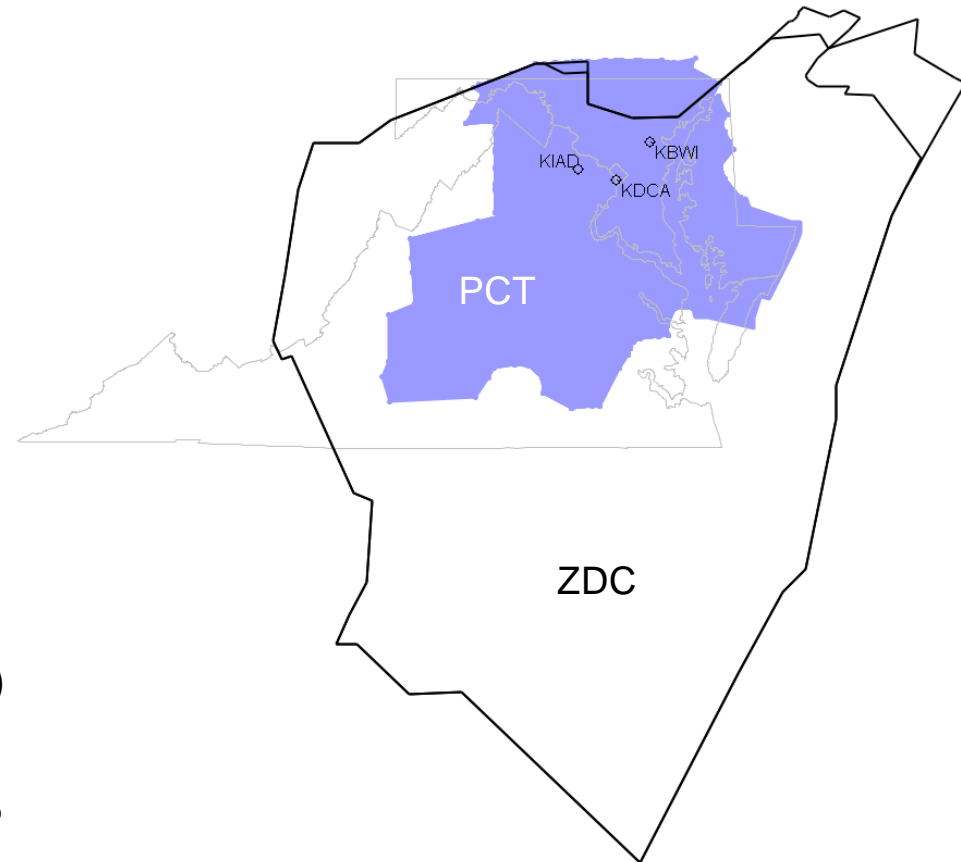


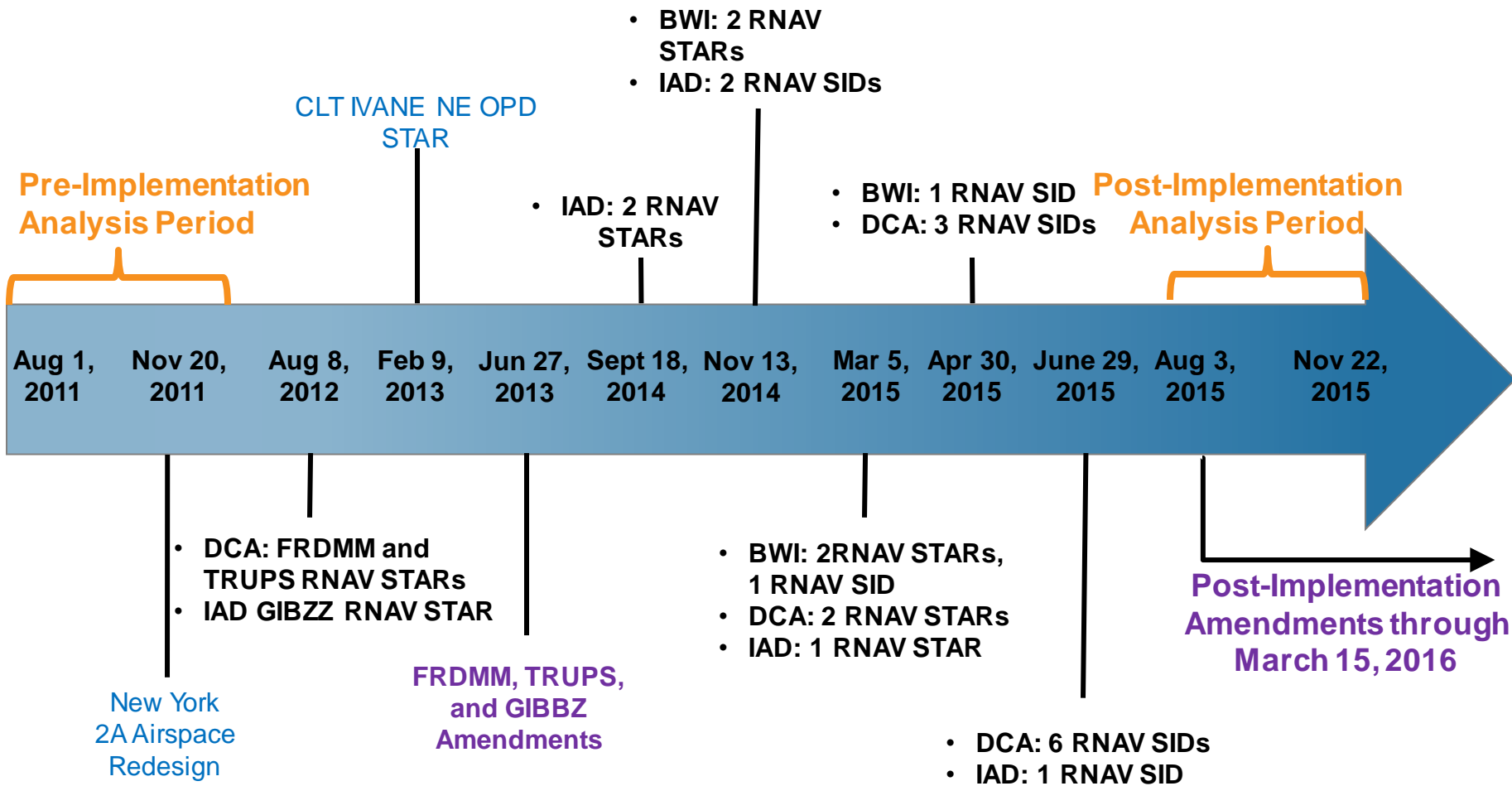
Washington DC Post-Implementation Analysis

Washington DC Metroplex Implementation Overview

- **Primary Facilities**
 - Washington ARTCC (ZDC)
 - Potomac TRACON (PCT)
- **Airports**
 - Reagan National (DCA)
 - Washington Dulles (IAD)
 - Baltimore Washington (BWI)
 - Satellite airports
- **Implementation/Amendments**
 - Seven implementation phases (August 2012 – June 2015)
 - Seven amendment phases (December 2014 – March 2016)
- **Procedures/Airspace**
 - 51 procedures implemented (58 with Q/T routes)
 - 13 airspace changes



Washington DC Timeline



Washington DC Metroplex Improvements

■ Primary procedure changes

- OPDs to all airports from the west and south
- Segregated BWI, DCA and IAD arrivals from the west and south
- Connectivity between RNAV off the ground at DCA and en route structure to reduce reliance on radar vectors
- Segregated BWI westbound and IAD eastbound departures
- Provided segregated routes for satellite airports where possible
- Created Q-routes to deconflict from New York flows

■ Qualitative benefits

- Reduction in controller/pilot transmissions
- Predictable and repeatable flight paths
- Reduced complexity for pilots and controllers

Methodology

■ Flight efficiency metrics

- Fuel burn, time flown, distance flown, level flight
- Metrics collected beginning after June 29, 2015 final implementation
 - Pre-implementation analysis period: August 1, 2011 to November 20, 2011
 - Post-implementation analysis period: August 3, 2015 to November 22, 2015
- Controlled for non-Metroplex-related FAA initiatives, industry practices, and data sample variations where practical
 - Controlled: runway configuration, runway closures, origin-destination pair demand shifts, fleet mix, seasonality, severe weather
 - Not controlled: TBFM usage changes, FMS cost index changes, winds
- Filtered for pistons, holding, midnight operations, and non-primary runway configurations

