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# Financing Sustainability and Resiliency of Transportation Infrastructure in an Era of Fiscal Constraint

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## Abstract

In this short paper, I review several solutions in order to provide technical assistance to U.S. State officials in implementing new financing approaches for surface transportation projects. The general idea is to educate transportation officials on project funding and finance options, project planning and delivery, and life-cycle asset management. I examine a strategic plan and attempt to identify specific goals of such technical assistance.

Keywords – Transportation system, Investment gaps, Education, .

## **Introduction**

This paper is focused on the U.S. transportation sector's urgent needs of new and innovative financing approaches to address the growing challenges of the sector. Key facilities, such as the U.S. Interstate Highway system, completed decades ago, are now well past their original design lives, and often suffer from years of deferred maintenance (Winston, 2012). A major challenge is that investment levels have not kept pace with the transportation system's investment needs (Rouhani et al., 2016a; Beheshtian et al., 2016; Beheshtian et al., 2017). The reason is that available funding is typically used for large capital projects that would consume most if not all available funding and still often fall short of being fully funded (Rouhani, 2012). Traditional mechanisms for funding infrastructure are no longer adequate to meet national and regional needs (NSTIFC, 2009). These problems underscore the importance of finance mechanisms that can bridge investment gaps between available resources and infrastructure needs (Rouhani et al., 2013; Rouhani and Beheshtian, 2013; Rouhani et al., 2014).

The overarching goal of this paper is to provide technical assistance to State officials in implementing new financing approaches for surface transportation projects that can address the above problems. There is a pressing need to educate transportation officials on project funding and finance options (Rouhani and Niemeier, 2011; Rouhani 2016; Rouhani and Gao, 2016), project planning and delivery (Rouhani et al., 2014a; Madani et al., 2014; Rouhani et al., 2015a), and life-cycle asset management (Lin et al., 2009; Rouhani, Daher et al., 2018). This paper reviews cutting edge information on the adoption and deployment of innovative finance and project delivery options, and on the application of alternative revenue options to real-life projects. The goal is to improve how the State DOTs and local transportation officials advance major projects and program initiatives in the sector. This paper also examine awareness of techniques and practices that protect the interests of the public (Rouhani and Zarei, 2014;

Rouhani and Gao, 2014) and the use of analytical tools for decision-making processes in selecting project delivery methods (Rouhani et al., 2018).

## **General Framework**

As part of that mission, I try to transfer university-based knowledge into practical application in order to realize broad social benefits of road infrastructure provision. Figure 1 shows an illustrative framework for the general strategic plan. Three major layers provide the basic foundations of the technical assistance: Education and Training, New and Innovative Practices (Research), and Fundamental Knowledge. These three layers provide a general service for all stakeholders in project finance. The bottom layer, Fundamental Knowledge, will provide the common knowledge surrounding the best practices in a variety of inter-connected fields, including public finance (Rouhani et al., 2018), private finance (Reinhardt, W. 2011; Rouhani et al., 2015a), project evaluation (Rouhani et al., 2015b; Rouhani, 2018) and system analysis (Mirchi et al., 2012; Rouhani et al., 2016b), asset management (Rouhani, 2014b), and sustainable transportation (Litman and Burwell, 2006; Anas and Lindsey, 2011; Rouhani, 2013).

The second layer offers insights into new and innovative practices/tools of financing transportation projects such as: (a) INVEST (Infrastructure Voluntary Evaluation Sustainability Tool) as a web-based tool to integrate sustainability into transportation projects, which considers the full lifecycle of projects; (b) Least Cost Planning (LCP) as a process for identifying the most cost-effective mix (both direct and indirect costs) of demand and supply options (Rouhani and Beheshtian, 2013) to meet transportation goals; (c) Housing +Transportation (H+T) Affordability Index to assess the percentage of affordable metropolitan areas (Isalou, et al., 2014); (d) innovations in travel demand models developed by metropolitan planning organizations (MPOs) for urban traffic analysis (Rouhani, 2018); (e) tools that can address the economic impact

analysis and cost benefit analysis (CBA) needs of competitive programs like Transportation Infrastructure Generating Economic Recovery (TIGER) (Rouhani et al., 2016b).

