

CEE 5614 and CEE 4674

The National Airspace System (NAS)

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Defining the NAS

- Complex and adaptive system
- FAA defines the NAS in several web sites:
 - <http://www.faa.gov/nextgen/snapshots/nas/>
- The NAS includes:
 - FAA - as service provider (50,000 people)
 - Air navigation facilities, airports and control centers
 - Airlines (~100 airlines provide commercial service with ~10,000 aircraft)
 - General aviation users (220,000 aircraft)

Flights and Operations

- NAS has 86,000 flights per day (FAA, 2017)
- Around 32,000 of these flights are commercial flights
- During some busy periods of time, the NAS can have 6,000 IFR flights and another 3,000 VFR flights in the air
- Check a day in the life of the NAS visualization at:
- <https://plus.google.com/photos/102371865054310418159/albums/6466446768274510353/6466446771223413602>
- Animation uses data from 2016 but still provides an idea of the complexity of the system

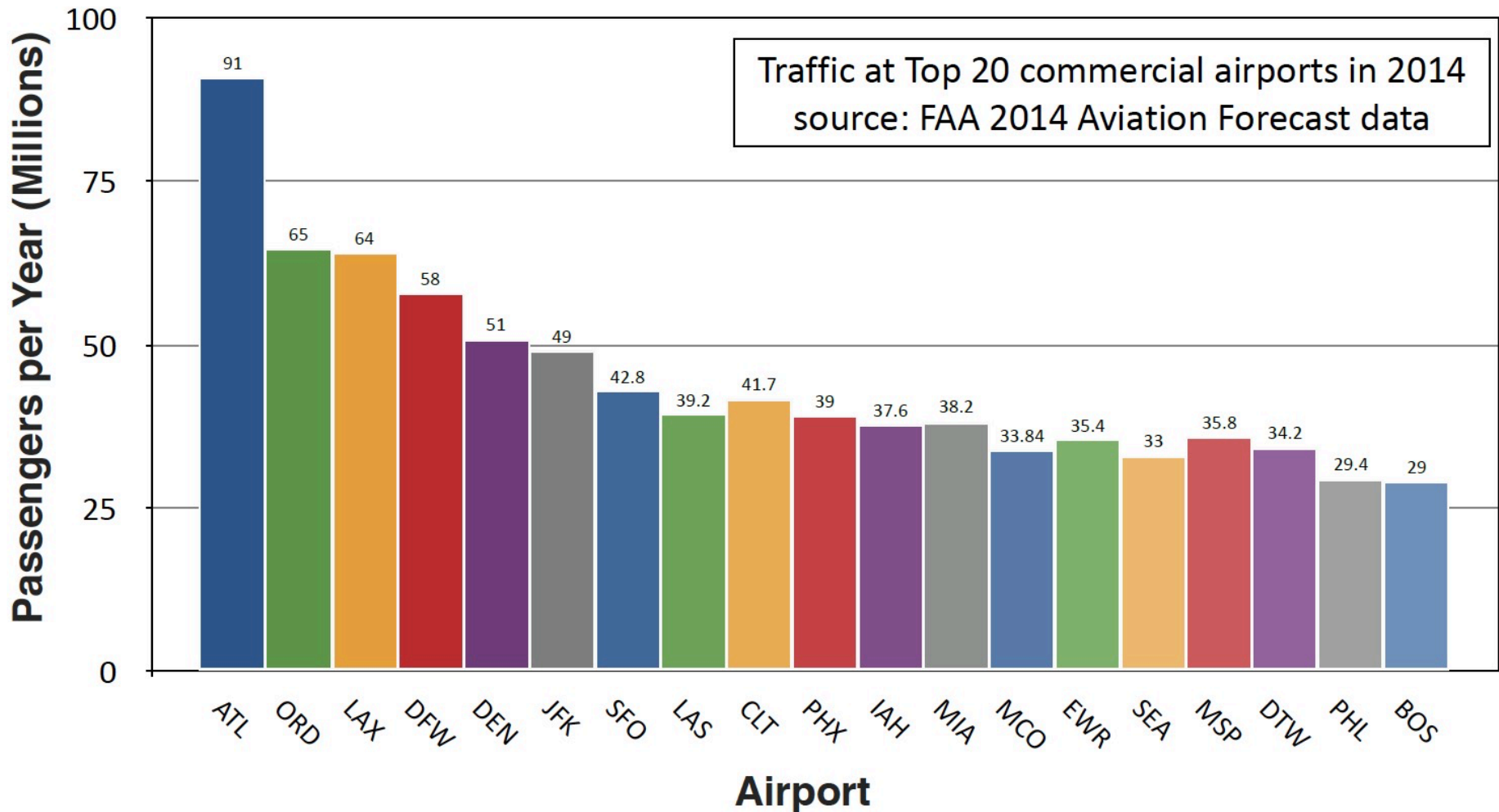
Airports

Airports in the NAS

- ~19,786 landing facilities in the NAS
- 3,355 public airports are considered critical and of national interest (NPIAS - National Plan for Integrated Airport Systems)
- 3,400 public airports with at least a paved runway equal or greater than 3,000 ft.
- There are thousands of private airport facilities
- Today, 84% of the passengers using the National Airspace System (NAS) use the top 55 airports in the U.S
- In 1989, 77% of the passenger traffic used the top 55 airports in the U.S.

Passenger Traffic at the Top 20 US Airports

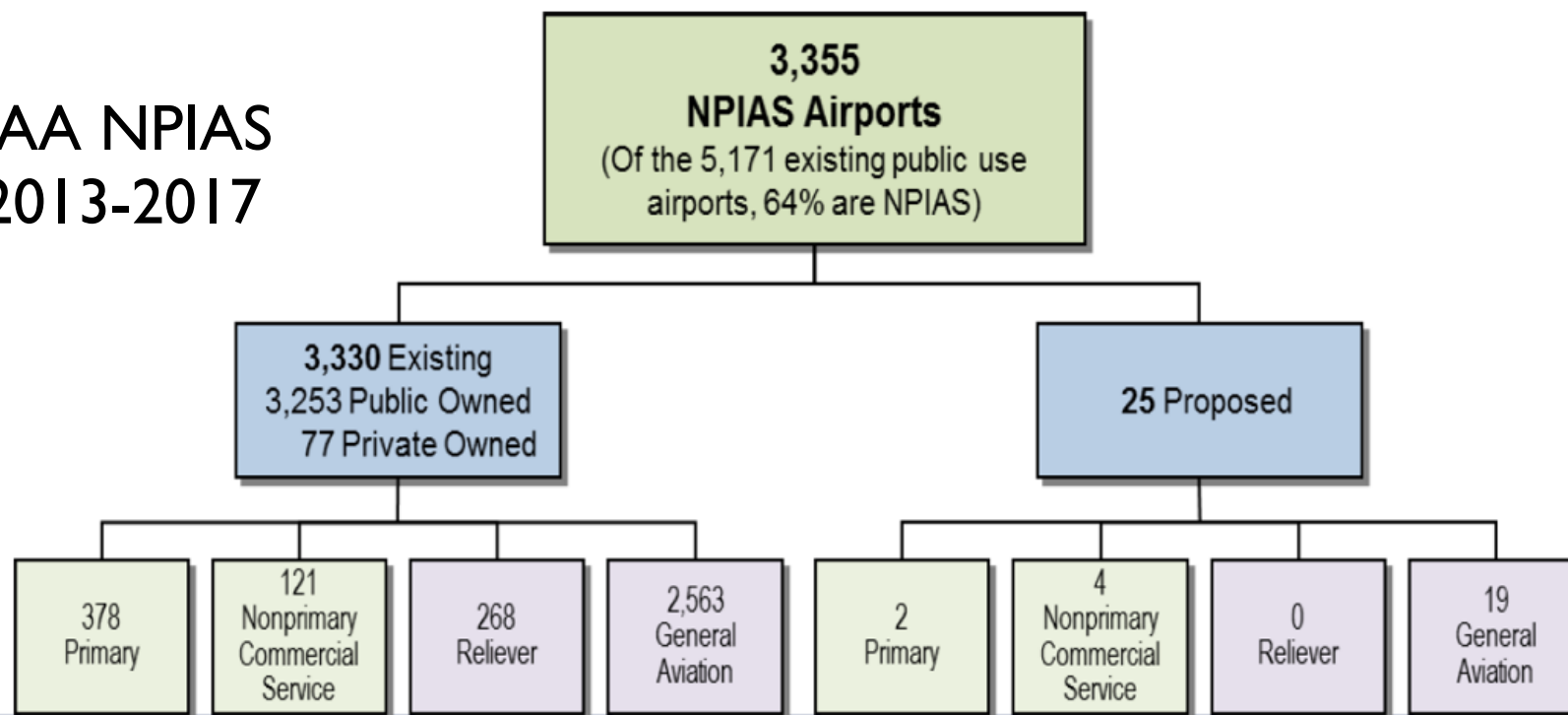
- 37% of passengers handled at the top 10 airports
- 59% of the passengers handled at the top 20 airports



