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## ESD Working Paper Series

### NEC FUTURE Tier I Scoping Process: Public Comment

**Joseph M. Sussman**

JR East Professor of Civil and  
Environmental Engineering and  
Engineering Systems  
Massachusetts Institute of Technology  
77 Massachusetts Avenue  
Cambridge, MA, 02139  
Email address: [sussman@mit.edu](mailto:sussman@mit.edu)

**Andrés F. Archila**

M.S. in Transportation Candidate  
Massachusetts Institute of Technology  
Email address: [archila@mit.edu](mailto:archila@mit.edu)

**S. Joel Carlson**

M.S. in Transportation Candidate  
Massachusetts Institute of Technology  
Email address: [scarlson@mit.edu](mailto:scarlson@mit.edu)

**Maite Pena-Alcaraz**

PhD Student  
Engineering Systems Division  
Massachusetts Institute of Technology  
Email address: [maitepa@mit.edu](mailto:maitepa@mit.edu)

**Naomi Stein**

M.S. in Transportation / Master in City  
Planning, Transportation, and Urban  
Planning Candidate  
Massachusetts Institute of Technology  
Email address: [negstein@mit.edu](mailto:negstein@mit.edu)

**Ryan J. Westrom**

M.S. in Transportation Candidate  
Massachusetts Institute of Technology  
Email address: [westrom@mit.edu](mailto:westrom@mit.edu)

Submitted by Regional Transportation Planning and High Speed Rail Research Group.



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**Massachusetts  
Institute of  
Technology**

Rebecca Reyes–Alicea, USDOT, Federal Railroad Administration

# NEC FUTURE Tier I Scoping Process

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## Public Comment

Submitted by Regional Transportation Planning and High Speed Rail Research Group;  
Massachusetts Institute of Technology (MIT), Professor Joseph M. Sussman, Director

October 19, 2012

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## Introduction

Thank you for this opportunity to comment on the scoping process for the forthcoming NEC FUTURE Tier I EIS.

## Background

We, the authors<sup>1</sup> of this comment memorandum, are members of a transportation research group at the Massachusetts Institute of Technology (MIT) directed by Professor Joseph Sussman. The focus of this group, with members from both the Civil and Environmental Engineering Department and the Engineering Systems Division, is regional transportation planning with a special emphasis on high-speed rail. As such, and due to MIT's location on the corridor, we pay close attention to progress on planning for the Northeast Corridor (NEC).

As members of a research institution, we are energized by the potential for innovative solutions to emerge from the upcoming focused and detailed analysis of the NEC. Given our personal and intellectual interests in the results of this effort, we attended the August 13, 2012 scoping meeting in Boston, and are now taking this opportunity to comment. Our hope is that the NEC FUTURE Environmental Impact Statement (EIS) will indeed serve as a strong basis for critical future upgrades along the corridor, and bring fiscal and planning efficiency for decades to come. The scope for this study is of utmost importance, and will provide the limits of breadth and depth to which the study will progress.

Additionally, we feel we can bring special expertise to the scoping process. Earlier this year our research group completed a comprehensive look at the complexities and challenges associated with mobility in the NEC. This submittal is based on a report prepared for and funded by the Institute for Transportation Policy Studies (ITPS) in Tokyo, Japan, entitled *Transportation in the Northeast Corridor of the U.S.: A Multimodal and Intermodal Conceptual Framework*. Their support is gratefully acknowledged. Our group at MIT is wholly responsible for the content or any errors that occur in this text. We applied novel combinations of system analysis methods to seek new insights for planning in this corridor. With the lessons learned from this account, we seek to provide input to the NEC FUTURE scoping process, and enrich the NEC FUTURE Tier I EIS study.

## Areas of Focus

We recognize that the **Purpose and Need** and a comprehensive and carefully articulated range of **alternatives** are of utmost importance for the EIS process, and we are focusing our comments in these two areas. With the lessons learned from the ITPS report, we hope to offer insights useful in formulating and refining the project's Purpose and Need, and as well in defining the alternatives to be considered. Additional insights remain, and we would reference you to the entire ITPS report (see sidebar at right) for the full breadth of our findings.

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<sup>1</sup> Authors include: Joseph M. Sussman, Andrés F. Archila, S. Joel Carlson, Maite Peña-Alcaraz, Naomi Stein, and Ryan J. Westrom

### Outline of Contents:

- Introduction
- Purpose and Need
- Alternatives
- Conclusion

### USDOT Strategic Goals

The USDOT has 5 strategic goals:

- Safety
- State of Good Repair
- Economic Competitiveness
- Livable Communities
- Environmental Sustainability

All these goals are related substantively to the NEC program and should be taken into account.

### Navigating Your Way

Resources for Further Information

The original ITPS report can be accessed via Professor Sussman's website: [http://esd.mit.edu/Faculty\\_Pages/sussman/Trans-Northeast-Corridor.pdf](http://esd.mit.edu/Faculty_Pages/sussman/Trans-Northeast-Corridor.pdf)

Throughout this memo, we will make use of sidebar notes to point towards relevant sections of the full ITPS report, should you wish to pursue an idea in more depth.

