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ITS and the Environment: Issues and Recommendations for ITS Deployment in California

**Thomas A. Horan, Lamont C. Hempel
Daniel R. Jordan, Erik A. Alm**

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ITS AND THE ENVIRONMENT

Issues and Recommendations for ITS Deployment in California

**Thomas A Horan, Ph.D., Principal Investigator
Lamont C. Hempel, Ph.D., Co-Principal Investigator**

**Daniel R. Jordan, Project Leader
Erik A. Alm, Research Assistant**

CLAREMONT GRADUATE SCHOOL RESEARCH INSTITUTE

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ABSTRACT

Environmental issues play an important role in the development and deployment of Intelligent Transportation Systems (ITS) technologies. ITS -- the application of advanced technologies (e.g. computers, communications, advanced sensors) to the surface transportation system -- could have significant effects on California's natural environment, economy and society, and this has prompted widespread research and speculation on the range of potential ITS impacts. This study culminates a two year, multi-faceted inquiry into the environmental issues associated with ITS. In addition to reviewing the literature on ITS-related environmental issues, this report presents results from three focus groups that explored the attitudes of California environmental stakeholders about ITS. The report also addresses public acceptance issues related to ITS, focusing on public acceptance of Advanced Traveler Information Services (ATIS), congestion pricing, and telecommuting. The report concludes with summary results and recommendations for devising regional and statewide ITS deployment strategies that garner public and environmental stakeholder support.

Keywords: Intelligent Transportation Systems, Environmental Issues, Environmental Stakeholder Attitudes, User Acceptance

EXECUTIVE SUMMARY

Environmental issues play an important role in the development and deployment of Intelligent Transportation Systems (ITS) technologies. ITS -- the application of advanced technologies (e.g. computers, communications, advanced sensors) to the surface transportation system -- could have significant effects on California's natural environment, economy and society, and this has prompted widespread research and speculation on the range of potential ITS impacts.

This study culminates a two year, multi-faceted inquiry into the environmental issues associated with ITS. The initial parts of this examination included two national conferences and a research paper. The research paper, entitled *Institutional Challenges to the Development and Deployment of ITS/ATS Systems in California*, explored the critical "non-technical" issues facing the California ITS program. The first conference, the *National IVHS and Air Quality Workshop* in Diamond Bar, California, addressed technical issues surrounding the air quality impacts of ITS technologies. This conference was followed by the *National Conference on Intelligent Transportation Systems and the Environment* held in Arlington, Virginia, which examined how ITS technologies could broadly impact the environment.

The two national conferences and the research paper made numerous summary findings and recommendations, but two issues emerged from these studies that required particular attention. The first was the need to mainstream environmental stakeholder groups into the ITS decision-making process. The research paper in particular underscored the importance of environmental stakeholder acceptance of the California ITS/ATS program, and recommended the "development of [a] structured forum to solicit and consider California environmental interest and concerns about ITS" (Horan et al., 1995: iv). The second issue highlighted the importance of regional diversity to ITS deployment. A central recommendation of the Arlington conference was that "ITS deployment be based upon local and regional decisions" (Hennessey and Horan, 1995: 203), and the research paper reinforced the importance of regional diversity and decision-making in the California context: "Because California has been and will continue to be a leader in early deployment of ITS, it must understand how to interface ITS systems within the regional decision-making process..." (Horan et al., 1995: 12). Addressing these two needs -- greater inclusion of California environmental stakeholders in ITS policy discussions, and the importance of understanding regional perspectives on ITS deployment -- is the purpose of this final report.

This report consists of four sections. Section One reviews the literature on ITS-related environmental issues. Section Two presents the cornerstone of this report: results from three focus groups that explored the attitudes of California environmental stakeholders about ITS. Section Three addresses public acceptance issues related to ITS, focusing on public acceptance of Advanced Traveler Information Services (ATIS), congestion pricing, and telecommuting. Finally, Section Four presents summary results and recommendations for devising regional and statewide ITS deployment strategies that garner public and environmental stakeholder support. Listed below are summary findings from each section.

Environmental Issues Associated with ITS

A distinguishing feature of the literature on ITS and the environment is the breadth of topics it addresses. Studies of the "environmental" issues associated with ITS consider not only the biosphere, but the entirety of social and ecological conditions that influence

the lives of individuals and communities. Within this broad conception of environmental issues, however, certain topics consistently emerge in environmental analyses of ITS. Presented below are the particularly salient concerns and recurrent themes with respect to ITS-related environmental issues:

Air Quality: ITS impacts on air quality is a critical issue, in part because the potential effects of various ITS applications on vehicle emissions remains uncertain. Studies indicate that ITS technologies could improve air quality by enhancing both supply-side and demand-side emission reduction strategies. Other studies raise concerns, however, about induced demand as well as the limited effectiveness of transportation control measures. Improvements in modeling and other impact measurement techniques may also be necessary to give more credibility to environmental impact assessments for ITS deployments. In addition, clean vehicle technologies (e.g. electric vehicles) could affect the air quality context into which ITS deployment takes place.

Land Use: Many analysts stress the need for integrated approaches to transportation and land use planning. Some experts express concern that congestion relief from supply-side strategies alone would increase travel distances for commuters while reducing commute trip times, leading to VMT increases and possible emissions increases. Others believe the relationship between transportation and land use patterns is weak, and thus believe ITS will have negligible land use impacts.

