Comparison of Essential Air Service Program to Alternative Coach Bus Service

Keeping Rural Communities Connected

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M.J. Bradley & Associates LLC

(603) 647 5746 / www.mjbradley.com

Authors: **Dana Lowell, Tom Curry, Lily Hoffman-Andrews, and Lea Reynolds**

M.J. Bradley & Associates LLC
1000 Elm Street, 2nd Floor
Manchester, NH 03101
(603) 647-5746 x103
dlowell@mjbradley.com

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111 K Street, NE 9th Floor
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Executive Summary

This report compares the cost and environmental impact of current subsidized air service provided to rural communities under the Essential Air Service (EAS) program, to an alternative method of connecting these rural communities to the nationwide air transport system. The alternative transport mode which is analyzed here is the use of scheduled inter-city coach bus service between these rural communities and nearby regional hub airports.

The EAS program provides subsidized air links to 153 rural communities in 35 states and Puerto Rico. For this analysis we only evaluated alternative coach bus service for EAS communities in the lower 48 states which are within 150 air miles of a medium or large hub airport – a total of 38 communities. These communities are shown in Figure 1, along with their air links currently subsidized under EAS. As shown, most of the communities analyzed have subsidized air service to only one regional hub airport, while five communities have subsidized service to two different hubs. Virtually all of the subsidized flights connect the EAS community to a large regional hub airport, and this hub is not always the large hub closest to the community.

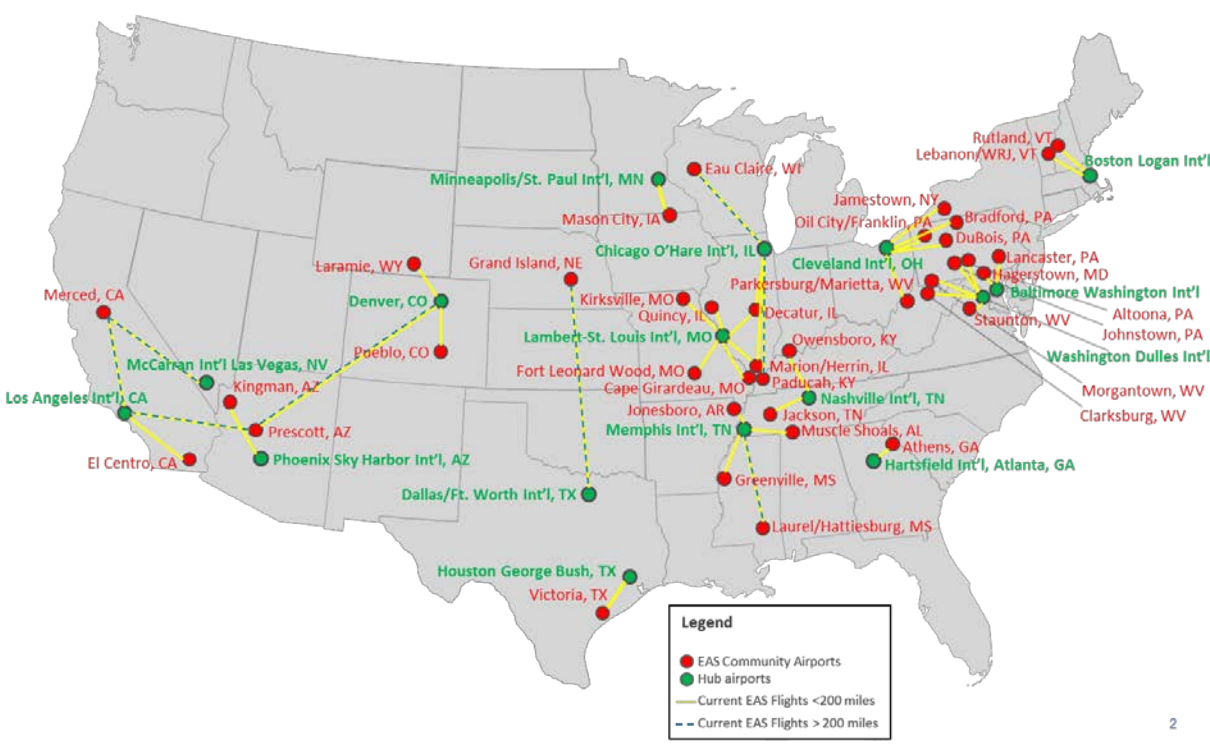

Figure 1 EAS Communities within 150 Air Miles of a Large or Medium Hub Airport

For each of these 38 EAS communities, this analysis compares the current total cost of EAS flights – both government subsidies and passenger fares – to the cost of providing "equivalent" bus service to make the same or similar links. For 32 communities the bus service analyzed goes to the same airport as the current EAS flights – this was done specifically to provide the best direct comparison between modes. For some of these communities there is a closer hub airport which could be reached with a shorter bus trip than the one analyzed, but these alternative bus trips were not included in the analysis.

For the other six communities, bus trips to the current EAS hub airports were judged to be too long – more than 200 miles or more than three hours drive time. For these six communities the alternative bus service analyzed goes from the EAS community to the closest regional hub airport that is within 200 driving miles; for two communities this is a large hub airport and for four it is a medium hub airport. This analysis did not attempt to compare the relative availability of follow-on flights at the alternative airport destinations compared to the current EAS-subsidized flight destinations.

This analysis assumes the same number of scheduled weekly bus trips as current scheduled EAS flights for each community – for most communities this is two or three round trips per day, for a total of between 28 and 72 one-way trips per week to/from the EAS community and a regional hub airport. For the alternative coach bus service operating costs included in the analysis are the annualized cost of bus purchase, annual bus maintenance, annual fuel costs, annual driver labor costs, and annual overhead and profit.

Total trip time for most of the alterative bus trips is longer than the total trip time for current EAS air flights. This analysis assesses the "value" of this incremental trip time to passengers, using a standard Department of Transportation methodology, and adds it to bus operating costs to determine the total cost of the bus alternative.

The analysis also evaluates the environmental impact of coach bus service compared to current EAS flights, by determining for each mode and each route annual fuel use (gallons) and annual exhaust emissions (tons) of carbon dioxide (CO_2), nitrogen oxides (NO_x), volatile hydrocarbons (HC), carbon monoxide (CO) and sulfur dioxide (SO_2)[1].

See Table 1 for a summary of the analysis. As shown, the EAS program currently subsidizes 79,040 annual one-way flights to/from the 38 EAS communities included in this analysis, which serve 615,528 annual one-way passengers. The total annual cost of these flights is $131.5 million – an average cost of $214 per one-way passenger trip. Government EAS subsidies currently cover 46% of this cost and passengers cover the rest via fares.

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[1] For the coach bus option the analysis also includes total annual particulate matter (PM) emissions, but PM emissions from current air flights could not be determined due to a lack of data.

Table 1 Costs and Environmental Effects of EAS Program Compared to Coach Bus Service

			unit	EAS-Subsidized Flights	Alternative Coach Bus Service	*Difference*
SERVICE	Annual Trips		#	79,040	79,040	0
	Annual Seats		#	1,539,720	4,347,200	2,807,480
	Annual Passengers		#	615,528	615,528	0
COSTS	Current Annual EAS Subsidy		$	$60,838,832		
	Current Annual Passenger Fares		$	$70,652,143		
	Annual Bus Operating Cost		$		$33,860,696	
	Annual Incremental Travel Time		$		$8,098,098	
	TOTAL			**$131,490,975**	**$41,958,794**	**($89,532,180)**
ENVIRONMENT	Annual Miles		mi	12,310,688	11,953,411	(357,277)
	Annual Fuel Use		gal	7,930,259	2,213,595	(5,716,665)
	Annual Emissions	CO_2	ton	88,149	24,605	(63,544)
		NOx	ton	28.1	14.9	(13.2)
		HC	ton	1,188.2	2.0	(1,186.3)
		CO	ton	2,067.7	1.2	(2,066.6)
		SO_2	ton	28.1	0.2	(27.8)

Totals for 38 EAS communities that are within 150 miles of a medium or large air hub. For 32 communities alternative bus service is to the the same destination as current EAS flights (large air hub); for two communities bus service is to the closest large air hub, and for 4 communities bus service is to the closest medium air hub.

This analysis indicates that the cost of providing equivalent hub airport links to these communities using scheduled coach bus service would be $41.9 million – an average cost of $68 per one-way passenger trip. Total costs for providing hub airport links to these communities using scheduled coach bus service are 68% lower than current costs for EAS-subsidized air links.

Eighty-one percent of the total cost for bus service is the operating cost of the buses required, and 19% is the "cost" to passengers of longer trip times using the bus. Incremental average trip times for the coach bus service compared to current air flights range from two minutes shorter to almost two hours longer. More than 67% of the bus trips are shorter, or are less than one hour longer, than current flights; the weighted average incremental trip time for all bus trips analyzed is 43 minutes[2].

For this analysis trip times on each route include check-in, drive time, congestion delays, and disembarking for buses, and include check-in/security clearance, flight time, flight delays, and deplaning for flights.

The use of scheduled coach bus service instead of air service would also reduce annual fuel use by 5.7 million gallons, would reduce annual CO_2 emissions by over 63,000 tons, and would reduce annual emissions of NO_x, HC, CO, and SO_2 by 13.2 tons, 1,186 tons, 2,066 tons, and 27.8 tons respectively.

See Figure 2 for a comparison of average total EAS one-way flight costs to average total one-way bus trip costs ($/passenger) for each of the EAS communities analyzed. As shown, for every community analyzed the total cost of bus service, including bus operating costs and the "cost" to passengers of additional trip time, is significantly less than the cost of current EAS air service[3].

See Figure 3 for a comparison of projected one-way bus operating costs to the one-way fares currently charged on EAS-subsidized routes. As shown, for more than half of the routes the actual cost of operating coach buses not including travel time ($/passenger, in red) is less than the fare currently charged for air flights not including the subsidy (in blue). This indicates that these routes might be able to operate profitably using buses, without the need for any government subsidy in the long term. If only the bus routes for which per-passenger operating costs are higher than current air fares were subsidized, and if the subsidy was set equal to the difference between current fares and bus operating costs, then the total required annual subsidy for coach bus service to these 38 communities would be $8.6 million. Compared to current annual EAS

[2] This weighted average only includes bus trips that are to the same hub airport destination as current flights. For the six communities where the analyzed bus trips are to a different, closer hub airport the bus trip is generally shorter than current flights (by up to 1.7 hours). If these trips are included the weighted average incremental trip time for all analyzed bus trips falls to 25 minutes.

[3] For the seven routes on the extreme right of Figure 2 the alternate bus trip is to a closer hub airport than the EAS flight. For most of these routes the total bus trip time is significantly shorter than the EAS air trip time, resulting in a negative "cost" for incremental trip time. For some of these routes the value of this trip time benefit is greater than bus operating costs, resulting in a negative value for total bus costs.

subsidies for these 38 communities, annual savings to taxpayers could be $50 million per year or more.