Composition of Airports

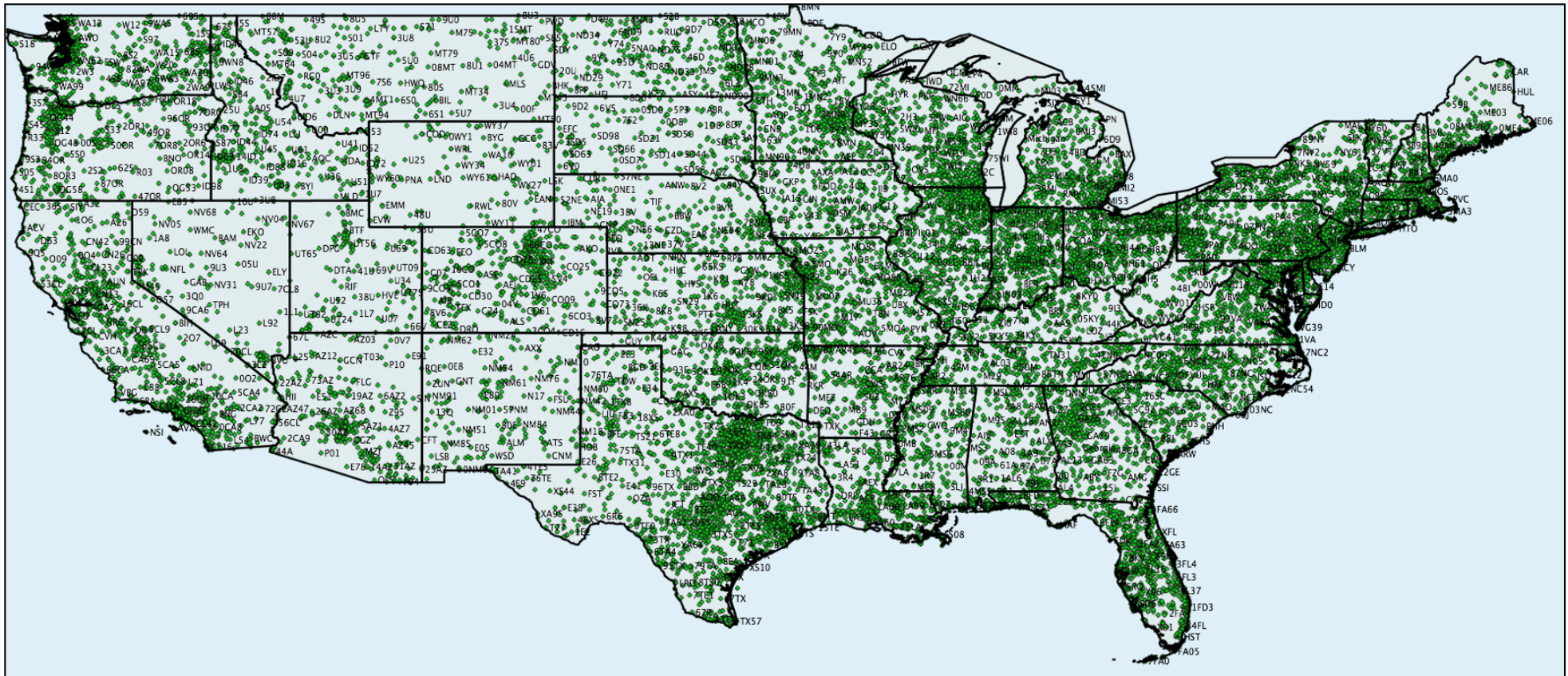
Type of Facility	Total U.S. Facilities	Private-Use Facilities	Public-Use Facilities	NPIAS Facilities
Airport	13,451	8,571	4,880	3,280
Heliport	5,658	5,590	68	10
Seaplane Base	498	283	215	40
Balloonport	13	12	1	
Gliderport	35	31	4	
Ultralight	131	128	3	
Total	19,786	14,615	5,171	3,330

source: FAA NPIAS
Report 2013-2017



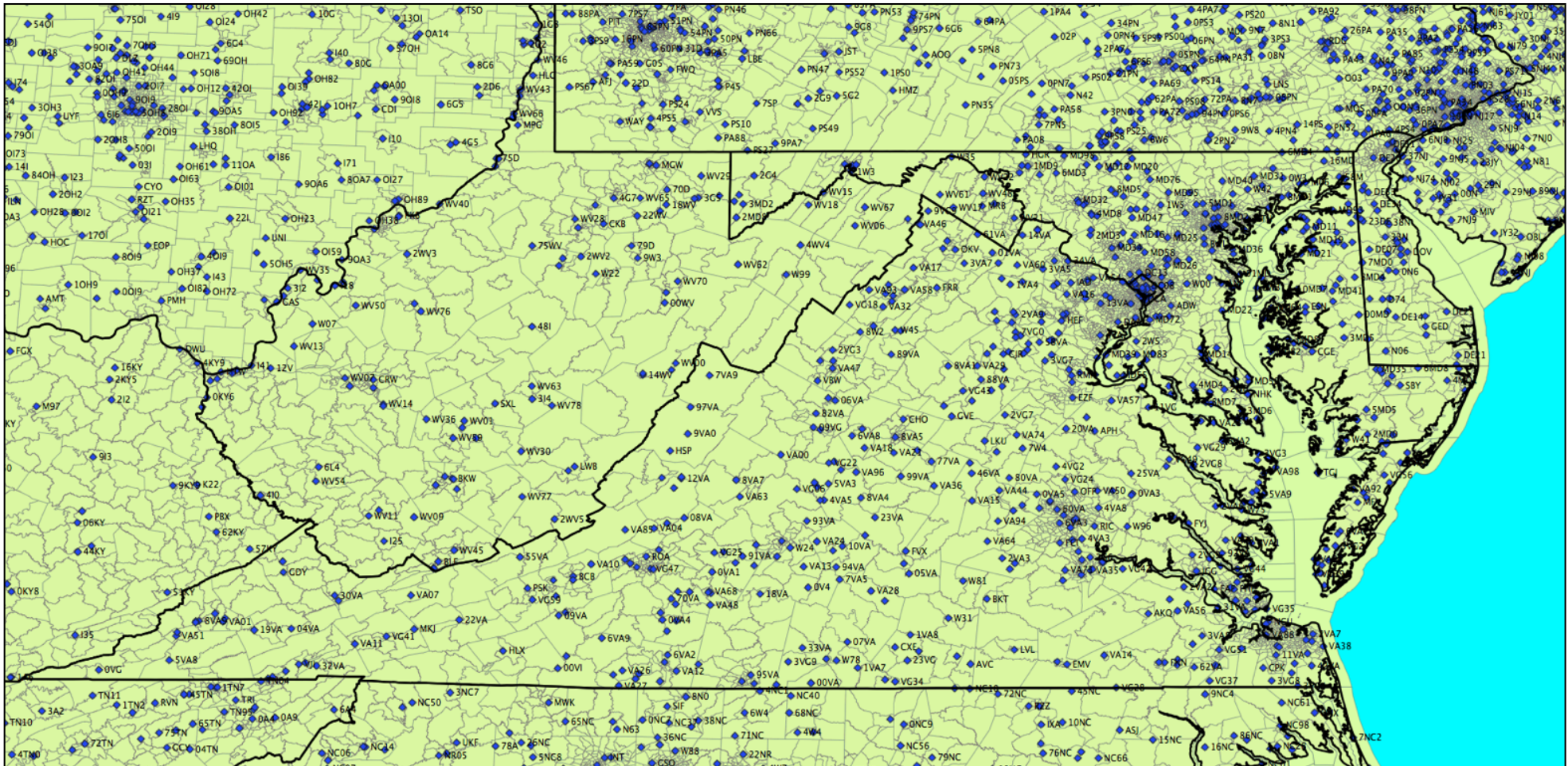
Landing Facilities in the US

- Note the distribution of airports and other landing facilities in the country
- More landing facilities where people reside



