Implementing value pricing on a highway in Southern California

Steven Vance

UPP 563: Joseph DiJohn

December 10, 2009

Abstract

Legislation enacted in 1991, Intermodal Surface Transportation Efficiency Act (ISTEA), started the era of Federal support for a relatively new and underutilized highway tolling method, charging a rate that was varied based on real time roadway conditions. The method, called value pricing in Federal policy and legislation, but more commonly known as congestion pricing, is now just shy of two decades old. The U.S. Department of Transportation (DOT), recognizing the potential for this innovative demand controller and revenue generator, offered funding to states to convert parts of highways into tolling lanes. The goal of the value pricing program is to manage congestion. It initially funded studies and implementation of highway tolling and pricing but are now no longer funded because the DOT considers them mainstream. One highway, Interstate 15 (I-15) in San Diego County, had its High Occupancy Vehicle lane (HOV) converted into a High Occupancy Toll lane (HOT). This article will examine how value pricing is implemented, the political process undertaken by a project champion, and a developing theory supporting value pricing projects. The article will demonstrate how I-15 is an exemplary project, in the planning context, but also how a well supported (both politically and publicly) comes to be.

Introduction

This paper will discuss the Interstate 15 (I-15) Express and Managed Lanes in San Diego County, California, a value pricing tolling project. Express and Managed Lanes are two separate projects: Express Lanes was the result of converting existing high-occupancy vehicle lanes (HOV) to high-occupancy toll (HOT) lanes that operated with a variable price; Managed Lanes is currently under construction and adds capacity to the Express Lanes and builds additional entry and exit ramps as well as improve bus facilities and customer service. The Managed Lanes pricing scheme will remain the same as it was with Express Lanes. Both projects will be discussed in more detail later and throughout this paper. Lastly, as with any pricing scheme of a public service, planners must deal with the requisite equity considerations.

Part 1

Value pricing: A definition

Value pricing is a way of using free market concepts to reduce congestion. Value pricing can be variable, making adjustments based on the current level of congestion, or it can be a fixed price that adjusts with time. Value pricing can exist lane-by-lane, or for an entire road. Less common in North America are cordon pricing charging based on entrances and exits to a well-defined

zone, and area-wide pricing, which is a per-mile charge on all roads. (Federal Highway Administration 2006)

The Netherlands central government in November 2009 announced a tax conversion from an annual road tax and car purchase tax to a per-mile charge. The Ministry of Transport predicts the new tax scheme will reduce congestion, overall traffic, fatalities, and carbon emissions. (Max 2009)

Value pricing implementation

To be implemented, value pricing needs political support more than any other aspect of project development. A "political champion" is a far more important project component than technology, funding, or legislative support. The latter three components are highly invariable relative to the political support needed, as the components are either standardized and widely used (technology), or are nationally similar (federal funding and legislative support).

Technology

The technology to implement value pricing has been available for a long time. Electronic toll collection has been used for decades – the difference between fixed price tolling and value pricing is the toll price and the timing at which it changes. As you will read later on, Phase I of the I-15 Express Lanes involved a no-tech solution: visible, colored badges inside vehicle windshields.

Funding

Funding is readily available to proficient, well-prepared and competitive projects. The current transportation legislation, Safe Accountable Flexible Efficient Transportation Equity Act-A Legacy for Users (or SAFETEA-LU), includes $59 million for an unspecified number of projects in fifteen states. (Federal Transit Administration 2005)

Any required funding matches or funding shortfalls can usually be covered by one of a number of other funding programs from federal, state or local sources. The San Diego Association of Governments (SANDAG) gathered funding from more than ten distinct federal, state and local sources for its I-15 Managed Lanes project (SANDAG Budget 2008). Revenue bonds were an option for the project because the project has a predictable revenue stream, but the project manager, SANDAG, was creative in utilizing all possible funding sources available.

Legislative support

Value pricing has excellent legislative support from Congress. Value pricing has been a Federal Highway Administration (FHWA) program since the introduction the transportation authorization bill adopted in 1991, the Intermodal Surface Transportation Efficiency Act (ISTEA). Funding levels have continued to rise year after year, and the belief that value pricing is efficient and useful continues with SAFETEA-LU. State legislation is a different matter. State statutes will usually restrict where tollroads can be built and who can operate tollroads.