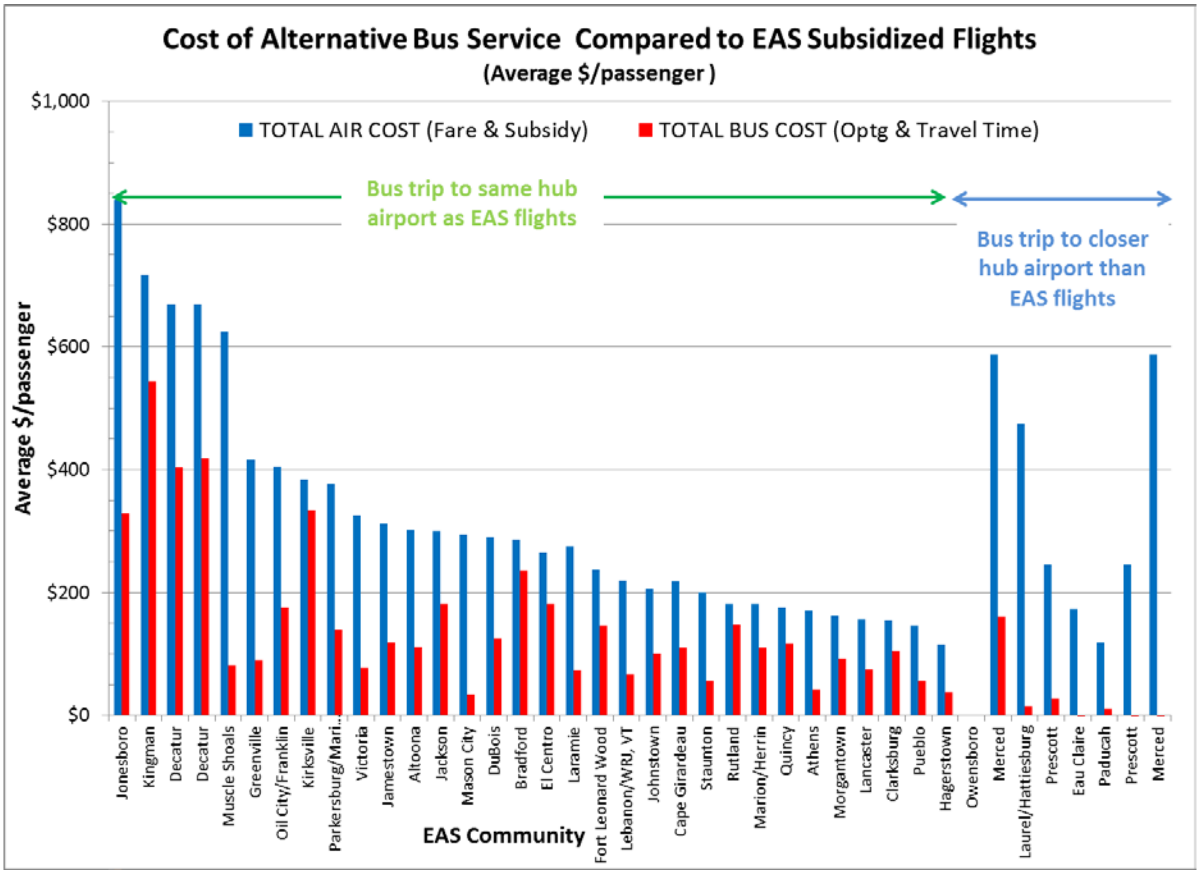

Figure 2 Total EAS Costs Compared to Total Costs for Alternative Bus Service ($/passenger)

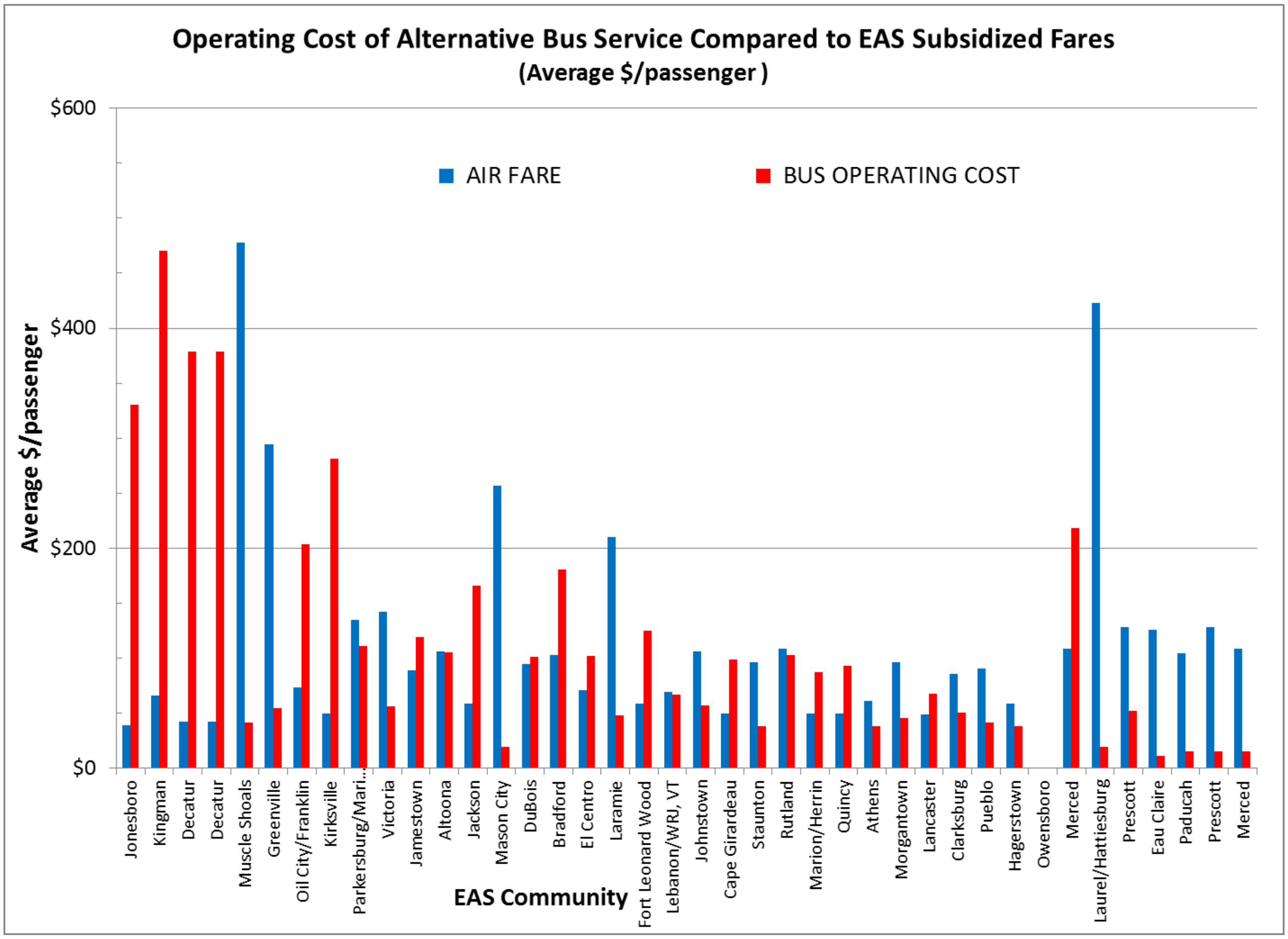

Figure 3 Coach Bus Operating Costs Compared to Current Fares on EAS Flights ($/passenger)

1 Background – Essential Air Service Program

The following text is from "WHAT IS ESSENTIAL AIR SERVICE (EAS)?, Prepared by the Office of Aviation Analysis, U. S. DOT, Revised April 1, 2009 (http://ostpxweb.dot.gov/aviation/rural/easwhat.pdf).

In 1978, when the Airline Deregulation Act (ADA) was enacted, 746 communities in the United States and its territories were listed on air carrier certificates issued under section 401 of the Federal Aviation Act of 1958. Before deregulation, air carriers' operating certificates for most of these communities required carriers to schedule and provide two daily round trips at each point on their certificates. During the pre-ADA debates, the prospect of allowing carriers to terminate scheduled service without prior Government approval raised concern that communities with relatively lower traffic levels would lose service entirely as carriers shifted their operations to larger, potentially more lucrative markets. To address this concern, Congress added section 419 to the Federal Aviation Act, which established the EAS program, which today is administered by the Department of Transportation, to ensure that smaller communities would retain a link to the national air transportation system, with Federal subsidy where necessary.

Under this program, the Department determines the minimum level of service required at each eligible community by specifying a hub through which the community is linked to the national network, a minimum number of round trips and available seats that must be provided to that hub, certain characteristics of the aircraft to be used, and the maximum permissible number of intermediate stops to the hub. The program's guidelines were codified by rulemaking as a Policy Statement of the Department in Volume 14, Code of Federal Regulations (CFR), Part 398. Where necessary, the Department pays subsidy to a carrier to ensure that the specified level of service is provided. Most eligible points, of course, do not require subsidized service; as of April 1, 2009, the Department was subsidizing service at 108 communities in the contiguous 48 states, Hawaii, and Puerto Rico, and 45 in Alaska.

Congress initially authorized the program for a ten-year period, through October 23, 1988. Its interest in ensuring service at small communities remained strong, and before the program's expiration, Congress enacted the Airport and Airway Safety and Capacity Expansion Act of 1987, Public Law 100-223, which expanded the program and extended it for ten more years, through fiscal year 1998. In so far as service guarantees were concerned, Public Law 100-223 amended section 419 of the Federal Aviation Act by codifying many of the Department's guidelines in 14 CFR 398 as well as specifying an increased minimum level of service—termed "basic" EAS--for any community that was eligible for service under the earlier program and actually receiving service during any part of fiscal year 1988. In addition, Public Law 100-223 provided for a higher level of service--termed "enhanced" EAS--which communities could obtain either by agreeing to a subsidy-sharing commitment or by agreeing to risk the loss of basic service if the Department-funded enhanced service failed to meet agreed levels of passenger use.

Effective June 1994, the Federal Aviation Act was recodified as subtitles II, III, and V-X of title 49, United States Code, "Transportation." The former section 419 of the Federal Aviation Act is now 49 U.S.C. 41731--41742.

Finally, the new law contained provisions by which new communities could participate in the program if they were willing to pay part of the total subsidy. The various statutorily-mandated elements comprising basic EAS exceeded the minimums that had prevailed under the Department's discretionary regulatory guidelines since 1978, but, at the time that Public Law 100-223 was enacted, program funding was insufficient for the Department to implement the service upgrades to meet the new standards, much less for what would be necessary to support enhanced service or service at new points. In fact, during fiscal year 1990, twenty-six communities were made ineligible as a result of reduced funding.

2 Study Methodology

This section briefly discusses the methodology, data sources, and assumptions used in this study. Additional details are included in Appendix A.

2.1 Current EAS Flights

For each of the EAS communities analyzed in this report, basic information about the location of the community, the hub to which EAS subsidized service flies, the EAS-subsidized carrier, the aircraft flown on EAS-subsidized routes, the number of seats on the aircraft, and current annual EAS subsidies, was taken from the U.S. Department of Transportation *EAS Subsidy Report, May 2010*; the data in this report was updated based on review of DOT dockets.[4]

The number of passengers carried annually on each EAS subsidized route was determined from annual enplanement data for each rural EAS airport in 2010, as published by the Federal Aviation Administration.[5] These data cover only passengers who leave from the airport – to calculate total annual passengers on each route enplanement numbers were doubled, on the assumption that virtually all passengers make a round trip.

For each route the number of daily/weekly scheduled flights, the scheduled flight time, and typical one-way passenger fare were determined by reviewing the website of the carrier serving the route. These websites were accessed on 8/18/2011 and 8/19/2011. Listed fares and flight times represent the lowest price and shortest duration for all outbound flights from the rural EAS airport on 9/19/2011; listed fares for flights on other days in the same week on six of the routes indicates that there is generally minimal variation in fares for flights on different days of the week.

Prices and durations are for direct flights only unless no direct flights exist. The listed fare on each route represents the price for a 30-day advance ticket; a review of fares listed on 9/7/2011, for travel on 9/19/2011, on a random sample of six routes, indicates that fares can increase by as much as 97% for a two-week advance booking compared to a 30-day advance booking. The fares used for this analysis represent a conservative (low) estimate of passenger costs; actual fares may be higher depending on how far in advance the ticket is purchased.