Analysis Challenges

- **Significant time elapsed between pre (2011) and post (2015) analysis periods**
- **Multiple implementation dates, including post-implementation amendments**
- **Many major airports in close proximity to DC Metroplex airports**
 - Analysis captures both climb and descent phases of these flights
- **Extended runway closures during analysis period (BWI)**
 - BWI analysis only includes dates when Runway 10/28 was open in the post-implementation period
 - Pre: August 1-29, 2011 and November 17-20, 2011
 - Post: August 3-31, 2015 and November 19-22, 2015
- **Neighboring airspace and procedure changes**
 - New York/New Jersey/Philadelphia 2A
 - CLT IVANE OPD STAR

Industry Changes from 2011 to 2015

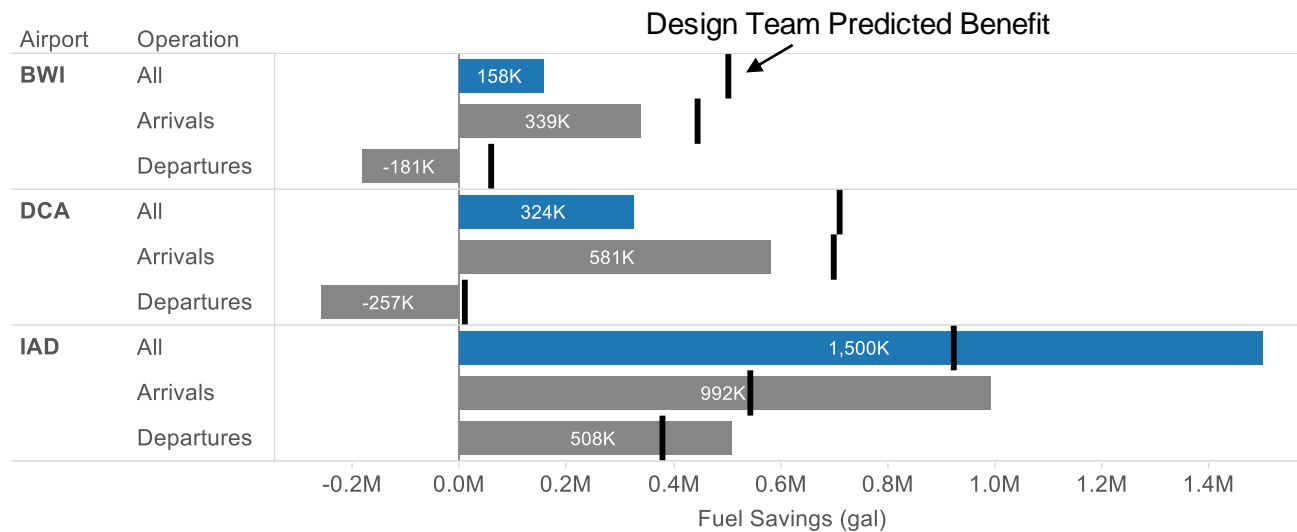
- **Airline mergers have changed regional landscape**
 - United and Continental (2012)
 - IAD: shift in traffic to EWR
 - Southwest and AirTran (2014)
 - BWI: expanded presence in major markets, started international routes
 - DCA: Southwest re-allocated AirTran slots
 - American and US Airways (2015)
 - DCA: emergence as a hub, slot reallocation to low cost carriers
- **Cost of fuel has decreased approximately 50%**
- **Changes in markets served**
 - Significant reduction in operations at CVG
 - Adjustments to international routes

Impact of Industry and DC Market Changes to Analysis

- **Fleet mixes have changed, leaving fewer common types to compare**
 - Reduction in use of certain aircraft (i.e., B717, B733, B757)
 - IAD: shift from A320 to B737; upgauging of smaller regional jets
 - DCA: upgauging to E190 and B737 from smaller regional jets
- **Markets served have changed, making comparisons more difficult**
- **Reduction in price of fuel may have changed airlines' FMS cost index which may impact climb rates**
 - Implementation of BADA fuel model assumes max thrust for entire climb phase and does not distinguish between different climb rates