Part 2

Political support and history

The aforementioned project components - technology, funding and legislative support - should be second thoughts to agencies considering implementing value pricing. The first, and most important, obstacle to overcome is political support. I will tell the story of how I-15 Express lanes came into fruition, which explains how an individual carried the entire project through its birth and development, battling the handful of antagonists, and obtaining the State legislation that was required for the Express lanes to materialize and the individual's ultimate goal to be realized.

Two HOV lanes opened in 1988, built by the California Department of Transportation (Caltrans) (Hultgren and Kawada). These lanes were funded by CMAQ grants (San Diego Association of Governments). At this time only 57% of Vehicle Miles Traveled (VMT) in the peak periods were in congestion conditions. In 2005, the last year from which data was collected, 85% of VMT in the peak periods were in congestion conditions. Delay per peak period traveler has grown from 31 hours in 1988 to 57 hours in 2005. The data are from the Texas Transportation Institute's Urban Mobility Report for 2007. To compare, Chicago peak period travelers experienced delay of 26 hours in 1988, which had increased to 46 hours in 2005. The San Diego urban area that was studied is denser than the Chicago urban area, and experiences a higher "congestion cost" or value lost due to travel delay, the average San Diegan paying $500 more than Chicagoans.

A local politician, then the Mayor of the City of Poway, Jan Goldsmith, was the first to bring attention to the excess capacity on the road. Mr. Goldsmith desired a light rail line to connect his city on the same corridor as the highway. Funds were allocated for a light rail line in the south of the county, nowhere near Poway. After some convincing, Mr. Goldsmith realized that SANDAG had no funds to allocate for light rail service near Poway. At this time, Mr. Goldsmith began his advocacy work to convert HOV lanes to tolled lanes. (Shoup, King and Manville)

Current state legislation did not allow HOV lanes to be used by non-exempt[1] vehicles that failed to meet the occupancy threshold of two persons. This would not be a difficult barrier to overcome because Mr. Goldsmith was elected to the California State Assembly in 1992. The bill he authored was Assembly Bill 713 (AB713). Still, Mr. Goldsmith's ultimate goal was to have transit service in Poway and the northern cities of San Diego county, and HOT lanes could pay for it. (Shoup, King and Manville)

AB713 was signed into law by Governor Pete Wilson in 1993. The act specifically allowed the I-15 HOV lanes to be used, for a fee, by vehicles that would normally be ticketed for such use. The act would expire on January 1st, 1998. The act also maintained that the Level of Service (LOS) of the HOV lanes should not be allowed to degrade after conversion to HOT lanes, and that high occupant vehicles shall never be restricted from the lanes. (Goldsmith and Kelley)

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[1] Exempt vehicles include those meeting the high occupancy requirements, as well as emergency vehicles, motorcycles, and buses.

As described above, the I-15 Value Pricing Project was a SANDAG planning project. Members of SANDAG made a resolution in May 1991 to develop a project that would demonstrate the feasibility of selling the excess capacity in the HOV lanes. (Hultgren and Kawada)

Legal consideration

Mayor Poway needed regional and statewide political support because, for the project to actually be constructed, a bill had to be voted on, one that would explicitly allow the tolling of an HOV lane. State law declares that HOV lanes should always be allowed for the use of carpoolers, transit buses and a variety of other exempt uses. The new statute – which was the first of many – allowing SANDAG's I-15 work to continue made two major exemptions to state law made the following actions legal:

1. It provided for SANDAG to be the sole operator of a "congestion pricing and transit development project," a role normally assumed by Caltrans.
2. It exempted SANDAG or its contractual toll operator from having to deposit into the State Highway Account the revenues from the project.
3. It allowed SANDAG to spend the revenues on projects in six categories as specified, the most important to Mayor Poway (now a State Assemblyman) being the development of a "light-rail equivalent transit system." (California State Assembly 1993)

Project goals

The group created the proposal for I-15 Value Pricing Project, which outlined three goals:

1. "Maximize the use of the existing capacity on the HOV lanes;
2. Improve transit and HOV services along I-15; and
3. Relieve congestion along I-15"

(Hultgren and Kawada)

In the final study, the third goal was modified to "to test whether allowing solo drivers to use the Express Lanes' excess capacity can help relieve congestion on the I-15 main lanes." The federal government's goal of funding a demonstration project like the I-15 Value Pricing Project is to determine if dynamic pricing can relieve congestion by selling to the user the service of a faster trip.