The ITPS report addresses content raised here in greater depth. The full report:

- Offers a systems representation of the institutional and physical systems relevant to NEC rail
- Identifies high-impact paths within the systems representation as a guide towards understanding highly leveraged points of influence within the system
- Conducts a scenario analysis of the performance of various alternative under uncertainty
- Enumerates methods of designing flexibility into design alternatives in order to address uncertainty

## Corridor History

In looking forward, we believe it is vital to also look back. As Confucius said, “Study the past if you would define the future.” The Northeast Corridor of the United States – stretching from Boston, MA to Washington, DC (and in the future, possibly beyond) – is the most densely settled region and the economic engine in the richest country in the world, yet it has been plagued for decades with congestion of all types on its roads, in the air and on its rails. It is arguably the most studied region in the world from a transportation perspective, but is also one of the most challenging to study: for example, the rail system alone has four owners and nine passenger rail operators, operating on infrastructure originally built beginning at the turn of the 20th century. Given the myriad studies that have been done, one might ask what value added there will be in yet another study of this vital region – vital from a regional, national and an international perspective. We believe, as you do, that another study is worthwhile, and continued growing understanding, collaboration, and refinement of ideas and ideals will bring about positive change for a corridor that needs it. Ultimately, the success of this newest study depends on learning from the past while simultaneously being broad and open enough in scope to capture the complexities, both physical and institutional, of the NEC transportation system.

The history of the NEC provides insights into the challenges faced when attempting to upgrade a multi-state, multi-use and multi-operator corridor, and provides some guidance for future developments. [Table 1<sup>2,3</sup>](#) presents a summarized history of development in the NEC is outlined.

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<sup>2</sup> Federal Railroad Administration (FRA). 1994. Final environmental impact statement/report and 4(f) statement: Northeast Corridor improvement project electrification-New Haven, CT to Boston, MA. U.S. Dept. of Transportation, Federal Railroad Administration, Northeast Corridor Project, Washington, D.C.

<sup>3</sup> de Cerreño, A.L.C. and Mathur, S. 2006. High-Speed Rail Projects in the United States: Identifying the Elements of Success Part 2. MTI Report 06-03, Mineta Transportation Institute, San Jose, CA

**Table 1: Summarized history of development on the Northeast Corridor**

Year	Description (Compiled from: FRA 1994 , and de Cerreño and Mathur 2006)
Early 1900s	<ul style="list-style-type: none"> <li>The Pennsylvania Railroad Company (PRR) owns the New York City to Washington, D.C. portion of the NEC, and the New Haven Railroad Company (NHRR) owns the New York City to Boston portion.</li> <li>The PRR constructs tunnels under the North and East Rivers to connect Manhattan to both the northern and southern portion of the NEC.</li> </ul>
1914	<ul style="list-style-type: none"> <li>NHRR installs a catenary system from New York to New Haven following a steam locomotive accident around New York.</li> </ul>
1917	<ul style="list-style-type: none"> <li>The Hell Gate Bridge from upstate New York to Queens is constructed.</li> </ul>
1928 to 1935	<ul style="list-style-type: none"> <li>The New York City to Washington, D.C. portion of the NEC is electrified.</li> </ul>
1961	<ul style="list-style-type: none"> <li>NHRR enters bankruptcy and remains under court supervision until it is acquired by the Penn Central Transportation Company.</li> </ul>
1963	<ul style="list-style-type: none"> <li>Congress establishes the NEC Project Office within the Department of Commerce.</li> </ul>
1965	<ul style="list-style-type: none"> <li>The High-Speed Ground Transportation Act provides \$51.8 million for high-speed rail demonstration projects on the NEC (including Metroliner [southern section] and Turbotrain [northern portion] services), and establishes the Office of High-Speed Ground Transportation (OHSGT), which takes over the NEC Project Office.</li> </ul>
1967	<ul style="list-style-type: none"> <li>The United States Department of Transportation is created and takes over the OHSGT from the Department of Commerce.</li> </ul>
1968	<ul style="list-style-type: none"> <li>The merger of the PRR and New York Central Railroad creates the Penn Central Transportation Company (PCT)</li> </ul>
1969	<ul style="list-style-type: none"> <li>NHRR is acquired by the PCT.</li> <li>Metroliner service between Washington, D.C. and New York City is established. In 1975, the travel time between these two cities is about 3 hours, but due to poor track infrastructure, it is not able to reduce travel times further.</li> <li>Turbotrain (a train powered by jet engine technology) is placed into service on the north end of the NEC from Boston to New York City, but due to mechanical difficulties, it was taken out of service in 1976.</li> </ul>
1970	<ul style="list-style-type: none"> <li>The Rail Passenger Service Act (RPSA) creates Amtrak to take over most intercity passenger rail services in the U.S.</li> </ul>
1973	<ul style="list-style-type: none"> <li>Although primarily concerned with freight railroads, the Regional Rail Reorganization (3R) Act commissions engineering studies to look at improving passenger rail service.</li> </ul>
1976	<ul style="list-style-type: none"> <li>Amtrak acquires most of the NEC as a result of provisions in the Railroad Revitalization and Regulatory Reform (4R) Act.</li> <li>The 4R Act establishes goals for shorter rail travel times between Boston and New York City and New York City and Washington, D.C. of 3:40 (h:mm) and 2:40, respectively, by 1981. The authors de Cerreño and Mathur (2006) note that these travel time goals and corresponding funding amounts were largely set through negotiation as opposed to by any formal analysis.</li> <li>To achieve these goals, the 4R Act creates the Northeast Corridor Improvement Project (NECIP) and appropriates \$1.75 billion for infrastructure improvement projects. This amount was later increased in 1979 to \$2.5 billion as a result of the 1979 U.S. DOT "Northeast Corridor Improvement Project: Redirection Study," which concluded that the draft Programmatic Environmental Impact Statement (DPEIS) did not appear to adequately consider commuter and freight operations, and that the project's scope, schedule and budget was not adequate.</li> </ul>
1978	<ul style="list-style-type: none"> <li>The FRA's final Programmatic Environmental Impact Statement (FPEIS) is released. It evaluates broad options for upgrades to the NEC, and, in particular, considers three alternative routes.</li> </ul>
1980	<ul style="list-style-type: none"> <li>The Passenger Railroad Rebuilding Act directs the FRA to transfer management of the NECIP to Amtrak by 1985. It also increases the funding amounts to \$2.5 billion (as described above) and lengthens the project to seven years in total.</li> </ul>
1992	<ul style="list-style-type: none"> <li>The Amtrak Authorization and Development Act (AADA) commits \$470 million per year to the NECIP for 1994 and 1995, sets a statutory goal of three hour travel times between Boston and New York City and requires that a master plan be developed to achieve this goal.</li> </ul>
1994	<ul style="list-style-type: none"> <li>Secretary of Transportation Federico Peña issues The Northeast Corridor Transportation Plan: New York City to Boston, which estimates a cost of \$3.1 billion to complete the electrification of remaining portion of the NEC, reduce trip times to AADA requirements and generally increase capacity on the NEC.</li> <li>The FRA releases the final Environmental Impact Statement/Report (FEIS/R) for the electrification of the NEC from Boston to New Haven.</li> </ul>
Late 1990s	<ul style="list-style-type: none"> <li>Amtrak installs electrical catenary between New Haven and Boston.</li> </ul>
2000	<ul style="list-style-type: none"> <li>Amtrak begins (initially limited) Acela high-speed rail service on the NEC</li> </ul>
2008	<ul style="list-style-type: none"> <li>The Passenger Rail Investment and Improvement Act (PRIIA) appropriates funds to Amtrak for 2009 to 2013. It also requires Amtrak to develop a master plan for the NEC.</li> </ul>
2009	<ul style="list-style-type: none"> <li>The American Recovery and Reinvestment Act (ARRA) provides around \$10 billion in funding for high-speed rail projects around the U.S.</li> </ul>
2010	<ul style="list-style-type: none"> <li>The NEC Infrastructure Master Plan and A Vision for High-Speed Rail in the Northeast Corridor are released by Amtrak.</li> </ul>
2012	<ul style="list-style-type: none"> <li>MIT/ITPS Transportation in the Northeast Corridor of the U.S. report is released</li> <li>MAP-21 is passed and the NEC FUTURE study is initiated</li> </ul>

