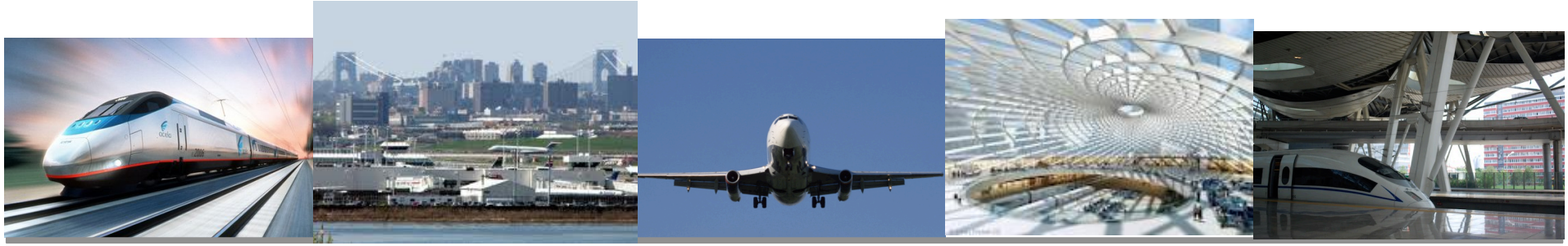

U.S. Aviation and High-Speed Rail Under Climate Policy

Regina R. Clewlow
Kendall Science Fellow, Union of Concerned Scientists
Ph.D. Candidate, Engineering Systems Division
Massachusetts Institute of Technology

National Aviation Systems Planning Symposium
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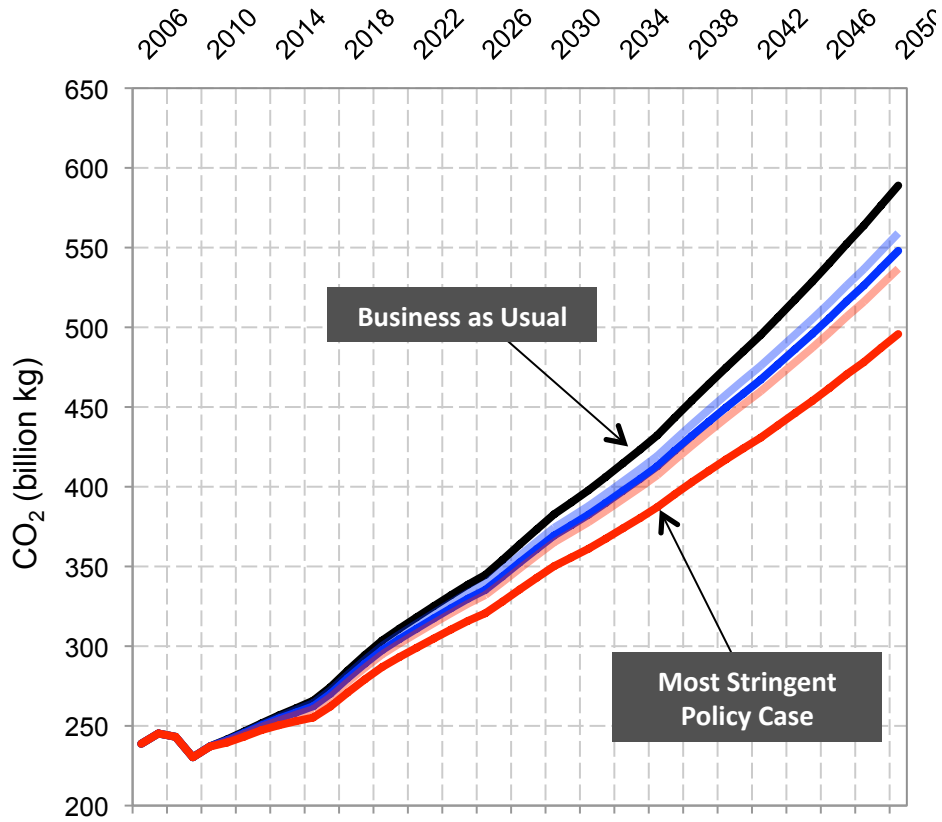
Galveston, Texas

Motivation

Climate Impacts of Aviation

- Transportation is the fastest growing source of CO_2 emissions, accounting for nearly half of the net increase in total U.S. emissions since 1990.
- Trend towards faster modes of transportation with GDP growth (Schafer, 2000). In the U.S., aviation is the dominant "high-speed" mode.
- Under business-as-usual, global aviation emissions anticipated to grow by 300% by 2050 (IEA, 2008).

U.S. Aviation Emissions Under Climate Policies



Winchester, N., C. Wollersheim, R. Clewlow, N.C. Jost, S. Paltsev, J. Reilly and I.A. Waitz. The Impact of Climate Policy on US Aviation. *Journal of Transportation Economics & Policy*. [In Press]

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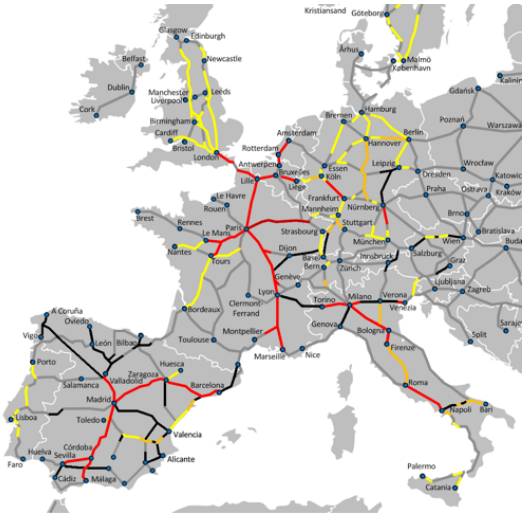
Motivation

Capacity Constraints in Megaregions

- Continued long-term capacity problems at airports serving major metropolitan areas (FAA and MITRE, 2007).
- A primary contribution to airport congestion in the U.S. are short-haul flights on routes of less than 800 km (500 mi).
  - Short-haul flights represent half of all domestic flights (Tomer and Puentes, 2009).
- In many parts of the world, high-speed rail has served as an alternative for these routes.

Airports and Metro Areas Needing Capacity in 2025 *After* Planned Improvements. Source: FACT-2, 2007.



Motivation

Costly Infrastructure / Long Time Scales

- Obama administration has been a strong proponent of high-speed rail in America.
- Both high-speed rail and aviation require costly infrastructure that is utilized over long time scales.
- Over these long time scales, climate policies may shape the demand, energy use, and environmental impacts of these systems.

Proposed U.S. High-Speed Rail Corridors

Source: Federal Railroad Administration

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Research Questions

Demand for HSR and Air

- How might (potential) HSR and air transportation demand evolve in the United States?

Transportation & Climate Policy

- How might different combinations of climate and transportation ***policies*** impact demand for these systems?

Energy/ environment

- What are the energy and climate impacts of these systems under climate policy?

