Written Testimony of Petra Todorovich to the U.S. House of Representatives Committee on Transportation and Infrastructure Subcommittee on Railroads, Pipelines, and Hazardous Materials

October 14, 2009

Chairwoman Brown and members of the Committee, thank you for inviting me to testify on this important and timely topic.

I am director of America 2050, a national initiative to promote a growth strategy and infrastructure plan for America in the 21st century in response to the challenges of population growth, climate change, energy independence and the need for robust and sustainable economic growth.

America 2050 strongly supports the creation of a national network of high-speed rail corridors organized around the nation's megaregions. Megaregions are networks of metropolitan areas—like the Northeast, the Florida Megaregion, the Texas Triangle—that are connected by overlapping commuting patterns, business travel, and manufacturing supply chains and supported by large natural systems, like watersheds and forests. Spanning areas of roughly 300-600 miles across, megaregions are the ideal size for high-speed rail networks and have densities comparable to Asian and European countries with successful high-speed rail programs. Over 70 percent of America's population and jobs are concentrated in the 11 megaregions we have identified. (See Figure 1.)

The strongest case for high-speed rail is economic. America must provide capacity in its infrastructure systems for future economic growth (beyond the current recession) or else our competitors will quickly pass us by. Our initial $8 billion investment in high-speed rail pales in comparison to our largest competitor, China, which is investing roughly $300 billion in a national high-speed network. And we are not sitting on our laurels because our current surface and air transportation systems meet the current or future needs of our population and economy. In fact, the opposite is true. They are outmoded, congested, and in disrepair. We have no meaningful plan to maintain current systems and accommodate future growth.

From 2000-2050, the U.S. Census Bureau forecasts that America will grow by 158 million people, reaching a total population of 439 million. That's more than the 120 million people that America added from 1950 to 2000, during the rapid growth years following World War II and in which time America built the entire Interstate Highway System. But America has outgrown the Interstate system and can no longer support the costs of automobile-dependent growth patterns on households, the environment, and the global implications of our dependence on foreign oil.

High-speed rail can help meet the mobility needs of a global, knowledge-based economy, while shifting more passengers from short-haul air flights and long auto trips to electric-powered rail (which provides the opportunity to draw from renewable energy sources.) Increased mobility within the megaregions can foster greater economic synergies among adjacent metro areas, more face-to-face meetings, interactions, and transactions, with greater energy efficiency. Rail's ability to connect center city to center city supports activities in dense, walkable communities, and will work best when integrated with regional and local transit networks, providing connecting services to the origin and destination of intercity trips.