DC Metroplex Fuel Summary and Key Findings

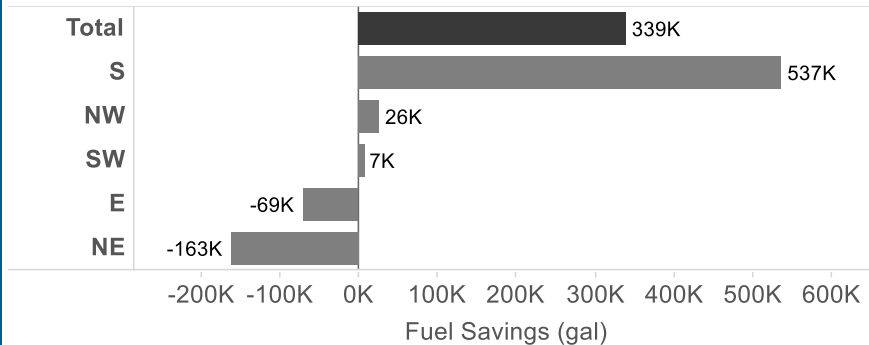
- Design Team (DT) Predicted Savings: 2.1M gal (\$5.9M)
- Post-Implementation Analysis Savings: 2.0M gal (\$5.6M)



- Post-implementation benefits were smaller than DT predictions for BWI and DCA but larger for IAD
- Arrival savings at DCA and IAD due to reductions in time, distance, and level flight
- Departures have distance and time savings at all airports but other factors result in costs

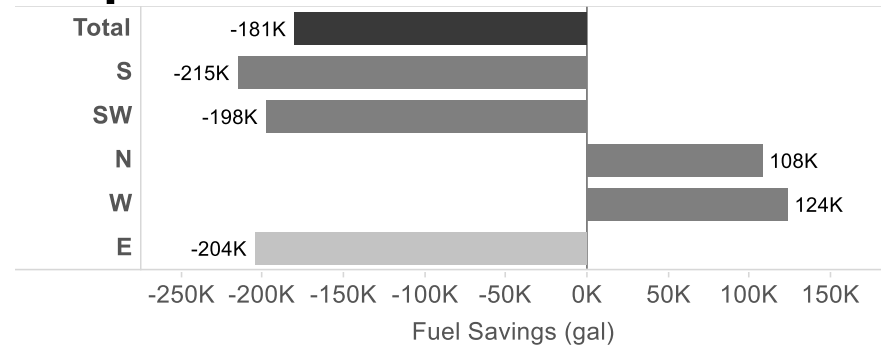
BWI Summary

Arrivals



- **DT predicted: 444K gal**
- **S savings largely due to level flight reductions**
- **Airports within 300NM had a disproportional cost, especially from the E and NE**

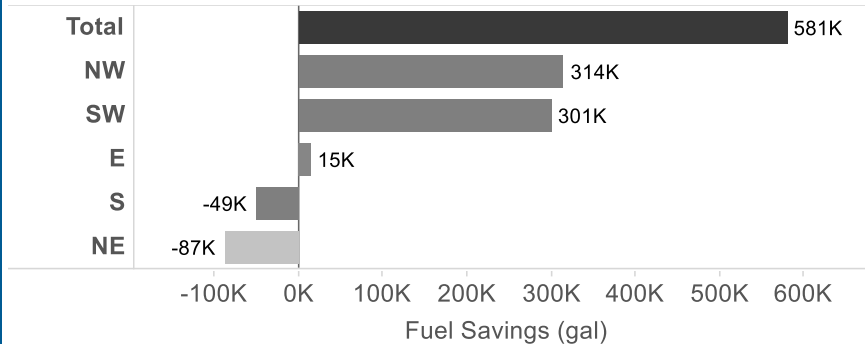
Departures



- **DT predicted: 59K gal**
- **Reduced time and distances overall**
- **Slower climbs and lower cruise altitudes**
- **DC Metroplex did not create a new departure procedure to the east (not included in total)**