A fourth goal arose during the project's implementation: to test a market-based approach to setting the price of the toll. (Supernak, Overall Report)

Project members

The project was implemented with the Project Management Team, whose members included SANDAG, Caltrans, FHWA, the FTA, the California Highway Patrol (CHP), Metropolitan Transit Development Board (MTDB), Jan Goldsmith's offices (first as Mayor of Poway, then as State Assemblyman), the city of San Diego, and the American Automobile Association (AAA). (Hultgren and Kawada)

The AAA's role in this project's development is unclear. It's understandable that their support of HOV lane tolling could only be beneficial to convince its members who may be potential highway users that the project's value pricing concept will be fair and only serve to increase the choices a roadway commuter has for travel. The other members' roles should be more obvious:

- Caltrans must approve the project and administer funding.
- Both FHWA and FTA provide funding and project approval.
- CHP enforces the HOV lane, ticketing violators.
- MTDB operates the Inland Breeze express bus service.
- Jan Goldsmith got the project out of the SANDAG boardroom, into the legislature, and on the road.
- City of San Diego, which is the major destination of I-15 travelers.

As you can ascertain, the I-15 Express lanes project successfully came to implementation because of the hard work of Mayor Poway. His strategy of personally visiting area mayors and educating them on the project, its benefits to them, and how he planned to continue his quest, should be looked at by other value pricing proponents as an example of effective political support.

Project description

Express Lanes

The project was implemented in two phases:

1. Phase I was a no-technology test, where SANDAG sold monthly passes which members affixed to their windshields. CHP officers patrolled the HOT section, ensuring that all vehicles met the HOV standards (2 or more occupants), or displayed the current month's pass.
2. Phase II involved traditional electronic toll collection. In California, toll roads use a system call FasTrack, which is identical in operation and technology to Illinois' I-PASS system or the Northeast region's EZ-Pass.

As Mayor, Jan Goldsmith wanted a light-rail to connect his town with San Diego. He saw I-15 as an appropriate corridor for this new line. The wording of the Assembly Bill he drafted and passed indicated a light-rail alternative could be built. This is exactly what happened.

The Inland Breeze, an express bus service operated by the San Diego MTDB, was the new transit, or light-rail alternative, service mentioned in the Assembly Bill. The bus operates in the HOV lanes. The Inland Breeze operates today, but with a revised schedule that gives a faster service to riders traveling in the peak direction. The operating costs are completely funded by HOT lane revenues. (San Diego Association of Governments 1999, pp 13-14)

Express lanes met all four goals and was well received by users and non-users. The project maximized the use of the empty capacity of the HOV lanes; it improved transit services (by providing transit where there was none previously); the Express lanes reduced congestion in the main lanes by allowing single occupant vehicles (SOV) pay a fee to use the HOV lane; and it showed that market, or dynamic, pricing is effective in setting tolls that are an essential tool to reduce congestion. (Supernak, et al. 1998)

Managed Lanes

In order to prepare the roadway for population growth along the I-15 corridor, a change in driving patterns, and to further improve transit, SANDAG proposed expanding the HOV lanes.

As demand for the HOV lanes continues to grow, the fee for using the HOV lanes will have to rise to ensure legislatively mandated Level of Service (LOS) C (or better) conditions, or SANDAG will have to open more HOV lanes. SANDAG has obviously chosen the latter option.

The Managed Lanes will not only allow SANDAG to sell more "excess capacity," but will bring benefits to transit as well. Tangible transit benefits being constructed in the Managed Lanes project include six new bus rapid transit centers with park and ride lots, modification of existing centers, direct access ramps which will decrease the amount of time a bus spends outside from the fast-moving HOV lanes, and increased capacity for large buses.

With the Managed Lanes system, one lane will always be open in the off peak direction. SANDAG can attract new users to the toll system and opens the door for additional revenue. The off peak lane will also be used by the express buses, further increasing the appeal of transit. The managed lanes will do a good job at "future proofing" the I-15 bus rapid transit system by making sure there will always be capacity for buses in both directions. Managed Lanes will transform the express bus system to something more identifiable with bus rapid transit.