Airports in Virginia

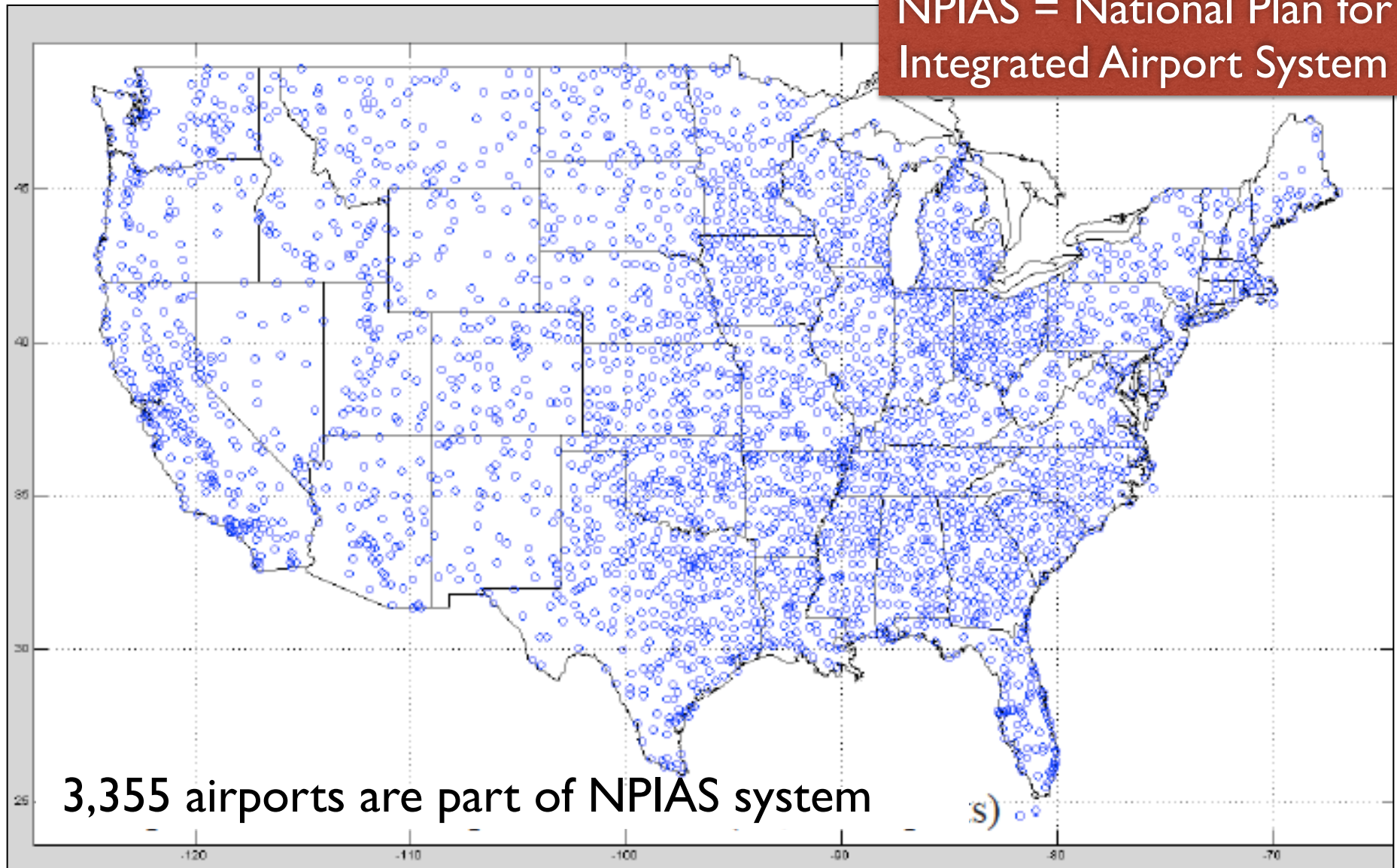
- Virginia, like most states in the nation, has a very well developed airport network



NPIAS Airports in the US

NPIAS = National Plan for Integrated Airport System

Latitude (deg.)



Longitude (deg.)

NPIAS Airports Provide

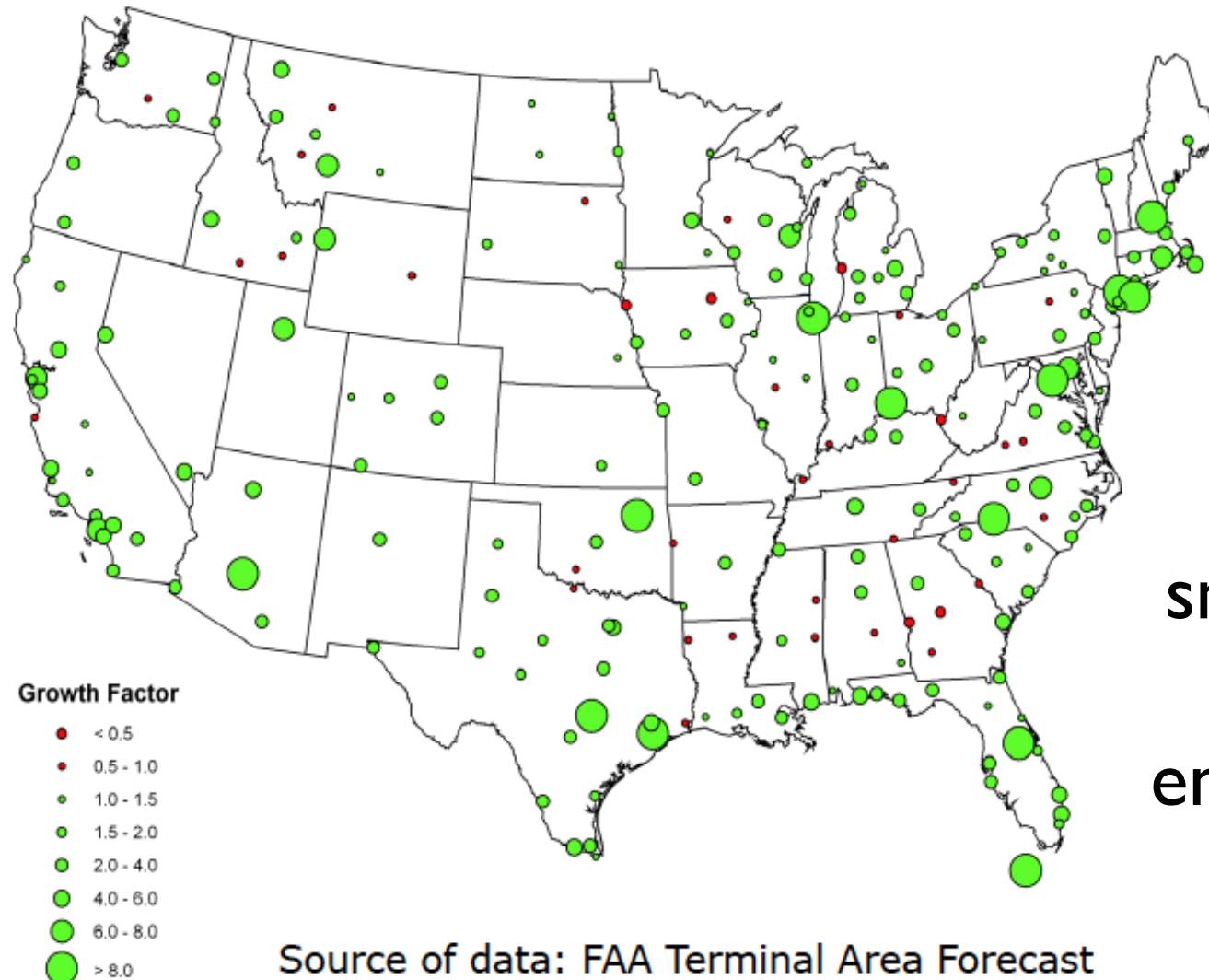
- 98% of US population live within 20 miles of a NPIAS airport
- Private automobile still primary mode of ground access
- 35% of commercial service airports served by public transportation
- 27 other commercial airports served by rail
- 97.5% of runways at 3,355 NPIAS airports are in excellent/good/fair condition

source: FAA NPIAS Report 2013-2017

Commercial Airports

- Around 443 airports in the country have commercial service
- After airline deregulation, many small commercial service airports lost traffic (i.e., airlines concentrate traffic at a few airports)
- Today we have:
 - Fewer airlines with larger fleets
 - Airline consolidation at fewer airports