[4] http://ostpxweb.dot.gov/aviation/x-50%20role_files/essentialairservice.htm#US. For 30 of 38 communities included in this analysis the data in the May 2010 subsidy report (the most current posted) is out of date. For these communities subsidy levels and other details of service (i.e. carrier, route) were updated between June 2010 and June 2011. See Appendix A. In most cases changes to annual subsidy levels since the May 2010 report were small in magnitude.

[5] *Preliminary CY10 Passenger Enplanements by State and Airport*, 6/22/2011, http://www.faa.gov/airports/planning_capacity/passenger_allcargo_stats/passenger/media/cy10_all_enplanements_prelim.pdf

2.2 Alternative Bus Service

To evaluate requirements for scheduled coach bus service in lieu of current EAS-subsidized flights on each route, this analysis assumes that there will be an equal number of scheduled bus trips each week as currently scheduled EAS flights. The number of currently scheduled weekly one-way fights (outbound and inbound) ranges from 14 to 72 on the routes analyzed.

Total one-way route length (miles) and average drive time (hours) for the bus on each route were determined using Google Maps, for trips from each rural EAS airport to the regional hub airport destination. For the routes analyzed this data results in average route speeds of between 46.6 MPH and 63.5 MPH, exclusive of loading and disembarking time.

The minimum number of buses required to service each route was determined based on the number of weekly one-way trips required and the drive time for each trip, assuming that trips would only be scheduled for fifteen hours per day (6 AM – 9 PM, or equivalent), and that average daily bus availability would be 85%. For most routes a minimum of two buses are required, while a few routes require only one bus and a few require three.

The analysis assumes that the calculated minimum number of buses (and their annualized purchase costs) would be dedicated to the route and not shared with other routes; this is a conservative assumption because for most routes bus utilization using this assumption (hours used ÷ hours available) is less than 70%. The annualized capital cost used is $75,960/bus/year based on an average bus purchase price of $500,000, an eight year bus life, and 5% cost of capital.

Other annual bus operating costs are calculated as follows:

- Operator Labor = Annual operator hours x $20.28/hr (direct labor plus benefits)
- Bus Maintenance = Annual miles x $0.39/mi
- Annual Fuel = Annual miles ÷ 5.4 MPG x Fuel Cost ($/gal)
- Overhead & Profit = (Operator Labor + Maintenance + Fuel) x 30%

Total annual bus operating costs for each route are calculated as: annualized bus purchase cost + operator labor cost + bus maintenance cost + fuel cost + overhead and profit. For the routes included in the analysis total bus operating costs range from $2.61/mile to $3.27/mile.

Annual bus hours are calculated as weekly trips x total trip time x 52 weeks x 1.05 – the factor of 1.05 is to account for an assumed 5% additional daily "dead-head" miles on each route[6].

Annual operator hours are calculated as annual bus hours, plus 0.5 hr/day x 365 day/yr x number of operators required each day (full-time-equivalent, FTE). The number of operators required each day (FTE) is calculated as annual bus hours ÷ 2,080 hrs/yr/FTE.

Annual bus miles are calculated as weekly one-way trips x distance per trip x 52 weeks/year x 1.05 (to account for assumed 5% daily dead-head miles).

Bus operating cost factors ($/hr operator labor, $/mi maintenance, OH&P %, average bus purchase price, and average bus MPG) were determined via a survey of American Bus Association (ABA) member companies. Responding companies represent national, large and medium sized companies from various parts of the country. These companies operate a total of approximately 2,000 coach buses. While there was variability in the responses received, there was no clear pattern of regional differences, so the analysis assumes one set of bus operating cost factors for all routes. For each cost factor the values used represent the median of all responses received.

Assumed fuel costs ($/gallon) are current average retail prices published by the Energy Information Administration (Weekly Retail Gasoline and Diesel Prices, 8/22/11, Diesel (on highway) all types). The assumed fuel prices vary from a low of $3.77/gallon in the East South Central region, to a high of $3.99/gallon in the New England region.

Note that all of the assumptions used to evaluate operating costs for coach buses on each route are conservative (high) – it is likely that in a competitive environment actual costs would be lower on many routes.

2.3 Incremental Trip Time

See figure 4 for a representation of how total trip time was calculated for both current EAS flights, and alternative bus trips, on each route. As shown, the assumed total trip time for EAS flights includes the scheduled flight time, and an assumed average flight delay, both of which vary by route. It also includes for every route a constant 60 minutes for check-in/security clearance at the EAS airport (per TSA guidelines), and ten minutes for deplaning at the hub airport.

[6] Dead-head miles are non-revenue miles required to move between the bus storage location and beginning/end of the passenger route each day.

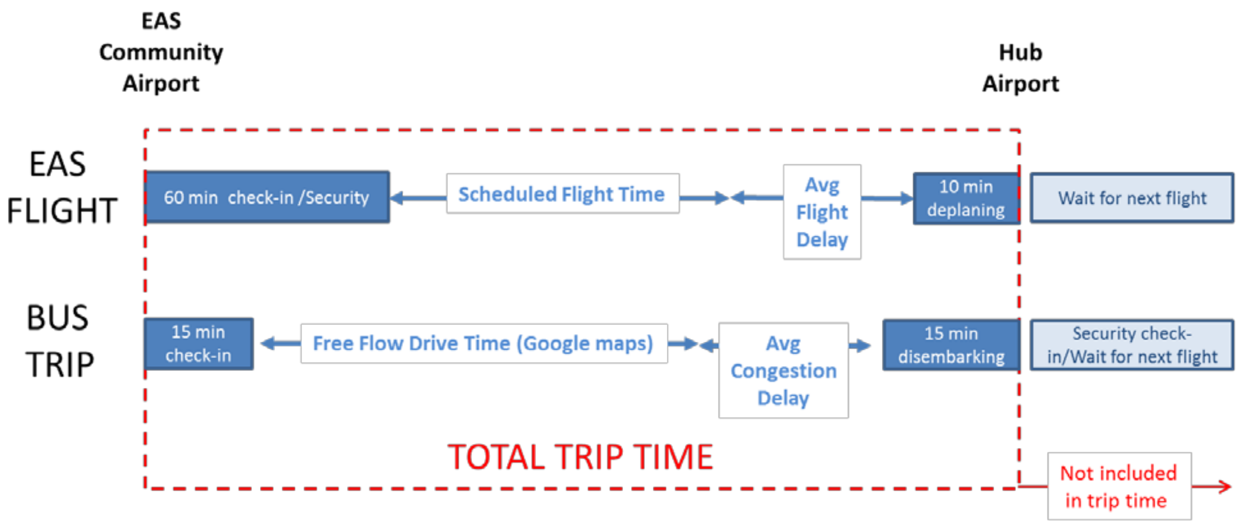

Figure 4 Calculation of Total Trip Time for EAS Flights and Alternative Bus Trips

For bus trips the assumed total trip time includes the free-flow route driving time, and an assumed average congestion delay for the urban portion of the trip (near the hub airport), both of which vary by route. It also includes for every route a constant 15 minutes for bus check-in at the EAS airport (or bus terminal), and 15 minutes for disembarking at the hub airport.

It is likely that most current trips taken on EAS-subsidized flights do not end at the hub airport, but continue on with a second flight to the passenger's final destination. Waiting and check-in time for these follow-on flights was not included in the total trip time for either current air flights or alternative bus trips. This analysis assumes that the minimum scheduled connection time at the hub airport between flight legs (for air passengers), and the time for check-in/security clearance at the hub airport (for bus passengers) would be essentially equal. Also, given that for most routes there are only two or three round-trip flights per day from the rural airport to the hub airport, actual wait time at the hub airport between flight legs is likely highly variable by passenger.

For each route, scheduled flight time for air trips was taken from the air carrier's website. Average flight delay time for each route was taken from Flight Stats.[7] The average flight delay for different routes ranges from 8 minutes to 95 minutes. The passenger-weighted average flight delay for all routes is 26 minutes.

For bus trips average free-flow drive time was taken from Google Maps. For each route the assumed average congestion delay is based on the Travel Time Index and Daily Congestion Time for the urban area which includes the hub airport destination. These values are published in the 2010 Annual Urban Mobility Report.[8]

[7] *On-time ratings by route*, http://www.flightstats.com/go/FlightRating/flightRatingByRoute.do, accessed 8/25/11
[8] Texas Transportation Institute, *Congestion Data for Your City*, http://mobility.tamu.edu/ums/congestion_data/

The travel time index is a measure of the ratio of travel time in the peak period to travel time during free flow conditions in that urban area, and the Daily Congestion Time is a measure of the average time each day (hr) in which congested conditions exist, resulting in slower drive times. To assess the average increase in travel time due to congestion during the urban portion of each bus trip (near the hub airport) this analysis assumes that for each route the urban portion is 30 miles long and that free flow traffic speed is 50 miles per hour, resulting in a baseline trip duration of 0.60 hours for the urban portion of each bus trip. This is multiplied by the travel time index to determine the increase in trip time (hr) when traffic is congested. Since not all trips will occur during peak periods, this peak period delay time is multiplied by the ratio of daily congestion time (hr) to total available daily bus travel time (15 hours) to get the average congestion delay time for all daily trips.[9]

For the urban areas included in the study the calculated congestion delay for the urban portion of the bus trips during peak periods ranges from four to fourteen minutes per trip, and the average congestion delay for all daily trips ranges from one to seven minutes. The passenger-weighted average congestion delay for all bus trips in the study is 2 minutes.

For each route the incremental total trip time for bus trips compared to current EAS-subsidized fights is calculated by subtracting total air trip time from total bus trip time. For most routes included in the analysis the incremental trip time is positive (i.e. the bus trip takes longer than the air trip).

2.4 Value of Incremental Trip Time

To determine the appropriate monetary value for incremental trip time for this analysis the authors used the methodology recommended by the U.S. Department of Transportation for transportation investments.[10] For personal travel this methodology starts with U.S. Census data on median annual household income, by census region, to calculate median hourly income ($/hr); DOT recommends using 110% of this figure for the value of time related to personal air travel. For business travel the methodology starts with data from the Bureau of Labor Statistics on total employer costs for employee compensation ($/hr), by census region; DOT recommends using 189% of this figure for the value of time related to business air travel. To determine a single figure for the value of time for all air travel DOT assumes that 68.7% of travel is personal and 31.3% is for business.

[9] For this analysis this average congestion delay is applied to all bus trips to a given urban area – in fact some daily trips will experience no congestion delay and others will experience a delay longer than the average.
[10] U.S. DOT, *Revised Departmental Guidance, Valuation of Travel Time in Economic Analysis, 2/22/03*

Using this methodology, the values used to monetize incremental trip times in this study range from a low of $28.71/hr (East South Central region) to a high of $42.35/hr (New England region).

2.5 Emissions and Fuel Use

For the specific aircraft used on current EAS-subsidized fights average fuel use (gallons/flight-hour) was gathered from various websites that offer aircraft specifications and advice to aircraft owners on typical operating costs (See Appendix A). The values used for average fuel use range from 37 gal/hr for the 9-seat Cessna 402, to 324 gal/hr for the 50-seat Bombardier CRJ-200. Using these values, calculated specific energy use on the routes analyzed (mega-joules per available seat kilometer, MJ/ASK) varies from 1.07 to 4.38 MJ/ASK, with an average of 2.73 MJ/ASK for all routes. These values are consistent with published values for specific energy use by turbo-prop aircraft used for regional service[11].

Calculated CO_2 emissions from air flights are based on calculated total fuel use on each route, and a fuel-specific CO_2 emissions factor of 10,084 grams CO_2 per gallon[12].