There are a few aspects of this history that motivate our systems approach to looking at the NEC. Noteworthy are the challenges faced during the late-1970s to define “good performance” on the NEC. In addition, there is the fluctuating performance of intercity passenger rail caused by the lack of consistent long-term funding. While it is tempting to dismiss these challenges because they are often driven by the political sphere, we feel that an appropriate systems approach can address such challenges during the planning process. With this history in mind, we urge you to consider the following in developing the Purpose & Need and scope of alternatives for the NEC FUTURE study.

## Purpose and Need

### Driving Forces

Transportation in the Northeast Corridor is a complex sociotechnical system (CSS)<sup>4</sup> in which several physical components and institutional actors, such as organizations and users, interact with each other in various ways, thus originating particular relationships and dynamics. According to the conceptual framework we developed for ITPS, this CSS is also subjected to several driving forces<sup>5</sup>, namely, key factors that are central to the behavior of the system.

Of particular importance in the NEC are economic growth, political support and political will, public perception of the transportation system, congestion and capacity constraints, technological changes in transportation vehicles and infrastructure, multi-modal cooperation or competition, energy availability and fuel prices, funding sources for transportation projects and programs, changes in land use in metropolitan areas, environmental changes and global warming, and social attitude and concern towards the environment.

Variations in these driving forces can provide clues to feasible situations in which the transportation system must reasonably be expected to perform, and thus may help us design a more robust system. Understanding that these driving forces evolve over time can also help us think about better strategies for deployment of the system.

### Goals, Objectives, and Performance Measures

A precondition for creating an appropriate set of outcome-based goals, objectives, and performance measures includes having stakeholders provide input regarding how they feel good performance should be defined. This process will create a clear and uniform framework with which to evaluate the alternatives developed. Overall, we are encouraged that the NEC FUTURE scoping package has highlighted a broad set of goals for improving rail service in the Northeast Corridor, including devoting attention to multi-modalism and sustainability issues within the initial scoping package<sup>6</sup>. Based on our review of the scoping package (particularly Section 2.3) as well our group’s previous work looking at high-speed rail in the Northeast Corridor, we submit the following comments regarding the development of the goals, objectives and performance measures to be included with the “Purpose and Need” statements.

See Chapter 4 and 5 of the ITPS report for further details on driving forces.

For a more full enumeration of objectives and performance metrics, refer to Chapter 2 of the full report.