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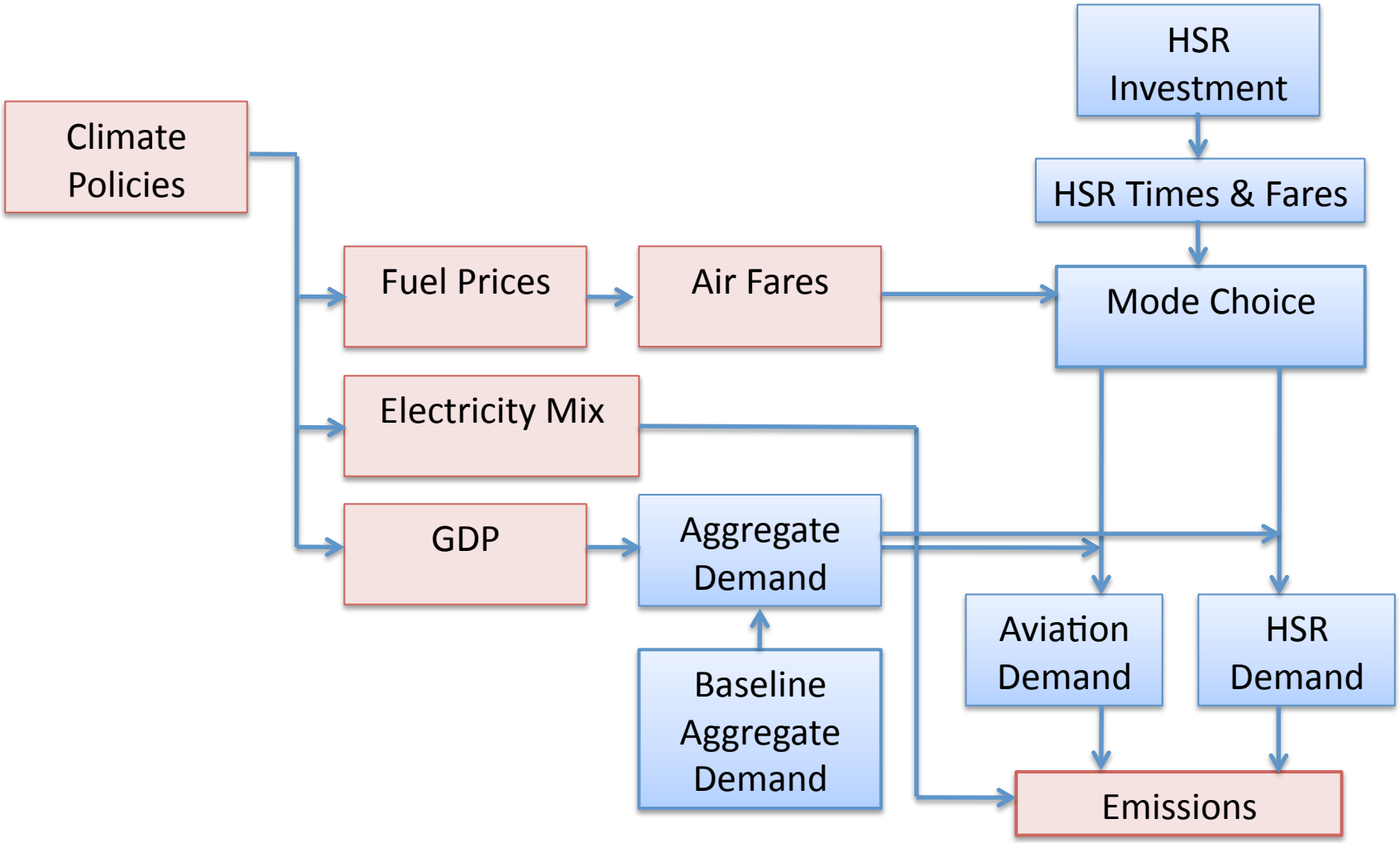
An Integrated Assessment of Climate and Transportation Policy



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3 x 3 Assessment of Climate and Transportation Policies

Climate Policies

- No policy/ business-as-usual
- Federal Clean Energy Standard
- Cap-and-Trade

Transportation Policies

- No build
- Medium competitiveness
- High competitiveness

Regional Analysis

- Regional-level demand forecasts.
- Regional-level climate policy impacts (e.g. gross state product, regional electricity generation, etc.)

Source: Joint Program on the Science and Policy of Global Change, USREP Model Aggregation

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Climate Policy Scenarios

No Policy

- Assumed average GDP growth of 1.44% per year.
- Average fuel price increase of 0.86% per year.

Clean Energy Standard

- In January 2011, Obama administration proposed a Federal Clean Energy Standard (CES).
- "Clean energy" includes renewables, nuclear, natural gas, and coal with CCS.
- Federal CES would shift the U.S. electricity production to 80% clean energy sources by 2035.

Cap-and-Trade

- In 2009, the House of Representatives approved the American Clean Energy and Security Act of 2009 (ACES) – also known as the Waxman-Markey Bill.
- Bill proposes a cap-and-trade system, under which there would be a limit on the total amount of greenhouse gas emissions that can be emitted nationally.

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The Case of California: An Overview

- Several multi-airport regions in California that may face capacity constraints in the next 20-30 years.
- Current plans to build high-speed rail from Northern California to Southern California have implications for airport capacity planning.
- Current Bay Area Regional Airport System Plan Analysis considers the potential substitution of HSR for aviation in the California region.

California High-Speed Train Map, Statewide Overview

April 2010

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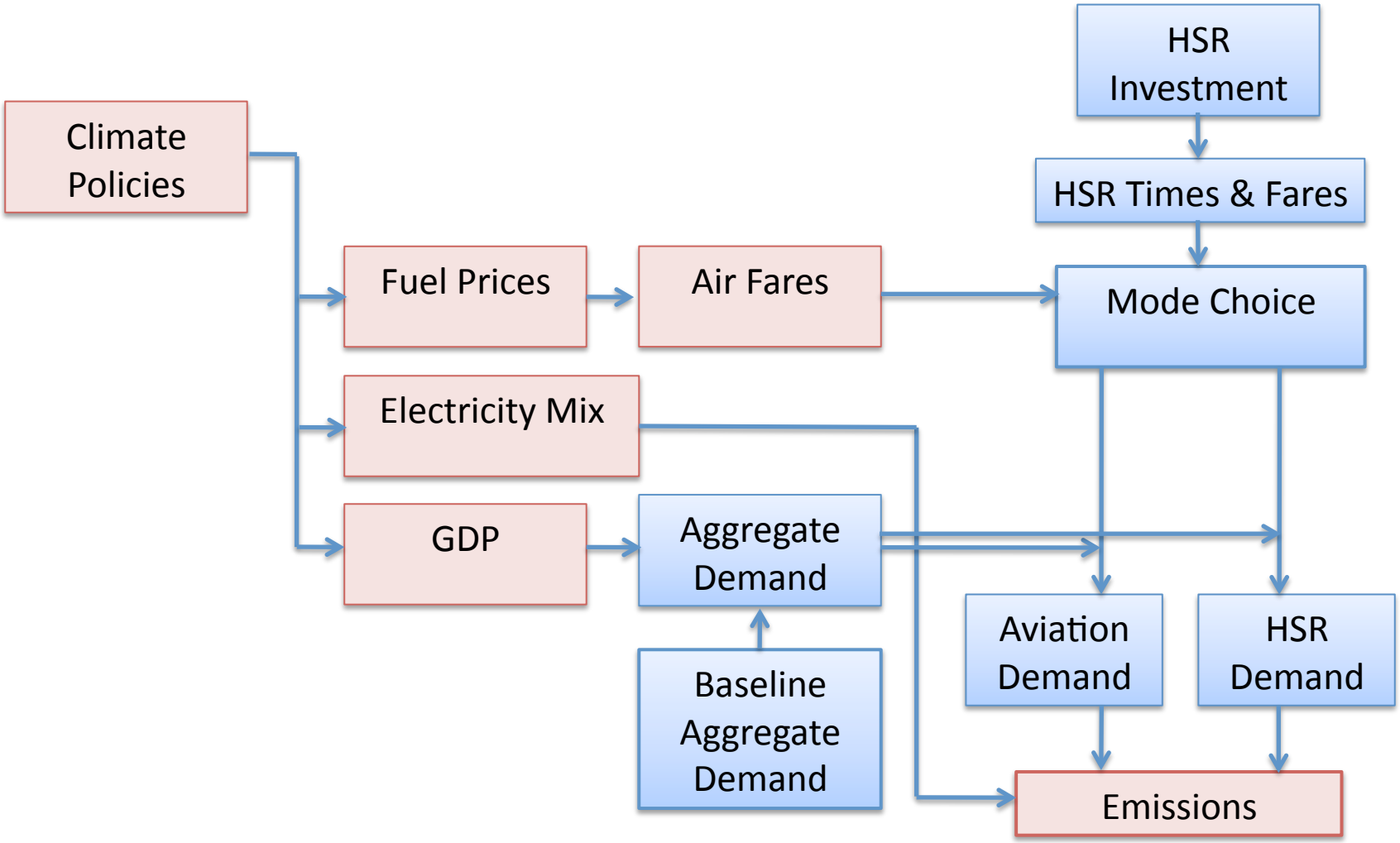
The Case of California: Model Development