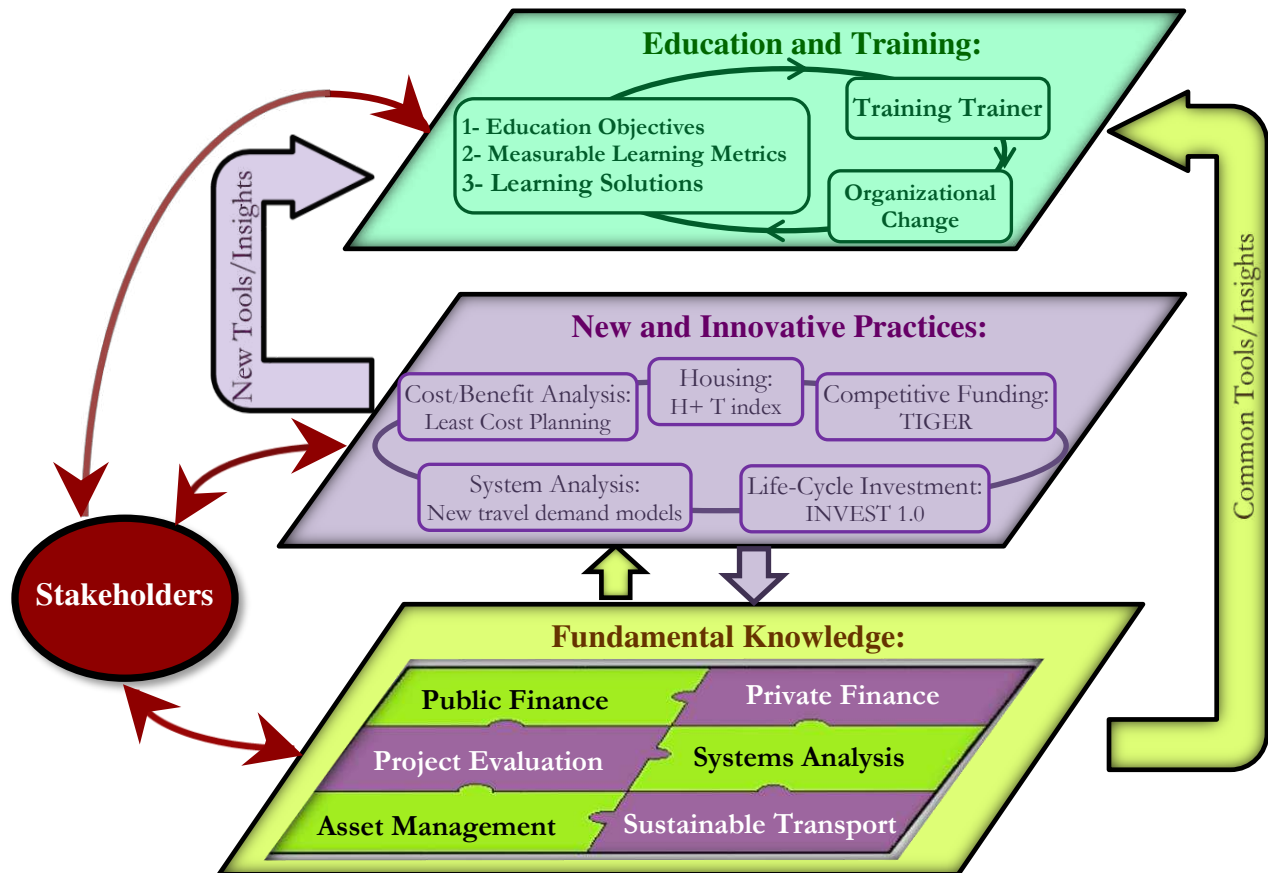


Figure 1 Strategic plan.

As the last layer, we should provide the required insights into new and innovative practices in interdisciplinary project finance research that require the sustained contribution of researchers from multiple disciplines. State departments should develop experimental and theoretical tools and techniques necessary for further advances, which will be pursued through three main research tracks: public finance, public private partnerships, and long-term strategies for transportation investments, as well as several smaller exploratory research themes known as

research Seeds (Bel and Foote, 2009). Three other activities complete the overall mission: industrial outreach and knowledge transfer; analysis of institutional capacity/capability issues of different organizations; envisioning the potential advantages and disadvantages of partnering with the private sector.