Calculated exhaust emissions of NOx, HC, CO, and SO_2 from air flights are based on calculated total fuel use and fuel-specific emission factors (g/gal). These fuel-specific emission factors are based on landing and take-off (LTO) cycle emission factors for turbo-prop powered aircraft published by the IPCC.[13]

Annual fuel use for coach buses is based on annual miles driven on each route, and an assumption that coach buses average 5.4 MPG (per ABA cost survey). Calculated CO_2 emissions from bus trips are based on calculated total fuel use and a fuel-specific CO_2 emissions factor of 10,084 grams CO_2 per gallon[11]. Calculated SO_2 emissions from bus trips are based on calculated total fuel use and a fuel-specific emissions factor of 0.1 grams SO_2 per gallon[14].

Calculated exhaust emissions of NOx, PM, HC, CO, from bus trips are based on calculated total annual fleet mileage and distance-specific emission factors (g/mi) from EPA's MOVES emissions model. The emissions factors used are national average

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[11] See: R. Babikian, et al, Department of Aeronautics and Astronautics, Massachusetts Institute of Technology, *The Historical Fuel Efficiency Characteristics of Regional Aircraft from Technological, Operational, and Cost Perspectives*, Figure 1

[12] EPA420-F-05-001, February 2005

[13] *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual*, Table 1-50, pg. 1.96. Emissions factors are not available for all of the aircraft used on EAS routes, so the SAAB 340 was used as a proxy for other turbo-prop aircraft.

[14] This emission factor is based on the maximum allowable sulfur content of 15 parts per million for highway diesel fuel, and an assumption that all fuel-borne sulfur is oxidized to SO_2 during combustion in a diesel engine.

values for vehicle type = intercity bus, model year = 2011, and roadway type = composite road (mixed driving cycles representing urban and rural traffic conditions). For this analysis the authors assumed that any alternative coach service would be operated with new vehicles.

3 Results

This section summarizes the detailed results of this analysis for each community and route studied. Additional detail is provided in the tables included in Appendix A.

3.1 EAS Air Flights Compared to Coach Bus Service

See Table 2 for a summary of average costs per passenger and per seat for all EAS-subsidized flights to/from the 38 EAS communities included in this study. This data is also plotted in Figure 5. As shown, average total costs for current flights range from a low of $115.41/passenger (Hagerstown, MD to Baltimore-Washington Airport) to a high of $840.00/passenger (Jonesboro AR to Memphis, TN). As is obvious in Figure 5, subsidy levels also vary significantly by route. The highest EAS subsidy ($801.00/passenger) also occurs on the Jonesboro-Memphis route, and the lowest subsidy ($14.32/passenger) occurs on the route from Paducah, KY to Chicago O'Hare airport.

See Table 3 for a summary of average costs per passenger and per seat for alternative coach bus service to/from the 38 EAS communities in this study. This data is also plotted in Figure 6. As shown, for bus trips to the same hub airport as current EAS flights, average total costs for alternative bus service range from a low of $38.41/passenger (Hagerstown, MD to Baltimore-Washington Airport) to a high of $543.94/passenger (Kingman, AZ to Phoenix Sky Harbor airport). As is obvious in Figure 6, for most routes bus operating costs constitute the vast majority of total cost, and the "cost" of incremental trip times for most bus trips is nominal (less than $25/passenger). The route with the highest cost for incremental bus trip time is the route from El Centro, CA to Los Angles, CA, at $78.43/passenger.

The last eight routes at the bottom of Table 3 (and at the extreme right in Figure 6) are routes for which the alternative bus trips analyzed are to a different location than current EAS-subsidized flights. For these routes the bus trip time is generally shorter than total trip time for current EAS flights, and the value of incremental trip time is negative.

Table 2 Costs of Current EAS-subsidized Air Service, by Route

	EAS Community	State	To/from	Current EAS Subsidized Air Trips						
				Trip Time [hr]	Cost per Current Passenger			Cost per Scheduled Seat		
					Subsidy	Fare	TOTAL	Subsidy	Fare	TOTAL
AIR & BUS TRIPS TO SAME LOCATION	Hagerstown	MD	Baltimore Washington Int'l	2.12	$56.41	$59.00	$115.41	$45.91	$48.02	$93.93
	Lancaster	PA	Baltimore Washington Int'l	2.07	$107.06	$49.00	$156.06	$52.37	$23.97	$76.34
	Athens	GA	Hartsfield Int'l, Atlanta, GA (L)	2.25	$109.20	$61.50	$170.70	$93.61	$52.72	$146.32
	Lebanon/WRJ, VT	NH	Boston	2.52	$149.98	$69.50	$219.48	$89.58	$41.51	$131.09
	Jamestown	NY	Cleveland	3.13	$222.79	$89.00	$311.79	$46.09	$18.41	$64.50
	Bradford	PA	Cleveland	2.71	$183.54	$103.00	$286.54	$30.57	$17.16	$47.72
	Jonesboro	AR	Memphis Int'l, TN (M)	2.00	$801.00	$39.00	$840.00	$74.45	$3.63	$78.08
	Morgantown	WV	Washington Dulles	2.80	$66.15	$96.00	$162.15	$23.38	$33.93	$57.32
	Johnstown	PA	Washington Dulles	2.75	$98.98	$106.00	$204.98	$26.30	$28.17	$54.47
	Jackson	TN	Nashville Int'l	2.33	$240.79	$59.00	$299.79	$68.92	$16.89	$85.80
	Oil City/Franklin	PA	Cleveland	3.28	$331.56	$73.50	$405.06	$30.87	$6.84	$37.72
	Kingman	AZ	Phoenix-Sky Harbor	2.32	$651.28	$65.92	$717.20	$45.48	$4.60	$50.09
	Owensboro	KY	Nashville Int'l	2.25	CANNOT BE DETERMINED [1]			CANNOT BE DETERMINED [1]		
	Altoona	PA	Washington Dulles	3.28	$194.85	$106.00	$300.85	$24.92	$13.56	$38.47
	Quincy	IL	Lambert-St. Louis Int'l, MO (L)	2.20	$125.71	$49.97	$175.68	$58.07	$23.08	$81.16
	Clarksburg	WV	Washington Dulles	2.98	$69.58	$86.00	$155.58	$23.38	$28.90	$52.28
	El Centro	CA	Los Angeles	2.55	$194.87	$71.00	$265.87	$42.40	$15.45	$57.85
	Parkersburg/Marietta	WV	Cleveland	2.72	$241.21	$135.00	$376.21	$55.72	$31.18	$86.90
	Rutland	VT	Boston	2.68	$72.07	$109.00	$181.07	$40.55	$61.33	$101.89
	DuBois	PA	Cleveland	2.70	$194.57	$95.00	$289.57	$49.04	$23.95	$72.99
	Decatur	IL	Lambert-St. Louis Int'l, MO (L)	2.33	$627.53	$42.00	$669.53	$182.95	$12.25	$195.20
	Decatur	IL	Chicago O'Hare	2.75	$627.53	$42.00	$669.53	$182.95	$12.25	$195.20
	Marion/Herrin	IL	Lambert-St. Louis Int'l, MO (L)	2.29	$130.77	$49.97	$180.74	$66.13	$25.27	$91.40
	Muscle Shoals	AL	Memphis Int'l, TN (M)	2.04	$147.08	$478.00	$625.08	$51.58	$167.62	$219.20
	Cape Girardeau	MO	Lambert-St. Louis Int'l, MO (L)	2.43	$167.42	$49.97	$217.39	$34.33	$10.25	$44.57
	Victoria	TX	Houston Bush	2.59	$184.27	$142.00	$326.27	$40.39	$31.13	$71.52
	Pueblo	CO	Denver Int'l, CO (L)	2.39	$55.83	$90.42	$146.25	$27.41	$44.39	$71.80
	Fort Leonard Wood	MO	Lambert-St. Louis Int'l, MO (L)	2.36	$177.70	$59.00	$236.70	$63.17	$20.97	$84.14
	Mason City	IA	Minneapolis/St. Paul Int'l, MN (L)	2.26	$36.73	$257.00	$293.73	$20.55	$143.83	$164.38
	Staunton	VA	Washington Dulles Int'l, VA (L)	2.39	$104.75	$96.00	$200.75	$61.30	$56.18	$117.49
	Laramie	WY	Denver Int'l, CO (L)	2.29	$65.65	$210.18	$275.83	$33.22	$106.35	$139.57
	Kirksville	MO	Lambert-St. Louis Int'l, MO (L)	2.50	$334.30	$49.97	$384.27	$72.35	$10.81	$83.16
	Greenville	MS	Memphis Int'l, TN (M)	2.16	$121.55	$294.50	$416.05	$32.46	$78.63	$111.09
AIR & BUS TRIPS TO DIFFERENT LOCATIONS	Eau Claire	WI	Chicago O'Hare	2.79	$47.15	$126.00	$173.15	$23.80	$63.59	$87.38
	Prescott	AZ	Los Angeles	3.27	$116.91	$127.92	$244.83	$66.23	$55.62	$121.85
	Prescott	AZ	Denver	4.28	$116.91	$127.92	$244.83	$66.23	$55.62	$121.85
	Merced	CA	McCarran Int'l, Las Vegas, NV	4.25	$478.10	$108.92	$587.02	$70.89	$15.51	$86.41
	Merced	CA	Los Angeles, CA	3.20	$478.10	$108.92	$587.02	$70.89	$15.51	$86.41
	Laurel/Hattiesburg	MS	Memphis Int'l, TN (M)	2.81	$50.81	$423.00	$473.81	$28.26	$235.25	$263.51
	Grand Island	NE	Dallas/Fort Worth	3.23	CANNOT BE DETERMINED [1]			CANNOT BE DETERMINED [1]		
	Paducah	KY	Chicago O'Hare	3.16	$14.32	$104.50	$118.82	$7.83	$57.14	$64.97

[1] Carrier offers subsidized and unsubsidized service from this airport. Given available information, cannot determine the number of passengers on subsidized routes.

See Figure 7 for a comparison of the total cost of current EAS-subsidized flights ($/passenger, including fare and subsidy) to the operating cost ($/passenger) of alternative bus service, not including the cost of incremental trip time. As shown, for all routes in the analysis the operating cost of coach bus service is significantly less than the operating cost of air service. The route with the biggest difference is the route from Muscle Shoals, AL to Memphis airport, where coach bus service would cost $583.89/passenger less to operate than current air service. The route with the smallest difference is Hagerstown, MD to Baltimore airport, where coach bus service would cost $77.34/passenger less to operate than current air service.

For all routes included in the analysis total costs for scheduled coach bus service are at least 24% less than total costs for air service ($/passenger) and are as much as 96% less.