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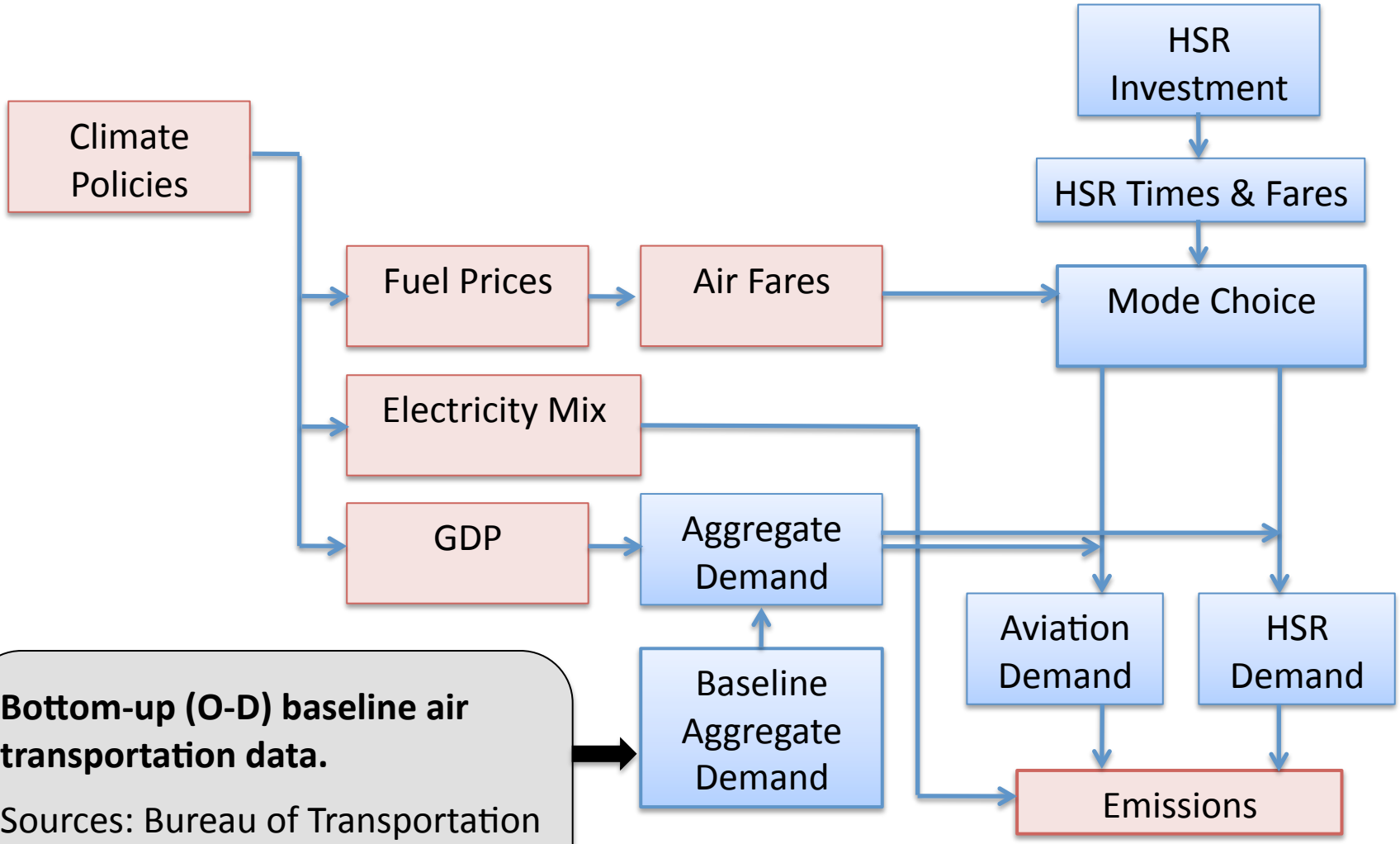
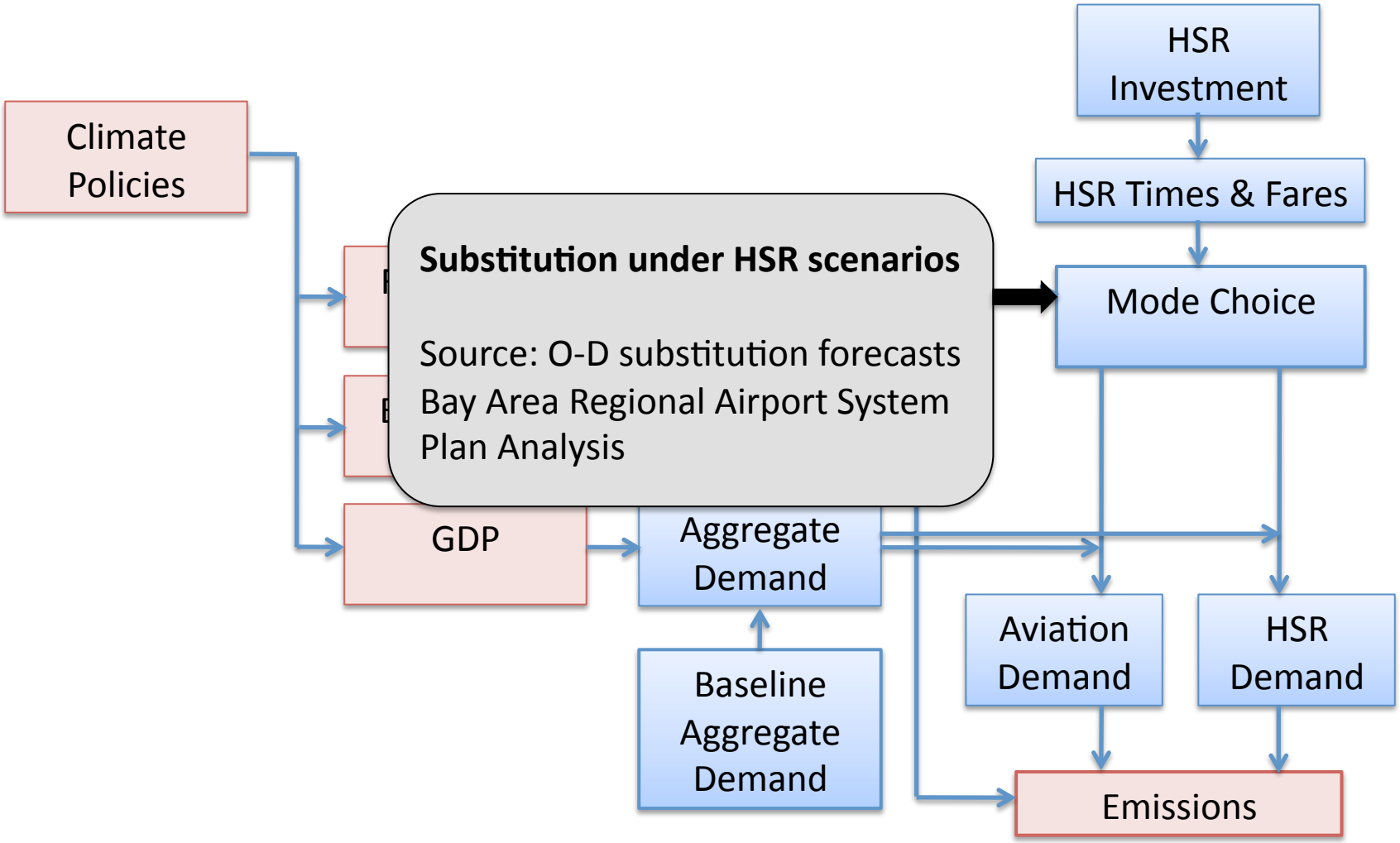
The Case of California: Model Development