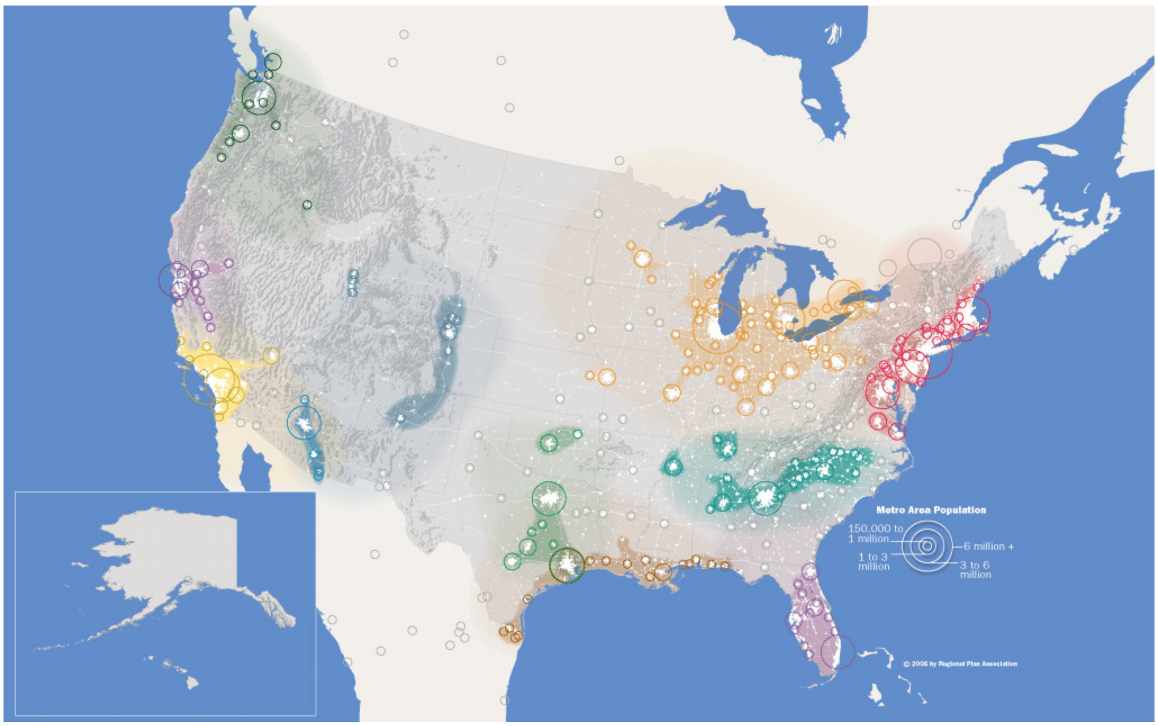

Figure 1: America's Emerging Megaregions Source: Regional Plan Association

However, going from virtually no high-speed rail in America to a robust national network is not without its risks. As the GAO recently observed, each of these high-speed rail systems will cost tens of billions of dollars in upfront costs to build the infrastructure before a single passenger pays a fare.[1] Therefore, the federal government should proceed strategically and invest first in corridors that show the greatest promise for generating ridership that will offset long-term operating costs. America 2050 recently released a report, "Where High-Speed Rail Works Best," which ranks 27,000 city pairs in the nation on their potential for ridership demand. This report is summarized below and can be downloaded in its entirety at: http://www.america2050.org/2009/09/where-high-speed-rail-works-best.html.

Where High-Speed Rail Works Best

Defining the corridors in America that are most appropriate for high-speed rail service is critical to the long-term success of the federal government's high-speed rail program. America 2050 offers one mechanism for assessing which potential high-speed rail corridors will have the greatest ridership demand based on population size, economic activity, transit connections, existing travel markets and urban spatial form and density. We evaluated 27,000 city pairs in the nation to create an index of city pairs with the greatest demand for high-speed rail service. We provide a list below of the top 100 city pairs, which are primarily concentrated in the Northeast, California, and the Midwest.

Our ranking system should be considered as an *additional factor* for the FRA to consider as it makes its decisions about where to grant high-speed rail funding, *not the only factor*. We support the criteria that the FRA is using to evaluate different corridors, pertaining to transportation benefits, economic benefits, project readiness, organizational capacity, project engineering, environmental studies, and financial plans. However, we wrote this report because we felt the FRA should also develop metrics to compare the scale of these benefits across regions. Specifically, the FRA should develop a mechanism for judging which corridors across the nation have the greatest potential ridership demand for high-speed rail. The $8 billion appropriated for high-speed rail in the ARRA legislation[2] is only a small fraction of what will be necessary to fully construct an American high-speed rail network. To maintain public support for a continued federal commitment to high-speed rail, the initial investments must be viewed as a success.

Although there are many promising projects in smaller travel markets that should be part of a fully constructed network, these will be better positioned for success if the initial $8 billion are invested in projects that can achieve the greatest travel benefits for the largest numbers in the shortest period of time.

For this to be true, they need to fund projects in corridors with the appropriate density, economic activity, and existing travel markets to support strong ridership on these new services. Investing in corridors with the maximum potential to support ridership reduces risk, increasing the probability of success and long term public support.