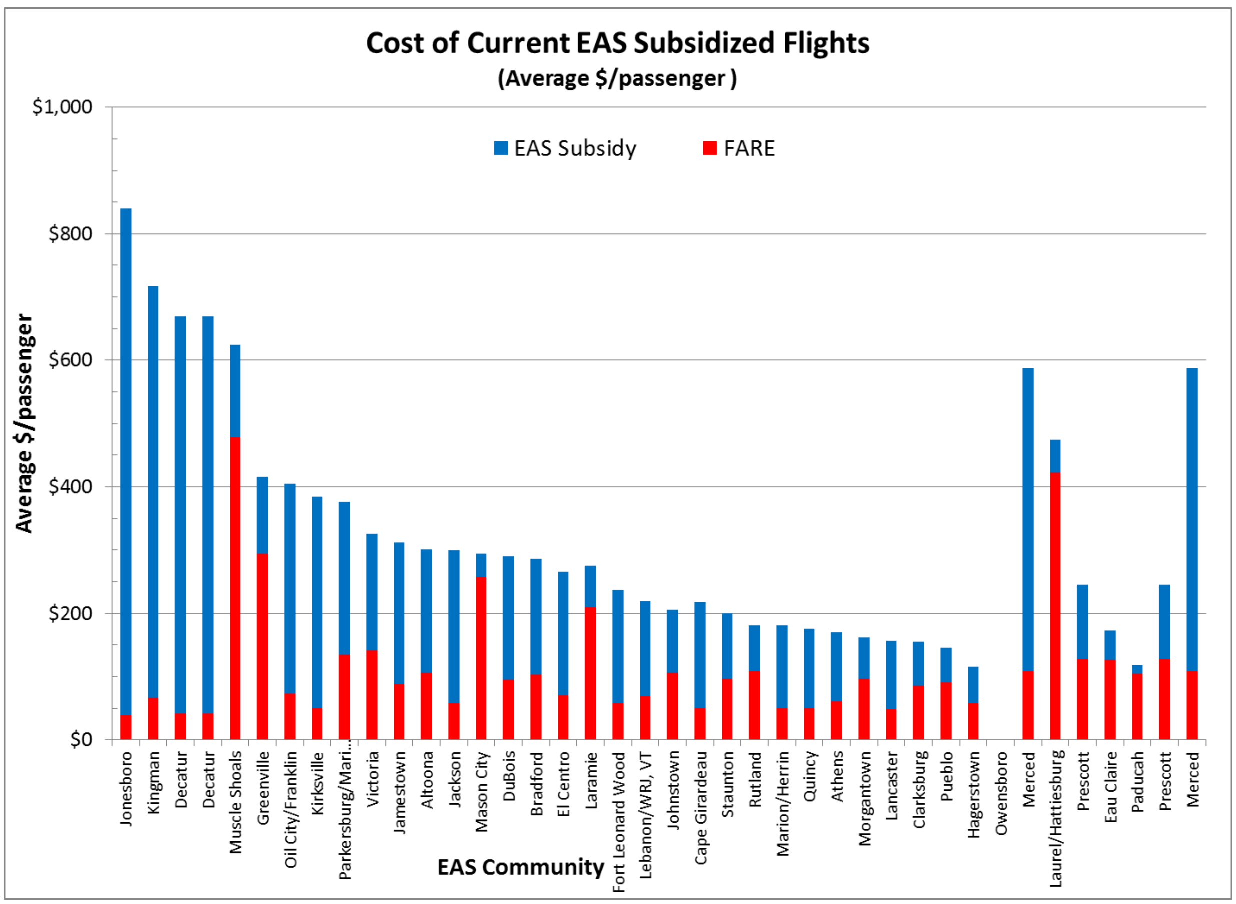

Figure 5 Total Cost of Current EAS-subsidized Air Flights (average $/passenger)

Table 3 Costs for Alternative Coach Bus Service to EAS Communities, by Route

	EAS Community	State	To/from	Alternative Bus Trips						
				Trip Time [hr]	Cost per Current Passenger			Cost per Scheduled Seat		
					Optg Cost	Incr Trip Time	TOTAL	Optg Cost	Incr Trip Time	TOTAL
AIR & BUS TRIPS TO SAME LOCATION	Hagerstown	MD	Baltimore Washington Int'l	2.13	$38.06	$0.35	$38.41	$5.07	$0.35	$5.42
	Lancaster	PA	Baltimore Washington Int'l	2.26	$67.64	$7.49	$75.13	$5.41	$7.49	$12.91
	Athens	GA	Hartsfield Int'l, Atlanta, GA (L)	2.34	$38.25	$3.12	$41.37	$5.37	$3.12	$8.49
	Lebanon/WRJ, VT	NH	Boston	2.52	$66.63	$0.14	$66.78	$6.51	$0.14	$6.65
	Jamestown	NY	Cleveland	3.10	$119.54	-$1.01	$118.53	$8.54	-$1.01	$7.53
	Bradford	PA	Cleveland	4.13	$180.84	$54.69	$235.53	$10.41	$54.69	$65.09
	Jonesboro	AR	Memphis Int'l, TN (M)	1.94	$330.37	-$2.03	$328.35	$5.02	-$2.03	$3.00
	Morgantown	WV	Washington Dulles	4.19	$45.65	$46.41	$92.06	$9.97	$46.41	$56.38
	Johnstown	PA	Washington Dulles	3.89	$57.21	$44.05	$101.27	$9.40	$44.05	$53.45
	Jackson	TN	Nashville Int'l	2.86	$166.20	$15.04	$181.24	$7.78	$15.04	$22.83
	Oil City/Franklin	PA	Cleveland	2.57	$203.27	-$27.52	$175.75	$6.54	-$27.52	-$20.98
	Kingman	AZ	Phoenix-Sky Harbor	4.36	$470.81	$73.13	$543.94	$11.36	$73.13	$84.49
	Owensboro	KY	Nashville Int'l	2.86	CANNOT BE DETERMINED [1]			$7.70	$17.43	$25.13
	Altoona	PA	Washington Dulles	3.44	$105.10	$6.40	$111.50	$8.31	$6.40	$14.71
	Quincy	IL	Lambert-St. Louis Int'l, MO (L)	2.89	$92.99	$23.79	$116.78	$7.03	$23.79	$30.82
	Clarksburg	WV	Washington Dulles	4.59	$50.41	$53.70	$104.11	$10.47	$53.70	$64.17
	El Centro	CA	Los Angeles	4.52	$102.10	$78.43	$180.52	$12.12	$78.43	$90.54
	Parkersburg/Marietta	WV	Cleveland	3.53	$111.11	$27.11	$138.22	$8.87	$27.11	$35.98
	Rutland	VT	Boston	3.72	$103.15	$44.37	$147.52	$9.50	$44.37	$53.87
	DuBois	PA	Cleveland	3.33	$101.05	$24.22	$125.27	$8.80	$24.22	$33.02
	Decatur	IL	Lambert-St. Louis Int'l, MO (L)	3.05	$378.95	$25.06	$404.02	$8.17	$25.06	$33.23
	Decatur	IL	Chicago O'Hare	3.89	$378.95	$39.76	$418.71	$9.91	$39.76	$49.67
	Marion/Herrin	IL	Lambert-St. Louis Int'l, MO (L)	2.95	$87.57	$23.12	$110.69	$7.25	$23.12	$30.37
	Muscle Shoals	AL	Memphis Int'l, TN (M)	3.42	$41.19	$39.73	$80.92	$8.93	$39.73	$48.66
	Cape Girardeau	MO	Lambert-St. Louis Int'l, MO (L)	2.77	$98.68	$12.03	$110.71	$6.99	$12.03	$19.02
	Victoria	TX	Houston Bush	3.24	$56.31	$21.28	$77.59	$7.63	$21.28	$28.91
	Pueblo	CO	Denver Int'l, CO (L)	2.78	$41.53	$13.91	$55.44	$7.04	$13.91	$20.96
	Fort Leonard Wood	MO	Lambert-St. Louis Int'l, MO (L)	2.94	$124.79	$20.19	$144.99	$7.26	$20.19	$27.45
	Mason City	IA	Minneapolis/St. Paul Int'l, MN (L)	2.67	$19.23	$14.49	$33.72	$6.65	$14.49	$21.14
	Staunton	VA	Washington Dulles Int'l, VA (L)	2.93	$37.87	$17.99	$55.86	$7.66	$17.99	$25.64
	Laramie	WY	Denver Int'l, CO (L)	2.99	$47.99	$25.35	$73.33	$8.39	$25.35	$33.73
	Kirksville	MO	Lambert-St. Louis Int'l, MO (L)	4.02	$281.11	$53.45	$334.56	$9.96	$53.45	$63.40
	Greenville	MS	Memphis Int'l, TN (M)	3.37	$54.44	$34.62	$89.06	$8.99	$34.62	$43.61
AIR & BUS TRIPS TO DIFFERENT LOCATIONS	Eau Claire	WI	Minneapolis/St. Paul Int'l, MN (L)	2.30	$11.66	($17.13)	($5.47)	$5.35	($17.13)	($11.78)
	Prescott	AZ	Sky Harbor Mun., Phoenix, AZ (L)	2.59	$52.04	($24.52)	$27.53	$6.79	($24.52)	($17.73)
	Prescott	AZ	Sky Harbor Mun., Phoenix, AZ (L)	2.59	$52.04	($60.68)	($8.63)	$6.79	($60.68)	($53.89)
	Merced	CA	San Jose Int'l, CA (M)	2.78	$218.75	($58.47)	$160.28	$5.60	($58.47)	($52.86)
	Merced	CA	San Jose Int'l, CA (M)	2.78	$218.75	($16.73)	$202.02	$5.60	($16.73)	($11.13)
	Laurel/Hattiesburg	MS	New Orleans Int'l, LA (M)	2.64	$19.52	($4.83)	$14.69	$6.71	($4.83)	$1.88
	Grand Island	NE	Eppley Airfield, Omaha, NE (M)	3.29	CANNOT BE DETERMINED [1]			$7.88	$2.22	$10.10
	Paducah	KY	Nashville Metropolitan, TN (M)	3.02	$14.94	($3.89)	$11.06	$7.43	($3.89)	$3.54

[1] Carrier offers subsidized and unsubsidized service from this airport. Given available information, cannot determine the number of passengers on subsidized routes.

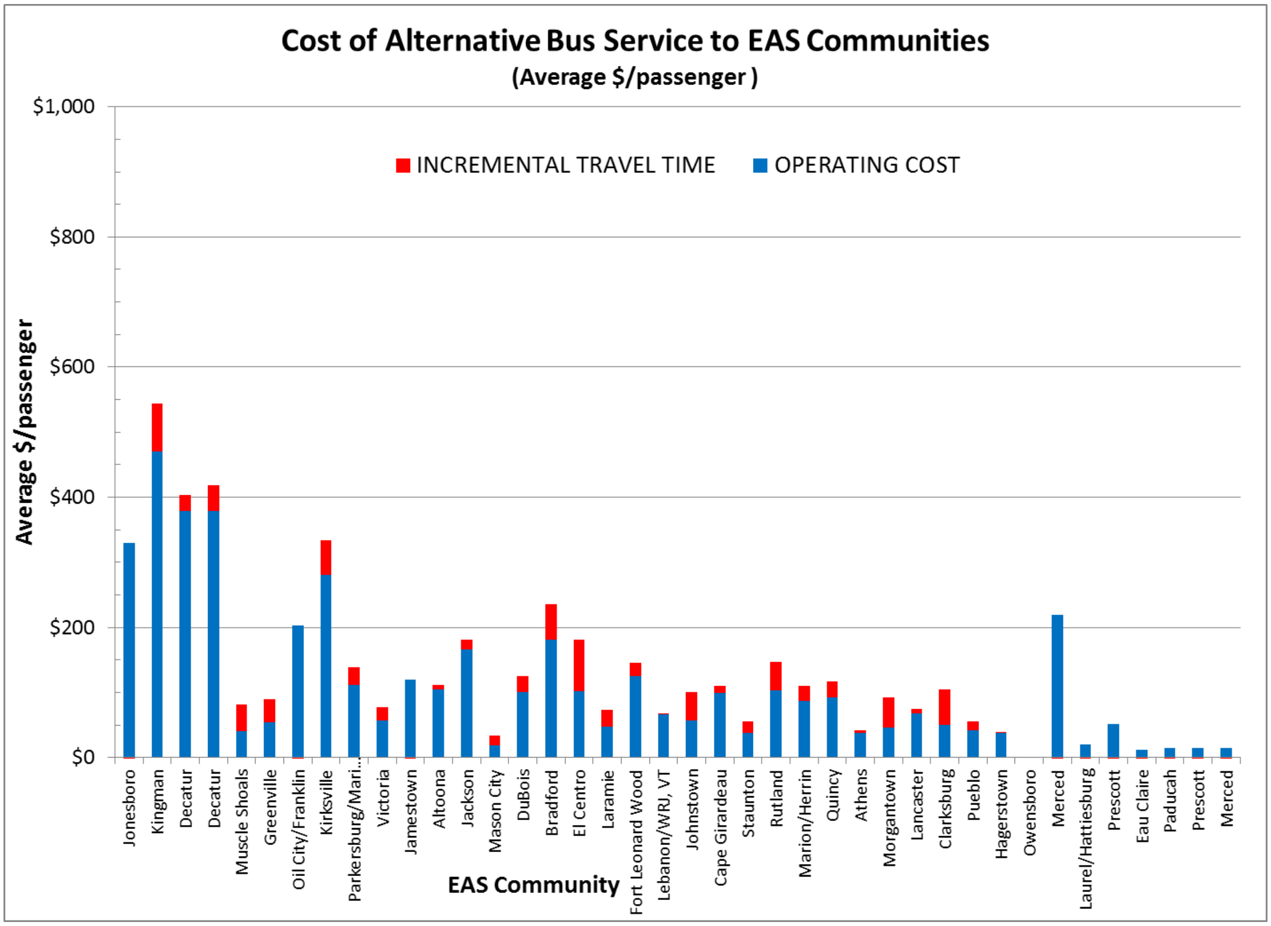

Figure 6 Total Cost of Alternative Coach Bus Service to EAS Communities (average $/passenger)