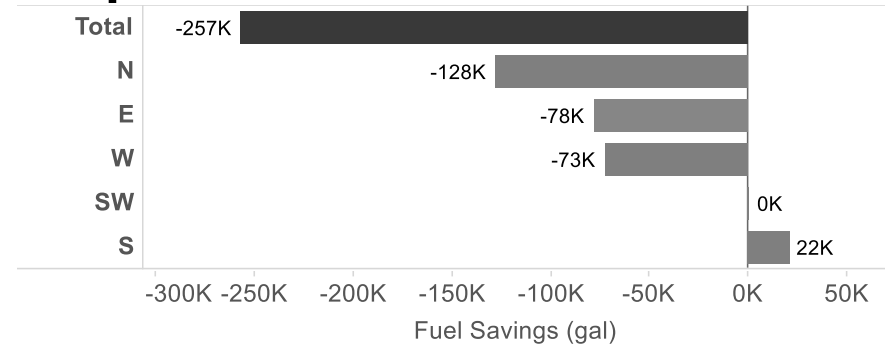
DCA Summary

Arrivals



- **DT predicted: 700K gal**
- **NW savings primarily due to level flight reductions**
- **SW savings due to reduced distance and time**
- **DC Metroplex did not create a new procedure for NE arrivals (not included in total)**

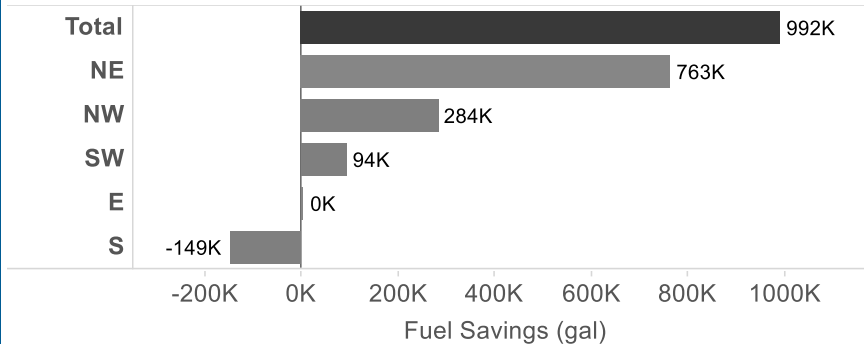
Departures



- **DT predicted: 11K gal**
- **Reduced time and distances**
- **Lower cruise altitudes**
- **CLT IVANE OPD may be adding benefit to SW results**
- **Some E departures to LGA excluded due to alternate routing**

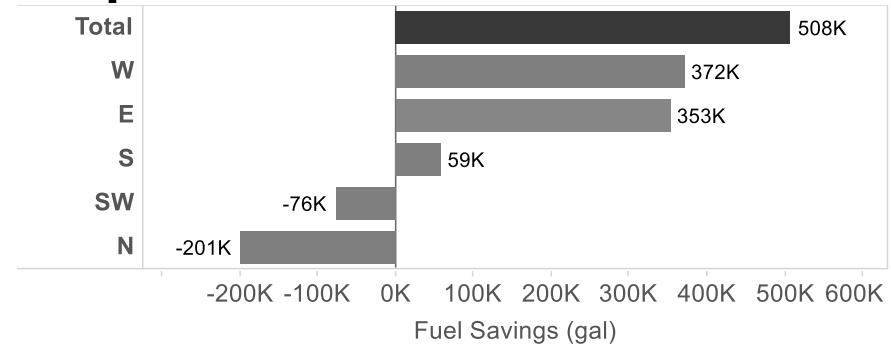
IAD Summary

Arrivals



- **DT predicted: 543K gal**
- **NE savings due to shorter distance on HYPER and MAPEL (post-implementation amendments)**
- **Level flight savings from the NW**
- **Lower cruise altitudes from S and SW result in small savings or costs**

Departures



- **DT predicted: 380K gal**
- **W savings due to FedEx DC10 departures to MEM climbing faster**
- **E savings due to distance reductions**
- **N costs due to lower cruise altitudes and slower climbs**

Conclusions

- **Total estimated post-implementation benefits were similar to DT predictions**
 - DT Predicted Savings: 2.1M gal (\$5.9M)
 - Post-Implementation Analysis Savings: 2.0M gal (\$5.6M)
- **Arrival savings at BWI, DCA, and IAD due to reductions in time, distance, and level flight**
 - BWI arrivals during the runway closure were not included in analysis
- **Many of the departure costs appear to be due to non-Metroplex related factors since distance and time savings were observed for BWI, DCA, and IAD**
 - Slower climbs and lower cruise altitudes
- **DC Metroplex amendments implemented after analysis period may provide additional benefits**