Determining Potential Market Demand for High-Speed Rail

Given the long lead time and inherent risk in high-speed rail investments, it is essential that the FRA select corridors where the conditions exist to support strong passenger demand for high-speed services. In addition to the FRA's criteria described above, America 2050 has developed a ranking system based on an index of six criteria to judge the extent of demand for high-speed rail between any two city pairs. Each city pair consists of two cities, each with a population of at least 50,000 that are separated by a distance of 100 to 500 miles. These criteria were weighted and then calculated into an index that scored the city pairs. The largest index score represented the best potential market for high-speed rail. The criteria and the results of the index are described below.

The city pairs were evaluated on the basis of the following criteria:

- **City and metropolitan area population, favoring cities with larger populations in large metropolitan areas.**
- **Distance between city pairs, confined to distances between 100-500 miles, with distances between 150 - 300 miles receiving the highest value.**
- **Metropolitan regions with existing transit systems including regional rail, commuter rail and local transit networks.**
- **Metropolitan GDP, awarding value based on the combined per-capita GDP.**
- **Metropolitan regions with high levels of auto congestion as measured by the**

Texas Transportation Institute's Travel Time Index.

- **Metropolitan regions that are located within a megaregion.**

Criterion 1: Metropolitan Population Size

To ensure sufficient travel demand for high-speed rail service, it is best to locate stations in major metropolitan areas. There are 21 metro regions in the nation with a population of at least 2.5 million; all are located within one of the 11 emerging megaregions across the country. The index also weighted whether the city was the primary city of a metropolitan region and the size of that city. The Northeast megaregion alone contains four of the top ten most populous metro regions in the nation – New York, Philadelphia, Washington, D.C., and Boston. The Midwest and Texas Triangle megaregions each contain two metro areas in the top ten.

Criterion 2: Distance

The competitive advantage of high-speed rail over other modes of travel is maximized at distances between 100 to 500 miles. Distances below 100 miles are better suited for auto and commuter rail networks whereas distances greater than 500 miles are more efficiently travelled by air. There are significant barriers to air travel causing it to be inefficient at short distances. These barriers include accessing airports located outside the metropolitan core, onerous security processes, long check-in times, and airport delays and congestion. These time barriers to air travel result in significant time advantages to efficient rail service. This time advantage drops off sharply at distances beyond 500 miles when the superior in-flight speed of air travel overwhelms the initial time costs of travelling to and checking in at the airport. This index weighted the distance criteria such that it peaked between 150 and 300 miles.

Criterion 3: Transit Connections

Two additional competitive advantages of rail over air are rail's ability to bring passengers directly into the city center and attract riders through connecting local and regional transit networks, which act as feeder services. High-speed rail systems will attract greater numbers of riders if they begin and end in central locations within the metro region and tie seamlessly into existing commuter rail and transit systems. These commuter and local transit systems support intercity ridership by offering passengers options to transfer to final destinations. Without access to transit systems, intercity passengers are dependant on autos to begin or end their trip, significantly decreasing rail's competitive advantage. The presence and use of transit and regional rail systems within a metropolitan region also may indicate a willingness of the people in that region to leave their cars at home and the land use patterns that support that choice—making use of high-speed rail a more likely option. (Our analysis could be improved by also factoring in the existence and extent of bus transit, for which we were not able to collect sufficient data in time for this study.)

Criterion 4: Economic Productivity

High-speed rail systems depend heavily on business travel to sustain ridership and business travel is highest in places with more productive economies. Studies also show that travel increases with increased income, whether for business, personal, or leisure travel.[3] [4] Gross Domestic Product (GDP) per capita is the broadest measure that is associated with both economic productivity and personal income.

Criterion 5: Congestion

The goal of congestion reduction, both at airports and on highways, is one motivation for building high-speed rail systems. Metropolitan congestion increases intercity auto travel time making rail a more attractive option. The Texas Transportation Institute (TTI) congestion index for metropolitan areas was used to select metro areas with high rates of auto congestion.

While relieving auto congestion is a major potential benefit, high-speed rail systems tend to compete more with short-haul air travel than intercity auto trips and have the potential to decongest some of the nation's most congested airports. Although not included in the rankings, airports with high levels of congestion may indicate high volumes of intercity passenger travel originating or ending in that city—though the effect of airlines hubs on congestion must be discounted.