<sup>4</sup> For more on the study of CSS, see Professor Sussman’s lecture at <http://techtv.mit.edu/videos/18975-complexe-sociotechnical-systems-the-case-for-a-new-field-of-study>

<sup>5</sup> Schwartz, P. The Art of the Long View. 1996.

<sup>6</sup> The following discussion is based on the NEC FUTURE Scoping Package (June 2012), and, in particular, Section 2.3 “Program Goals and Objectives.”

Overall, we believe that there should be a clearer distinction between and greater clarity in the project goals, objectives, and performance measures. Goals should identify the desired future state of the system; objectives should describe a measurable outcome that works toward a goal; and performance measures should gauge the success with which a given objective has been met (qualitatively and/or quantitatively). Section 2.3 “Program Goals and Objectives” indicates that there are “seven goals and objectives of the overall program” and seemingly uses the two terms synonymously. However, it appears that the first level of bullets in this section indicates the programs goals, and the second level of bullets (appearing only under the goal “[d]evelop program alternatives that would provide attractive, competitive, high-quality passenger rail service that offers customers”) identifies measurable objectives. While we are generally supportive of these seven goals, we believe that there needs to be greater clarity of the objectives and performance measures, as faulty objectives and performance measures can lead to unintended consequences in the decision-making process.

As intercity passenger rail requires other transportation services to be coordinated with it, including urban transportation to deal with first-mile/last-mile mobility, as well as other intercity modes to provide complementary service to different markets, the Purpose and Need should include a set of mode-neutral and multi-modal program goals, objectives, and performance measures. Mode-neutral measures can allow for comparisons between modes, and multi-modal measures allow for comparisons of a traveler’s entire trip from origin-to-destination between different alternatives. For example, “Competitive Travel Time” could perhaps be better defined as “Competitive Trip Times (from origin to destination).” This definition would allow for a better comparison between different modes of transportation (e.g. air versus rail versus bus), as well as better comparison of alternatives: for example, reducing trip time by facilitating transfers between public transit and rail at stations, versus increasing passenger rail speeds between stations. Although undertaking multi-modal comparisons poses challenges given the FRA’s jurisdiction of commuter, intercity passenger, and freight rail, efforts should nonetheless be made during this planning process to keep the goals, objectives and performance measures as multi-modal as possible. Partnerships across modes, agencies, and governments within the NEC FUTURE planning process will support this multi-modal perspective.

One dimension that is missing from the listed goals in Section 2.3 and should be included in the subsequent statement of Purpose and Need is a focus on the third “E” of sustainability – social equity – in addition to the environment and the economy. Currently, business travelers dominate premium Acela service ridership<sup>7</sup>, and prices on other Amtrak NEC services are also very high, albeit partly due to limited supply. Efforts should be made to make rail service more affordable and hence available to more travelers. This helps meet goals of social equity in the NEC. Although business travel is an important component of NEC ridership currently and will be in the future, consideration should be given to other market segments that should benefit from new rail service. For example, an objective of “affordability” could be defined with a corresponding performance measure such as the ratio between fare and income. In addition, some consideration should be given to facilitating the provision of alternative

<sup>7</sup> Chen, Z. 2010. Who Ride the High Speed Rail in the United States – The Acela Express Case Study. Proceedings of the 2010 Joint Rail Conference, April 27-29, 2010, Urbana, IL, USA.

### Connecting to USDOT Strategic Goals

The goals for the NEC FUTURE should be connected with the DOT’s strategic goals when possible, and in particular the three concerning sustainability:

- Economic Competitiveness
- Livable Communities
- Environmental Sustainability

The Livable Communities strategic goal encourages aspects of social equity by promoting “investments that increase transportation choices and access to transportation services.”



lower-cost services, such as trains with longer trip times, fewer amenities, tighter seating, and less space for baggage; or facilitating or providing lower-cost intercity bus service. Setting an “equity” goal will ensure that these considerations are taken into account when developing and evaluating the alternatives and that the benefits of any significant infrastructure investments accrue to a larger portion of the population.

Social equity is also an important consideration within the political sphere, and is increasingly receiving political consideration within the context of transportation in the NEC. For example, Congresswoman Eleanor Holmes Norton (D-DC) has put forth much effort to bring lower-cost intercity bus service to Union Station<sup>8</sup>. If improved passenger rail is perceived as being largely focused on improving business travel, it will likely be much more difficult to advance the NEC FUTURE program politically. Therefore, we feel that that “equity” should be a program goal so that there is a commitment to advance all three “E’s” of the sustainability triple-bottom line and highlight these efforts to decision-makers.

The DOT’s State of Good Repair Goal also applies to the existing assets within the NEC.

One other goal that is missing from the list in Section 2.3 is a focus on returning the NEC to a state of good repair. While such a goal may be obvious to those individuals familiar with the NEC, it is important to emphasize taking care of the assets that already exist for passenger rail. The DOT also has a strategic goal promoting a return to the state of good repair of transportation infrastructure, and applying it to the NEC is particularly appropriate.

We were pleased to see a focus on multi-modalism and some of aspects of sustainability within the NEC FUTURE goals, and were also encouraged by the focus on pragmatism within the goal: “create a phased improvement program that reflects funding and financial limitations as well as the challenges of improving the existing corridor under full operation.” We believe that these goals, with some refinement, should be explicitly included in the subsequent Statement of Purpose and Need, along with mode-neutral and multi-modal measurable objectives and corresponding performance measures. As noted, a goal focusing on “social equity” should be included to bring this issue to the forefront.

