

Operational Impact Study of Advance Transit Fixed-Route Bus Network

Final Report (Excerpt)

Executive Summary Only, Updated August 2006

Originally prepared for:
City of Lebanon, New Hampshire
June 28, 2005

Executive Summary Updated by UVTMA August 2006

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i. Executive Summary

A study of the impacts of the fixed-route public bus system operated by Advance Transit, Inc. (AT) on the City of Lebanon was prepared in response to the Lebanon City Council's December 9, 2004 Motion that ordered the work (*Operational Impact Study of Advance Transit Fixed-Route Bus Network, Final Report, June 28, 2005*). This updated version of the Executive Summary reflects ridership data (boardings) through June, 2006. Material changes from the original version (June, 2005) are noted in the text or by footnotes.

The June, 2005 document examined Advance Transit's boardings history, impact on personal vehicle use, fuel consumption and exhaust emissions as well as an assessment of the costs, feasibility and policy issues of instituting fares. It also addressed employment opportunities made possible by the access the bus service provides to people who do not drive. The UVTMA has studied and analyzed AT's past and recent operations and surveyed AT's riders (April, 2005) to determine who is using the system and for what purposes. In the course of that study, we determined that the impacts of Advance Transit's fixed-route bus system on the City of Lebanon and Lebanon residents are both positive and significant.

Advance Transit's fixed-route system currently provides regular scheduled service to the core Lebanon, Hanover, White River Junction area as well as service to Enfield, Canaan, Norwich, Wilder and Hartford. It is primarily structured to serve employees and shoppers with destinations in the core area. Since the fixed-route service was upgraded in September 2000, ridership has nearly tripled as shown in **Figure 1**. Total fixed route passenger boardings in calendar (CY) 2004 were 281,202. Since our study was completed in June, 2005, boardings data through June, 2006 has become available: Boardings in CY 2005 were 321,389, (a 14.3% increase over CY 2004); boardings for CY 2006 through June were 183,942 suggesting a further 14% increase over CY 2005 if the trend continues for the remainder of CY 2006.

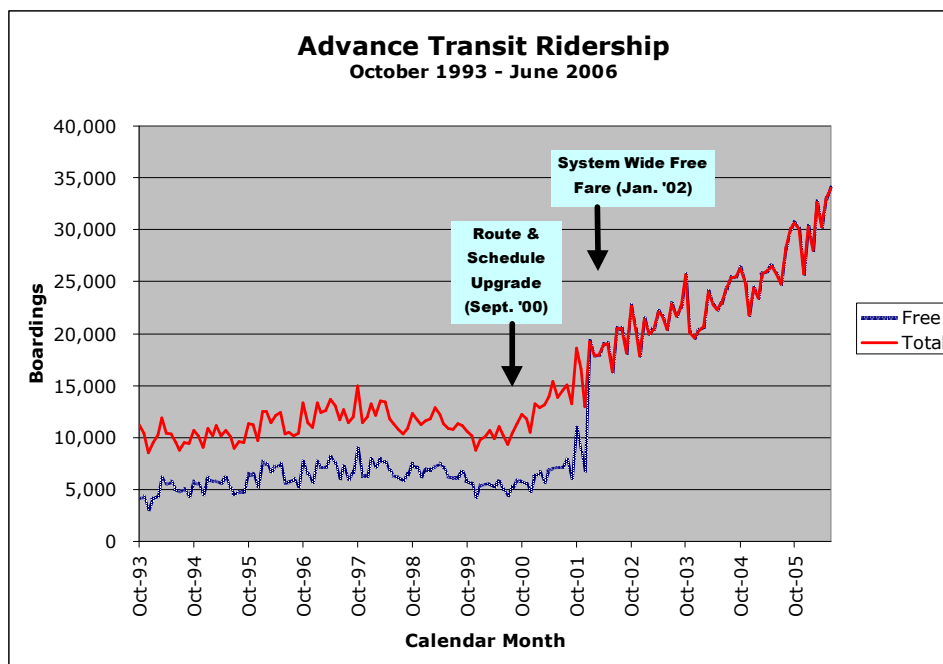


Figure 1. Monthly Advance Transit Fixed Route Fare-Paid and Fare-Free Boardings.