Criterion 6: Megaregion

The final criterion included in the index takes into account urban form and population density, by determining whether a city is located in a megaregion. Megaregions are networks of metropolitan regions with shared economies, infrastructure and natural resource systems, stretching over distances of roughly 300 miles - 600 miles in length. High-speed rail systems work best as part of a network with multiple connections, as has been shown in European and Asian megaregions. Cities that are located in one of the eleven megaregions are more likely to be part of a network of interconnected cities with the appropriate density to support high-speed rail systems, rather than an isolated city pair. Most of these megaregions have population densities similar to European countries with successful high-speed rail systems. The most densely populated megaregion is the Northeast, which approaches densities found in Japan and other Asian countries, followed by Southern Florida.[5]

Results

The six criteria described above were used to create an index that ranked 27,000 city pairs on their suitability, based on potential market demand, to act as origin and destination nodes of one leg of a high-speed rail corridor.[6] The top 100 pairs in the index are shown below. The top city pairs identified were primarily concentrated in the Northeast, California, and the Midwest.

Top 100 City Pairs

Rank	Corridor	Score	Rank	Corridor	Score
1	New York-Washington	100.00	51	Columbus-New York	85.11
2	Philadelphia-Washington	98.24	52	New York-Richmond	85.08
3	Boston-New York	97.22	53	Baltimore-Cleveland	84.98
4	Baltimore-New York	96.83	54	Austin-Houston	84.95
5	Los Angeles-San Francisco	96.43	55	Bridgeport-Washington	84.58
6	Boston-Philadelphia	96.05	55	Houston-San Antonio	84.58
7	Los Angeles-San Diego	94.92	57	Baltimore-Charlotte	84.46
8	Los Angeles-San Jose	94.19	58	Ann Arbor-Chicago	84.41
9	Boston-Washington	92.79	58	Buffalo-Philadelphia	84.41
10	Dallas-Houston	91.37	60	New York-Worcester	84.35
11	Chicago-Detroit	91.09	61	Manchester-Philadelphia	84.30
12	Baltimore-Boston	90.39	62	Durham-Washington	84.24
13	Chicago-Columbus	89.42	62	Washington-Winston-Salem	84.24
14	Chicago-Saint Louis	89.25	64	Chicago-Pittsburgh	84.23
15	Los Angeles-Phoenix	89.03	65	Chicago-Madison	84.20
16	Chicago-Cleveland	88.71	66	Baltimore-Detroit	84.12
17	Charlotte-Washington	88.43	67	Philadelphia-Rochester	84.08
18	San Diego-San Francisco	88.39	68	Baltimore-Pittsburgh	84.02
19	Columbus-Washington	88.32	68	Rochester-Washington	84.02
20	Cleveland-Washington	88.21	70	Dallas-San Antonio	83.96
21	New York-Pittsburgh	88.13	71	New York-Raleigh	83.91
22	Phoenix-San Diego	88.03	72	Philadelphia-Richmond	83.91
23	Las Vegas-Los Angeles	87.97	73	Los Angeles-Salinas	83.85
24	Detroit-New York	87.79	74	Chicago-Lansing	83.69
25	Chicago-Minneapolis	87.47	75	Baltimore-Columbus	83.67
26	Detroit-Washington	87.33	76	Riverside-San Francisco	83.62
27	Cleveland-New York	87.27	77	Las Vegas-San Diego	83.52
28	Philadelphia-Pittsburgh	87.25	78	Chicago-Fort Wayne	83.44
29	Portland-Seattle	87.23	79	Durham-Philadelphia	83.37
30	Pittsburgh-Washington	87.19	80	Atlanta-Charlotte	83.35
31	Los Angeles-Sacramento	86.69	80	Chicago-Dayton	83.35
32	New York-Providence	86.58	82	Erie-New York	83.33
32	Raleigh-Washington	86.58	83	Chicago-Green Bay	83.30
34	Detroit-Philadelphia	86.36	83	Philadelphia-Virginia Beach	83.30
35	Chicago-Louisville	86.30	85	Buffalo-Washington	83.24
36	Hartford-Philadelphia	86.25	85	Virginia Beach-Washington	83.24
37	San Diego-San Jose	86.14	87	Houston-New Orleans	83.19
38	Hartford-Washington	86.13	88	Philadelphia-Worcester	83.18
39	Chicago-Cincinnati	86.02	89	New York-Springfield	83.15
40	Cleveland-Philadelphia	85.99	90	Greensboro-Washington	83.13
41	Charlotte-Philadelphia	85.78	91	Baltimore-Hartford	83.02
42	Philadelphia-Raleigh	85.60	92	Providence-Washington	82.95
43	Buffalo-New York	85.58	93	New Haven-Philadelphia	82.90
43	New York-Virginia Beach	85.58	94	Allentown-Washington	82.90
45	Austin-Dallas	85.52	95	New Haven-Washington	82.85
46	Manchester-New York	85.47	96	Chicago-Grand Rapids	82.84
47	Philadelphia-Providence	85.41	97	Chicago-Peoria	82.82
48	Bridgeport-Philadelphia	85.36	98	Fayetteville-Washington	82.74
49	Columbus-Philadelphia	85.31	98	Los Angeles-Modesto	82.74
50	New York-Rochester	85.24	98	Miami-Tampa	82.74