Bottom-up (O-D) baseline air transportation data.

Sources: Bureau of Transportation Statistics, Bay Area Regional Airport System Plan Analysis

The Case of California: Model Development



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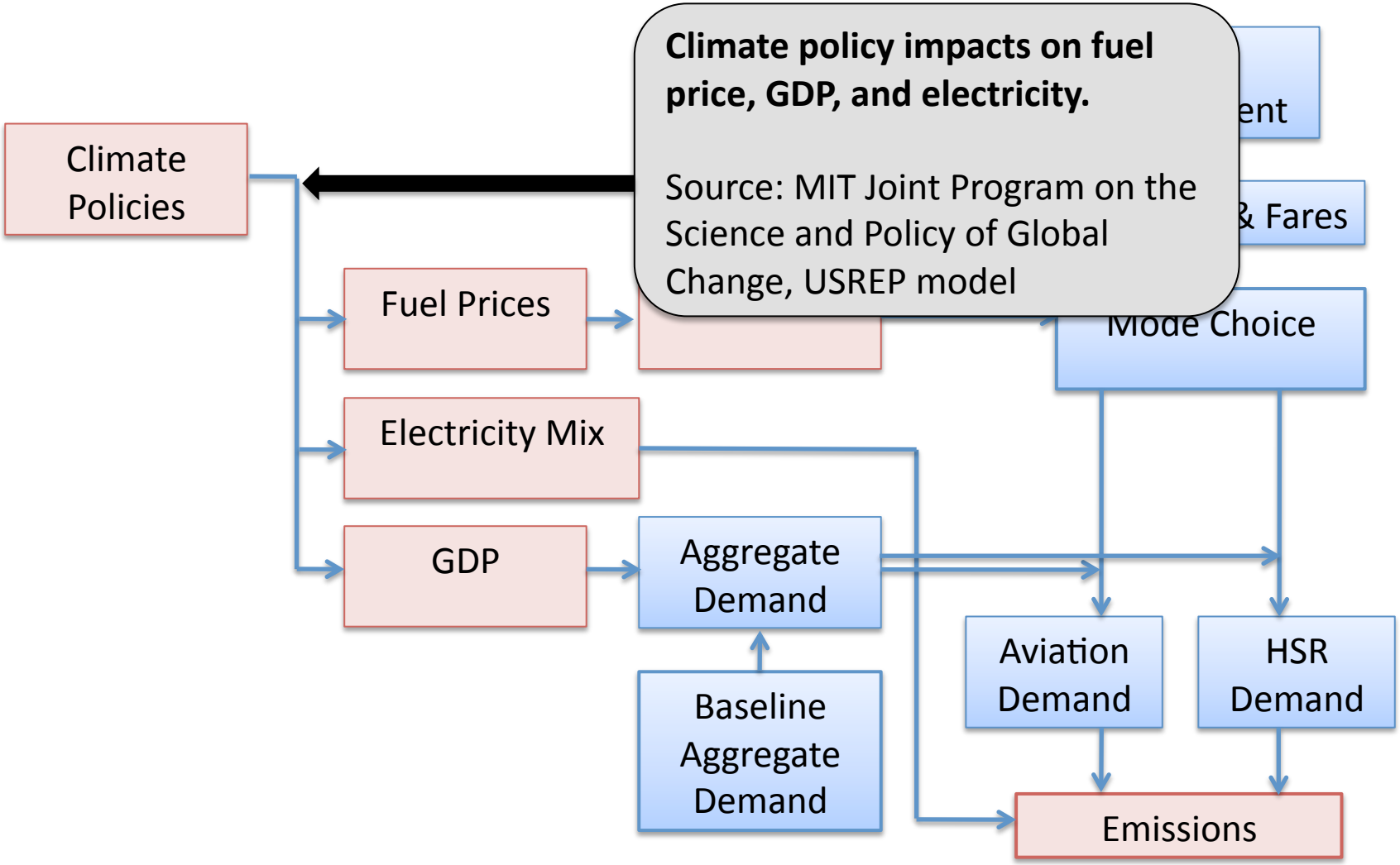
The Case of California: Model Development