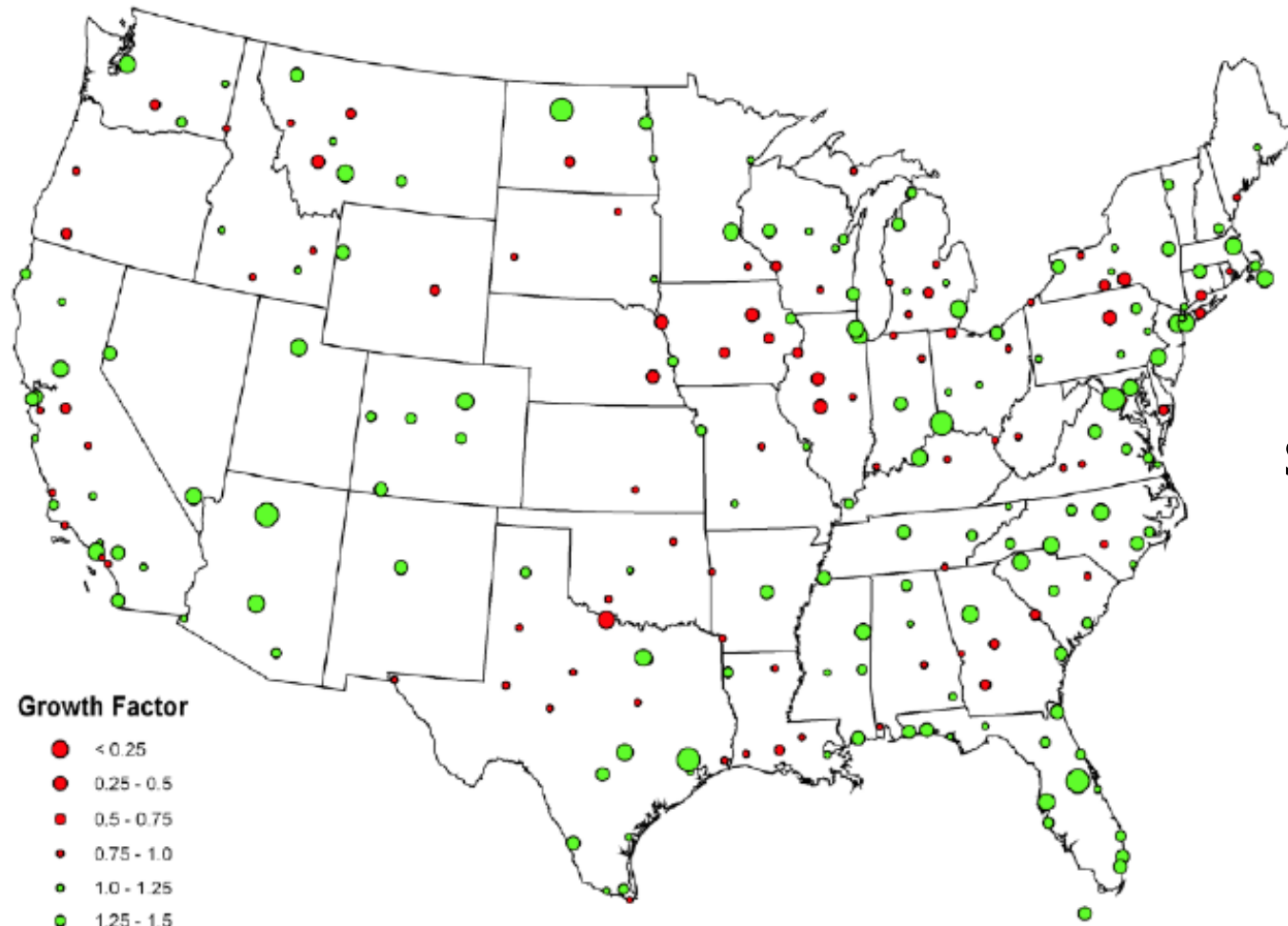
Airport Enplanement Growth at Commercial Airports (1976 to 2006)



Source of data: FAA Terminal Area Forecast
GIS Plot by Virginia Tech Air Transportation Lab

Many
small airports
have lost
enplanements
over time

Airport Operations Growth at Commercial Airports (1976 to 2006)

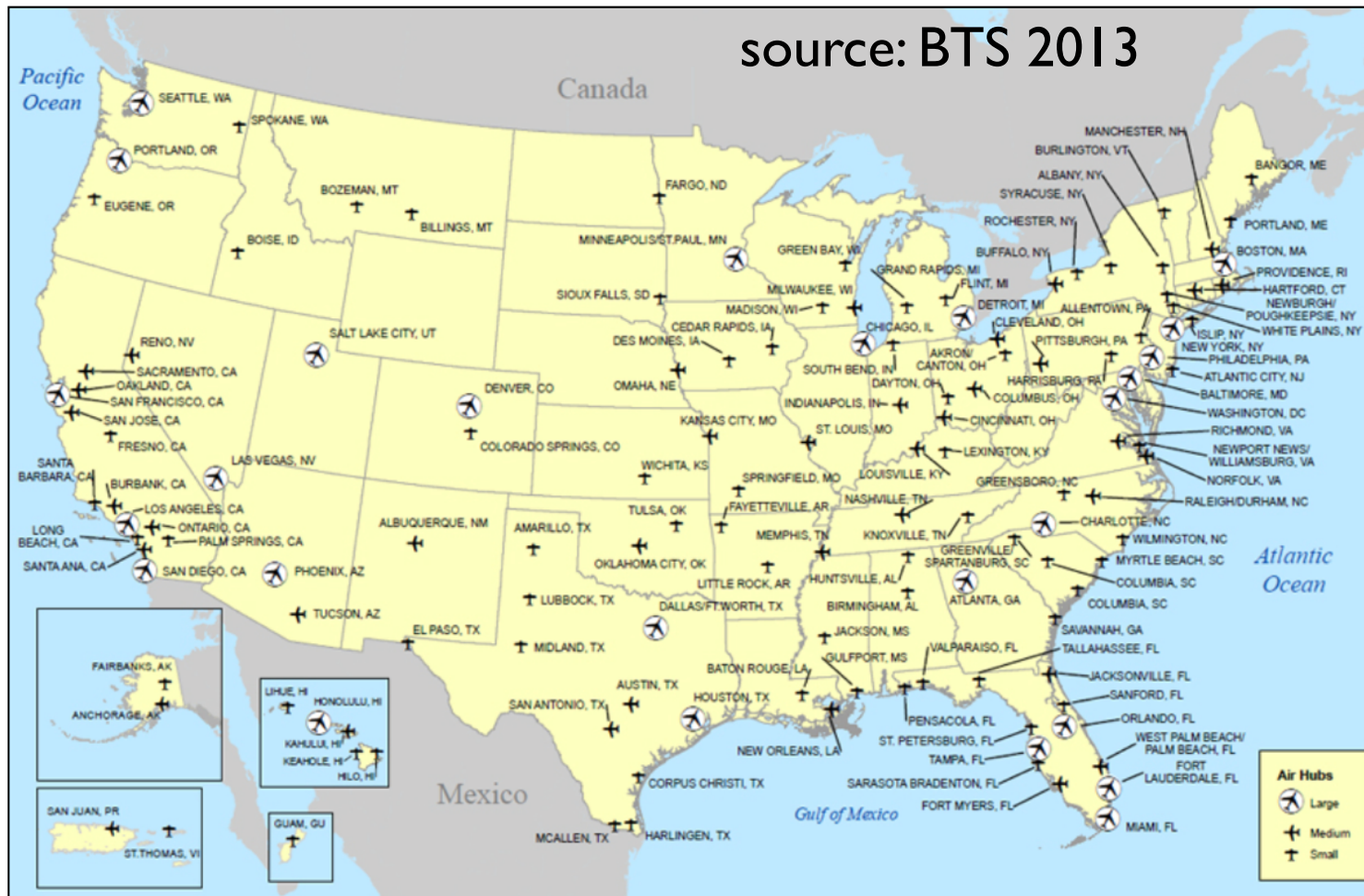


More
small airports
have lost
operations
over time

Source of data: FAA Terminal Area Forecast
GIS Plot by Virginia Tech Air Transportation Lab

Airports and Air Traffic Hubs (2013)

- Large = 1% or more of all US enplanements (about 34 airports)
- Medium = 0.25-0.99% of total US enplanements
- Small = 0.05-0.24% of total US enplanements



Top 50 Airports in the US (2016)