It is no surprise that the nation's four largest cities (New York, Los Angeles, Chicago, and Houston) are all represented near the top of the list as part of city pairs with potential demand for high-speed rail. These are the places that not only contain a critical mass of population to support these systems, but also a large percentage of the nation's economic productivity, existing travel markets, and metropolitan congestion.

The New York to Washington, D.C. market was the top pair of the 27,000 pairs analyzed.[7] In many ways this city pair typifies the ideal corridor for high-speed rail and shares similar attributes with successful existing corridors around the word. Population density in the Northeast megaregion is higher than anywhere else in the nation, is higher than almost anywhere in Europe, and is similar to densities in Japan. Both cities have extensive transit and regional rail systems to complement intercity rail traffic. Both cities have productive economies and have an extensive existing travel market. And the two cities are separated by just over 200 miles with two major cities in between, Philadelphia and Baltimore. This corridor shares many of the characteristics with the most successful (in term of ridership) high-speed rail corridor in the world, Tokyo to Osaka, which is similar in distance, density, existence of supportive transit systems, and major intermediate cities, Nagoya and Kyoto.

Although one Texas city pair made it into the top ten in the index (Dallas-Houston), the other major connections in the Texas Triangle are further down on the list (Austin-Dallas: 45th; Austin-Houston: 54th; Houston-San Antonio: 56th: Dallas-San Antonio: 70th). These corridors tended to be ranked lower than the city pairs in California (six California city pairs were ranked in the top 25) and the Midwest (with city pairs including Chicago, Detroit, Columbus, Cleveland, and Pittsburgh), which all appeared multiple times in the top 50 pairs. Although these Texas corridors scored well in overall population, length of corridor, and economic activity, the lack of (or limited) existing local and regional transit systems in these cities reduced their overall rankings.

The only Florida pair to make the top 100, Miami-Tampa, included two large metros (at least 2.5 million), but cities of only moderate in size (300-400K). This hurt their ranking in relation to cities like New York, Chicago, and Los Angeles and reflected the methodology (below), which used city population in addition to metro region population to account for how much of the region's population is centrally located rather than sprawled out in suburbs and exurbs. Next, although both cities have transit systems, they are small relative to many of the other cities that appear above them in the rankings. The per capita GDP of the metro areas are 46K for Miami and 42K for Tampa, which placed them in the middle of the pack. The criterion for auto congestion was toward the top of the city pairs (particularly for Miami) but still behind many of the city pairs above them on the list including most of the California cities, New York and Chicago.

City pairs with at least one city with local transit and commuter rail systems tended to populate the top 100 city pairs. Corridors which included two such cities including New York, Washington, Philadelphia, Los Angeles, and San Francisco all can be found in the top 10.