Part 3

This section discusses how the I-15 projects utilize value pricing, how they are successful in achieving their goals because of value pricing, and then present a discussion on theoretical approach to value pricing roads: willingness to pay and value of time.

Value pricing on I-15

Over the past 15 years, SANDAG has used or will use three unique value pricing schemes. The first two schemes will be discussed in detail. The third scheme hasn't yet begun operation. It's apart of the Managed Lanes, which is still under construction. Since there are multiple entries and exits in the I-15 stretch of managed lanes, a user could hypothetically enter one section and exit immediately into the main lanes. The user could then reenter the managed lanes at a different section. Therefore, the toll is divided into fractions, one for each section. Depending on congestion which would force the the toll to increase or decrease, though, the user could pay a different toll for each section they drove on because of the multiple entries, whereas a driver who never left the managed lanes would pay a consistent toll in each segment for the entire trip.

In transportation economics and implementation, links and networks can be value priced in two ways: statically or dynamically. Both the Express and Managed Lanes employ dynamic pricing. Static value pricing is the mechanism when the price changes to a predetermined amount at a set time or time interval. Dynamic value pricing has neither a predetermined amount, nor a set time ort time interval at which the price will change. On the I-15 Express Lanes, the price *can* change every six minutes, but it won't always do so. The price to which it will change, if the computer algorithm decides it must, will increase in 25-cent increments. However, where static pricing might raise the price 50 cents each half-hour, dynamic pricing can raise the price 50 cents in 12 minutes, or in 18 minutes.

Express Lanes, first scheme

The first phase of Express lanes involved selling a windshield sticker to interested drivers on a monthly basis. The price was $50 per month. After only three months, SANDAG raised the price to $70 per month. It should be noted that this is an odd form of static value pricing, and it was shown to not reduce congestion on the Express lanes. (Supernak, et al. 1998)

Express Lanes, second scheme

The second phase of Express lanes saw the introduction of electronic toll collection, using the statewide-compatible FasTrak transponder. The monthly pass was done away with, and users paid a toll that varied dynamically with congestion levels on the main lanes. Computer software checks the Express lanes' congestion levels every six minutes, using the magnetic loop conductors in the roadbed. The legislation governing the I-15 HOV lanes states that SANDAG must maintain LOS C. When congestion rises on the main lanes, the likelihood for SOVs to pay to use the HOT lanes. Too many additional SOVs at one time could potentially decrease the LOS of the HOT lanes so the charge rises.

For each measurable level of congestion increase, the tollway operators know that the propensity for more SOVs to pay for HOT lanes is greater and the toll price should rise yet again. The toll rises in 25-cent increments, and will reach a maximum of $4.00 each day. In the case of extreme congestion events, due to weather or roadway collisions, the tollway operator has the authority to raise the toll to as much as $8.00. Some users may feel that in these cases, the HOV lanes should be free so that the combined roadway LOS increases in order to get around the collision or slow driving because of weather. However, the legislation requires that the tollway operator maintain LOS D in these conditions and the tollway operator has the capability to charge the $8.00 toll in order to fill that obligation.

Achieving goals

It appears that the I-15 Express Lanes project met the goals SANDAG planners set for it. The use of dynamic value pricing can be attributed with the project's success in meeting all four goals. How did value pricing work so well in this implementation?

1. *To maximize use of the existing I-15 Express Lanes*
   Obviously, opening up the express lanes to a new category of users (SOV users, for a fee) brought in more vehicle volume. The switch from a monthly sticker to Electronic Toll Collection (California's FasTrak) increased the amount of fee-paying users. (Supernak 2001)
2. *To fund new transit and HOV improvements in the I-15 corridor*
   The tolling provided completely new revenue. This new revenue provided for additional service on the Inland Breeze bus service. The final report from Supernak et. al. explained that the bus attracted new ridership. Managed lanes will see more BRT-like bus service, with park and ride lots and reduced time maneuvering into the express lanes. (Supernak 2001)
3. *To test whether allowing solo drivers to use the lanes' excess capacity can help relieve congestion on the I-15 main lanes*

"Average peak period volumes on the I-15 main lanes generally decreased…" (Supernak 2001)