A summary of calendar year boardings for the past twelve years appears below as **Table 1**:

Table 1 -- AT Fixed-Route Boardings and Year-over-Year % Change Calendar 1994 thru 2005 (2006 (proj.))			
Year	Boardings¹	Pct. Change Over Prior Year	Cumulative Percent Chg. (1994 = Baseline)
1994	119,499		---
1995	123,438	3.3%	3.3%
1996	138,440	12.2%	15.9%
1997	151,214	9.2%	26.5%
1998	142,720	-5.6%	19.4%
1999	133,620	-6.4%	11.8%
2000	127,582	-4.5%	6.8%
2001	173,656 ²	36.1%	45.3%
2002	229,696	32.3%	92.2%
2003	258,677	12.6%	116.5%
2004	281,202	8.7%	135.3%
2005 (proj.)	298,602 ³	6.2%	149.9%
2005 (actual)	321,389	14.3%	168.9%
2006 (proj.)	367,884	14.5%	208.0%

Note that in the updated Table 1, above, our original projection for boardings for all of CY 2005 was too low by more than 22,000. This is partly because the growth rate of Advance Transit's fixed-route boardings accelerated sharply between 2004 and 2005.

Approximately 40% of AT's riders are residents of Lebanon as confirmed by passenger surveys in October 2004 and April 2005. The April 2005 survey also found that 60% of passengers on the four AT routes that directly serve Lebanon are going to destinations within Lebanon. Assuming these survey findings are still valid, Lebanon residents appear to be using Advance Transit more frequently than a year ago.

Key findings of the 2005 Study include:

Lebanon has about 28% of the population of the six municipal-ities served by the bus but supplies 40% of boardings.

- Sixty percent of all of AT's fixed-route riders, and 58% of AT riders who are Lebanon residents, are traveling to destinations in Lebanon or West Lebanon.
- More than half (57%) of the riders going to Lebanon or West Lebanon are making a work-related trip.
- Lebanon residents use Advance Transit in numbers that are proportionally larger than Lebanon's population relative to the other five municipalities that are served by AT. Based on the 2000 census, the City of Lebanon had 28% of the combined population of the six municipalities served by AT. By contrast, Lebanon residents generate 40% of AT's fixed-route boardings, even when passengers who

¹ Source: Advance Transit, except CY 2005 projection developed by UVTMA.

² Includes Dartmouth "Show ID-Ride Free" paid ridership of 4,195 boardings. (Source: Advance Transit)

³ A simple projection for CY 2005 computed by multiplying actual boardings for January through April 2005 by 3. This projection is conservative because AT boardings for May-Aug and Sept-Dec have been somewhat stronger than the first four months of the year for the last two calendar years in a row.

said they reside in unserved towns are taken into account. This finding has been confirmed by two consecutive surveys of AT passengers.⁴

Bus service replaced over 156,000 local auto trips in CY 2004 (151,469 when adjusted for Fiscal Year 2004-05). In **FY 2005-06, this jumped to 171,490 assuming the same diversion rate.**

- Based on the UVTMA’s April, 2005 face-to-face survey, Advance Transit fixed-route service allowed over 100 individuals to be gainfully employed who, without access to public transit, might be unemployed or under-employed. These are not Advance Transit employees, but AT passengers who are traveling to or from work on the bus and said they would not be able to make the trip without the bus.
- It is conservatively estimated that the people who depend on AT to reach their workplace collectively earn at least \$1.2-million annually in gross wages.
- The fixed-route service was responsible for more than 156,400 avoided local automobile trips⁵ in calendar 2004, averaging an estimated 5.4 miles each way. This is more than 844,500 miles. These avoided automobile trips represent real savings for the individual riders, reduced air pollution, and reduced demand for parking. Valued at the 2005 Internal Revenue Service allowance of 40.5 cents per mile, this avoided automobile mileage is worth over \$341,000. (*see box at left*)
- Survey results suggest that at least 50% of these avoided auto trips would’ve been made during peak periods. This means that the bus service is helping to reduce auto trips at the times of day when the roads are most crowded.

Table 2 compares AT’s diesel fuel consumption per boarding passenger in 2004 with gasoline that would’ve been consumed by 844,500 miles of additional automobile use assuming 1.1 occupants per vehicle and 20 miles-per-gallon:

Table 2 -- Avoided Gasoline vs. AT Diesel Fuel Consumption, 2004		
Diesel Fuel Used by AT’s Fixed-Route Buses	61,606 gallons ⁶	1.52-million passenger-miles
Avoided Private Auto Gasoline Use <i>Per Passenger</i> (at 20 mpg; 1.1 passengers per auto; 842,400 miles)	38,290 gallons	926,640 passenger-miles
Diesel Fuel Used Per Boarding Passenger (AT bus):	0.22 gallons ⁷	

Although AT used almost 61% more diesel fuel (in gallons) than the private auto trips it replaced in 2004, it generated 64% more passenger miles using that fuel, and will generate even more passenger-miles with about the same fuel in the future assuming the boardings trend of recent years remains positive.⁸ A straight-line allocation of diesel fuel per boarding bus passenger yields less than ¼ gallon required per boarding passenger. But, since most AT fixed-route buses

⁴ Crikelair survey of October, 2004 and UVTMA survey of April, 2005.