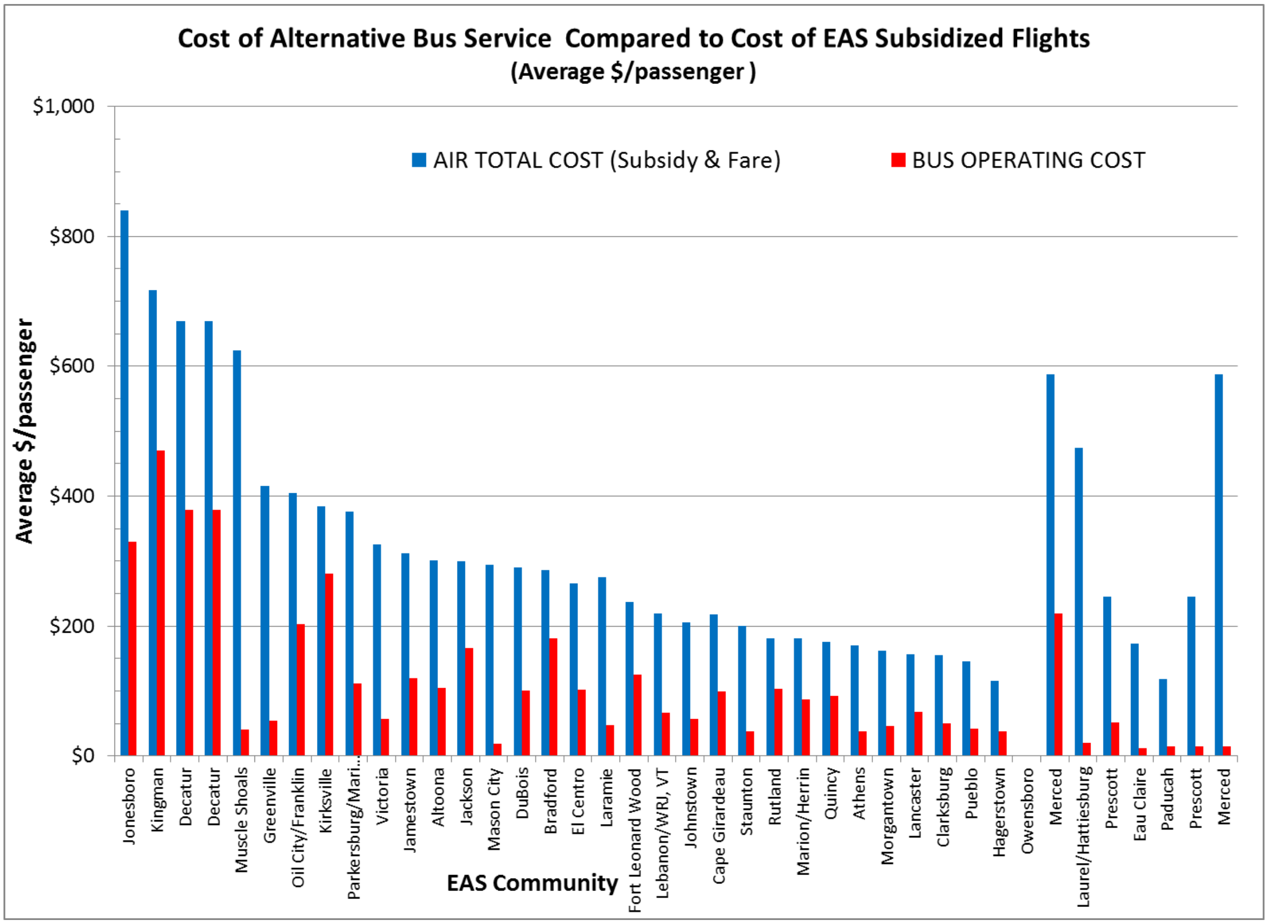

Figure 7 Total Cost of Current EAS-subsidized flights Compared to Operating Cost of Bus Service

See Table 4 for a summary of estimated annual fuel use and exhaust emissions from current EAS-subsidized air flights on each route included in this study. As shown, there is a wide variance in annual fuel use and emissions by route, based on the number of annual flights, route length, and the size of the aircraft operated. In total, EAS-subsidized flights to/from the 38 EAS communities included in this study burn approximately 7.9 million gallons of jet fuel[15] annually, and emit approximately 88,000 tons of CO_2, approximately 28 tons of NOx, approximately 1,188 tons of HC, approximately 2,067 tons of CO, and approximately 28 tons of SO_2[16].

[15] The jet fuel burned by the turbo-prop aircraft used for EAS-subsidized service is essentially identical to highway diesel fuel, but is allowed by EPA to have higher sulfur content.
[16] Aircraft also emit small amounts of particulate matter (PM) but these emissions could not be estimated because PM emission factors were unavailable.

Table 4 Emissions from Current EAS-subsidized Air Flights

	EAS Community	State	To/from	Annual Fuel (gal)	CO_2 (ton)	NOx (ton)	PM (ton)	HC (ton)	CO (ton)	SO_2 (ton)
			Current EAS Subsidized Air Trips		Annual Emissions from Air Flights					
AIR & BUS TRIPS TO SAME LOCATION	Hagerstown	MD	Baltimore Washington Int'l	75,421	838	0.27	NOT AVAILABLE	11.3	19.7	0.3
	Lancaster	PA	Baltimore Washington Int'l	68,238	758	0.24		10.2	17.8	0.2
	Athens	GA	Hartsfield Int'l, Atlanta, GA (L)	39,312	437	0.14		5.9	10.3	0.1
	Lebanon/WRJ, VT	NH	Boston	98,765	1,098	0.35		14.8	25.8	0.3
	Jamestown	NY	Cleveland	205,920	2,289	0.73		30.9	53.7	0.7
	Bradford	PA	Cleveland	223,080	2,480	0.79		33.4	58.2	0.8
	Jonesboro	AR	Memphis Int'l, TN (M)	46,176	513	0.16		6.9	12.0	0.2
	Morgantown	WV	Washington Dulles	237,463	2,640	0.84		35.6	61.9	0.8
	Johnstown	PA	Washington Dulles	241,488	2,684	0.85		36.2	63.0	0.9
	Jackson	TN	Nashville Int'l	78,381	871	0.28		11.7	20.4	0.3
	Oil City/Franklin	PA	Cleveland	143,000	1,590	0.51		21.4	37.3	0.5
	Kingman	AZ	Phoenix-Sky Harbor	123,933	1,378	0.44		18.6	32.3	0.4
	Owensboro	KY	Nashville Int'l	70,543	784	0.25		10.6	18.4	0.2
	Altoona	PA	Washington Dulles	242,159	2,692	0.86		36.3	63.1	0.9
	Quincy	IL	Lambert-St. Louis Int'l, MO (L)	115,440	1,283	0.41		17.3	30.1	0.4
	Clarksburg	WV	Washington Dulles	269,662	2,997	0.95		40.4	70.3	1.0
	El Centro	CA	Los Angeles	180,093	2,002	0.64		27.0	47.0	0.6
	Parkersburg/Marietta	WV	Cleveland	251,680	2,798	0.89		37.7	65.6	0.9
	Rutland	VT	Boston	79,461	883	0.28		11.9	20.7	0.3
	DuBois	PA	Cleveland	285,047	3,168	1.01		42.7	74.3	1.0
	Decatur	IL	Lambert-St. Louis Int'l, MO (L)	74,256	825	0.26		11.1	19.4	0.3
	Decatur	IL	Chicago O'Hare	111,384	1,238	0.39		16.7	29.0	0.4
	Marion/Herrin	IL	Lambert-St. Louis Int'l, MO (L)	109,027	1,212	0.39		16.3	28.4	0.4
	Muscle Shoals	AL	Memphis Int'l, TN (M)	156,520	1,740	0.55		23.5	40.8	0.6
	Cape Girardeau	MO	Lambert-St. Louis Int'l, MO (L)	251,680	2,798	0.89		37.7	65.6	0.9
	Victoria	TX	Houston Bush	159,874	1,777	0.57		24.0	41.7	0.6
	Pueblo	CO	Denver Int'l, CO (L)	178,464	1,984	0.63		26.7	46.5	0.6
	Fort Leonard Wood	MO	Lambert-St. Louis Int'l, MO (L)	83,373	927	0.30		12.5	21.7	0.3
	Mason City	IA	Minneapolis/St. Paul Int'l, MN (L)	153,390	1,705	0.54		23.0	40.0	0.5
	Staunton	VA	Washington Dulles Int'l, VA (L)	168,168	1,869	0.60		25.2	43.8	0.6
	Laramie	WY	Denver Int'l, CO (L)	147,576	1,640	0.52		22.1	38.5	0.5
	Kirksville	MO	Lambert-St. Louis Int'l, MO (L)	87,542	973	0.31		13.1	22.8	0.3
	Greenville	MS	Memphis Int'l, TN (M)	159,650	1,775	0.57		23.9	41.6	0.6
AIR & BUS TRIPS TO DIFFERENT LOCATIONS	Eau Claire	WI	Chicago O'Hare	589,680	6,555	2.09	NA	88.4	153.8	2.1
	Prescott	AZ	Los Angeles	253,587	2,819	0.90		38.0	66.1	0.9
	Prescott	AZ	Denver	222,889	2,478	0.79		33.4	58.1	0.8
	Merced	CA	McCarran Int'l, Las Vegas, NV	240,240	2,670	0.85		36.0	62.6	0.9
	Merced	CA	Los Angeles, CA	272,272	3,026	0.96		40.8	71.0	1.0
	Laurel/Hattiesburg	MS	Memphis Int'l, TN (M)	241,041	2,679	0.85		36.1	62.8	0.9
	Grand Island	NE	Dallas/Fort Worth	502,493	5,585	1.78		75.3	131.0	1.8
	Paducah	KY	Chicago O'Hare	691,891	7,691	2.45		103.7	180.4	2.4
			TOTAL	7,930,259	88,149	28.07		1,188.2	2,067.7	28.1

See Table 5 for a summary of estimated annual fuel use and exhaust emissions from alternative coach bus service on each route included in this study. In total, alternative bus service to/from the 38 EAS communities included in this study would burn approximately 2.2 million gallons of diesel fuel annually, and would emit approximately 24,600 tons of CO_2, approximately 14.9 tons of NOx, approximately 0.3 tons of PM, approximately 2.0 tons of HC, approximately 1.2 tons of CO, and approximately 0.2 tons of SO_2. Note that this analysis assumes that because alternative bus service would be "new" service on most, if not all, routes included in this study the emissions calculations assume the use of new model year 2011 buses for all routes.

Based on a significant change in EPA emission regulations over the past few years new coach buses have significantly lower emissions of NOx and PM than buses built prior to model year 2007. If service were operated with existing, older buses actual emissions would be higher than those shown in Table 5.