Social Equity: ITS deployments, particularly those involving public funds, raise concerns about “equity,” or the distribution of ITS benefits and costs across both geographic areas and socio-economic groups. Some question whether ITS benefits will be either concentrated in affluent areas or inaccessible to low income individuals.

Sustainability: “Sustainability” refers to attempts to understand environmental impacts in a long-term, holistic manner. Many issues associated with transportation can be treated individually, but some believe attempts at sustainable transportation policies provides a more integrated approach. While ITS alone could not create sustainability, as an amplifier of transportation trends ITS could promote significant positive or negative long-term environmental impacts.

Environmental Regulation: The emerging nature of many ITS technologies makes it difficult to gauge the impact of environmental regulations on ITS deployment. Various laws (e.g. CAAA, ISTEA, EIR requirements) could pose constraints on the deployment of some ITS technologies, while other ITS projects could proceed without delay. A key to successful deployment is integrating ITS with the web of policies involving public and private transportation, energy, and the environment.

Public/Private Roles: The private sector’s strong role in the provision of ITS goods and services places unique opportunities and constraints on governments generally and on the role of environmental regulations in particular. As a result, ITS deployment goals must reflect a balance between the environmental goals pursued by governments and the market goals of private industry.

Congestion Pricing: Congestion pricing is a controversial yet potentially effective means of reducing both traffic congestion and pollution. While ITS could enable congestion pricing through electronic toll collection, widespread pricing might divert traffic to unpriced arterial streets and disrupt neighborhoods. Many see congestion pricing as an area where the interests of business and government could intersect.

Overview of Focus Groups

The major empirical activity summarized in this report are findings from three focus groups conducted in separate regions throughout California. These included:

Los Angeles: September 22nd, 1995, at the Streisand Center for Conservancy Studies in Santa Monica;

San Francisco: October 23rd, 1995, at the Presidio in San Francisco;

Sacramento: November 15th, at the State Capitol in Sacramento.

The Los Angeles and San Francisco meetings highlighted regional issues related to ITS and the environment, while the Sacramento meeting focused on state-wide issues. The focus groups consisted of activists and professionals from the business, government, and non-profit sectors (see Section Two for a complete list of attendees). Roughly half of the participants represented government agencies, except for the Los Angeles focus group which had a larger percentage of business and non-profit representatives. Participants possessed either an interest or expertise in ITS-related environmental, social and economic issues, and we chose individuals from professionally diverse backgrounds in an attempt to generate a range of responses representative of the environmental community. While not statistically representative of all decision-makers in the ITS deployment process, the focus groups did provide an opportunity to explore environmental perspectives from many key stakeholders.

The seven issues highlighted in the review of ITS-related environmental issues -- air quality, land use, social equity, sustainability, environmental policy, public-private issues, and congestion pricing -- provided the discussion framework for the focus groups. We structured the focus groups around these issues for two reasons. First, our previous research (the two conferences and research paper conducted earlier in this study, and the review of the literature on ITS-related environmental issues) revealed the salience of these issues to environmental stakeholders. Second, practical constraints related to conducting a focus group -- such as the time needed for detailed discussion of topics -- required that we target the discussions on core issues.

The charts on the following pages summarize key findings from the focus groups. We divided the summary results from the focus groups into two parts: 1) general assessments and crosscutting themes and 2) topic-specific observations. Also below is a summary of the range of issues discussed at each of the three focus group meetings. A detailed overview of all these findings appears in Section Two.

Focus Group Findings: General Assessments and Cross-Cutting Themes

- There were regional differences in how environmental stakeholders viewed ITS: participants in the Los Angeles and San Francisco meetings highlighted ITS-related environmental issues of considerable importance to their respective regions, while the Sacramento attendees focused more on state-wide issues.
- On the whole, the Los Angeles and San Francisco groups exhibited greater support for ITS than the Sacramento group.
- Discussions of ITS impacts on social equity elicited particularly strong feelings and debates among focus group participants, highlighting the political sensitivity of these issues.
- A recurrent theme was that the ITS program should be “goal-driven” rather than “technology-driven,” with clear transportation goals (e.g. reducing vehicle trips) guiding ITS development and deployment decisions.
- Attendees generally, though not unanimously, gave remote sensing technologies and Advanced Traveler Information Systems (ATIS) solid endorsements on environmental grounds.
- In all three meetings, general consensus emerged that ITS-enabled road pricing strategies could reduce both pollution and congestion but that the barriers to their implementation were formidable.
- General consensus prevailed in all three meetings that California’s current environmental policy context differs from that in the recent past, and that this change bodes poorly for attempts to use ITS deployments to pursue environmental objectives.
- Participants repeatedly cited the lack of data about the environmental impacts of ITS as detrimental to informed discussion about the technologies and as a potential obstacle to ITS deployment. It was also noted that reliable data and models on potential ITS impacts would be critical if ITS deployments faced legal challenge on environmental grounds.