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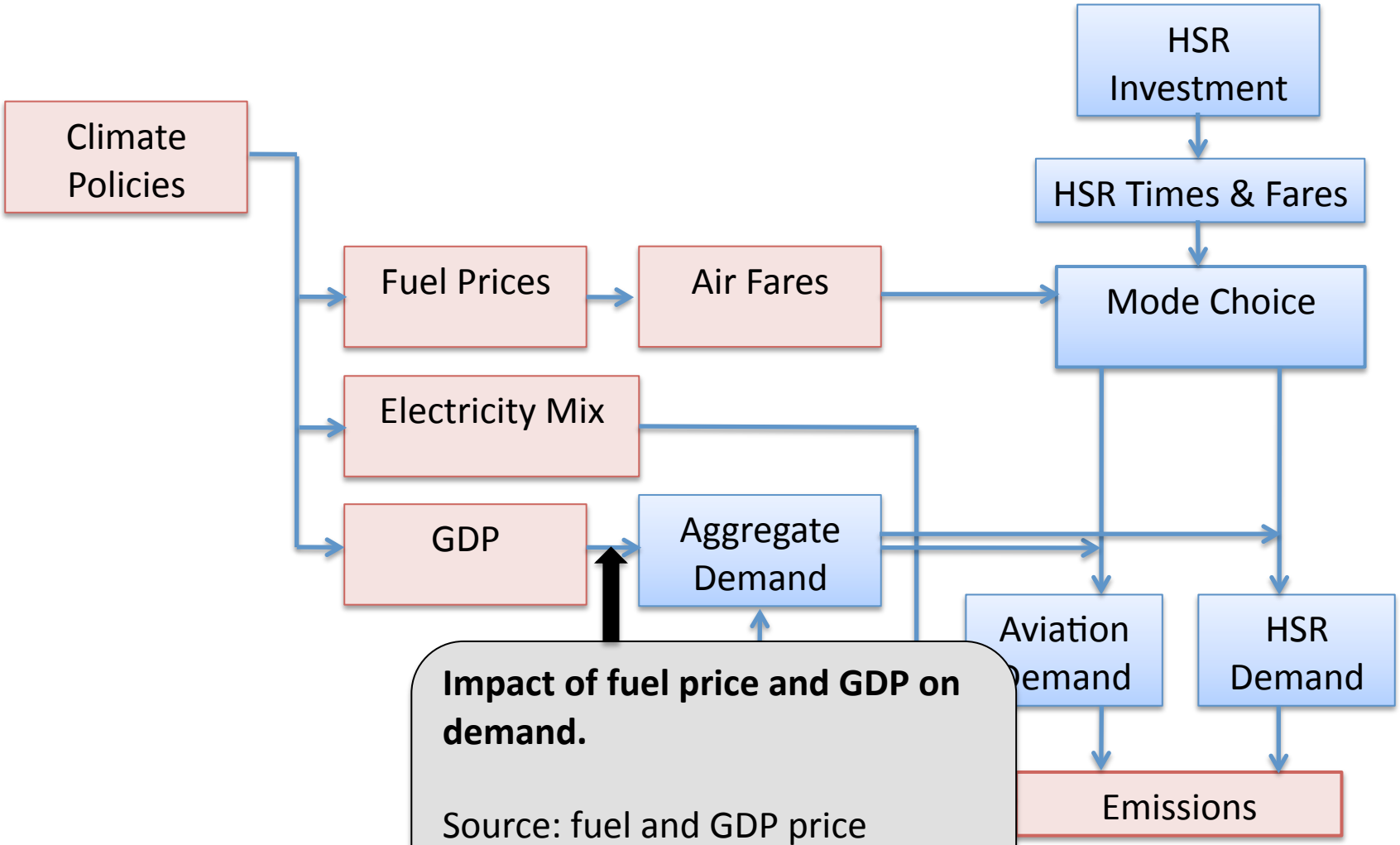
The Case of California: Model Development



Impact of fuel price and GDP on demand.

Source: fuel and GDP price elasticities from summary literature.

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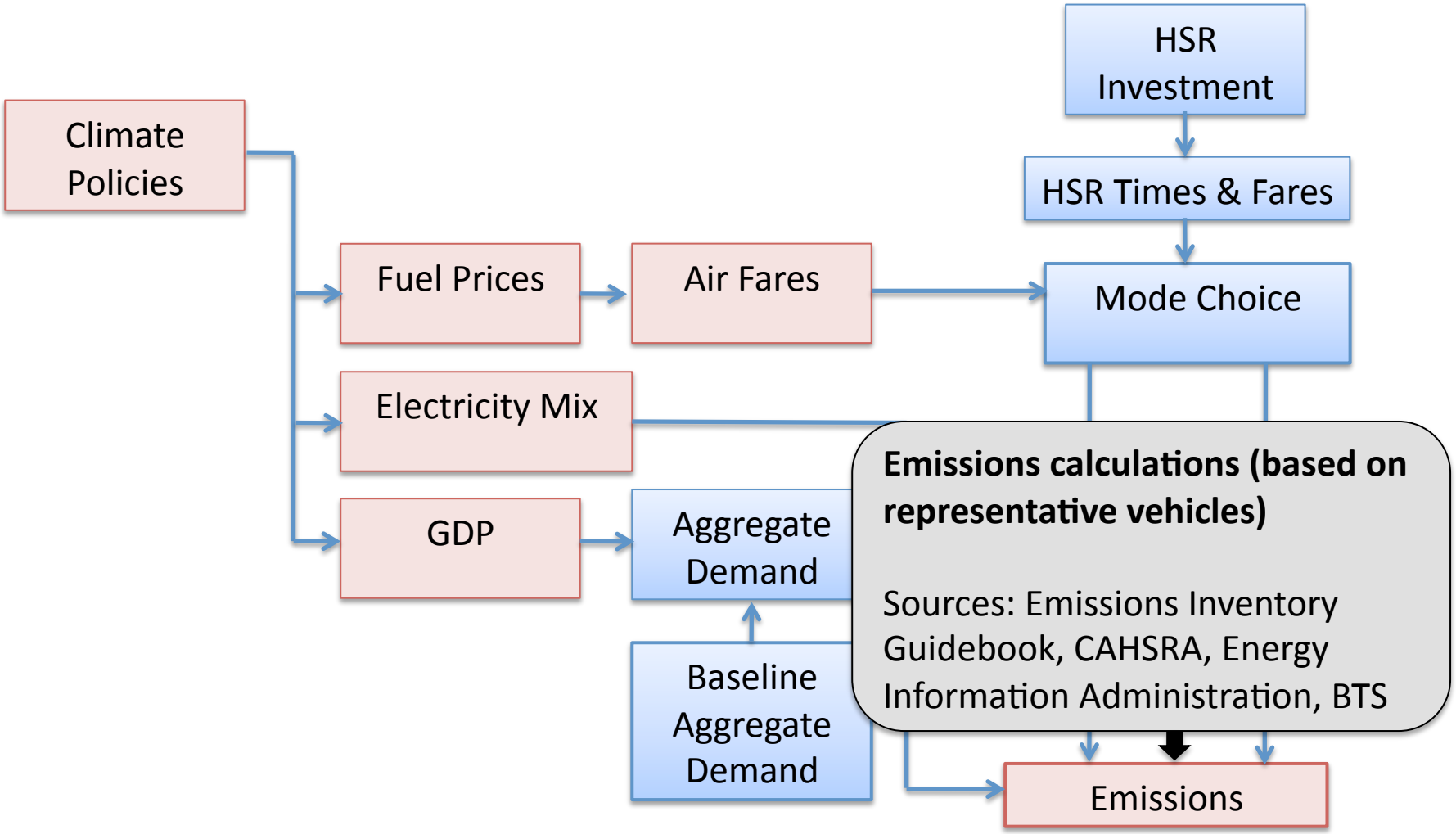
The Case of California: Model Development