⁵ Persons making auto trips.

⁶ Source: Advance Transit. Based on 67.5% of 91,268 total gallons consumed by AT to operate all services in CY 2004. 67.5% represents mileage operated in fixed-route service after subtracting parking shuttles and other non-fixed-route operations.

⁷ 61,606 gallons divided by 281,202 boardings in CY 2004.

⁸ Actual boardings data for June 2004 through June 2006 indicate that this projection was correct.

have seats available on most routes and at most hours, the incremental diesel fuel required for each additional boarding passenger is very small.

Air pollutant gases and particles were **reduced** by about 3-1/2 tons in 2004. An informal projection indicates that this number increased to about 5 tons in FY 2005-6 because of increased use of the bus.

- The latest EPA Mobile 6 emissions analysis model and rider survey data concerning origin, frequency and purpose of trips were used to estimate air quality impacts. Three emissions groups were estimated: Volatile hydrocarbons (VOCs or VCs), carbon monoxide (CO) and oxides of nitrogen (NOx). AT contributed a material reduction in CO emissions and a total reduction of about 3-1/2 tons of airborne pollutant particles and gases in 2004. This is equivalent to operating a late model automobile approximately 219,200 miles.
- Each additional avoided automobile trip has a direct air quality benefit, especially for avoided volatile hydrocarbons (VOCs) and carbon monoxide (CO). On the other hand, emissions of oxides of nitrogen (NOx) – associated with diesel engines – are confined to a fairly narrow range if the bus service stays the same and the composition of the fuel is the same.⁹
- About 14% of survey respondents¹⁰ said they would otherwise take a taxi for their trip, suggesting that they do not own and/or cannot afford an automobile.
- 47% of passengers surveyed said they would participate in a voluntary contribution program to help AT defray operating costs.
- Had AT not converted to fare-free on the entire system in January 2002, 2004-5 ridership might have been reduced by 50,000 (or more) boardings (19% to 20%). Given that almost 75% of the riders surveyed indicated that they had alternatives to riding the bus, the system would be at risk of losing significant ridership and the associated community benefits were AT to reinstate a fare on its existing routes.
- Potentially attractive opportunities exist for future expansion, better service frequencies or both as funds permit. However, there is an opportunity cost to expanding service because expansion must be supported by sources of long-term funding, which are severely limited. This demands that careful choices be made. These choices must be prioritized based on relative number of people served, costs, and on AT's and the City's goals and objectives.

In summary, boardings for the first 4 months of calendar 2005 (the latest data that was available at the time of the original Study) indicated that AT's fixed-route bus system was handling at least 2-1/2 times as many boardings as it had exactly a decade earlier (1994). And, by the conclusion of Fiscal 2004-5 would have five consecutive years of ridership growth. Based on data now available (August 2006), it is very likely that AT will add a sixth consecutive year of ridership (boardings) growth. Forty percent of these boardings are Lebanon residents. About 56% of

⁹ Diesel buses exhibit variability in performance due to passenger load, outside temperature, fuel quality and operating condition of the vehicle, plus variations in driver performance, traffic conditions, etc.. All of the foregoing is also true for automobiles and trucks. This study ignores variability in operating performance due to these factors. The EPA Mobile-6 air pollution model aggregates performance variability into a standard for buses and for cars and light trucks. See Section 6 and Appendix F.

¹⁰ Based on 366 survey respondents who said they'd make their trip by some other mode if the bus service didn't exist.

people surveyed face-to-face in April 2005 said they would otherwise make their trip by automobile.

Table 3 below summarizes many of the key findings of this study:

Table 3 – Summary Table of Key Findings (June, 2005 Study Except in Italics)		
Finding	Value (or values)	Comments
AT Boardings Growth, 1994-2004	135.3%	
<i>AT Boardings Growth, 1994-2005</i>	<i>168.9%</i>	
Population Growth, 1990-2000	10.6%	six municipalities served by AT
Employment Growth, 1991-2000	21%	35 municipalities that make up the Hartford/Lebanon Labor Market Area (LMA)
Percentage of AT passengers who said they live in Lebanon	40%	UVTMA survey, April 2005
Percentage of AT passengers who said their destination was Lebanon or West Lebanon	60%	UVTMA survey, April 2005
Lebanon population as percentage of six served municipalities	28%	City of Lebanon population 12,568 per 2000 census
Percentage of AT passengers who are transit-dependent	24%	UVTMA survey
Percentage of AT passengers who said they would otherwise travel by private auto	56%	UVTMA survey
Percentage of AT passengers who ride the bus because of work	57%	UVTMA survey
Percentage of AT passengers who ride the bus because of medical or other appointments	9%	UVTMA survey
Percentage of AT passengers who ride the bus to go shopping	13%	27.4% of Red Route passengers said they were shopping; UVTMA survey
Estimated number of people whose job may depend on the bus	111	Projected from UVTMA survey
Projected number automobile trips avoided, 2005	166,059	Based on UVTMA survey
Estimated auto miles avoided, 2004 vs. 2005 (projected)	844,500 (2004) vs. 896,700 (2005 proj.)	Avg. 5.4 miles per trip
Estimated net air pollution benefit	3-1/2 tons of pollutants	Net effect autos vs. buses
Estimated number of annual boardings attracted by fare-free policy	33,000 to 56,000+	Based on two estimating methods: boardings growth rates and fare elasticity.