Focus Group Findings: Topic-Specific Observations

Air Quality	<ul style="list-style-type: none"> • Consensus that air quality goals associated with ITS should not be considered in a vacuum • General consensus on the air quality benefits of remote sensing of emissions and ATIS • Agreement that emissions models are currently insufficient
Land Use	<ul style="list-style-type: none"> • No consensus on effects of ITS suburban “sprawl” and land use patterns • Some felt ITS could help revitalize urban areas
Social Equity	<ul style="list-style-type: none"> • Equity/ITS issues were contentious, highlighting their political sensitivity and the need for coalition-building • Consensus that ITS could and should serve the needs of low-income people • Broad agreement that ITS benefits would concentrate in more affluent, suburban areas
Sustainability	<ul style="list-style-type: none"> • Many participants expressed concerns or gave suggestions consistent with sustainability principles
Environmental Policy	<ul style="list-style-type: none"> • Discussion of environmental policy varied substantially across groups • Many participants argued that ITS program should be “goal-driven” rather than “technology -driven” • Each meeting discussed the extent to which environmental policy and ITS should focus on technological solutions vis-à-vis behavioral change • Participants felt innovative ITS regulatory regimes needed to be devised.
Public/Private Roles	<ul style="list-style-type: none"> • Overriding concern at each meeting with the opportunities and risks of public/private ITS partnerships • Consensus that regulations must encourage private sector ITS investment, but some feared “under-regulation” of ITS could thwart public goals
Congestion Pricing	<ul style="list-style-type: none"> • General consensus emerged on the technological feasibility and potential environmental benefits of congestion pricing, but political obstacles viewed as formidable

Focus Group Findings: List of Issues Discussed at Each Focus Group

<i>DISCUSSION AREA: ITS and...</i>	<i>ISSUES RAISED: Los Angeles</i>	<i>ISSUES RAISED: San Francisco</i>	<i>ISSUES RAISED: Sacramento</i>
AIR QUALITY	<ul style="list-style-type: none"> • The need for continued technological innovation • Emissions monitoring, particularly through remote sensing • Positive influence of Advanced Traveler Information (ATIS) • Potential air quality tradeoffs • Considering the larger context when discussing air quality 	<ul style="list-style-type: none"> • Positive impacts of APTS and ATIS applications • Incident Management applications • Availability of reliable air quality data • Emissions monitoring, especially through remote sensing 	<ul style="list-style-type: none"> • Emissions monitoring, especially through remote sensing • Potential positive air quality impacts of CVO and AVI
ENVIRONMENTAL POLICY	<ul style="list-style-type: none"> • Technological solutions versus behavioral change • Environmental impact models and performance indicators • Early deployment of Advanced Traveler Information (ATIS) 	<ul style="list-style-type: none"> • Effect of Bay Area's Clean Air Act attainment • Accessibility vs. Mobility as transportation policy goal • Environmental impact models and performance models • Representation of full spectrum of stakeholders • Technology-driven ITS program • Increased environmental education and awareness • Deployment of ATIS applications • Lack of public sector transportation funding and high costs of ITS technologies 	<ul style="list-style-type: none"> • Goal-driven versus technology-driven ITS program • Potential ATIS benefits • ITS-related politics
SOCIAL EQUITY	<ul style="list-style-type: none"> • Equal access to mobility: more demand responsive transit • Impacts on different socio-economic groups: road/vehicle pricing strategies and vehicle scrappage programs 	<ul style="list-style-type: none"> • Ability of ATIS to address equity concerns • Equal access to mobility 	<ul style="list-style-type: none"> • What are needs of low-income people: low tech buses versus high-tech ITS • Geographic distribution of ITS costs/benefits
LAND USE	<ul style="list-style-type: none"> • ITS impacts on "sprawl" • ITS as a tool for urban renewal 	<ul style="list-style-type: none"> • ITS impacts on "sprawl" • Linkage of equity and land use issues 	<ul style="list-style-type: none"> • Likely marginal ITS impacts on land use patterns • ITS as tool in urban planning
SUSTAINABILITY	<ul style="list-style-type: none"> • ITS should not reverse gains made in environmental quality • Road/Emissions pricing programs 	<ul style="list-style-type: none"> • Need for long-term perspective on environmental issues 	<ul style="list-style-type: none"> • Need to broaden transportation discussion from efficiencies to quality of life
PUBLIC-PRIVATE	<ul style="list-style-type: none"> • Public-Private partnerships • Incentives for private sector participation 	<ul style="list-style-type: none"> • Private sector control of ITS deployments • Partnerships with high-tech industries • Ability to support a private ATIS market • Market-driven research on ITS 	<ul style="list-style-type: none"> • Distribution of public/private ITS responsibilities • Risks and opportunities associated with privatization and public/private partnerships
CONGESTION PRICING	<ul style="list-style-type: none"> • ITS as facilitator of congestion pricing • Congestion pricing's political acceptability • Factors influencing congestion pricing's political prospects • Congestion pricing for early deployment 	<ul style="list-style-type: none"> • Political acceptability issues viewed as formidable implementation challenges 	<ul style="list-style-type: none"> • ITS as a facilitator of congestion pricing • Congestion pricing's political acceptability

Public Acceptance of ITS: Selected Issues

The degree to which the public uses and/or purchases ITS goods and services has direct environmental implications. Zimmerman (1994: 1) best articulates this point, arguing that debates over ITS's likely environmental impacts include

assumptions, expectations, and projections about the users of [ITS] technologies. These [ITS] users will, by virtue of the travel behavior they exhibit, have an impact on environmental quality. Despite this fundamental linkage between users and the environment..., basic questions remain unanswered, such as how many people will use [ITS] technologies, how will they change their travel behavior, what motivates those changes, and what are the impacts of those changes on environmental conditions?

Results from ITS operational tests underscore the importance of user acceptance in projecting ITS impacts. For example, the SmarTraveler project in Boston (an ATIS operational test) found that nearly half of those who used the services changed their travel behavior in ways that could reduce traffic congestion. Nevertheless, system usage remained "too low by any measure to provide noticeable impacts on congestion" (Multisystems, 1995: viii), thus precluding the opportunity for significant environmental benefits.

