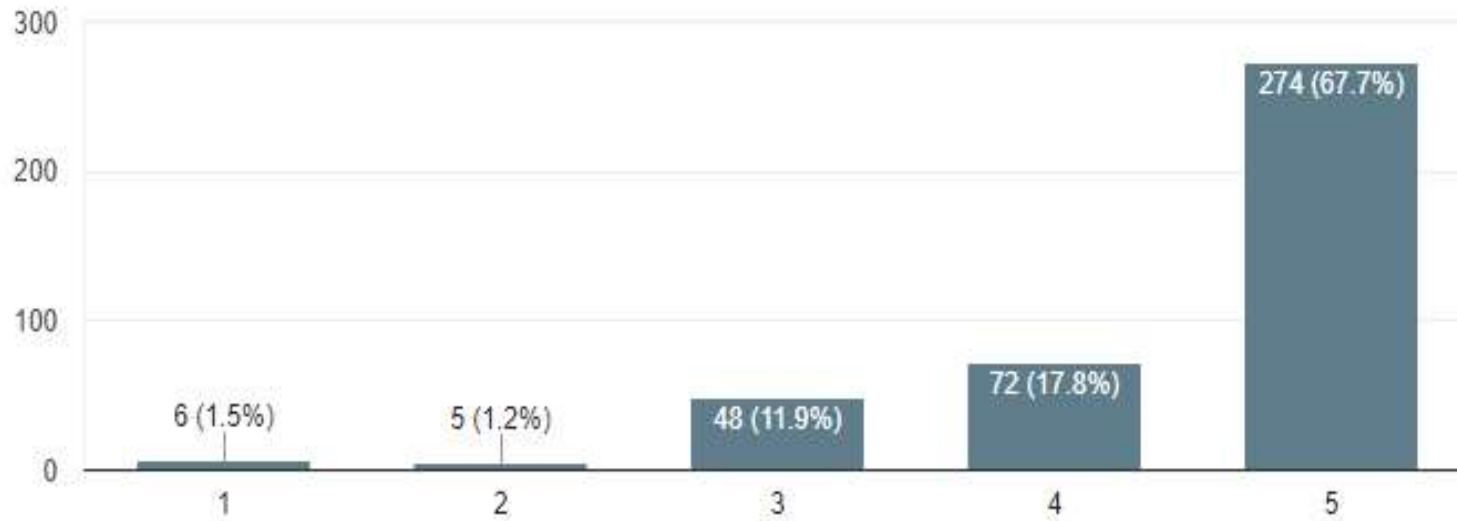
The Hyperloop Experience

- Virtual reality experience engaging the public
 - To get a sense of what hyperloop travel would feel like
 - To experience moving through a hyperloop station
- Participants completed pre- and post-experience surveys
- 412 people participated