To complement the strategic plan, we should identify specific goals of such technical assistance:

1. Provide a comprehensive understanding of the benefits and costs of various financing approaches (Rouhani et al., 2016b);
2. Advance knowledge and the state of practice about financing techniques and tools that complement traditional highway financing methods (Rouhani et al., 2018);
3. Communicate and consult effectively with State DOTs, public agencies, policy makers, and stakeholders at large, in order to advance awareness of States DOTs;
4. Offer professional training and outreach services to public officials; and
5. Transfer knowledge to industry and other sectors by promoting extensive collaborations.

## **Educational Program**

The support system needs to focus on the four core elements of learning; Knowledge, Actions, Beliefs and Networks. The education program would be led by industry and university experts, including faculty, practitioners, executives or other leaders in their industries that would create a compelling educator group (Figure 2).

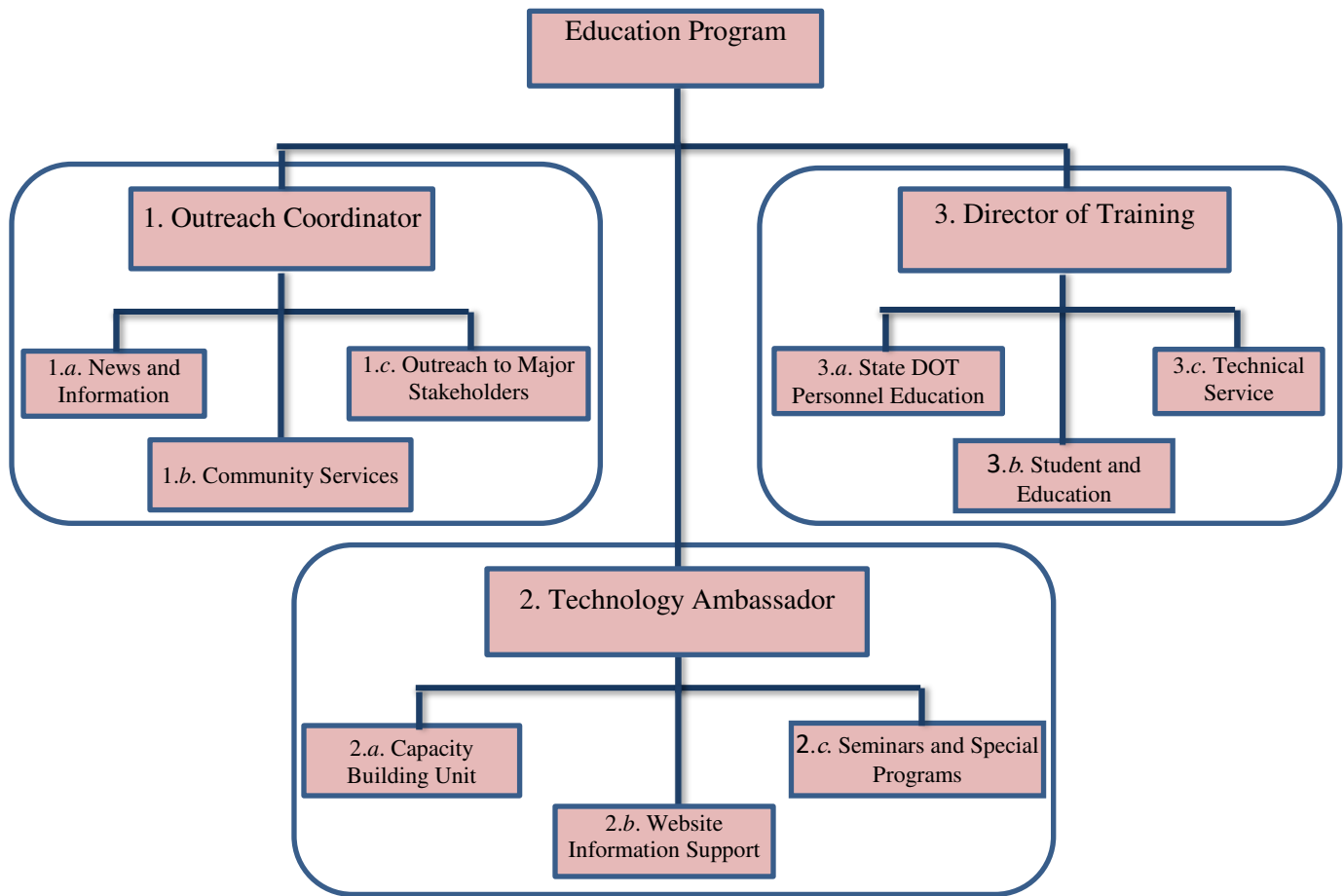


Figure 2. Education program structure

The education component should be organized to execute the following tasks:

An illustrative list of research programs/topics that could be offered is shown in Table 1.