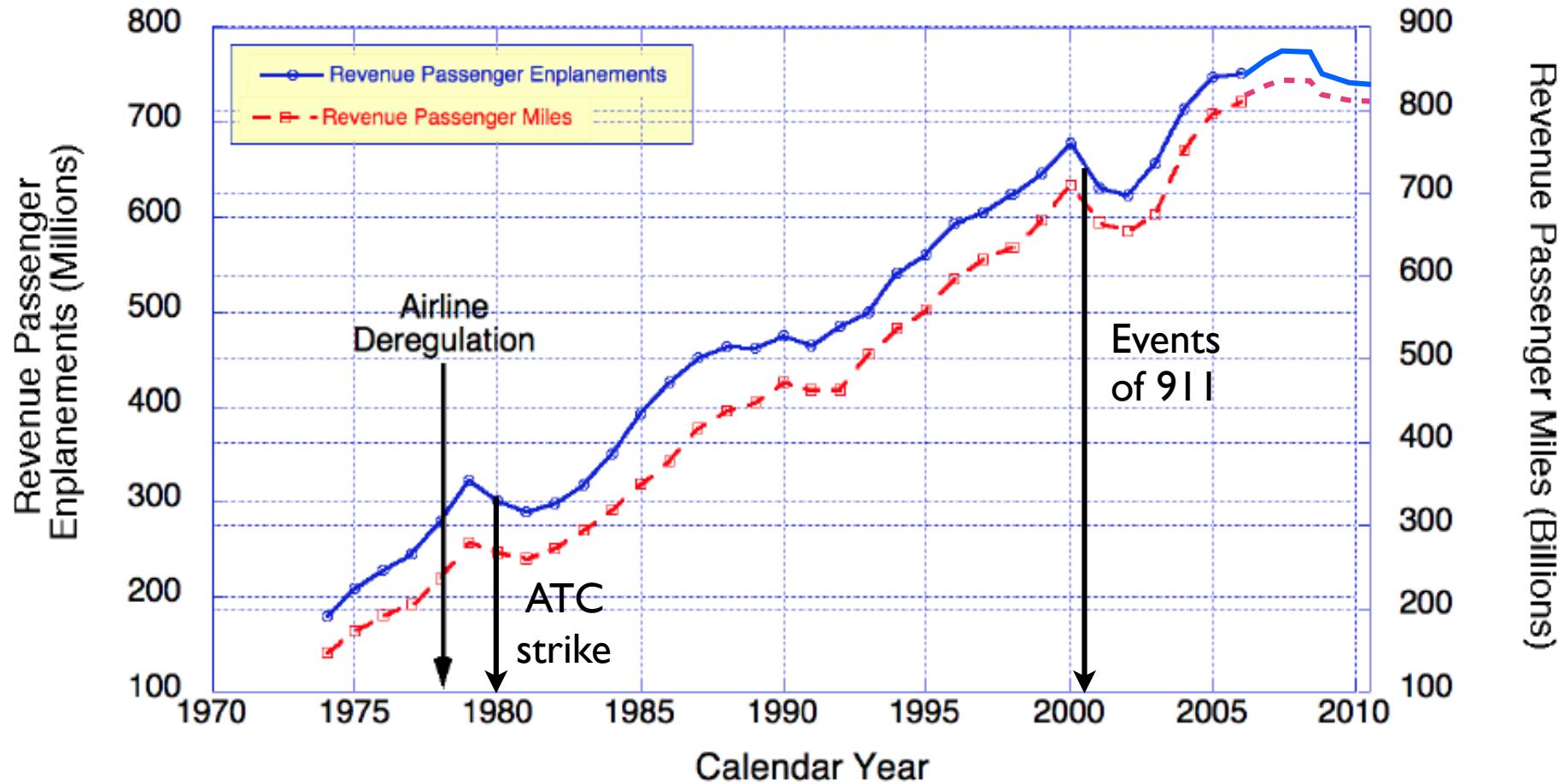
Enplanements at Top 50 U.S. Airports: 2016



source: <https://www.bts.gov/topics/airlines-and-airports>

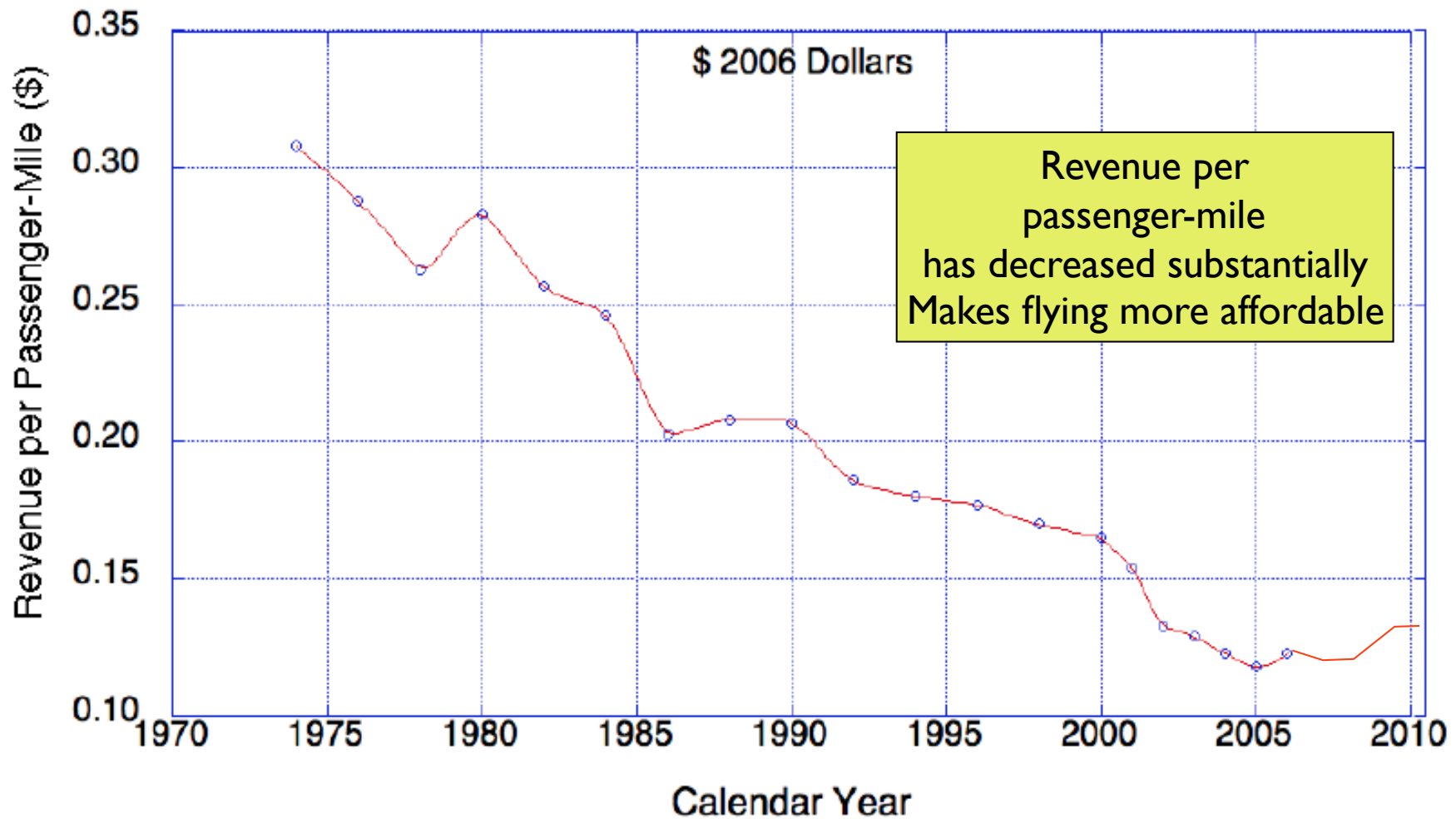
Passengers and Fares

Long-Term Historical Trends



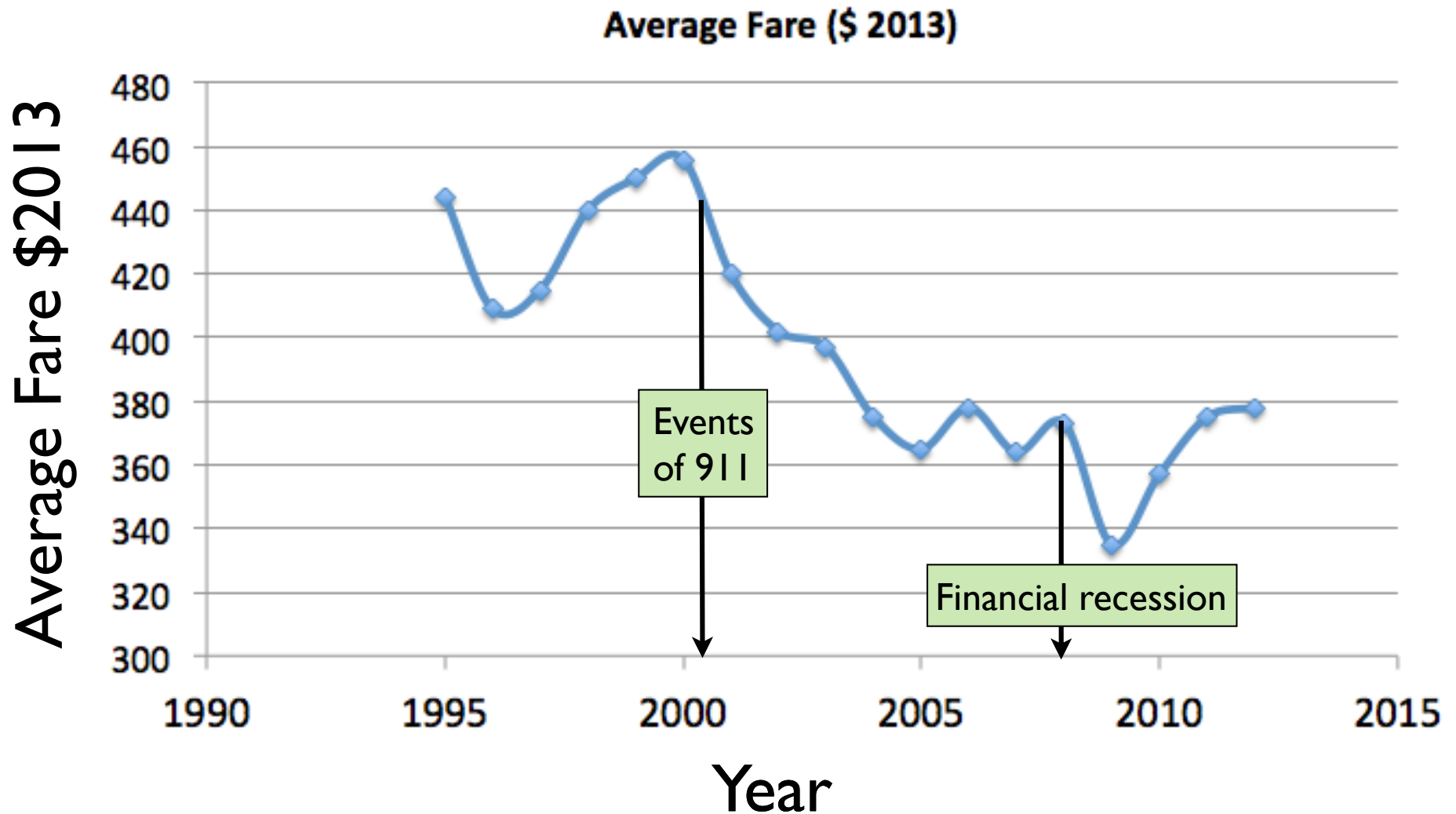
Source of data: Bureau of Transportation Statistics