Extending the above focus on implementation within pragmatic limitations, the following section addresses the limitations imposed by uncertainty—be it political, economic, or technical.

## Uncertainty

The planning and implementing of HSR in the NEC is a decades-long process. As such, we recognize that the system is subject to uncertainties that planners and designers should be aware of. Recognizing that outcomes are uncertain and only known probabilistically may lead to the identification of new opportunities and to improved performance of the system over a broader range of possible outcomes.

<sup>8</sup> Norton, E.H. Norton Efforts Launch First Bus Service from Union Station. [http://www.norton.house.gov/index.php?option=com\\_content&task=view&id=1500&Itemid=88](http://www.norton.house.gov/index.php?option=com_content&task=view&id=1500&Itemid=88).

As with all complex, sociotechnical systems, “uncertainty is everywhere”. On one hand, we have uncertainties related to the inputs of the system. We do not know the evolution of the aforementioned driving forces, i.e. economic conditions, political will, technological change, regulatory framework, and so on. Furthermore, we have significant uncertainty related to important design parameters of the system, such as future demand and system requirements. Designers should understand that point estimates of demand forecasts are “always wrong”, and that there is no precedent of international-quality HSR in the US that can give us a reference point for what the system’s requirements and costs are in this country<sup>9</sup>. On the other hand, we have uncertainty related to the implementation of the system. The actual pricing levels, ridership, and level of service of the system are not known with certainty. The reaction of stakeholders, such as operators of other transportation modes, cannot be fully anticipated. The estimation and assessment of wider economic and environmental impacts of HSR is still a matter of research.

That said, the planning process should not be paralyzed by the large uncertainties that confront it. Along with the downside risks, there is also great upside potential for passenger rail that could be realized because of these uncertainties. Therefore, we urge that the evaluation of the NEC alternatives account for ranges of possible outcomes. The following section details a scenario-planning framework and flexibility-based approach to alternatives that can be used to mitigate inherent uncertainties in NEC transportation planning.

## Alternatives

### Types of Alternatives

Defining the scope of an EIS is inherently a boundaries problem; analysis inevitably simplifies the world and therefore the critical choice is how to define a system broadly enough such that the analysis of impact yields adequate insight, while at the same time defining alternatives narrowly enough that they are feasible and implementable by the agency(ies) involved. The Northeast Corridor incorporates diverse ownership, regulatory, and planning structures, as well as dense multi-modal transportation infrastructure. The challenge posed by the EIS is to define alternatives that suitably capture the relevant variables, institutionally and physically, as well as across modes.

In scoping the EIS we urge you to consider multiple categories of decision variables that can be used to define alternatives. The NEC FUTURE scoping package defines alternatives according to rail markets. This highlights the geographic and consumer-oriented aspects of the system while giving less attention to the institutional management, multi-modal, and technological aspects. **Figure I** presents the alternatives analyzed by our research group. Bundles of cascading decisions are organized hierarchically as a one way of generating alternatives for study. International-quality refers to developing an HSR system similar in

See Chapter 3 of the ITPS report for more on this approach to defining strategic alternatives.

<sup>9</sup> For example, Bain (2009) found that the actual traffic volumes during the first year of operation of 104 international toll roads fell between 14% and 151% of the traffic volume predicted by traffic and revenue studies. Furthermore, this study found that, on average, actual traffic volumes turned out to be only 77% of the predicted traffic demand.

Bain, R. 2009. Error and optimism bias in toll road traffic forecasts. *Transportation*, 36(5): 469-482.

service quality to the Japanese Shinkansen or the French TGV on a primarily dedicated track alignment. Incremental HSR refers to upgrading the existing NEC alignment gradually to reduce trip times. Lower down, according to this approach to alternatives-definition, are decisions regarding the infrastructure ownership and competitive structure of operations—but that is not to say that these are less important decisions. They will, in fact, be as critical to the success of NEC rail as decisions regarding physical infrastructure investment.

The scoping package also defined one of the NEC FUTURE goals as “developing a rail network...[that] complements planned investment in other modes.” The alternatives must be defined in broad enough terms to capture intermodal effects. For example, they should address the implications of air-rail<sup>10</sup> or motor vehicle-rail competition for greenhouse gas emissions. Related to intermodal effects are issues of intermodal connectivity and livability, the latter one of USDOT’s five strategic goals. The alternatives should be defined so as to capture door-to-door access to stations, as well as land use impacts that affect the safety, economic competitiveness, and health<sup>11</sup> of neighborhoods served by HSR.

10 R. Clewlow, Sussman J., Balakrishnan H., Interaction of High-Speed Rail and Aviation: Exploring Air-Rail Connectivity, Journal of the Transportation Research Board, Issue 2266, 2012.