Table 1 List of topics

1) Public Finance (Taxation, Bonds, Loans)	6) Financial and Legal Structures	11) Working with Unions – Project Labor Agreements
2) Financial Regulations	7) Managing Complex, Cross Functional, Cross Sector P3 Teams	12) Role of Government Agencies under P3's
3) Role of Government Agencies & PPP's	8) Innovative Debt Financing Techniques - Securitization	13) Negotiation and Interest Based Bargaining
4) Overview of Public Private Partnerships	9) Economic Evaluation Techniques (Cost/Benefit Analysis)	14) Innovative Traffic Management Techniques
5) Risk Analysis and Management	10) Life Cycle Analysis – Funding Deferred Maintenance & Renewal	15) Transportation Economics

### Research Programs

Effective project finance management will depend on informed leadership. The proposed objective is advancement of knowledge regarding best practices in financing and delivery options. To that end, we identified three major research themes, which we refer to as research tracks: public finance, public private partnerships, and long-term strategies (Ortiz et al., 2008). The research component will result in the creation of research reports, journal papers, white papers, and detailed annual guidelines that offer information sharing of best practices in project finance and assist training in the use of tools and decision-making processes to state DOTs. Figure 3 illustrates the general framework of the research programs.



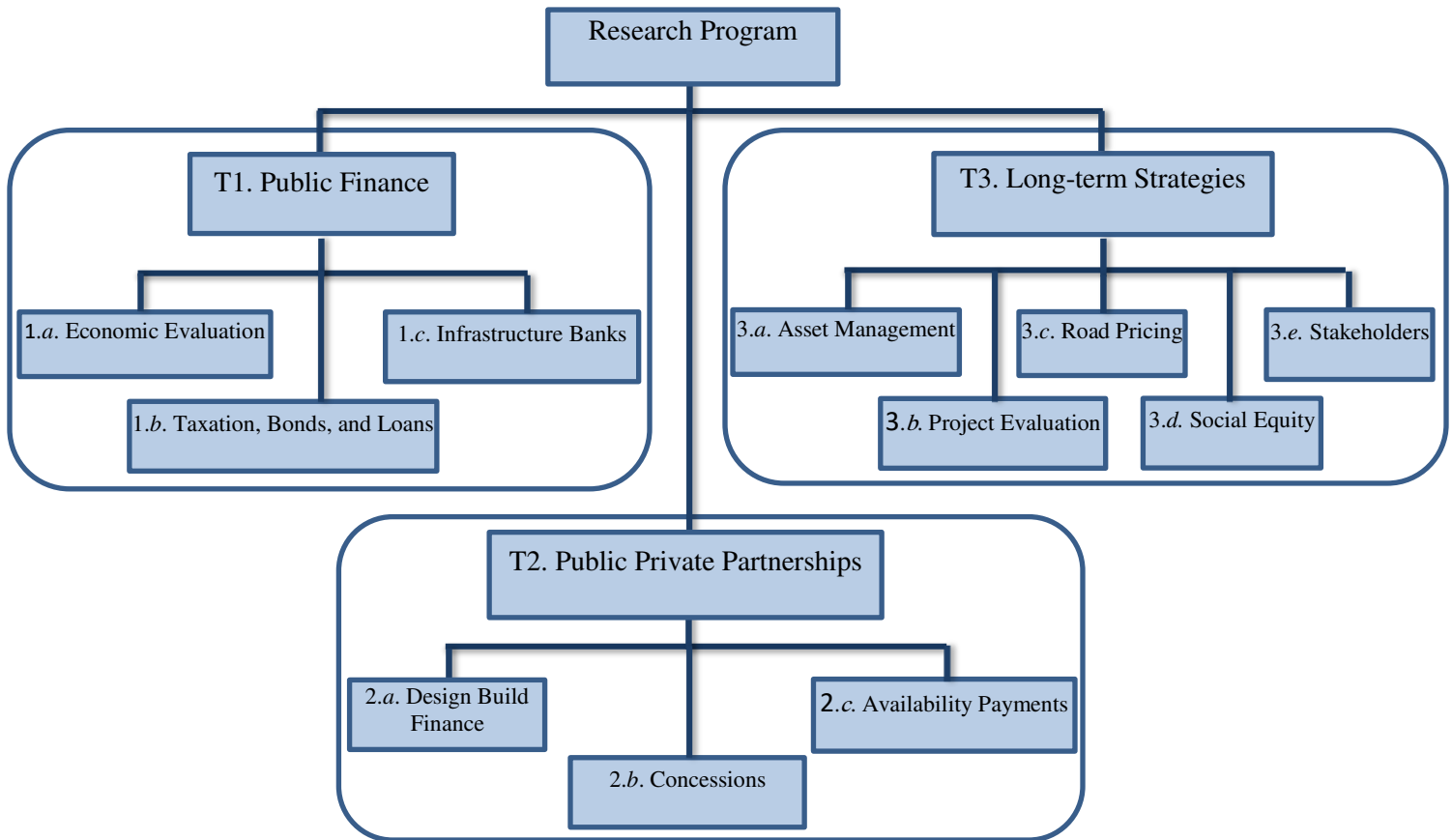


Figure 3. Research framework

## Conclusion

This paper provides an overview of a strategic plan to educate U.S. state officials about new and innovative approaches regarding transportation finance and investment. I develop two key teaching and research frameworks that are in line with my proposed overall strategic plan. I examine the key aspects, however, our existing knowledge and as a result our actions do not guarantee a successful future transportation system for the USA, in specific.

## Copyright Note

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## References

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- Anas, A., and R. Lindsey (2011) "Reducing Urban Road Transportation Externalities: Road Pricing in Theory and in Practice." *Rev. Environ. Econ. Policy*, 5(1), 66-88.
- Beheshtian et al. (2017). "Planning resilient motor-fuel supply chain" *International Journal of Disaster Risk Reduction* 24 (2017): 312-325.