Historical Revenue per Passenger-mile



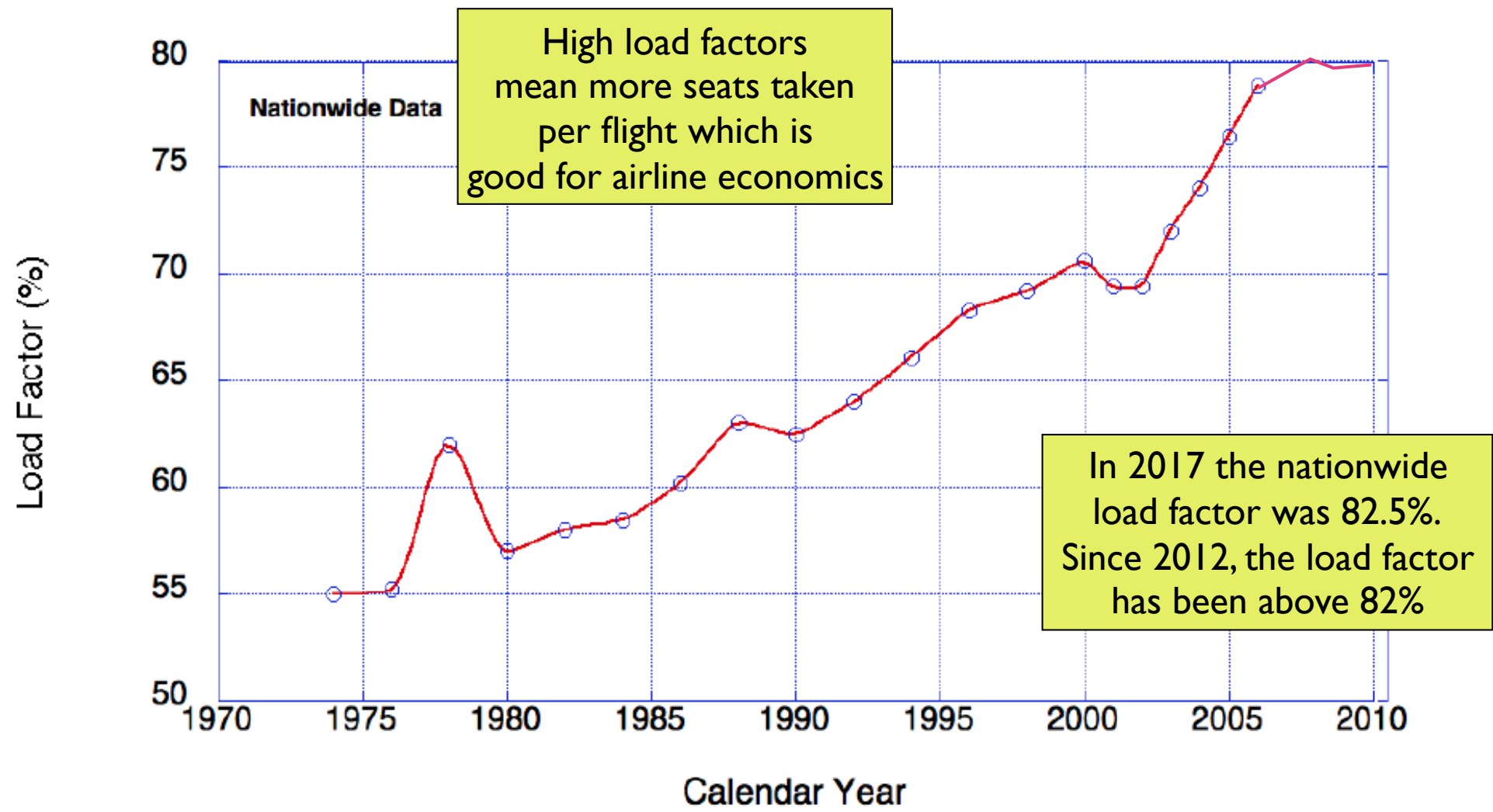
Source of data: FAA and DOT databases (Analysis by A. Trani)

Historical Fares (in \$2013)



source: BTS and DOT data

Historical Commercial Load Factors



Source of data: FAA and DOT databases

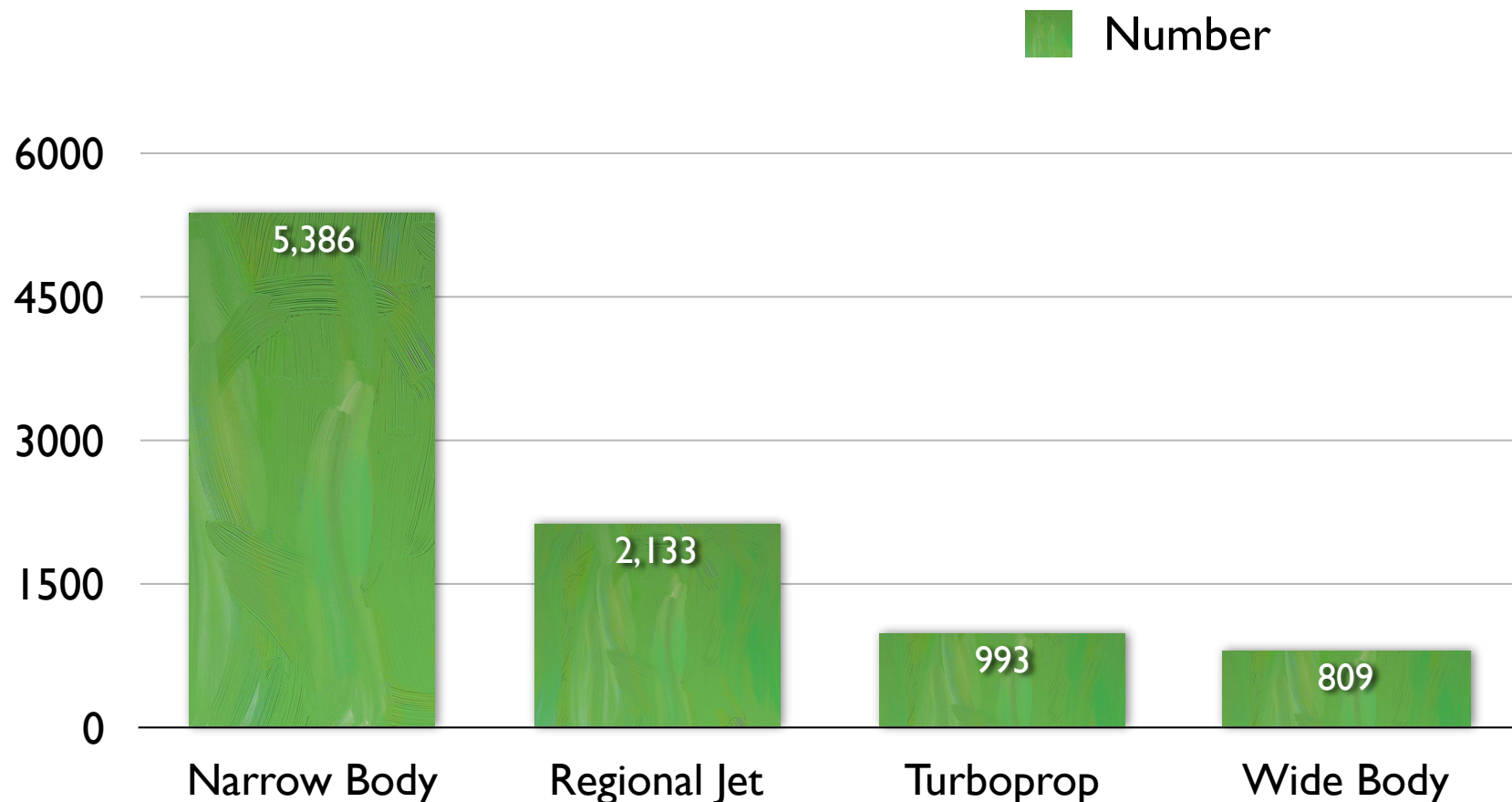
More Information about Airlines

- MIT Airline Data Project
 - <http://web.mit.edu/airlinedata/www/Revenue&Related.html>
- Airlines for America
 - <http://www.airlines.org/Pages/Airline-Handbook-Chapter-4-Airline-Economics.aspx>
- BTS web site (Form 41 data)
 - <http://www.rita.dot.gov/bts/node/11792>