The importance of user acceptance in environmental analyses of ITS -- as demonstrated by the attention given this issue in both the environment literature on ITS and during this study's focus groups -- prompted our review of the literature on public acceptance of Advanced Traveler Information Systems (ATIS). In addition, we supplemented this review with shorter reviews of the public acceptance literature on congestion pricing, telecommuting, and advanced telecommunications technologies.

Among the myriad ITS technologies, we reviewed user acceptance of ATIS and congestion pricing for three reasons. First, the limited scope of this study required that we narrow our review to selected ITS applications. Second, compared to many other ITS applications, a relatively large literature exists on user acceptance of ATIS and AVI-based congestion pricing, making a literature review in these areas a means of gaining information on user acceptance of other ITS applications. Finally, consumer acceptance of ATIS and congestion pricing could be especially important to environmental stakeholders, as many analysts speculate that these applications could have significant environment impacts (Juster et al., 1994; Zimmerman, 1994; Replogle, 1994).

In addition to examining public acceptance of ATIS and congestion pricing, we went beyond the traditional purview of ITS and reviewed public acceptance literature pertaining to telecommuting and select telecommunications technologies. As with ATIS and congestion pricing, public acceptance of telecommuting and new telecommunications technologies was a salient topic during this study's focus groups, with participants believing that these technologies might have important implications for transportation-related environmental impacts. Furthermore, public acceptance of telecommuting and emerging telecommunications may hold lessons for ITS, as all involve the public's interface with the continuing revolution in telematics.¹

Our review of the literature on public acceptance of ATIS yielded many key findings. First, consumers express interest in ATIS products and services, yet their

¹ "Telematics" refers to the merging of telecommunications and computer technologies.

willingness to pay for them remains largely unknown. At present, consumers seem satisfied with the travel information they obtain for “free,” and thus may perceive little added value in paying for additional information. Consumer reluctance to pay for advanced traveler information may also derive from unfamiliarity: the research suggests consumers are often unaware of the benefits ATIS offers. Second, consumers may be more willing to pay for advanced traveler information that is bundled with other services and which permits a monthly payment instead of a large up-front fee. Third, drivers appear most interested in advanced en-route information (or a combination pre-trip/en-route information package) that provides specific information about traffic congestion, travel time estimates and alternate routes. Finally, safety features offered by ATIS are highly valued by consumers, particularly technologies that prevent accidents, increase drivers’ ability to request assistance (e.g. mayday systems), and assist drivers in navigating unfamiliar areas. Thus, the safety components offered by ATIS may prove pivotal in initiating user acceptance of these technologies.

Summary Conclusions and Recommendations

The summary conclusions and recommendations draw upon information contained in each element of this report: the review of environmental issues associated with ITS, the literature review on public acceptance of ATIS, and, most of all, from the three focus groups. We offer these recommendations to assist the development of ITS deployment strategies that will garner environment stakeholder support in California:

Programs and Policies

Recommendation: Methods of implementing remote sensing, ATIS, and congestion pricing as environmentally beneficial ITS programs should receive particular attention.

Among the myriad of ITS applications discussed during the focus groups, remote sensing of emissions, ATIS, and congestion pricing received particularly strong endorsements on environmental grounds. The potential for ITS to enable remote sensing of emissions was the most common topic during the focus group discussions of air quality, and participants generally felt that although significant efforts at garnering public support would be necessary, remote sensing could be a cost-effective means of dealing with “gross polluters” and a generally effective tool for improving air quality. Participants in Los Angeles were especially convinced that continued technological innovation was necessary to address the region’s air quality problems. Similarly, focus group attendees believed ATIS could improve air quality by making vehicle trips more efficient (e.g. by reducing the amount of driving time spent looking for destinations), reducing congestion, and by encouraging transit use. Finally, most participants felt congestion pricing and various other road pricing strategies (e.g. emissions pricing, VMT charges) could reduce both pollution and traffic congestion.

It should be noted, however, that not every focus group participant believed these applications held great promise for the environment. A few attendees felt, for example, that remote sensing technology was currently insufficient, that no market existed for ATIS, and that congestion pricing was politically unpalatable in the current “no new taxes” political climate. The challenge, then, is to construct creative programs that use these ITS applications to serve environmental goals. One such proposal comes from Sperling and Replogle (1994), who advocate the introduction of road/congestion pricing together with other services (e.g. ‘smart’ paratransit and electric vehicles) to afford alternatives to driving and to reduce public opposition to pricing strategies.

Recommendation: ITS should be framed within the context of how these technologies address transportation problems or serve clear policy goals.

Many focus group participants viewed ITS as a “technology solution looking for a problem,” or the ITS program as “technology-driven” rather than “goal-driven.” Many attendees seemed particularly troubled with descriptions of ITS as a collection of arcane acronyms or “technology bundles” devoid of any reference to broader transportation policy strategies. As a transportation consultant argued, “The key public policy issue is what kind of framework should [ITS] exist in. The question is not the technologies themselves; the key question is how they are going to be applied.” Substantial efforts should therefore be made to position the ITS program as offering tools that address specific problems (e.g. traffic congestion) or goals (e.g. improving transit) consistent with broader policy concerns.

Research

Recommendation: There remains a need for regional forums to discuss environmental issues associated with ITS.