How to Interpret America 2050's Ranking

It is important to note that America 2050's ranking and analysis above did not take into account on-the-ground factors, such as the condition of existing rail infrastructure, local support, or preliminary engineering of rail plans. We are confident that these are factors the FRA will strongly consider in their evaluation process. We also lack access to the information in the hundreds of high-speed rail grant applications that have been submitted by states across the nation.

We believe that the presence of any city pair in the top 100 pairs of our ranking indicates a potential to support high-speed rail service in that corridor. Many more on-the-ground factors will make the difference in whether ridership will materialize. Most critical will be the integration of high-speed rail services within existing local and regional transit networks, the location of stations within walkable, dense environments with easy access to major destinations, and the existence of intercity travel markets between the points which the new high-speed rail connection will serve.

Our ranking and analysis demonstrate one mechanism of comparing ridership demand across corridors in the nation. We hope this will spur additional studies and conversations about what factors must be in place to create the conditions to maximize high-speed rail investment. Since releasing the report, we have already collected suggestions on additional criteria that would improve this analysis in a second round, such as by evaluating:

- Corridors that connect to Canadian and Mexican cities, like Vancouver, Montreal, Toronto, and Tijuana.
- Existing air travel between city pairs.
- The benefits of connecting multiple cities with strong ridership demand along a corridor or in a network.
- Population density around proposed high-speed rail stations.
- Numbers of tourists and visitors that may use high-speed rail, particularly in regions with high numbers of visitors, like Orlando and Las Vegas.
- The presence of other forms of public transportation in addition to fixed rail transit.

In conclusion, we strongly support the federal government's new high-speed rail program and offer this analysis as another factor for the FRA to consider as it makes decisions about where to invest first.

Ultimately, America must invest at higher levels that the $8 billion provided in ARRA, and must secure a new long-term revenue source for high-speed rail America.

To ensure the long-term success of this program, we must increase understanding about where high-speed rail works best in the United States. We believe it is in corridors of roughly 100 – 500 miles in length, with growing populations, economies, and the presence of regional and local transit networks that can provide connections for intercity passengers. America’s 11 emerging megaregions – networks of metropolitan regions connected by linked economies, travel patterns, and shared environmental resources – are among the prime areas suited for intercity rail investment.

Technical Appendix

This technical appendix defines the terms and equation used in this analysis.

In this study, evaluation criteria were applied to city pairs to analyze potential high-speed rail corridors. However, before doing so, these "city pairs" were created using a geographic information system. First, we selected every incorporated place in the nation with a population of at least 50,000. This process yielded approximately 600 cities and towns. From these 600 places, city pairs were created by connecting each one of the cities to every other city located between 100 and 500 miles from the originating city. This yielded approximately 27,000 city pairs across the nation on which the analysis was based.

Twelve variables were used in the creation of the index across six categories: metropolitan size, distance, transit connections, economic vitality, and congestion. These variables were weighted and then summed into an index that scored the city pairs. An explanation of each variable with its associated value and the equation used to create this index follows.

The scores for the 27,000 city pairs ranked in this index ranged from 3.9 to 44.9. The scores listed beside the city pair in the table in the text of this document represent that city pair's scores as a percentage of the top score.

Transit Variables:

Commuter Rail

Is there a commuter rail system in the metropolitan area?

Yes--------------------------1
No---------------------------0

Syntax in equation:
CR = Commuter Rail Starting City
CR_1 = Commuter Rail Ending City

Light Rail

Is there a light rail system in the city?

Yes--------------------------1
No---------------------------0

Syntax in equation:
LR = Light Rail Starting City
LR_1 = Light Rail Ending City

Light Rail System Route Miles

If a light rail system exists, how many route miles are there in the system?