11 Health relates to both active transportation options, i.e. walking and biking, and air quality. See FHWA Livability and Health: [http://www.fhwa.dot.gov/livability/fact\\_sheets/transandhealth.cfm](http://www.fhwa.dot.gov/livability/fact_sheets/transandhealth.cfm)

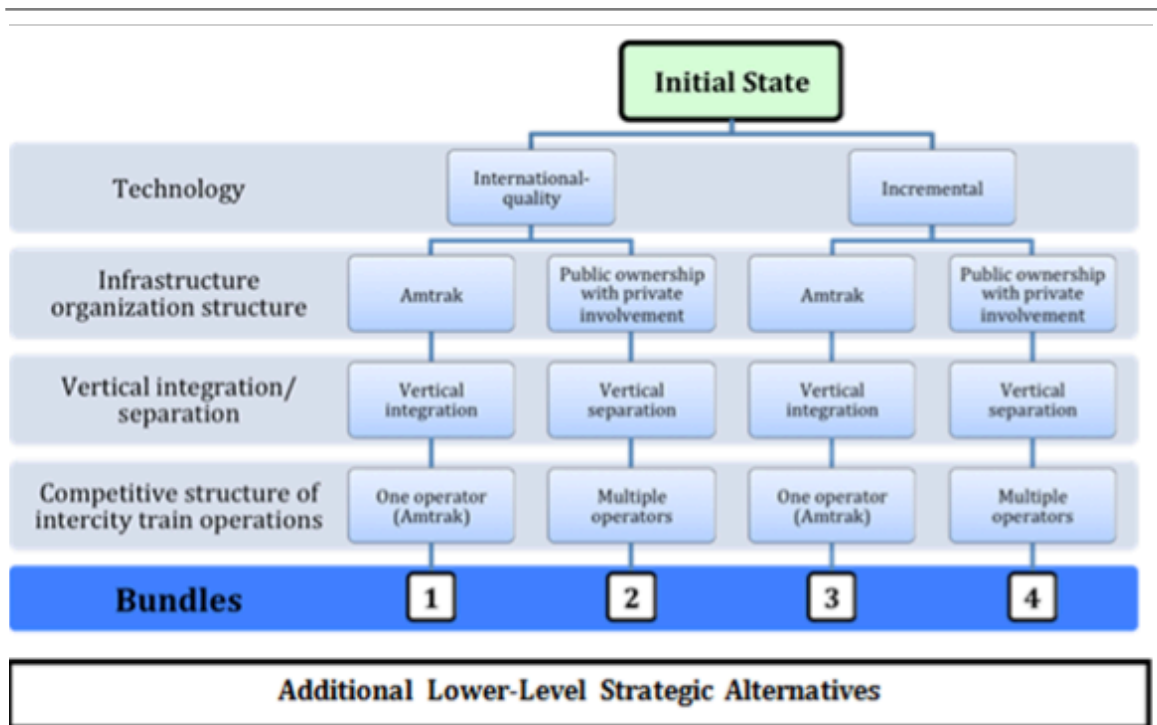


Figure II A technology and organizationally driven approach to defining NEC alternatives

Finally, while it is tempting for a project at this scale to think according to top-down national-policy approaches, the realities of federal funding and political uncertainties make bottom-up approaches increasingly important. Therefore, the EIS should recognize the importance of greater stakeholder involvement from state and local governments and regional businesses — not only in planning, but also in finance, management, and implementation. For example, the Business Alliance for Northeast Mobility is one group already taking steps towards defining what a city-driven approach to NEC Rail might be. In addition, Lee<sup>12</sup> highlighted how a “community-driven approach” allowed for the development of a “locally accepted” alternative for the California High-Speed Rail project.

## Flexibility

Given the significant uncertainties associated with forecasting many driving factors (such as the economy or the political context), the success of an alternative is difficult to predict. The success of HSR is particularly susceptible to these uncertainties due to the high capital costs (on the order of \$100 billion for the NEC) and decades-long timelines that will ultimately be required to implement the system. While there may be approaches taken that are intended to reduce these uncertainties, some are inevitable. As a result, NEC FUTURE should explore how flexibility can be used to achieve better outcomes for HSR, by allowing decision-makers the ability to respond dynamically to different realizations of the future. In particular, we propose a joint scenario-planning and real-options framework to deal with the uncertainty that planning in the NEC faces.

Rather than taking at face value one set of predictions about the future, scenario planning involves the telling of multiple “*stories about the way the world might turn out.*”<sup>13</sup> Scenarios should not be mistaken for “predictions of the future” nor extrapolations of the past. They are “tools for ordering one’s perception about alternative future environments in which one’s decision might be played out”; “might be rational”; and should “have to do with the driving forces of the system”. In addition, scenarios “can help inform decisions that involve high stakes and poorly characterized uncertainty...[They can] help inform specific decisions, or can provide inputs to assessments, models that need specification of potential future conditions...[They can] also provide various forms of indirect decision support, such as clarifying an issue’s importance, framing a decision agenda, shaking up habitual thinking, stimulating creativity, clarifying points of agreement and disagreement, identifying and engaging needed participants, or providing a structure for analysis of potential future decisions.”<sup>14</sup>

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12 Lee, M. 2012. Community Planning & High Speed Rail: “A Square Peg in a Round Hole?” UIC HIGHSPEED: 8th World Congress on High Speed Rail, Philadelphia, PA, July 10-13, 2012.

13 E.A. Parson, et al. Global-Change Scenarios: Their Development and Use. 2007.

14 P. Schwartz. The Art of the Long View: Planning for the Future in an Uncertain World. Doubleday: New York, NY, 1996.

See Chapters 6 and 7 of the ITPS report for a more detailed account of these scenarios.