The focus groups uncovered important regional differences in how environmental stakeholders viewed ITS. Of all such differences, perhaps the most significant was that the Los Angeles and San Francisco groups exhibited greater support for ITS than the Sacramento group. Whether discussing ITS impacts on air quality and land use, or the likelihood that ITS would encounter success either commercially or as a government program, the tone in the Sacramento meeting was decidedly more negative compared to the other meetings. Two reasons may account for this. First, Sacramento participants gave particular attention to partisan politics within the state, and many felt that legislators (particularly Democrats in urban areas) would encounter difficulty in “selling” ITS to their constituents. Second, Sacramento participants exhibited a general skepticism that Caltrans could adequately address environmental issues in the ITS program. The tone in Sacramento contrasted most sharply with that in Los Angeles, where attendees seemed to assume that ITS (and technology in general) would play a large role in achieving transportation and environmental goals.

Another regional distinction was the relative attention each group gave to various ITS-related environmental issues. Los Angeles attendees, for example, considered at length how ITS could address air quality and congestion problems, while the San Francisco group considered the implications of the Bay Area’s Clean Air Act attainment status for ITS deployments. Participants in Sacramento, on the other hand, gave considerable attention to the potential impacts of state politics on funding for ITS initiatives.

These regional differences underscore the need for continued region-specific forums and research to both understand why such differences exist and to ensure that ITS deployments garner regional stakeholder support.

Recommendation: Both ITS field tests and empirical modeling studies that generate data on the environmental impacts of ITS technologies should continue.

Focus group attendees repeatedly cited the lack of data on ITS impacts as inhibiting their ability to appraise ITS and as a source of apprehension about the technologies in general. Furthermore, better empirical data and more reliable models related to ITS impacts (especially on air quality) could be invaluable if ITS deployments face legal challenges on environmental grounds. Thus, information gathering on the environmental effects of ITS should continue with the hope of reducing the role that perceptions and speculation currently exert over the ITS program (joint research currently underway by Claremont Graduate School and UC Davis will address some of these concerns).

Recommendation: Research needs to be conducted on how ITS could impact land use patterns.

The focus group discussions of potential ITS impacts on land use patterns mirrored the academic debates on this issue: no consensus emerged on whether ITS would amplify, mitigate, or have no measurable impacts on settlement patterns and urban form. Some focus group attendees believed ITS could exacerbate suburban “sprawl” while others argued that the myriad of powerful variables shaping land use patterns outweigh any potential ITS impacts. This lack of consensus underscores the controversy surrounding the relationship between transportation and land use, the consequences of continued low-

density, decentralized development (e.g. “sprawl”), and the how ITS might impact both these issues.

The public debate over land use and ITS has attained particular salience with the publication of two widely-circulated reports that assert California’s current land use patterns threaten the state’s economy and quality of life and that ITS could exacerbate these patterns.² ITS is now central to the debate over transportation investments and land use patterns, and because this issue will continue to surface as ITS deployment proceeds, continued research in this area is critical.

Recommendation: Research needs to be conducted on public acceptance of ITS applications.

Both the focus groups and the review of the literature on public acceptance of ATIS suggest a continuing need for public acceptance research on this specific ITS application, and it is likely that similar research needs to be conducted on other ITS applications. With respect to ATIS, our literature review uncovered significant information about public/consumer acceptance issues. It seems clear, for example, that the public exhibits an interest in having advanced traveler information, and that safety -- both the reliability of the technology and as a means to increase personal safety (e.g. “mayday” systems) -- is important to drivers. On the whole, however, much remains to be learned about which ATIS products and services people want or, more importantly, their willingness to pay for them. Thus, future research on public acceptance of ATIS (which likely applies to consumer/public acceptance research on other ITS applications) should address willingness-to-pay issues, aim for more generalizable results by using samples that better represent the broad driving public, and should build upon past research findings. Not only will such research assist in efforts to market ATIS and other ITS applications, but it will also provide information on the degree to which ITS deployments (and other telecommunications technologies) could affect the environment.

Outreach and Public Education

Recommendation: Caltrans should enhance its image as a socially and environmentally responsible organization through continued inclusion of environmental stakeholders into ITS policy discussions.

The focus groups revealed a palpable skepticism among many participants about the ability of Caltrans to adequately address environmental and social issues as part of its ITS program. This skepticism animated the Sacramento meeting in particular, where one attendee stated flatly that the social/environmental consequences of Caltrans setting ITS deployment priorities “scares the hell out of me.” Whether Caltrans deserves such

² The two publications include a report compiled by Bank of America and several environmental groups entitled “Beyond Sprawl: New Patterns of Growth to Fit the New California,” and an article by Professor Bob Cervero in *Scientific American* entitled “Why Go Anywhere?” The Bank of America report argues that California’s ongoing trend of low-density suburban development (e.g. “sprawl”) threatens the state’s economic vitality and overall quality of life. The Cervero article asserts that ITS could exacerbate the trend toward sprawl “by orders of magnitude” and that, instead of making ITS investments, policy-makers should create urban designs that reduce the need to travel. For contrasting views on the consequences of “sprawl,” see Gordon and Richardson (1995). In addition, Giuliano (1995) provides a good review of the literature on the relationship between land use patterns and transportation, and asserts that this relationship is probably weakening over time. Our report gives a more detailed review of all these articles in the review of ITS-related environmental issues (under “Land Use”).

skepticism is irrelevant: Caltrans must address the *perception* that it is incapable of integrating environmental and social goals into its ITS program. Addressing this perception will require continued efforts by Caltrans to incorporate environmental stakeholders into ITS policy deliberations and decision-making forums. By doing so, Caltrans will not only improve its image within the environmental community, but will also ensure that the perspective and concerns of environmental stakeholders continue to inform the ITS program.