0---0
>0 -15-------------------------------------0.5
15-30--------------------------------------1
>30--1.5

Syntax in equation:
S_LR_Len_I = Starting City Light Rail System Mileage
E_LR_len_I = Ending City Light Rail System Mileage

Heavy Rail Transit
Is there a heavy rail transit system in the city?
Yes--------------------------1
No---------------------------0

Syntax in Equation:
HRT = Heavy Rail Transit Starting City
HRT_1 = Heavy Rail Transit Ending City

Heavy Rail Transit System Route Miles
If a heavy rail transit system exists, how many route miles are there in the system?
0---0
>0 -25---------------------------------------0.5
25-100--------------------------------------1
>100--3

Syntax in equation:
S_HR_Len_I = Starting City Heavy Rail Transit System Mileage
E_HR_Len_I = Ending City Heavy Rail Transit System Mileage

Population Variables

Metropolitan Area Population
What is the population of the metropolitan area in which the city is located?
Under 250,000-------------0
250,000 – 1,000,000-------1
1,000,000 – 2,500,000-----2
More than 2,500,000-------3

Syntax in Equation:
Met_Pop = Metro population Starting City
Met_Pop_1 = Metro population Ending City

Largest City in Metro Area
Is the city the largest city in the metro region? Note: This variable is heavily weighted in the equation to select for the primary city in metro region for HSR location.
Yes---------------------------- ----1
No----------------------------------0

Syntax in Equation:
Metro_Main = Largest city in Metro Area Starting City
Metro_Ma_1 = Largest city in Metro Area Ending City

City Population

What is the population of the city?

Under 100,000---------------0
100,000 – 500,000----------1
500,000 – 1,500,000--------2
More than 1,500,000--------3

Syntax in Equation:
City_pop = City Population Starting City
City_pop_1 = City Population Ending City

Location Variable

In Megaregion
Is the city located in a megaregion?

Yes----------------------------------1
No-----------------------------------0

Syntax in Equation:
Mega = In Megaregion Starting City
Mega_1 = In Megaregion Ending City

Distance Variable

Corridor Length
What is the distance between city pairs?
For lengths < 150 miles the value is obtained by ((length/100) +1); for lengths 150 – 300 miles the value plateaus at 2.5; for lengths 300 - 350 values is obtained by (((500-length)/100) +0.5); for lengths > 350 miles (500-length/100).

The value begins at 2 for corridor lengths of 100 miles, increases linearly and peaks at 2.5 for corridor lengths between 150 – 300 miles, decreases linearly to 2 at lengths of 350, then decreases to 1.5 and continues decreasing linearly to a value of 0 for lengths of 500 miles.

100-----------------------2
150 – 300 --------------2.5
350-----------------------2
400-----------------------1
500-----------------------0

Syntax in Equation:
C_Length = Corridor Length

Economic Variable

Metro GDP
What is the combined geometric mean of the two metro areas that make up the city pair? The geometric mean of the two metro regions' per capita GDP was created by taking the square root of the product of the per capita GDP of the starting metro area and the per capita GDP of the ending metro area.

< 20,000--------------------------------0

20,000 - 30-----------------------------0.5
30,000 - 40-----------------------------1
40,000 - 50-----------------------------1.5
50,000 - 60-----------------------------2
> 60,000--------------------------------2.5

Syntax for Equation:
C_GDP_Cap = Geometric mean of GDP of the two metro regions

Congestion Variable

TTI Index
What is the combined Texas Transportation Institute's Travel Time Index (TTI) for of the two cities that make up the city pair? TTI ranges from 1 to 1.5. The combined index was created by subtracting 1 from the TTI from each city and multiplying their sum by 2.5. This resulted is a value for this variable that is a continuous scale between 0 and 2.275.

Note: Not all metro areas have TTI indices. Cities not specifically identified with a TTI were given the TTI for their class of metro region, either "small" (150,000-500,000 = 1.09), "medium" (500,000 – 1,000,000 = 1.16), or "large" (1,000,000 = 1.23) metro region.