- Beheshtian, A., K. P. Donaghy, and O. M. Rouhani. (2016). "Flood-resilient deployment of fueling stations: extension of facility location problem." *Transportation Research Record: Journal of the Transportation Research Board* 2599 (2016): 81-90.
- Daher, N., F. Yasmin, M. Wang, E. Moradi, and O. M. Rouhani. (2018) "Perceptions, Preferences, and Behavior Regarding Energy and Environmental Costs: The Case of Montreal Transport Users." *Sustainability* 10, 2 (2018): 514.
- Isalou, A. A., Litman, T., & Shahmoradi, B. (2014). Testing the housing and transportation affordability index in a developing world context: A sustainability comparison of central and suburban districts in Qom, Iran. *Transport policy*, 33, 33-39.
- Lin, C. Y., et al. (2009) "The implications of an E10 ethanol-blend policy for California." *California State Controller John Chiang Statement of General Fund Cash Receipts and Disbursements* 5.5 (2009): 6-7.
- Litman, T., Burwell, D. (2006). Issues in sustainable transportation. *International Journal of Global Environmental Issues*, 6(4), 331-347.
- Madani, K., et al. (2014) "A negotiation support system for resolving an international trans-boundary natural resource conflict." *Environmental modelling & software* 51 (2014): 240-249.
- Mirchi, A., et al. (2012) "World energy balance outlook and OPEC production capacity: implications for global oil security." *Energies* 5.8 (2012): 2626-2651.
- National Surface Transportation Infrastructure Financing Commission (NSTIFC), 2009. *Paying Our Way: A New Framework for Transportation Finance*, February 2009, 108, [http://financecommission.dot.gov/Documents/NSTIF\\_Commission\\_Final\\_Report\\_Mar09FNL.pdf](http://financecommission.dot.gov/Documents/NSTIF_Commission_Final_Report_Mar09FNL.pdf) (accessed February 5, 2010).
- Ortiz, I.N., Buxbaum, J.N., Little, R. 2008. Protecting the Public Interest – Role of Long-Term Concession Agreements for Providing Transportation Infrastructure. *Transportation Research Record* 2079, 88–95.
- Reinhardt, W. 2011. *The Role of Private Investment in Meeting U.S. Transportation Infrastructure Needs*. American Road & Transportation Builders Association (ARTBA) Transportation Development Foundation (May 2011).
- Rouhani, O.M. et al. (2013) "Integrated modeling framework for leasing urban roads: A case study of Fresno, California." *Transportation Research Part B*, 48 (1): 17-30.1
- Rouhani, O. M. (2013) "Clean development mechanism: an appropriate approach to reduce greenhouse gas emissions from transportation." *Transportation Research Board* 92 (2013).