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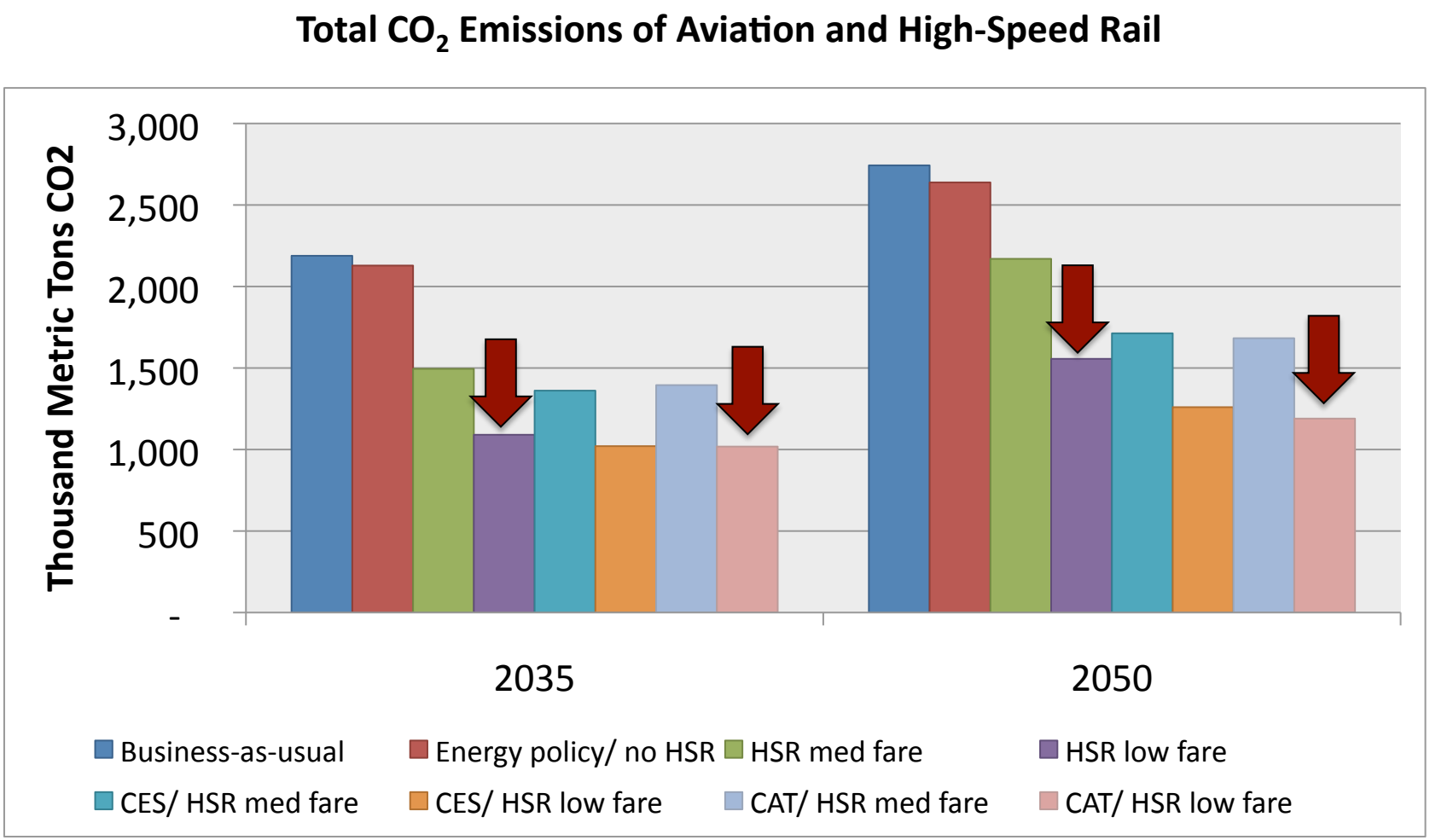
California: Total Aviation and HSR Emissions



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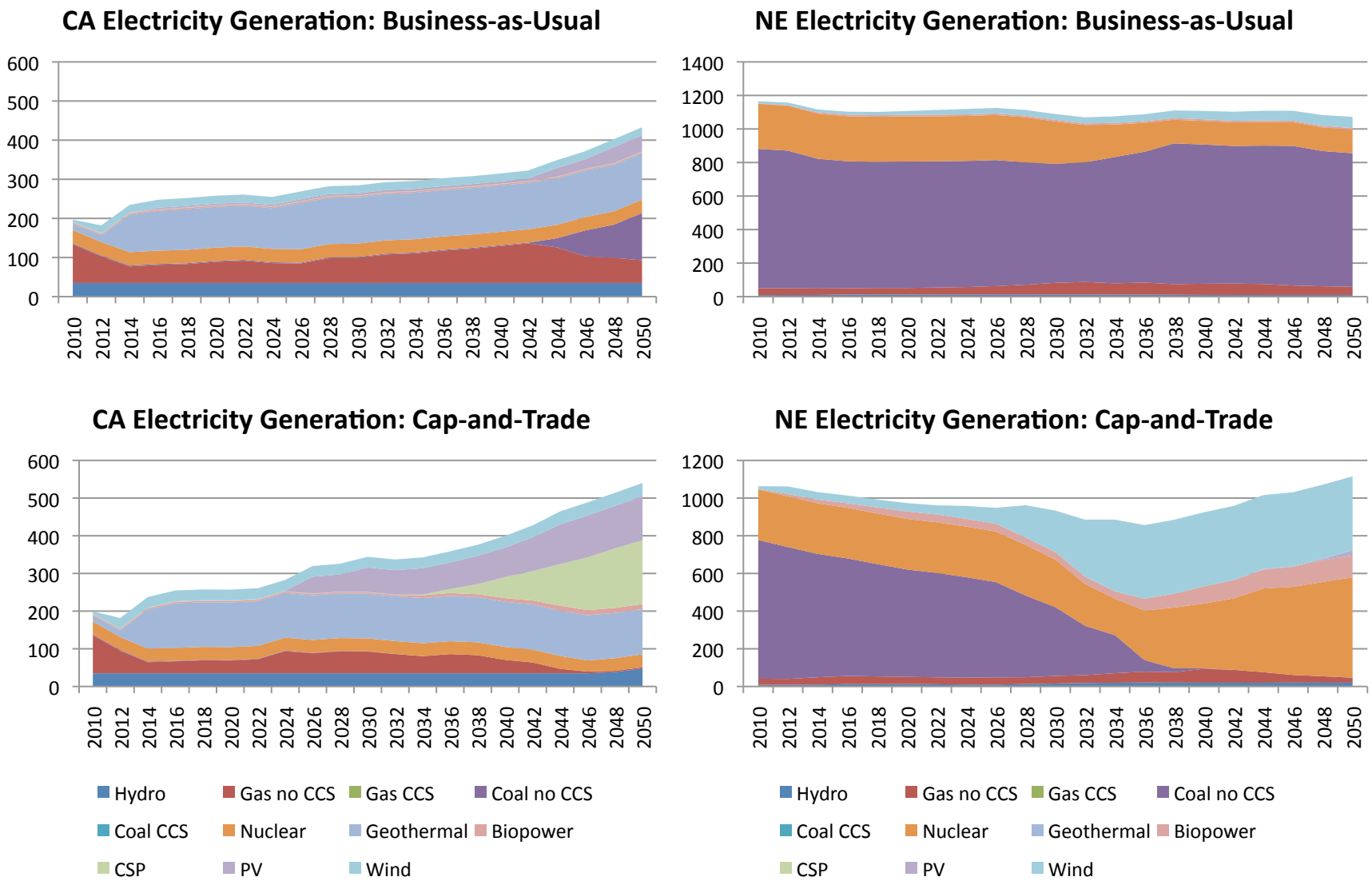
A Closer Look at Electricity Generation