For a description of how the flexibilities discussed in the next sections would play out under different hypothetical scenarios, refer to Chapter 7 of the ITPS report.

Note that it is not necessary to develop scenarios representative of each plausible future situation in order to gain some insights about the performance of the alternatives under future uncertainties. We recommend the choice of a small number of scenarios (3 to 5) as the best way to test the timing and level of investment in HSR for the NEC under a diverse set of “positive” and “negative” future situations. A plausible set of scenarios is proposed in the Transportation in the Northeast Corridor of the U.S. report developed by our group.

A real option<sup>15</sup> is the “*the right, but not the obligation, [for the option holder] to take some action at a future date at a predetermined price.*”<sup>16</sup> In other words, a potential option holder (decision-maker) can pay more now (for example, investing greater funds, planning effort, or initial institutional steps) in order to create or maintain the possibility of taking a potential action in the future—as the future evolves and uncertainty gradually resolves into greater certainty.

Previous work carried out by our research group<sup>17</sup>, shows that the strict adherence to one definition of an alternative—e.g. developing international-quality HSR in the NEC—does not lend itself to a scenario with postponed investment, whereas alternatives considering greater flexibility might allow a gradual transition between incremental and international-quality HSR. Potential opportunities to design-in flexibility in the alternatives have been identified. The flexibilities identified relate to the decision hierarchy (presented in [Figure I](#)) used to develop our bundles of strategic alternatives .

### Intermodal connectivity flexibility

Full intermodal cooperation and coordination will likely not be achieved between modes immediately; however, it will be important to create opportunities for it to occur, even if it is not exercised immediately. In particular, airports and airlines might initially be resistant to international-quality HSR (because of the potential loss of short-haul air travelers), but efforts should be made to develop cooperation with these groups; good physical connectivity between airports and the rail system can have positive implication for both industries. While we are not advocating for airport high-speed rail stations at all cost, we emphasize that airlines and airports may have different views pre- and post-introduction of HSR, and that it is important to take a longer run view when planning these stations.

<sup>15</sup> R. de Neufville, Scholtes, S. Flexibility in Engineering Design. Cambridge, MA: MIT Press, 2011.

<sup>16</sup> J.B. McConnell. A Life-Cycle Flexibility Framework for Designing, Evaluating and Managing “Complex” Real Options: Case Studies in Urban Transportation and Aircraft Systems. MIT PhD dissertation, 2007.

<sup>17</sup> Pena-Alcaraz M., Carlson S.J., Archila A.F., Stein N., Sussman J., “Analysis of High-Speed Rail Implementation Alternatives in the Northeast Corridor: the Role of Institutional and Technological Flexibility”, submitted to TRB. <http://esd.mit.edu/WPS/2012/esd-wp-2012-23.pdf>.

For example, the two main proposals for international-quality HSR in the NEC both include additional airport stops along their alignments: Amtrak's<sup>18</sup> proposal contains an additional airport stop at New York Westchester County White Plains Airport (HPN)<sup>19</sup> and Philadelphia International Airport (PHL). PennDesign's<sup>20</sup> study contains an additional stop at Long Island MacArthur Airport (ISP), JFK International Airport in New York (JFK) and PHL. Although connecting these airports to the railway alignment is subject to trade-offs (both in terms of what airports and stations to provide, and certainly cost), these intermodal connections would provide airlines and the HSR operator(s) reason to pursue cooperation agreements (such as codeshare train trips, for example). The same level integration should be pursued with buses, metro, regional trains, and pedestrian and bicycle connectivity in the city context. Centrally located stops can go a long way to achieving good accessibility without automobile dependence.

### Institutional flexibility

Another subject of debate regarding HSR in the NEC is the institutional structure that should be responsible for the implementation of infrastructure upgrades and ultimately operations. Amtrak currently owns most of the NEC infrastructure and already operates higher-speed Acela service, and therefore could begin the process of upgrading NEC infrastructure and service immediately<sup>21</sup>. Other stakeholders, like commuter rail operators, may prefer the implementation of an alternative public ownership structure<sup>22</sup>. Implementing a "regional public benefit corporation"<sup>23</sup> structure could take months if not years of negotiations to set up, however, which would hold up improvements to HSR service in the NEC.

The implementation plan for the NEC must detail not only physical upgrades to the system but must also ensure that an institutional structure is in place that can appropriately manage the significant capital investment projects that will be required and balance the needs of all NEC users. While Amtrak has the advantage of being already in place and is able to begin implementing any upgrades relatively quickly, it may be possible to design-in flexibility within Amtrak that allows for (but does not require) a transition into a new organizational structure. An example of institutional flexibility includes separating NEC Infrastructure and Operations into separate business lines (as Amtrak is proposing to do), such that in the future, it is relatively easier to separate these business lines into a separate organization, such as the regional-public benefit corporation mentioned above.<sup>24</sup> Some of this flexibility could be designed-in immediately, while some of it could be included at a later date. Additionally, some of the flexibility (such as Amtrak's

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18 Amtrak, *Vision for High-Speed Rail in the Northeast Corridor*, Washington, DC., 2010.

19 Amtrak has removed this stop in its 2012 update report, but is still in discussion with local community stakeholders.

20 PennDesign, *High-Speed Rail in the Northeast Megaregion: From Vision to Reality*, Philadelphia, PA: University of Pennsylvania School of Design, 2011.