Although the combined population of the six municipalities through which AT's bus service operates is small (45,266 according to the 2000 census), a surprisingly large number of employed

persons work and live within the immediate area. For example, a recent employer survey¹¹ indicates that 4,473 full-time employed people¹² who work in Lebanon or the immediate surrounding area live in one of the six towns served by AT. Of these, 1,073 – or roughly one-quarter – live in Lebanon. The fixed-route bus system is configured to be responsive to these work-related trips and is succeeding at diverting would-be auto trips onto the bus in addition to serving people who don't drive for their local work, shopping and other personal business needs.

AT's ridership growth history indicates that its customers respond strongly to improvements in the service. Principally, this means service frequencies (scheduled operating headways), hours of operation and faster schedules for commuters. However, any adjustments or expansion must be carefully planned and managed because the small population of the area coupled with limited funds means there is little margin for error.

Finally, AT passengers often make unsolicited comments praising the courtesy of drivers, the cleanliness of the buses, express gratitude that the bus service exists and express interest in more service in the future.¹³

To summarize the updating of the original June, 2005 Study that is possible because of actual ridership (boardings) data available through June, 2006, the following overall observations and conclusions are offered:

- Utilization of Advance Transit bus service accelerated on all routes. This phenomenon is true of commuter routes such as the Blue Route but is also true of the Red Route (a commuter and shopping route) and to a lesser extent the other three fixed routes operated by AT.
- Boardings for Calendar 2005 and FY 2005-6 exceeded projections presented in the 2005 study that were based on actual boardings through April, 2005. This is partly due to the fact that boardings for the last eight months of the calendar year have tended to be stronger than the first four months for at least the past two or three years, but also because utilization increased dramatically.
- AT's boardings increased during the first six months of calendar 2006 at the same rate as a year ago (over 14%).
- The air quality benefit achieved by diverting would-be private auto and taxi trips into bus trips was already beyond "breakeven" in 2004 based on the aggregate mass of pollutants emitted into the air (avoided auto emissions offset by bus emissions). We predicted that as more people ride the bus, this would further improve.

¹¹ Upper Valley Housing Coalition Employer Survey conducted late 2004-early 2005.

¹² We suspect that this headcount omits a large number of workers who are classified as "hourly" and therefore may not have been reported as "full time", even if they essentially work full-time or almost full-time. For example, many employees of Dartmouth-Hitchcock Medical Center, the area's largest employer, are hourly and therefore would not have been included in the 4,473 figure cited. For example, nurses working three 12-hour shifts each week are "hourly"; also, of 667 current DHMC employees who have a Lebanon or West Lebanon zip code, 386 of them were classified as "40 hour" employees. The remaining 281 were classified as hourly or had some other status.

¹³ Advance Transit Schedule Improvements, Final Report, December 2004, Tom Crikelair Associates, p. 2-10.

- Since AT operated substantially the same route network and service frequencies in 2005 as it did in 2004, using substantially the same equipment, the local air quality benefit has likely further improved to about 5.0 tons avoided (assuming the April, 2005 UVTMA survey results showing automobile diversion rates ranging from 54% for the Orange Route to 69% for the Blue Route (AT's premier commuter route) are still valid).

Finally, we note that ridership has increased since 2004 on all of the scheduled "commuter" transit bus services in the Upper Valley, including those operated by Stagecoach and Connecticut River Transit (CRT). This phenomenon of as much as double-digit ridership growth is straining capacity on some bus routes in the region, and carriers are struggling with limited resources to respond to the demand. Although difficult to prove analytically, the carriers and the UVTMA surmise that at least part of the increased demand is a reaction to sharply higher gasoline prices. Some of the increase might also be due to increased awareness of the availability of scheduled transit bus services in the region. A small but increasing number of the area's employers have become alert to commuting options for their employees, based on the level of interest the UVTMA has detected among employers.