An Economic and Policy Analysis of the Introduction of High-Speed Rail in California:

Phase I from the San Francisco Bay Area to Los Angeles and Anaheim

A Masters Project by David R. Tucker
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Dr. Claude Gravatt, MP Advisor

Masters of Environmental Management; Energy & Environment
Nicholas School of the Environment and Earth Sciences
Duke University, Spring 2012 Semester
Focus of My Research

• Research Question:
  Should Phase One of the California HSR System be built?

• Research Objective:
  To analyze comparative capital construction cost Net Present Values for (1) HSR system & (2) airports / highways BAU alternative.
California HSR: Background 1

• Created by CA’s Proposition 1A (2008) to:
  – Build 800-mi. statewide HSR system
  – Link all major cities w/ 220 mph electric trains

• Phase 1 of HSR system (520 mi.) will go:
  – From San Francisco Bay area (N. end)
  – To Los Angeles / Anaheim (S. end)

• No operating subsidy planned
  – Required by the law to operate in the black

• CA HSR Authority’s 2012 Draft Business Plan
  – Published Nov. 2011 w/ supporting docs
  – Details plans for Phase 1 of HSR system
California HSR: Background 2

- **Technology**: Steel wheels on steel rails; electric
- **Travel Times**: L.A. to S.F. in 2h, 40m
- **Ridership**: 29.6 M – 43.9 M annually by 2040
- **Route**: Mostly dedicated HSR tracks, with many above- and below-grade crossings
- **Stations**: No more than 24 for Phases 1 & 2
- **Funding Secured**: $9.95 B (CA) + $3.3 B (USA)
California HSR System Maps

Source: CHSRA 2012 DBP, p. 2-20
Alternatives to HSR: Airports

11 airports could be expanded (for ¼ needed capacity)

Source: CHSRA 2012 DBP, p. 2-20
Alternatives to HSR: Highways

775 miles of highways could be expanded for the other ¾ of capacity.

Mostly I-5 would be expanded (but also parts of US-101, I-880, SR-152, I-80, I-580, SR-99, and SR-14).
HSR Phase 1: Construction Timeline

HSR Phase 1: Schedule by Section

ICS  2012-2017

IOS  2015-2021

Bay to Basin  2021-2026

Phase 1  2026-2033

Source: CHSRA 2012 DBP, p. 4-2
Rapidly Growing CA Population

Pop. Growth by 2040

Highest:  +17.2 M
High:     +12.5 M
Low:      +7.6 M

Source:  CHSRA 2012
DBP, p. 6-5
CA HSR: Proposed Benefits

- **Jobs**: 800k – 900k job-years created
- **Environment**: abate 3M tons CO$_2$/year
- **Roads**: 8 billion fewer VMT’s / year
- **Airports**: Reduced congestion (esp. LAX, SFO)
- **Time Saved**: 146 million hours / year
- **Value of Time Saved**: $ billions / year
- **NPV**: $30.6 - $39.8 B (CHSRA BCA, 2010-2080)
Potential HSR Benefits: Energy

CA HSR: Proposed Capital Costs

- 2008 HSR Cost Estimate: $40 B (Phases 1 & 2)
- 2009 Air/Highway Estimate: $100 B (Phase 1)
- 2011 HSR Update: $98.1 - $117.6 B (Phase 1)
- 2011 Air/Highway Estimate: $171 B (Phase 1)

<table>
<thead>
<tr>
<th>Transportation Alternative</th>
<th>Added Capacity</th>
<th>Required Investment (2010 $B)</th>
<th>Required Investment (YOE $B)</th>
</tr>
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<tbody>
<tr>
<td>High-speed rail</td>
<td>Full Phase 1</td>
<td>65.0</td>
<td>98.5</td>
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<td></td>
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<td>Highways and airports</td>
<td>2,326 new lane-miles of highway</td>
<td>114.0</td>
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<td></td>
<td>115 new airport gates</td>
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<td></td>
<td>4 new runways</td>
<td></td>
<td></td>
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<tr>
<td>Proposed cost savings ($)</td>
<td></td>
<td>49.0</td>
<td>72.5</td>
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<tr>
<td>Proposed avoided cost increases (%)</td>
<td></td>
<td>75%</td>
<td>74%</td>
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4/26/2012
David R. Tucker
Previous HSR Studies

• Numerous International & General Studies

• California HSR Studies
  • Pro: CHSRA 2012 Draft Business Plan and supporting BCA and other contractor documents
  • Con: Legislative Analyst’s Office, State Auditor’s Office, Peer Review Group, Chamber of Commerce

• Few or no NPV analyses (esp. for comparative capital investment costs)
Basic Research Methodology

• Compare capital construction costs for Option 1 (HSR) and Option 2 (air/hwy) using NPVs

• Option 1 (HSR):
  • Evaluate HSR for both IOS-S and IOS-N first
  • Evaluate HSR for both low-cost and high-cost

• Option 2 (air/hwy):
  • Create simulated cash-flow for air/hwy option
  • Adjust air/hwy option for 21-year time scale
  • Adjust highways for 0/2/4 lanes phasing (not 3)
  • Adjust airports for delay-based 3 phases
Inputs and Sensitivity Analysis

• Rates Used:
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  • 3% annual inflation rate
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  • 4% medium discount rate
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• Look at 2, 3, 4 & 6 highway lanes

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<td>Airport Component (25%)</td>
<td>115 gates &amp; 4 runways</td>
<td>$29.7 billion</td>
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• Examine adding O&M costs to HSR NPV for a “total cost” result, not just capital cost
Key Research Findings

Notes: All discount rates are real; no project liquidation values included; capital costs only, except for HSR far-right.
Key Research Findings

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<th>Transportation</th>
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<th>Investment: Best NPV (based on 2010 $B)</th>
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<td>4 new runways</td>
<td>no hwy/air phases</td>
<td>hwy/air both phased</td>
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<td>Proposed cost savings ($)</td>
<td>18.71</td>
<td>25.00</td>
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<tr>
<td>Proposed cost savings (%)</td>
<td>47%</td>
<td>52%</td>
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- Using best estimates (4% RDR), HSR saves $25 B (52%)
  - Low vs. Low: HSR saves $4 B (10%)
  - High vs. High: HSR saves $63 B (133%)
- HSR still saves $13 B (22%) with O&M for HSR only
Implications of Findings

• Based on this analysis, CA should build HSR system

• Additional data would improve analysis:
  – Full HSR capital cost cash-flows for high-cost scenarios
  – Full HSR O&M cost cash-flows for all scenarios
  – Full HSR benefits / revenues cash-flows for all scenarios
  – Full air / highway cash-flows (independently verified)

• Further HSR / BAU analysis needed:
  – Current air / highway capacities & future needs
  – Detailed and realistic HSR funding options
  – HSR project management reforms
  – HSR benefits (economic, environmental, etc.)
  – Potential effects of tying in HSR system with AB32 (cap-and-trade)
Questions?