21 D.L. Roth, Aggarwala R.T. Whose railroad is this, anyway? Opportunities and challenges in regionalizing the Northeast Corridor, in *Transportation Research Records: Journal of the Transportation Research Board*, No. 1785, Transportation Research Board of the National Academies, Washington, D.C., 2002.

22 L.S. Thompson. *Options for the Federal Ownership of Northeast Corridor (NEC) Infrastructure*. 2005.

23 PennDesign, *High-Speed Rail in the Northeast Megaregion: From Vision to Reality*. Philadelphia, PA: University of Pennsylvania School of Design, 2011.

24 Amtrak. 2011. *Amtrak Strategic Plan FY 2011 – FY2015*.

strategy to implement business lines for NEC Infrastructure and Investment Development and NEC Operations)<sup>25</sup> presented could also have inherent value, even if it is never exercised.

There would be advantages and disadvantages to a flexible approach. The first advantage is that Amtrak could begin upgrading infrastructure almost immediately. At the same time, the flexibility in the approach would provide Amtrak and other decision-makers some ability to redefine their operation if they choose to exercise that institutional option. If an alternative public-ownership structure were pursued immediately, years might go by before any actual upgrades (incremental or otherwise) take place on the NEC. In addition, the flexibility allows decision-makers to gradually change the ownership structure of the NEC if needed and test additional reforms without having to jump completely to a radically different ownership structure.

There are some disadvantages to this approach, however. For example, although many of the proposals above have inherent value, designing-in flexibility adds cost. For instance, there is the added cost of separating Amtrak into separate business lines based on NEC operations that may not be needed (but it *would* substantially reduce the cost of implementing a new institution if needed from scratch, in terms of time, political willingness, money, etc.). Note that this section does not opine whether Amtrak should or should not develop international-quality HSR in the NEC; we simply recognize the fact that Amtrak already owns most of the NEC infrastructure and operates Acela services, as well as the possibility of having different ownership formulations.

### Technological flexibility

Another type of flexibility that could be designed-into the bundles is the option to change from implementing international-quality HSR to incremental HSR and vice-versa (or between other alternatives) as future economic or political conditions demand.

If an incremental HSR alternative were implemented, a flexible approach would focus on upgrades that would benefit both international-quality and incremental HSR systems. Some examples of these projects include expanding the capacity of New York Penn Station and its access tunnels and increasing the capacity of Boston South Station. In addition to upgrading the NEC infrastructure incrementally, the planning, permitting and design processes associated with international-quality HSR could be pursued so that future opportunities would not be delayed (as much) by regulatory and design issues.

If an international-quality HSR alternative were chosen initially, flexibility could be designed-in by allowing the construction of the new alignment in phases, connecting it with the existing system, and ensuring trains are interoperable on both the new and old system. For example, a section from New York to Philadelphia could be constructed first. If demand were much lower than expected, the infrastructure owner could avoid losses associated with a locked-in

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<sup>25</sup> Amtrak. 2011. Amtrak Strategic Plan FY 2011 – FY2015.

decision to build the entire system at once. There would still be inherent value to this construction as trains would be able to run on the new alignment for part of the route (from Philadelphia to New York, for example), and thus overall trip time would be reduced. If demand were higher than expected, then the new riders of the HSR system would represent a new stakeholder group who could advocate for the further expansion of the system. Amtrak's Vision for HSR<sup>26</sup> presents a potential phasing scheme in their report.

In summary, under circumstances of low transportation demand or low economic growth, providing flexibility allows for a transition from a more ambitious to a less ambitious alternative (in terms of international-quality standards). Conversely, under circumstances of significant economic growth and well-received upgrades of the railway system, flexibility would facilitate a change from the less ambitious to international-quality HSR alternative. Again, there are risks and costs associated with implementing flexibility into the system that should be explicitly considered. Flexibility therefore helps minimize the downside risks, while still providing opportunities to capture the benefits of greater than expected results.

## Conclusion

Again, we thank you for this opportunity to comment on the scoping process for the forthcoming NEC FUTURE Tier I EIS as you embark on this study process.

We hope that consideration for the corridor's history, interwoven with an understanding of the importance of reliable performance measures, and coupled with recognition of the uncertainty involved, will help initiate the NEC FUTURE project. Then, understanding the types of strategic alternatives and the flexibility needed will allow it to move forward effectively.

Further, we offer our group's assistance to the process. Whether via participation in a forum here in Boston, or via directed research efforts, we would be happy to work with the FRA and USDOT to further study the NEC. As part of an academic institution, we can provide a "level-playing field" for comparing various ways forward. We are indeed excited about what the future will bring the NEC, and we look forward to playing a role in that process.

### Flexibility Application

More details about the design of the alternatives, flexibility, and possible framework to consider uncertainty can be found in the reports developed by the research group; refer to Chapter 3, 6 and 7 of the ITPS report and the paper "Analysis of High-Speed Rail Implementation Alternatives in the Northeast Corridor: the Role of Institutional and Technological Flexibility," available here: <http://esd.mit.edu/WPS/2012/esd-wp-2012-23.pdf>.

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<sup>26</sup> Amtrak, Vision for High-Speed Rail in the Northeast Corridor. Washington, DC., 2010.