The US Aircraft Fleet

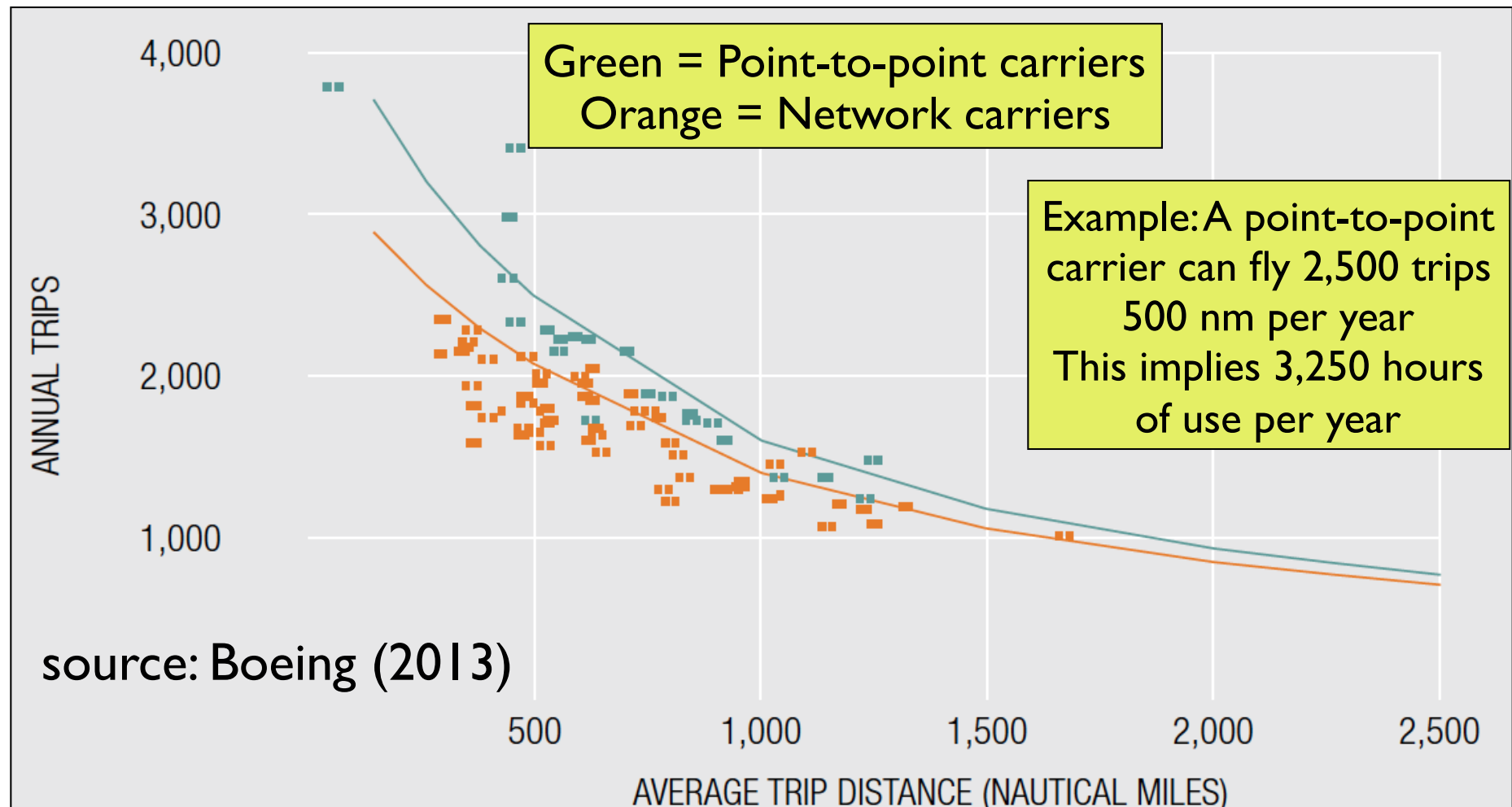
Commercial Jet/ Turboprop Aircraft Fleet

- As of June 2013, there were 9,343 aircraft providing passenger service in the United States (source: Buch Air Database)