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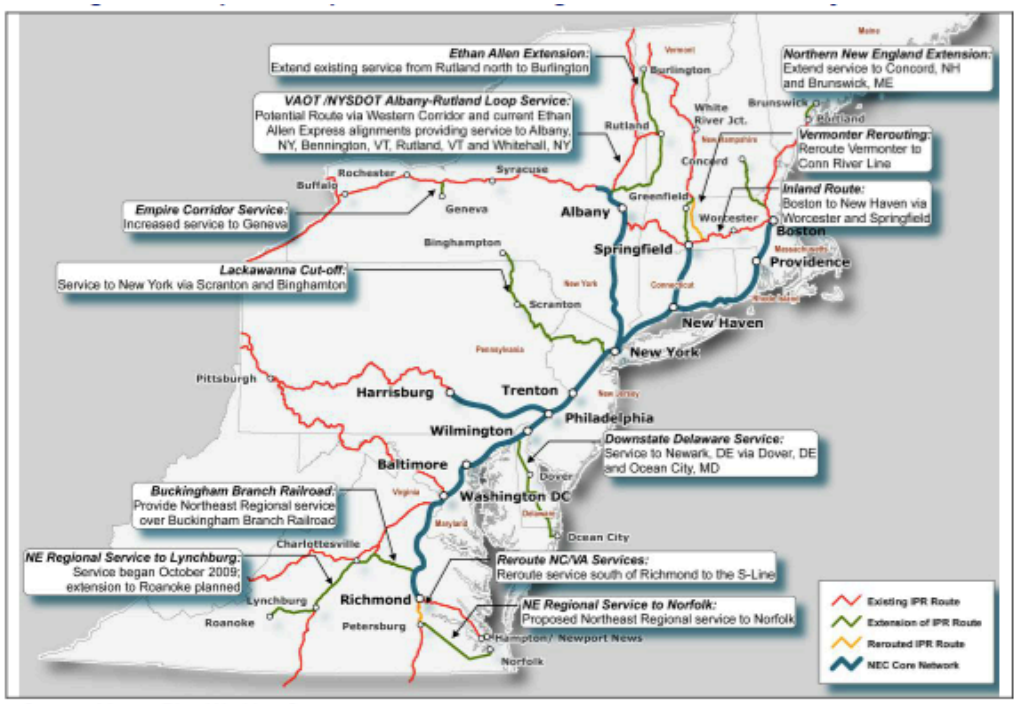
Source: USRep Regional Model of Electricity Generation, Joint Program on the Science and Policy of Global Change.

The Northeast Corridor

- For intercity trips that are 75 miles or longer, Amtrak accounts for roughly 45% of mode share between air and rail.
- Northeast airports are among the nation's most congested.
- Approximately one-third of departing flights from the three New York airports have destinations within 500 miles.



Source: Northeast Corridor Master Plan

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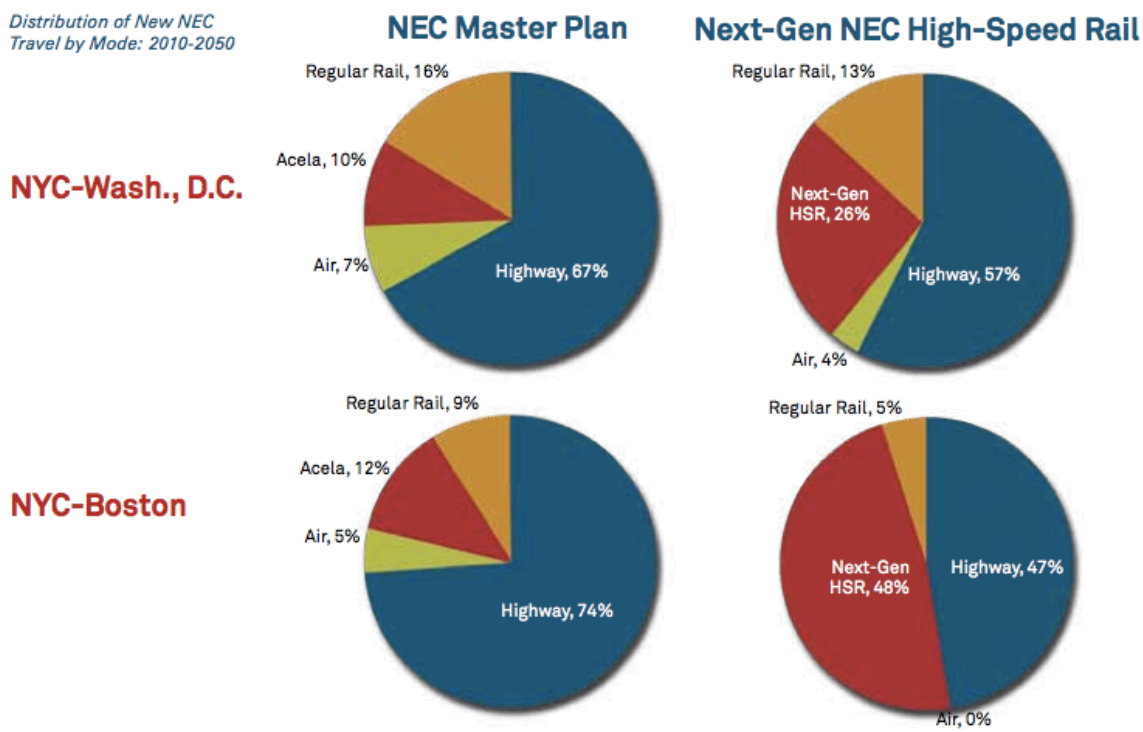
The Northeast Corridor: HSR Scenarios

- Two "high-speed rail" scenarios for the Northeast Corridor:
  - NEC Master Plan
  - Next-Gen NEC High-Speed Rail
- Next-Gen

  Boston-New York and New York-DC travel times less than 1h 30m; Boston-DC trip time less than 3h 30m.