While enthusiasm for the ITS program varied across the three focus group meetings, it is important to note that participants never voiced a fundamental or “radical” critique of ITS *per se* as environmentally destructive. This is not to say that such a critique does not exist within the environmental literature on ITS (see Cervero, 1995) or that focus group attendees refrained from criticizing specific ITS technologies or elements of California’s ITS program. It does mean, however, that participants did not view ITS in monolithic terms (e.g. equating ITS solely with automated highway systems) or as all “good” or all “bad.” In general, attendees viewed ITS as a group of technologies whose environmental and social impacts would vary according to technology and with the way that technology was deployed. This conclusion corroborates one of the major findings of the National ITS and Environment Conference in Arlington (Horan, 1995: 201), and is a positive sign as the ITS program goes forward.

Recommendation: The ITS program should adequately address social equity issues by conducting outreach efforts across a broad range of communities.

Some of the strongest feelings and debates among focus group participants surfaced during discussion of social equity. Many attendees argued that ITS would serve only white, affluent, suburban residents, that ITS-enabled congestion pricing was “elitist,” or that less affluent urban residents would benefit more from investment in “low-tech buses” rather than in “high-tech” ITS. The intense feelings surrounding the issue of social equity, as well as recent legal activity related to transportation and equity,³ suggests that the ITS program ignores equity concerns at its peril. We thus recommend outreach into communities with diverse socio-economic groups to elicit input from citizens, community organizations and elected officials about how ITS deployments can be made consistent with community needs and concerns. In addition, public education efforts should emphasize the potential benefits of ITS for low-income individuals and/or urban areas. This could include

³ A recent civil rights law suit failed against Caltrans and the California Transportation Commission by community groups in El Sereno, California over the planned 4.5 mile extension of the Long Beach Freeway illustrates the linkage of transportation and equity issues. The suit alleges the planned extension imposes disproportionate environmental and housing burdens on their neighborhood compared to the impacts on the more affluent Pasadena communities through which the extension will also run. The lead attorney for the plaintiffs called the proposed extension “a stark case of environmental injustice” (see *BNA State Environmental Policy*. “Latino Groups File Civil Rights Law Suit Over Freeway extension in California.” The Bureau of National Affairs, Inc., September 25, 1995).

The nature of this suit exemplifies what Bosso (1994: 43-44) labels the “new environmentalism” and demonstrates the kinds of political groups and issues that almost certainly will impact the ITS program. The “new environmentalism,” according to Bosso, is non-elite, grass-roots activism that links environmental issues to social, economic and environmental justice, often through legal means. Bosso believes this “immense and inchoate” collection of non-traditional environmental groups are “spiced by a lingering suspicion that they are pitted against institutions and forces mostly beyond their control, [and this] makes these activists particularly wary of government and industry experts and skeptical about science and technology generally.” Bosso sees such groups as the locus of “real energy” in 1990s environmentalism.

marketing ITS as a tool for urban renewal, as a means to more efficient and demand-responsive transit, and explaining how congestion pricing could benefit affluent and less affluent drivers alike.

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SECTION 1: ENVIRONMENTAL ISSUES ASSOCIATED WITH ITS⁴

A distinguishing feature of the literature on ITS and the environment is the breadth of topics it addresses. Studies of the “environmental” issues associated with ITS consider not only the biosphere, but the entirety of social and ecological conditions that influence the lives of individuals and communities. Dittmar (94:17) illustrates this notion:

We need to think about system impacts (of ITS technologies and programs) in a broad sense...Environment is more than air quality, [but includes] water quality, open space, the preservation of agricultural land, neighborhood cohesion, pedestrian and bicycle safety, the location of facilities, and environmental and economic justice.

Within this broad conception of environmental issues, however, certain topics consistently emerge in environmental analyses of ITS. Table 1 shows the particularly salient concerns and recurrent themes with respect to ITS and environmental issues.

TABLE 1: OVERVIEW OF ENVIRONMENTAL ISSUES RELATED TO ITS

Issue Area	Specific Topics
Potential ITS Impacts	
Air Quality	<ul style="list-style-type: none"> • ITS could facilitate supply-side and demand-side emission reduction strategies • ITS could induce demand and increase VMT and emissions • Uncertainty about the ability of emissions models to gauge air quality impacts • Impact of clean fuel technologies on air quality and implications for ITS
Land Use	<ul style="list-style-type: none"> • Impacts of ITS on land use efficiency and suburban “sprawl” • Impact of ITS-facilitated congestion relief on VMT
Social Equity	<ul style="list-style-type: none"> • Geographic and socio-economic distribution of ITS benefits • Public funding and equity concerns
Sustainability	<ul style="list-style-type: none"> • Long-term impacts of ITS on the natural environment and overall quality of life
Select Factors Shaping These Impacts	
Environmental Regulation	<ul style="list-style-type: none"> • Impact of environmental regulations (e.g. CAAA, ISTEA, EIRs) on ITS deployment
Public/Private Roles	<ul style="list-style-type: none"> • Strong private sector role in provision of ITS goods and services • Need for balance between public sector and private sector goals in ITS
Congestion Pricing	<ul style="list-style-type: none"> • Political feasibility of congestion pricing • Potential positive impacts on traffic flow and environment

⁴ This overview is a shortened and slightly modified version of the analysis of ITS-related environmental issues in the “White Paper on ITS and Environmental Issues” prepared under PATH MOU 115, Phase II.