Rouhani, O.M., and A. Beheshtian (2013) "Social and Private Costs of Driving." Lecture presentation at the 2013 Annual Conference of the International Transportation Economics Association, Northwestern University, Evanston, Illinois.

Rouhani, O., and D. Niemeier (2011). Urban Network Privatization: Example of a Small Network. *Transportation Research Record: Journal of the Transportation Research Board*, (2221), 46-56.

Rouhani, O.M., and D. Niemeier (2014a) "Resolving the Property Right of Transportation Emissions through Public-Private Partnerships." *Transportation Research Part D*, 31: 48-60.

Rouhani, O.M., and D. Niemeier (2014b) "Flat versus Spatially Variable Tolling: A Case Study in Fresno, California." *Journal of Transport Geography*, 37, 10-18.

Rouhani, O.M., and H. Zarei (2014) "Fuel Consumption Information: An Alternative for Congestion Pricing?" *Road and Transport Research*, 23(3), 52-64.

Rouhani, O.M., and H.O. Gao (2014) "An Advanced Traveler General Information System for Fresno, CA", *Transportation Research Part A*, 67: 254-267.

Rouhani, O. M. (2012) *Frameworks for public-private partnerships*. University of California, Davis, 2012.

Rouhani, O. M. (2016) "Next Generations of Road Pricing: Social Welfare Enhancing." *Sustainability* 8.3 (2016): 1-15.

Rouhani, O. M. (2018) "Beyond Standard Zonal Congestion Pricing: A Detailed Impact Analysis." *Journal of Transportation Engineering, Part A: Systems* 144, 9 (2018): 04018052.

Rouhani, O. M., and A. Beheshtian. (2016) "Energy Management."

Rouhani, O. M., and H. O. Gao. (2016) "Evaluating various road ownership structures and potential competition on an urban road network." *Networks and Spatial Economics* 16.4 (2016): 1019-1042.

Rouhani, O. M., C. R. Knittel, and D. Niemeier. (2014) "Road supply in central London: Addition of an ignored social cost." *Journal of the Transportation Research Forum*. Vol. 53. No. 1. Transportation Research Forum, 2014.

Rouhani, O. M., et al. (2015a) "Policy lessons for regulating public-private partnership tolling schemes in urban environments." *Transport Policy* 41 (2015): 68-79.

Rouhani, O. M., et al. (2015b) "Implications of fuel and emissions externalities, spillovers to the outside, and temporal variations on zonal congestion pricing schemes." TRB paper No. 15-0905. 2015.

Rouhani, O. M., et al. (2016a) "Social welfare analysis of investment public-private partnership approaches for transportation projects." *Transportation Research Part A: Policy and Practice* 88 (2016): 86-103.

Rouhani, O. M., et al. (2016b) "Cost-benefit analysis of various California renewable portfolio standard targets: Is a 33% RPS optimal?" *Renewable and Sustainable Energy Reviews* 62 (2016): 1122-1132.

Rouhani, O. M., et al. (2018) "Revenue-Risk-Sharing Approaches for Public-Private Partnership Provision of Highway Facilities." Case Studies on Transport Policy, in press, <https://doi.org/10.1016/j.cstp.2018.04.003>.

Bel G., Foote J. 2009. Tolls, terms, and public interest in road concessions privatization: A comparative analysis of recent transactions in the US and France. *Transport Reviews* 29 (3): 397-413.

Winston, C., 2012, U.S. Transportation System Performance: It's Effects On The Economy And Alternative Policy Reforms, Washington, DC: Brookings Institution working paper, 2012.