4. *To use a market based approach to set tolls*
   "[T]he dynamic nature of fee adjustment, never tested elsewhere, as it demonstrates that the goal of better facility utilization does not need to be accompanied by a diminishing level of service." (Supernak 2001)

Equity

Political support is necessary for any value pricing application. Mayor Jan Goldsmith's story of political maneuverings gave that indication. Implementing value pricing is politically difficult to implement because of the high opposition from the public. This is because of the costs borne by the user. In the case of I-15 Express lanes, all users have the opportunity to use the express lanes if they ride the bus, a motorcycle, ride with a friend or coworker, or drive an exempt low-emission vehicle. There are several tollways around the United States and the world which don't have a free alternative.

Weinstein and Sciara (2006) suggest that we should avoid defining whether or not the HOT lane concept is equitable, but instead how to address perceived equity issues. The pair have written two reports for planners who will potentially work on value pricing projects. Both reports are cited in this section.

It has been found in the I-15 Express lanes application that users who never use the express lanes, and only use the main lanes (free lanes) occasionally benefit from the lane shift of users to the Express lanes. (Supernak, et al. 1998)

Another concern is that low-income drivers, by avoiding the tolled lanes because of their cost, will "disproportionately benefit high-income drivers" (Weinstein and Sciara 2006, 179). This debate between rich and poor drivers has emerged under the title of "Lexus lanes," but the arguments calling HOT lanes a fast lane for the wealthy are unfounded:

a. Users from all income groups use the express lanes on I-15 and find it fair. The final report's (Supernak 1999) attitudinal survey found that within all income groups, a majority of respondents approved of the FasTrak tolling of solo drivers in the I-15 HOV lanes.

b. As a mitigation measure to this perception, the Express lanes operation is paid for entirely by toll revenue, which also pays for increased express bus service. Oddly, though, Calfee and Winston (1996) found that the way toll revenues are used does not affect commuters' WTP, suggesting that these two mitigation measures do not affect public perception.[2]

See Appendix A for additional information on equity considerations in value pricing projects.

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[2] Weinstein and Sciara (2004, p13) present their findings on how other tolling and value pricing projects address equity issues, including returning toll revenues to the corridor in the form of transit service.

Cost-benefit ratio

A value pricing application should only be implemented when all costs will be outweighed by all benefits, for all users. In a value pricing application that prices all lanes the same, some users may be priced off the road. This equity consideration was addressed above, but necessitates another analysis, converting the price barrier to low-income groups to a cost that shall be calculated into the cost-benefit ratio.

Value of time theory is useful when performing cost-benefit analysis. All benefits, whether they begin as monetary valuations or not, must be expressed in a present dollar value. Value of time theory lends itself to the determination of actual value of time transforms travel time savings into the necessary present dollar value.

Conclusion

The Interstate 15 Express and Managed lanes projects are a display of well supported projects, both in the planning, political and public contexts.
The projects demonstrate that value pricing is:

- Effective in reducing congestion
- Able to generate revenues to mitigate perceived equity issues
- Demonostrates the power to find the most accurate value of time

This article should find its audience comprised of project planners and managers, in addition to politicians who already support the value pricing and HOT lane initiatives, as well as those who don't yet support the project. Like any new tax or toll, public opinion quickly comes down against the prospect and the news media tend to oversimplify and sensationalize the announcement.

Thorough research and understanding of the I-15 Express and Managed lanes will convert any skeptical skateholder of the positive consequences of the value pricing of transportation.

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Appendix A

Value pricing has inherent economic factors and externalities that affect fairness and equity of the users of a value priced roadway. Some of these factors are the result of misconceptions and lack of understanding. However, many factors are legitimate and have the potential to negatively affect identifiable groups of road users.

For example, value pricing may push some original users of the road to an alternative transit route, possibly crowding the vehicles serving the route or slowing boarding times. The benefits of a value pricing may bypass low-income drivers because of their inability or reluctance to afford the road tolls.

Planners developing a project whose goal is to either raise revenue, reduce congestion, or both, must take into consideration how the project's design will affect and hopefully mitigate the equity concerns that will inevitably arise.

Project designers should perform research on a project by project basis, as there's no single way to define or measure equity - however, many mitigation techniques are available to categorically defeat the most popular arguments about equity issues.