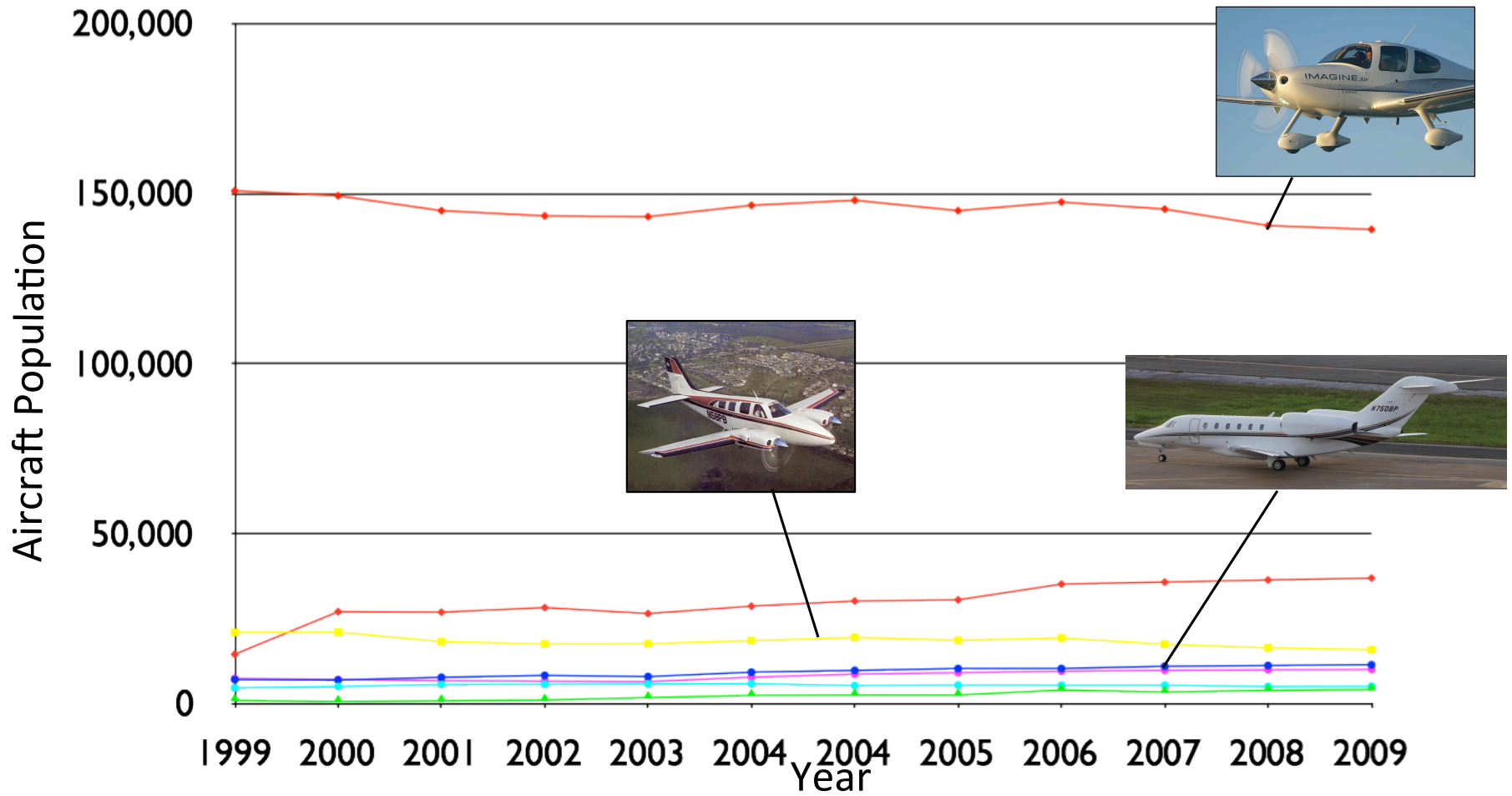


Utilization of Commercial Aircraft

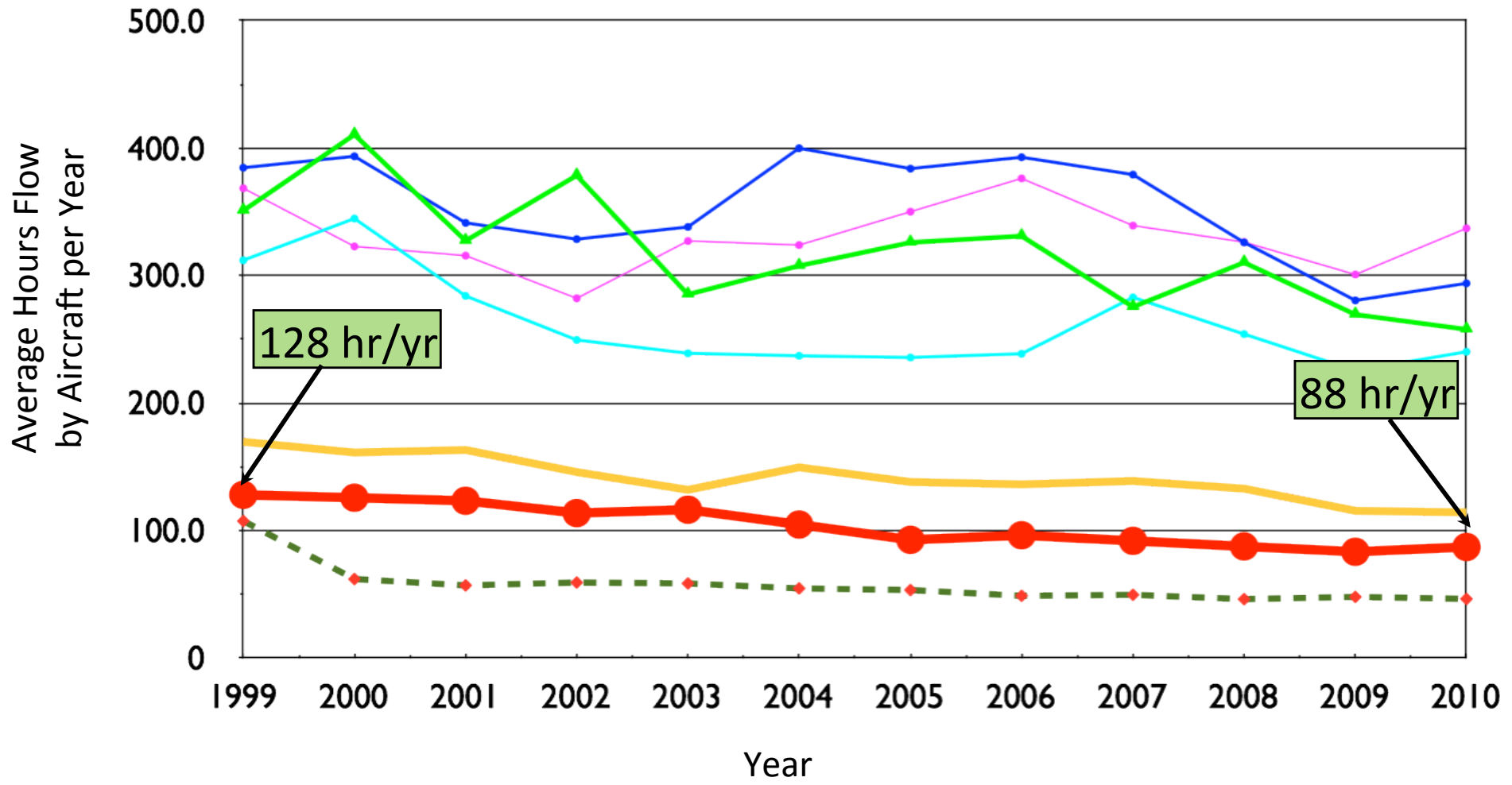
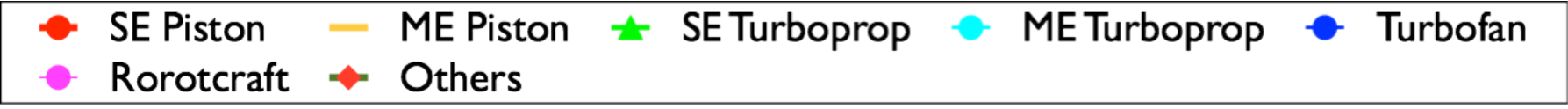
- Commercial airlines use aircraft between 8-13 hours per day (actual block time)



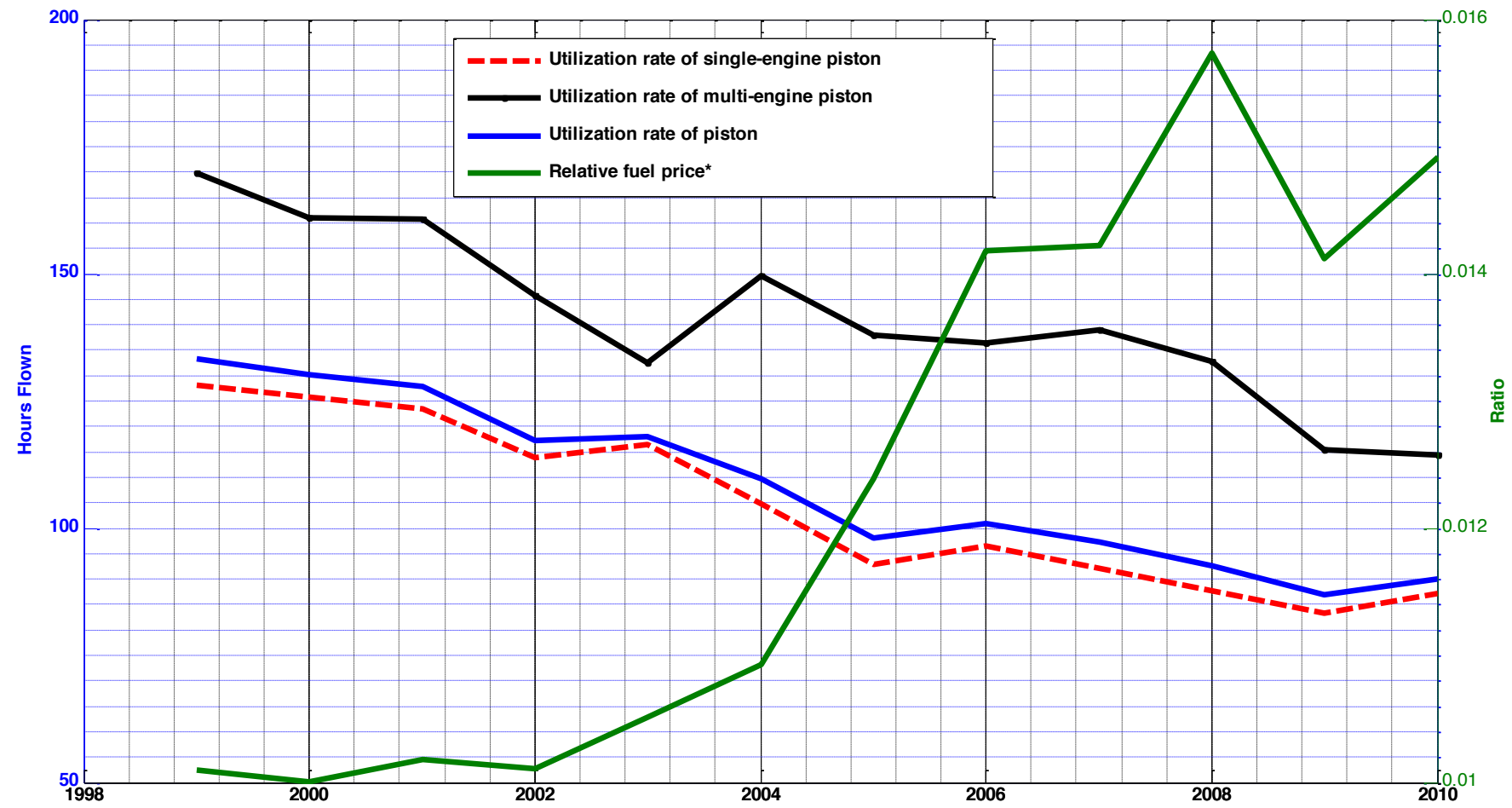
General Aviation Fleet



GA Utilization Trends



General Aviation Aircraft Utilization



- * Relative fuel price: ratio of the cost of purchasing 1000 gallons of Avgas to disposable income per capita