Syntax for
TTI_IND = Combined TTI index of two cities in city pair

Equation

[CR]+ 0.5*[LR]+ 0.5*[S_LR_Len_I]+ 0.5*[HRT]+ 0.5*[S_HR_Len_I] +[Met_Pop]+10* [Metro_Main] + [City_pop] + [Mega] + [CR_1] + 0.5*[LR_1]+ 0.5* [E_LR_Len_I] + 0.5*[HRT_1]+0.5* [E_HR_Len_I]+ [Met_Pop_1]+10* [Metro_Ma_1]+ [City_pop_1] + [Mega_1]+ [C_Length] + [C_GDP_Scal]+ [TTI_Ind]

Starting City [Does city have of Commuter rail (0,1) + 0.5 times does the city have light rail (0,1) + 0.5 times length of light rail system (0, 0.5, 1, 1.5) + 0.5 times does the city have heavy rail transit (0,1) + 0.5 times length of heavy rail transit system (0, 0.5, 1, 3) + What is metropolitan population in which the city is in (0,1,2,3) + ten times is the city the largest city in its metro region (0,1) + what is the city population (0,1,2,3) Is the city in a megaregion (0,1)] + **Ending City** [Does city have of Commuter rail (0,1) + 0.5 times does the city have light rail (0,1) + 0.5 times length of light rail system (0, 0.5, 1, 1.5) + 0.5 times does the city have heavy rail transit (0,1) + 0.5 times length of heavy rail transit system (0, 0.5, 1, 3) + What is metropolitan population in which the city is in (0,1,2,3) + ten times is the city the largest city in its metro region (0,1) + what is the city population (0,1,2,3) Is the city in a megaregion (0,1)] + **Corridor** [what is the length of the corridor (0-2.5) + what is the geometric mean of the GDPs of the two cities (0, 0.5, 1, 1.5, 2, 2.5) + combined TTI index of the two cities.

[1] U.S. Government Accountability Office, March 2009, "High-speed Passenger Rail: Future Development Will Depend on Addressing Financial and Other Challenges and Establishing a Clear Federal Role."

[2] An additional $5 billion over five years was proposed in the Obama administration's budget request; the House of Representatives recently raised this amount $4 billion in the first year alone, however in the Senate version of the bill it was reduced back down to $1.2 billion.

[3] Polzin, S. E., 2004, "Relationship Between Land Use, Urban Form And Vehicle Miles Of Travel: The State Of Knowledge And Implications For Transportation Planning," Tampa: University of South Florida, Florida Department of Transportation, Federal Highway Administration.

http://www.cutr.usf.edu/pubs/Trans-LU%20White%20Paper%20Final.pdf

[4] Ewing, R. and Cervero, R., 2001, "Travel and the Built Environment: A Synthesis." *Transportation Research Record 1780.* Washington, D.C.: Transportation Research Board, National Research Council. http://depts.washington.edu/trac/concurrency/lit_review/trr1780.pdf

[5] The densities of the major European countries range from 200 to 650 people per square mile (sq. mi.). France and Spain, two countries that have successfully deployed high speed rail networks have population densities of 300 and 200 per sq. mi. respectively. In the U.S. seven of the eleven megaregions have population densities in the 200 to 400 range with the Northeast as a notable outlier with a density of 800 per sq. mi. Although a comparison between international countries and domestic megaregions may not be an equal comparison, it does provide some evidence that high-speed rail networks at this density are viable. For a complete listing of densities of all eleven U.S. megaregions, see: Regional Plan Association, 2008, "America 2050: An Infrastructure Vision for 21st Century America." p. 11. http://www.america2050.org/2008/11/an-infrastrucutre-vision-for-2.html

[6] A complete description of the criteria and equation used to create this index is included in the technical appendix at the end of this report.

[7] This study only analyzed city pairs between 100 and 500 miles apart. However, city pairs either less than 100 miles or more than 500 miles could potentially be good candidates for high speed rail based on congestion levels between the cities and geographic constraints. For example, city pairs such as New York-Philadelphia and Chicago-Milwaukee are not included in this study because they are separated by only 90 miles, but rank second and seventh respectively in current intercity rail volume. Despite their omission, both of these city pairs are part of a larger network included in the first phase of the proposed plan discussed below.