Table 5 Emissions from Alternative Bus Service to EAS Communities

	Alternative Coach Bus Trips								
	To/from	Annual Miles (mi)	Annual Fuel (gal)	Annual Emissions from Bus Operations: CO_2 (ton)	NOx (ton)	PM (ton)	HC (ton)	CO (ton)	SO_2 (ton)
AIR & BUS TRIPS TO SAME LOCATION	Baltimore Washington Int'l	261,731	48,469	538.8	0.33	0.006	0.043	0.026	0.005
	Baltimore Washington Int'l	282,522	52,319	581.6	0.35	0.006	0.047	0.028	0.006
	Hartsfield Int'l, Atlanta, GA (L)	109,812	20,335	226.0	0.14	0.002	0.018	0.011	0.002
	Boston	376,085	69,645	774.1	0.47	0.008	0.062	0.037	0.008
	Cleveland	306,634	56,784	631.2	0.38	0.007	0.051	0.030	0.006
	Cleveland	389,189	72,072	801.1	0.48	0.009	0.064	0.039	0.008
	Memphis Int'l, TN (M)	105,618	19,559	217.4	0.13	0.002	0.017	0.010	0.002
	Washington Dulles	367,567	68,068	756.6	0.46	0.008	0.061	0.036	0.008
	Washington Dulles	332,186	61,516	683.8	0.41	0.007	0.055	0.033	0.007
	Nashville Int'l	296,696	54,944	610.7	0.37	0.007	0.049	0.029	0.006
	Cleveland	208,026	38,523	428.2	0.26	0.005	0.034	0.021	0.004
	Phoenix-Sky Harbor	288,179	53,366	593.2	0.36	0.006	0.048	0.029	0.006
	Nashville Int'l	290,472	53,791	597.9	0.36	0.006	0.048	0.029	0.006
	Washington Dulles	300,846	55,712	619.3	0.37	0.007	0.050	0.030	0.006
	Lambert-St. Louis Int'l, MO (L)	511,056	94,640	1,052.0	0.64	0.011	0.085	0.051	0.010
	Washington Dulles	385,258	71,344	793.0	0.48	0.008	0.064	0.038	0.008
	Los Angeles	353,153	65,399	726.9	0.44	0.008	0.058	0.035	0.007
	Cleveland	471,744	87,360	971.1	0.59	0.010	0.078	0.047	0.010
	Boston	421,949	78,139	868.6	0.53	0.009	0.070	0.042	0.009
	Cleveland	439,530	81,394	904.7	0.55	0.010	0.073	0.044	0.009
	Lambert-St. Louis Int'l, MO (L)	290,909	53,872	598.8	0.36	0.006	0.048	0.029	0.006
	Chicago O'Hare	375,430	69,524	772.8	0.47	0.008	0.062	0.037	0.008
	Lambert-St. Louis Int'l, MO (L)	493,802	91,445	1,016.5	0.62	0.011	0.082	0.049	0.010
	Memphis Int'l, TN (M)	224,734	41,617	462.6	0.28	0.005	0.037	0.022	0.005
	Lambert-St. Louis Int'l, MO (L)	343,325	63,579	706.7	0.43	0.008	0.057	0.034	0.007
	Houston Bush	210,101	38,908	432.5	0.26	0.005	0.035	0.021	0.004
	Denver Int'l, CO (L)	345,946	64,064	712.1	0.43	0.008	0.057	0.034	0.007
	Lambert-St. Louis Int'l, MO (L)	379,470	70,272	781.1	0.47	0.008	0.063	0.038	0.008
	Minneapolis/St. Paul Int'l, MN (L)	197,215	36,521	406.0	0.25	0.004	0.033	0.020	0.004
	Washington Dulles Int'l, VA (L)	261,425	48,412	538.1	0.33	0.006	0.043	0.026	0.005
	Denver Int'l, CO (L)	306,634	56,784	631.2	0.38	0.007	0.051	0.030	0.006
	Lambert-St. Louis Int'l, MO (L)	458,640	84,933	944.1	0.57	0.010	0.076	0.046	0.009
	Memphis Int'l, TN (M)	229,320	42,467	472.0	0.29	0.005	0.038	0.023	0.005
AIR & BUS TRIPS TO DIFFERENT LOCATIONS	Minneapolis/St. Paul Int'l, MN (L)	140,191	25,961	288.6	0.17	0.003	0.023	0.014	0.003
	Sky Harbor Mun., Phoenix, AZ (L) Sky Harbor Mun., Phoenix, AZ (L)	274,194	50,777	564.4	0.34	0.006	0.045	0.027	0.006
	San Jose Int'l, CA (M) San Jose Int'l, CA (M)	274,194	50,777	564.4	0.34	0.006	0.045	0.027	0.006
	New Orleans Int'l, LA (M)	201,802	37,371	415.4	0.25	0.004	0.033	0.020	0.004
	Eppley Airfield, Omaha, NE (M)	220,038	40,748	452.9	0.27	0.005	0.036	0.022	0.004
	Nashville Metropolitan, TN (M)	227,791	42,184	468.9	0.28	0.005	0.038	0.023	0.005
	TOTAL	11,953,411	2,213,595	24,605	14.89	0.264	1.976	1.186	0.244

See Figure 8 and Figure 9 for a comparison of estimated average emissions (pounds) per passenger and per passenger-mile from the current EAS flights included in this study, to average estimated emissions from alternative coach bus service on the same routes. In these figures NOx and SO_2 emissions are multiplied by 1,000, HC emissions are multiplied by 100, and CO emissions are multiplied by 10 to allow them to be shown on the same graph as CO_2 emissions.

As shown in these figures, the use of new coach buses to operate scheduled service on these routes instead of the current air flights would reduce per passenger CO_2 emissions by 72%, would reduce per passenger NOx emission by 47%, and would reduce per passenger emissions of HC, CO, and SO_2 by over 99%.

The use of new coach buses to operate scheduled service on these routes instead of the current air flights would reduce per passenger-mile CO_2 emissions by 57%, would reduce per passenger-mile NOx emission by 19%, and would reduce per passenger-mile emissions of HC, CO, and SO_2 by over 98%.

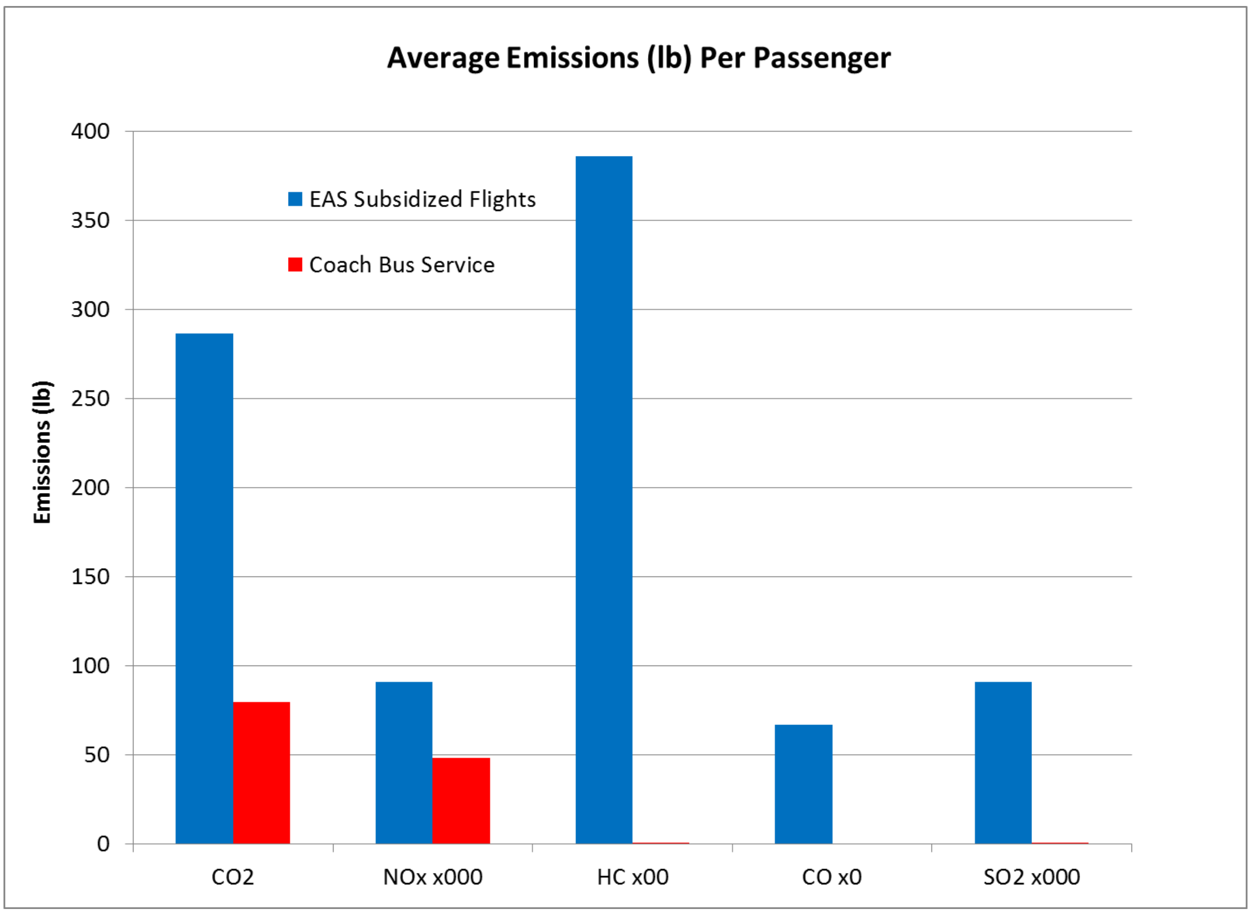

Figure 8 Average Emissions Per passenger from EAS Flights Compared to Coach Bus Service

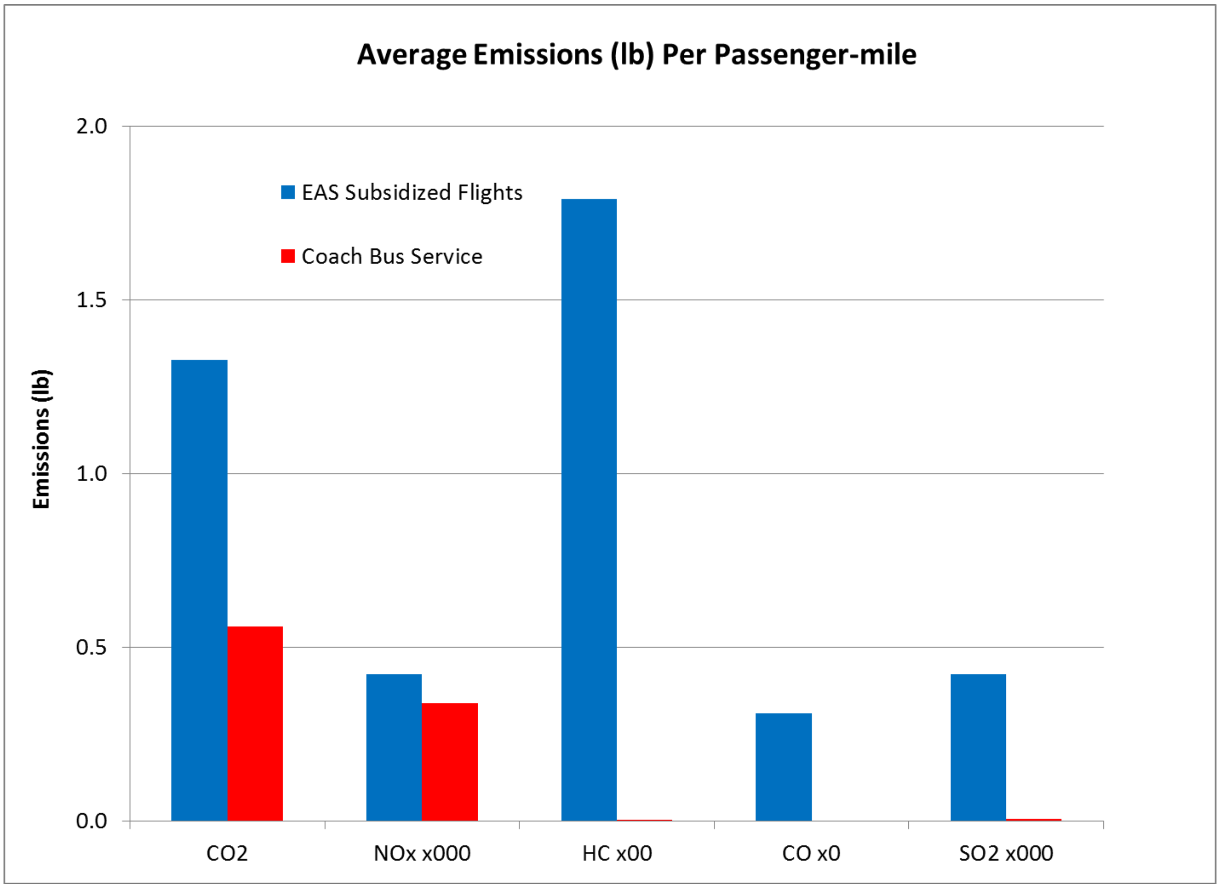

Figure 9 Average Emissions Per passenger-mile from EAS Flights Compared to Coach Bus Service