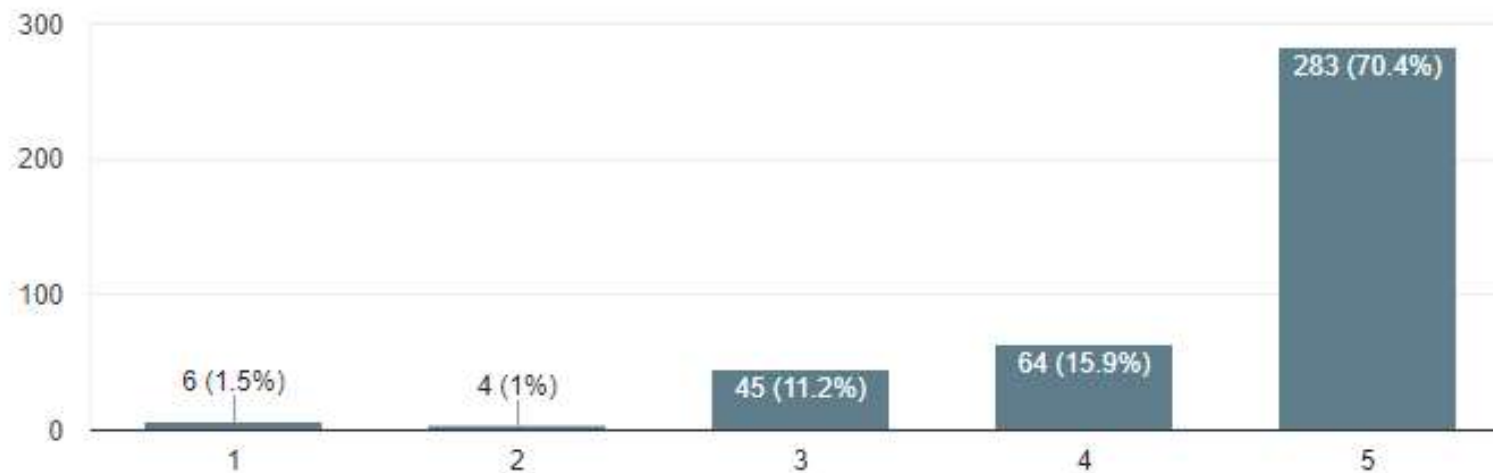
Cleveland to Chicago Hyperloop is a good idea.

405 responses



Cleveland/ Northeast Ohio should be one of the first in the country to get this new form of transportation.

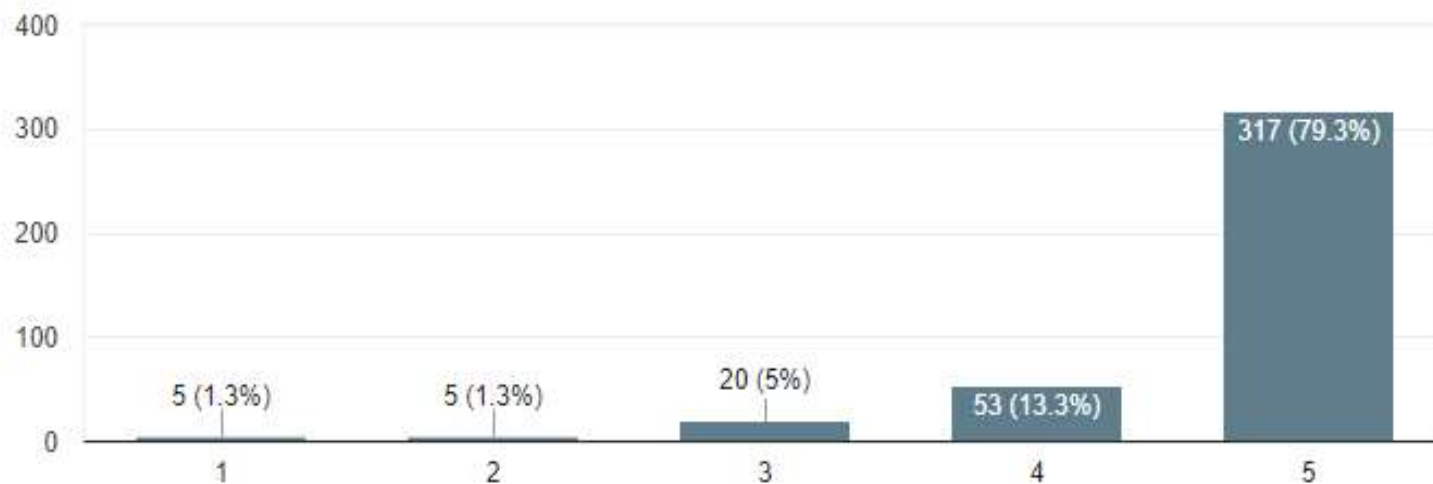
402 responses



If a Hyperloop route existed between Cleveland and Chicago, I would consider using it.



400 responses



Video: “Once in a Lifetime”