Source: A Vision for High-Speed Rail in the Northeast Corridor

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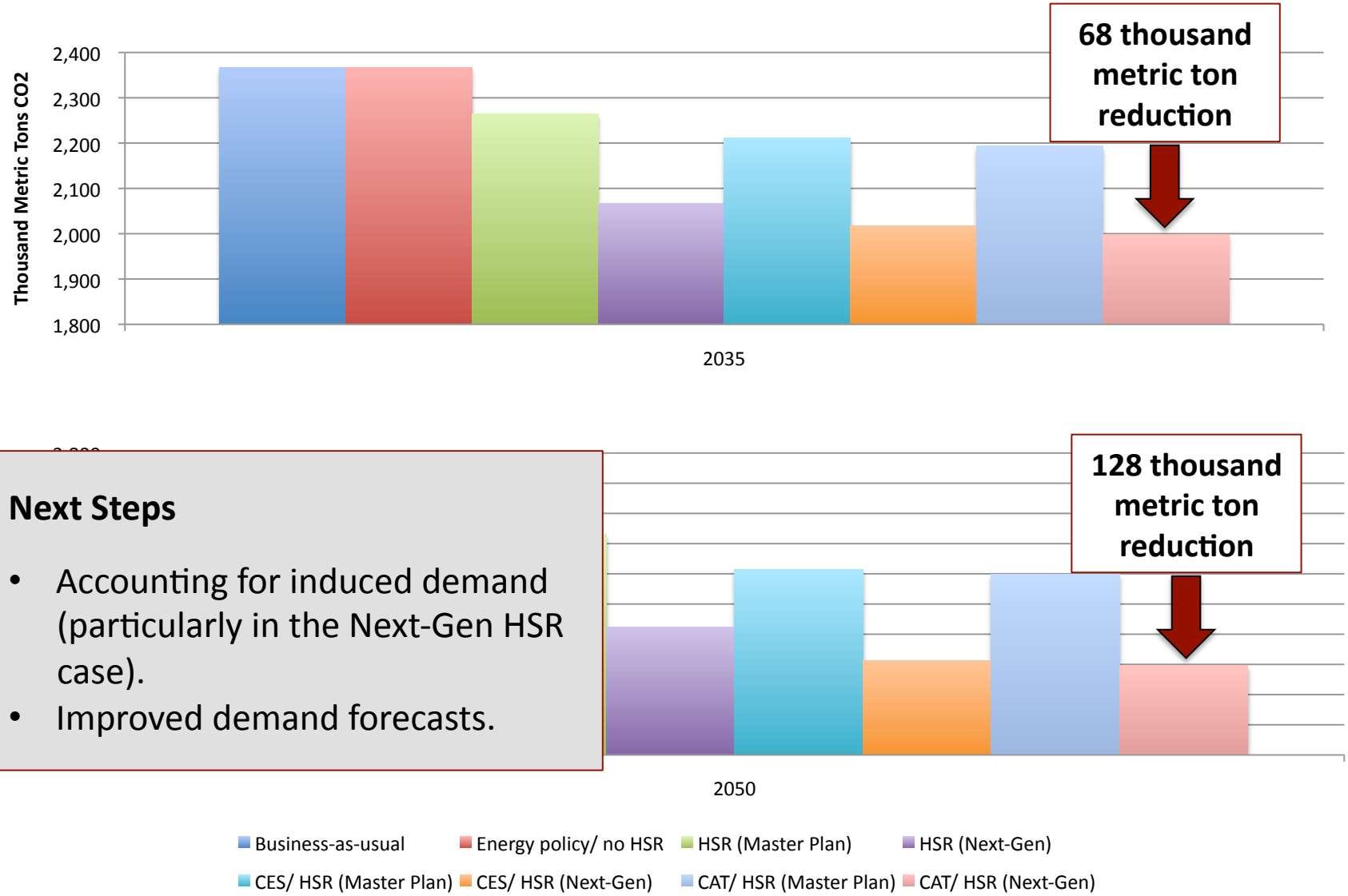
The Northeast Corridor: Total Emissions



Next Steps

- Accounting for induced demand (particularly in the Next-Gen HSR case).
- Improved demand forecasts.

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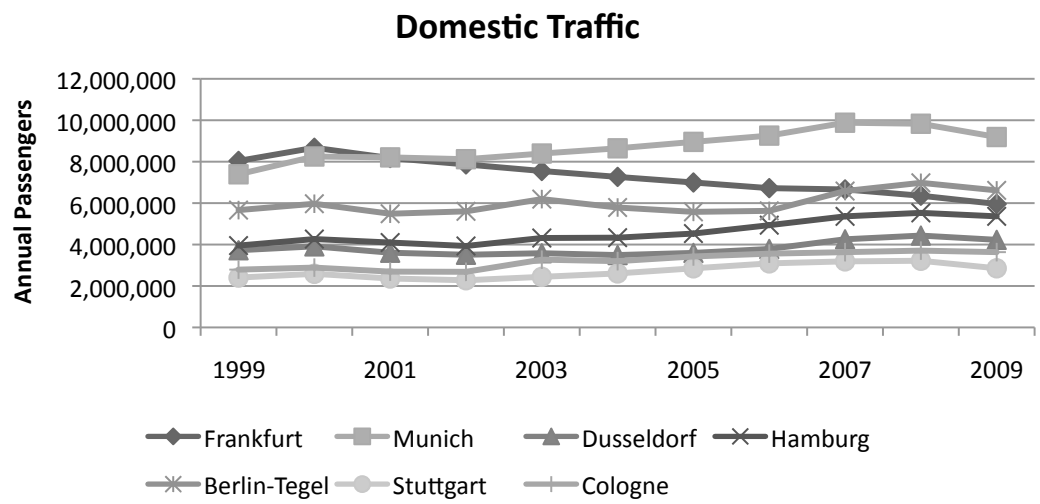
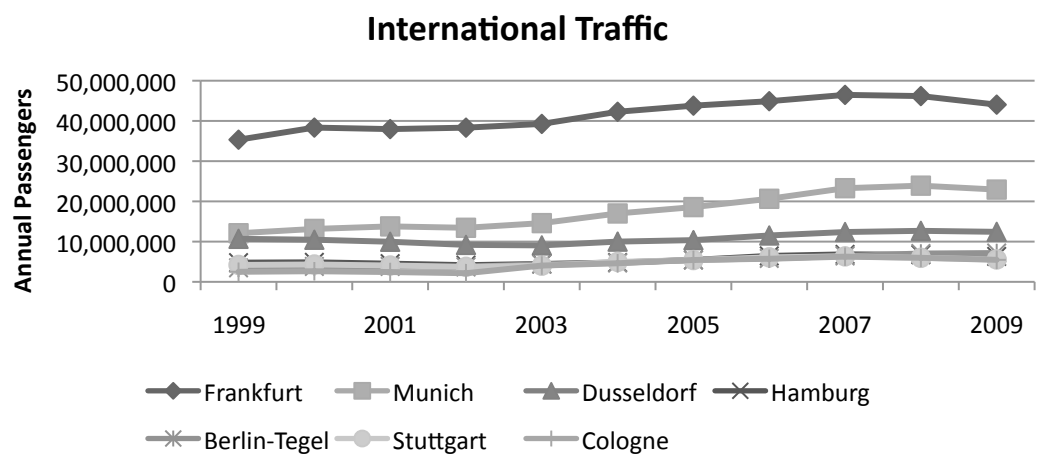
Air-Rail Connectivity

Lessons Learned from Europe

- Air-rail connectivity can enable potentially desirable capacity shifts.
- However, optimizing utilization requires:
- HSR link at the airport.
- Significant coordination between airport planners, airlines, and high-speed rail operators (e.g. ticketing and coordination of timetables).
- High frequency service.

Frankfurt Airport: A Special Case





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Conclusions

- Even with fairly low to average load factor assumptions (25% up to 50%), total emissions of the next generation of high-speed trains represents significant environmental savings.
- Climate impacts are even further reduced when climate policies are enacted concurrent with development of new transportation infrastructure.
  - Under a Clean Energy Standard or Cap-and-Trade program in California, transportation emissions would be further reduced by roughly 10% in 2035 and up to 23.5% in 2050 (on an annual basis).
  - The relative climate emissions savings are likely to vary from region to region.
- However, there are significant uncertainties in demand forecasts, particularly re: substitution by mode and induced demand.

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Thank You

Regina Clewlow
Kendall Science Fellow,
Union of Concerned Scientists

rclewlow@ucsusa.org
rclewlow@mit.edu

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