3.2 Use of Smaller Buses

This analysis compares current EAS-subsidized air flights to equivalent coach bus service. Inter-city coach buses were chosen as the alternative mode for analysis because they are the most common equipment used for long-distance intercity travel and because they provide a higher level of comfort compared to some smaller vehicle options. A typical 45-foot coach bus has 55 passenger seats, though some operators run "premium" or "executive" service with as few as 35 seats and more room per passenger in the coach.

Many of the current EAS-subsidized flights on the routes included in this analysis operate with 9-seat or 19-seat aircraft, and even with these small planes the average load factor on these flights is often less than 50%. In this situation, the use of a smaller vehicle than a 55-seat coach bus to provide alternative on-road service may be more cost effective for some routes. To put bounds on the potential for further savings from better matching vehicle size to passenger demand the authors modeled an alternative bus service on each route using a 12-seat mini-bus.

For this analysis a Mercedes Sprinter™ van was used as the base vehicle for comparison. This vehicle is available from the factory in a 15-seat "commuter bus" version. For this analysis we assumed that the rear three seats would be removed to provide additional luggage space, leaving 12 passenger seats. The manufacturer's suggested retail price for this vehicle is $72,000 (commuter bus version), resulting in an annualized capital cost of $16,700/yr/vehicle (assuming a 5-year life). Annual maintenance costs are assumed to be $0.12/mile, and average fuel economy is assumed to be 20 MPG[17]. All other cost factors (operator labor costs, OH&P, fuel costs) are assumed to be the same as for coach buses.

On a handful of routes current passenger volume is high enough that the use of a 12-seat vehicle would require more daily/weekly trips than the number of currently scheduled EAS flights to provide enough seating capacity – this was accounted for in the analysis.

See Figure 10, which compares the average operating costs ($/passenger) on each route from the use of a 55-seat coach or a 12-seat Sprinter van. Figure 11 plots the same data, but on a $/seat basis.

As shown, on every route average operating costs per seat are much lower for the coach than for the smaller Sprinter van, but on many routes average operating costs per current passenger are higher.

The reality is that the choice of the "best" vehicle to support a particular route will vary by location, and may in fact change over time. Some routes will be best served by coach buses and others will be better served by smaller vehicles.

[17] Based on data from Edmunds.com, product reviews and True Cost of Ownership for 2010 Mercedes Sprinter Van.

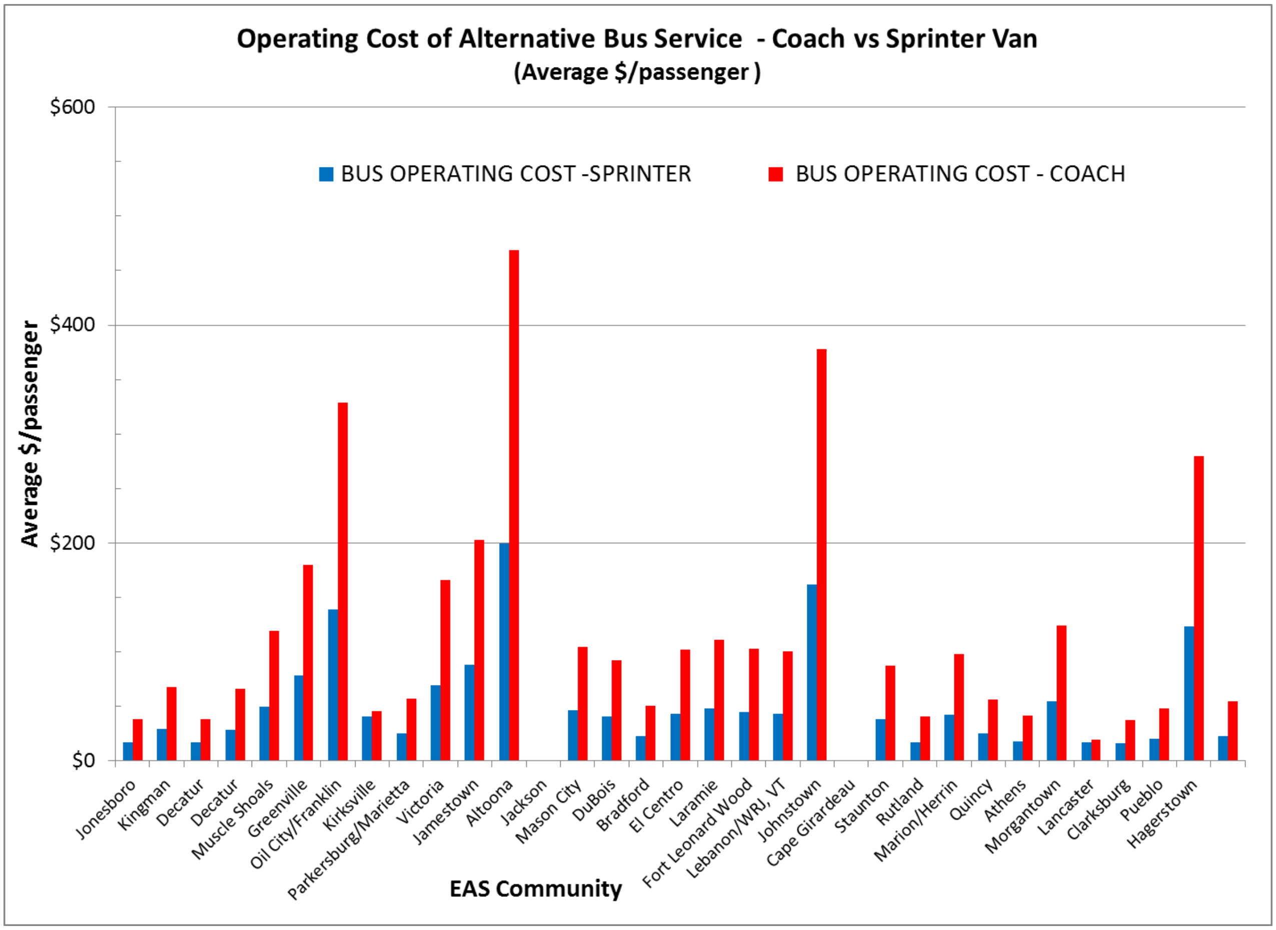

Figure 10 Average Operating Costs per Passenger – Coach Bus versus Sprinter Van

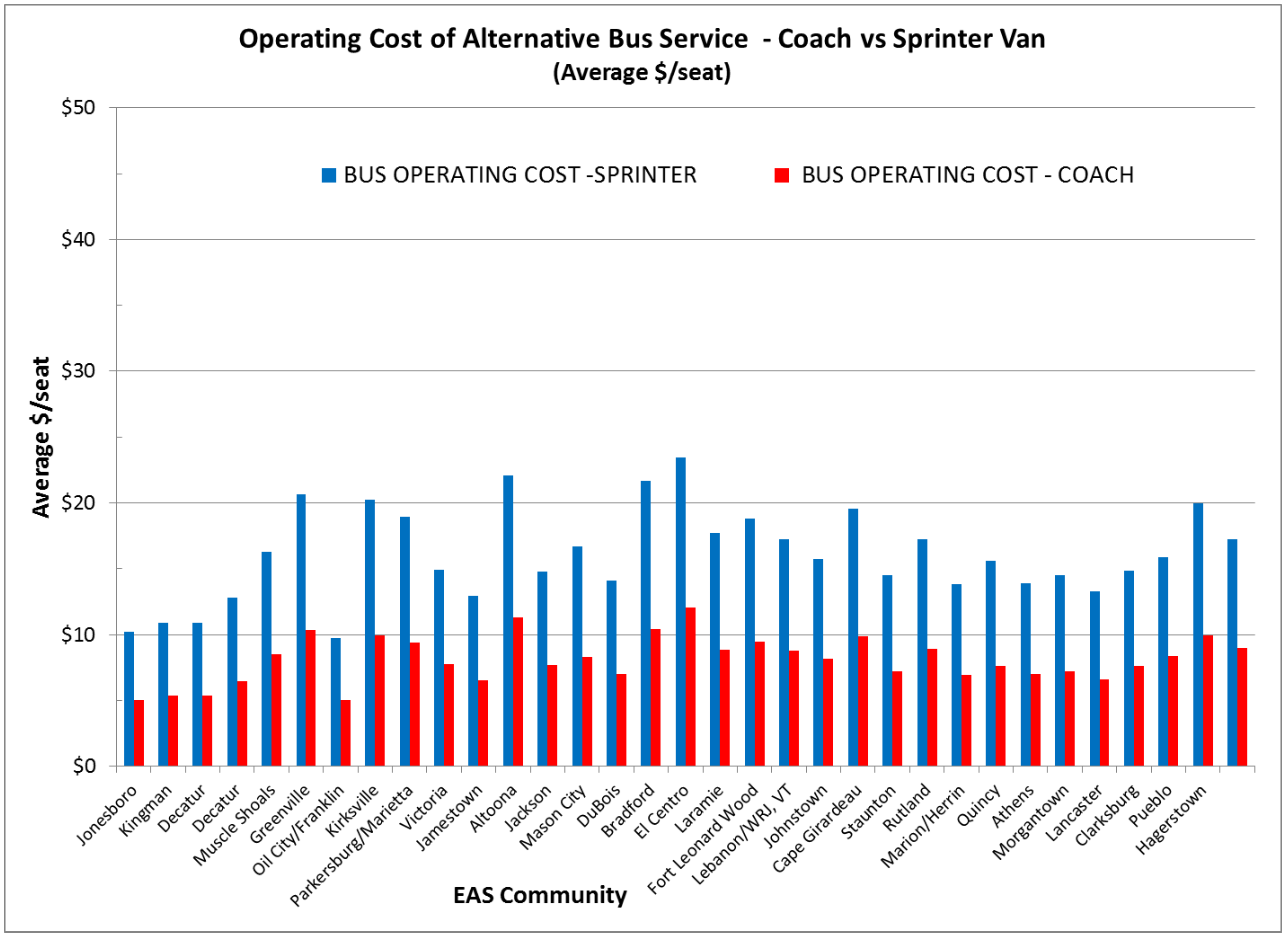

Figure 11 Average Operating Costs per Seat – Coach Bus versus Sprinter Van