As Table 1 illustrates, the ITS-related environmental issues highlighted in this study encompass two analytically distinct dimensions. The first dimension is potential ITS *impacts on the natural and social environment*. This includes impacts on air quality, land use, social equity, and sustainability. The second dimension is *factors that could shape the nature and degree of these impacts*. This includes environmental regulation, public/private roles in providing ITS goods and services, and specific ITS applications such as congestion pricing. Presented below is an overview of each topic.

Air Quality

ITS impacts on air quality is a critical issue, in part because the potential effects of various ITS applications on vehicle emissions remains uncertain. The discussion below addresses 1) the potential for ITS to facilitate both supply-side and demand-side emissions reduction strategies; 2) traffic smoothing and induced demand; 3) emissions modeling.

Many analysts argue that ITS technologies could improve air quality by enhancing both supply-side and demand-side emission reduction strategies. Supply-side management strategies aim to reduce the environmental impacts generated by the existing transportation system by making the system function more efficiently. The belief is that improvements in travel flow will reduce the emissions associated with unnecessary “stop and goes.” While supply-side strategies seek to better manage demand upon the transportation system, demand-side strategies seek to reduce that demand. Travel demand is measured through either vehicle miles traveled (VMT) or the number of vehicle trips taken. Table 2 shows selected ITS technologies that could serve such strategies .

TABLE 2:
Selected Supply-Side and Demand-Side Strategies Related to Emissions Reduction

<u>Strategy</u>	<u>Examples</u>
<p>Supply-Side Strategies</p> <p>(improve and expand upon existing system elements)</p>	<ul style="list-style-type: none"> • Traffic Management Centers • Emissions testing and monitoring • Commercial Vehicle Operations • Emergency/Incident Management • En-route driver information and/or route guidance
<p>Demand-Side Strategies</p> <p>(creates incentives to reduce system demand)</p>	<ul style="list-style-type: none"> • Travel Demand Management strategies • Public Transportation Operations • Electronic Payment: Road/Congestion pricing • Privately operated transit services • Pre-trip travel information

Evidence generally suggests supply-side improvements will produce modest to moderate reductions in emissions (e.g., on the order of 10-15% reductions in CO²), though at higher speeds NOx emissions could increase. For example, recent analyses found that Electronic Toll Collection (ETC) devices could reduce emissions by minimizing stop and go travel associated with toll stops (Washington and Guensler, 1994). Another study (Lampe & Scott, 1995) of electronic toll collection in New Jersey and Massachusetts suggested that significant reductions would occur due to reduced toll stopping (e.g., 3,441 ton/year reduction of CO on the MassPike). With an estimated 3.5 trillion toll transactions a year in the US, the potential reduction is considerable.

A relatively new approach to linking supply efficiency with emission reduction involves the use of emission detection technologies such as remote sensing to identify both gross polluters and emission “hotspots.” Regarding the former, research indicates that a small number of gross polluters emit a disproportionately high percent of total mobile emissions (some estimates are that 10% of vehicles emit up to 60% of emissions) Thus, emissions detection technologies that identify these vehicles could facilitate reductions in their polluting, although the institutional complexities in implementing these systems are considerable (Hempel, 1992). As for the detection of emission hot-spots, experience in America has mainly involved the use of the LIDAR radar-like system to track emissions from various intersections. In Europe, however, there has been more extensive testing of how ATMS systems could be linked to emissions detection. A current field test in Southampton and Cologne, for example, uses emissions as the primarily criterion for adjusting signal timing patterns, and the results are promising (Taylor and Herbert, 1993).

Many researchers endorse demand-side emissions reduction strategies (Replogle, 1994; Van Hattum and Munnich, 1994). Tools to pursue demand-side strategies include both regulatory mandates and price signals. Regulatory mandates often fall under the rubric of Transportation Control Measures (TCM) -- demand management techniques mandated by the Clean Air Act - that include ridesharing mandates,⁵ High Occupancy Vehicle (HOV) lanes, and public transit improvements. In 1993 the GAO estimated the air quality benefits of TCMs in the LA Basin at less than 2% of total hydrocarbon and carbon monoxide reductions, and no more than 5% for any region they studied (GAO, 1993). While some ITS approaches can encourage TCM strategies -- notably ATIS and Advanced Public Transit Systems (Juster et al., 1994; Lampe & Scott, 1995; Benke, 1993) -- the accumulating evidence shows that only marginal success can be expected in this area.