I've reviewed three works ("Acceptability of Transport Pricing Strategies," "Unraveling Equity in HOT Lane Planning," and "Transportation, Efficiency, and Equity") below and noted how they can assist value pricing project developers and champions. Each work presents, discusses and solves (actually, at best offers possible solutions) different perspectives, experiences, and problems respectively.

Jens Schade and Bernhard Schlag of the Dresden University of Technology in Germany edited and published a book of journal articles about value pricing policy in Europe, a continent that is pioneering value pricing of roadways. "Acceptability of Transport Pricing Strategies" (2003, Elsevier Ltd.) can act as a guide to American planners developing value pricing projects.

The articles present analysis of value pricing projects from conception, to development, implementation, and evaluation, as well as from conception to failure, noting all the ways governments and agencies have attempted to overcome political and equity barriers.

For example, in the article, "Meeting the Challenge," the author discusses an argument against value pricing that fits specifically into the story of the I-15 Express and Managed Lanes projects. Jones writes that congestion is the road system's failure and the road users are against paying for this. However, he adds that many value pricing projects (including I-15) offer a better level of service for a charge and "still have the option of using the unpaid facility with a lower quality of service."

The second work, "Unraveling Equity in HOT Lane Planning," by Asha Weinstein and Gian-Claudia Sciara, reviews similar articles available in "Acceptability of Transport Pricing Strategies" but provides organized conclusions from their research.

The authors write two summary explanations I believe are relevant to the I-15 projects:

- "When viewed only as a tax, congestion pricing is mildly regressive, but probably less so than other forms of transportation finance utilized in the United States (particularly the sales tax and motor-fuel tax)."
- "When congestion pricing revenues are redistributed, the overall effect can be progressive. This may even be the case with a uniform redistribution of revenue to users of tolled facilities, as well as other mechanisms that specifically benefit lower-income groups. Of all the points in this section, we find the broadest agreement that redistribution is key to equitable outcomes."

Finally, Myers, Saunders, and Chung investigate empirically using 1990 Census Data the potential impacts of value pricing on racial groups in four cities in the United States. The researchers find that among races, there already exist significant inequalities of travel time. The researchers use travel time as means to calculate savings and benefits - value pricing is often seen as a way to reduce travel time in the priced lanes.

These inequalities are due to differences in mode access[4], racial discrimination, and location and housing segregation. The findings show that a well-designed value pricing system can compensate users who experience direct or indirect monetary losses because of their travel mode, and it is highly unlikely that value pricing will resolve problems the structural problems listed above.[5] The study was written before any value pricing system was implemented (the I-15 carpool lanes were converted to HOT lanes in 1999) and suggested that a value pricing experiment be conducted in a city with an already low racial disparities in travel time. The study included the "Twin Cities" (Minneapolis and St. Paul, Minnesota) and mentioned them as a starting place, a place where "redressing the inequality would be far easier to implement than in metropolitan areas like Chicago."

Appendix B

List of states with Value Pricing Pilot Programs, funded in part by the Federal Highway Administration. One "slot" remains.

1. California
2. Florida
3. Georgia
4. Illinois
5. Maryland
6. Minnesota
7. New Jersey

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[4] Does the individual have access to a private automobile or carpool? Users with access to these modes typically have a lower travel time than those who take transit.

[5] A narrative example of a structural problem from the study: "In Houston, black public transport users face a disadvantage of three minutes directly as a result of not living and working where whites live and work." The study mentions that non-whites typically have longer trips to work that whites.

8. New York
9. North Carolina
10. Oregon
11. Pennsylvania
12. Texas
13. Virginia
14. Washington

In November 2009, Arizona Department of Transportation (ADOT) expressed interest in converting some lanes on the I-10 highway through the Phoenix Valley. The Arizona Republic reported on the story, but did not indicate if the organization would seek federal funding. Federal .Transportation Secretary Mary Peters was quoted as saying that ADOT should find private partners because "they have the technical know-how and access to quick capital to open HOT lanes."[6]

[6] "Would you pay a toll to beat traffic in the Valley?" *The Arizona Republic*. 23 November 2009. Accessed 27 November 2009. <http://www.azcentral.com/news/articles/2009/11/23/20091123hotlanes1123.html>.