The limited effectiveness of TCMs lead many to conclude that demand management strategies that employ price signals and other economic incentives are a more promising alternative (UCLA, 1992). One study showed that congestion pricing fees of about \$0.10 to \$0.15/mi may reduce travel during that period by 10%-15% (NRC, 1994), with potential emissions reductions of key pollutants of around 8% (Burbank, 1995).⁶ Furthermore, Californians for Better Transportation and the Transportation Research Board estimate significant revenue generation potential for local and project-specific applications using congestion pricing (CBT, 1995; NRC, 1994). Also, electronic payment technologies could

⁵ The SCAQMD ridesharing mandate (Rule 1501) is an example of an air quality/congestion relief strategy that is under severe political attack because of a perceived inequity in costs and benefits. Rule 1501 required that all employers with more than one hundred employees develop a ride-sharing plan for SCAQMD approval. The goal was to reach a target of 1.5 riders per vehicle during the morning rush hour (up from 1.13 riders/vehicle as the 1987 baseline). SCAQMD officials hail the program as having reduced car trips in the LA basin by 90,000 daily, reaching 1.24 riders per vehicle (LaGanga, 1993). However, many believe the cost to not have been worth the marginal benefit. The cost of Rule 1501 up to September 1992 was estimated at \$3,000 per car removed (Hempel, 1994a). Criticism of Rule 1501 has come from small businesses and local government, who claim that the program unfairly targets their employees, since the program was meant to target businesses whose employees commute long distances (King, 1992). It is perhaps not surprising, then, that both state and federal ridesharing mandates are being severely reduced or repealed (ITE, 1995).

⁶ One of the easiest methods to charge peak-period fees would be through Electronic Toll Collection technology. Other methods to charge fees for road use include VMT fees based on distance traveled. Tamper-proof odometers would be required for such a strategy to be feasible.

make multi-modal transportation easier to plan and finance, reduce congestion at existing toll plazas, and enable congestion/ road pricing strategies.

Latent Demand/Traffic Smoothing and Emissions Modeling

Although the evidence suggests ITS applications could reduce emissions in some areas, some argue that the aggregate air quality impacts of ITS will be negative. The fear is that ITS technologies such as ATIS or an Automated highway System (AHS) could both increase highway speeds and unleash “latent demand” for highway use by increasing system capacity, and that these effects, in turn, would increase both VMT and emissions of certain pollutants.

Evidence on induced demand is mixed (Humphrey, 1995). In the I-80 Magic project in New York/New Jersey, the ATMS system significantly reduced carbon dioxide, nitrous oxide, and hydrocarbons emissions despite significant increases in VMT over the 14 year study period (Kraft & Redl, 1994). Using a microeconomic analytic framework, Ostria et al. (1994) argue that many ITS technologies will undoubtedly reduce the marginal costs of driving and therefore increase travel, but believe other ITS technologies could reduce the environmental impacts associated with this increased travel. Nonetheless, major demand increases (such as in a high growth area) could swamp the gains from such an ATMS area, although the extent to which such demand could be induced remains uncertain (Shladover, 1993; Ostria et al 1994; Replogle, 1994; Horan, et al 1995).

In addition to concerns over latent demand, the extent to which smoother traffic may reduce emissions is also uncertain. Empirical studies indicate that such reductions vary with ITS technology bundles and over time. ATMS and related systems, for example, log impressive emissions reductions when stop and go is reduced. The ATSAC system in Los Angeles, for example, yielded a 20% reduction in delay and 10% reduction in air emissions over and above the prior Transyt-7F based improvements (Yates, 1994). Assessment of ATIS systems provide similar though less pronounced emissions reductions (Juster et al., 1994).⁷ It remains unclear, however, whether these emissions reductions will continue. A Chicago report notes the short-term flow improvements are considered passing improvements rather than long-term mobility strategies (Shank, 1995).

The uncertainties over whether ITS applications will induce travel demand or whether smoother traffic will reduce emissions highlight the need for improved modeling and other environmental impact measurement techniques for ITS deployments. Many authors highlight the lack of adequate modeling and impact measurement ability for transportation-related issues (Guensler, 1994; Horan (ed.) 1993; GAO, 1993).

Some studies project net emissions reductions resulting from ITS. Both Mobility 2000 (1990) and an early GAO report (GAO, 1991) estimated a 15-20% reduction in congestion costs in selected metropolitan areas by 2011, as well as a general reduction in mobile emissions. Other studies suggest traffic flow improvements can reduce vehicle emissions, since a vehicle produces fewer emissions (except NOx) at a steady 55 mph highway speed than during stop-and-go traffic conditions below 40 mph (Nadis and MacKenszie, 1993; Ostria & Lawrence, 1993; Sperling et al., 1992).

⁷ It should be noted that in addition to emissions impacts, traffic-flow improvements might also accommodate overall regional growth. A longitudinal study of the ramp metering/freeway management system in Seattle (over a six year period) found that it had accommodated growth ranges of 10 to 100% along various segments while speeds remained either steady or improved (Henry & Meyhan, 1989).

Yet uncertainty remains since many emissions models (such as EPA's MOBILE 5, California's EMFAC7F, among others) use average speeds and driving conditions to predict environmental effects, and these assumptions consistently underestimate real-world conditions (Konheim & Ketcham Inc., 1995). ITS technologies could make dramatic changes in average driving conditions, requiring new modeling techniques to predict their effects.

Land Use

Land use is a highly contested subject in debate over ITS deployment. As many analysts stress the need for integrated approaches to transportation and land use planning (Burwell, 1994), it is not surprising that ITS is part of the broader debate over California's current land use patterns and the relationship between transportation and land use. Indeed, two recent, widely-circulated reports highlight the salience of land use issues in California and the potential intersection of these issues with ITS.

The first report, compiled by Bank of America and a coalition of environmental groups⁸, argues that California's ongoing trend toward low-density suburban development (often called suburban "sprawl"⁹) threatens the state's economic vitality and quality of life. According to this report, "sprawl" imposes severe costs on business, residents in both suburbs and inner cities, and on the natural environment. To address these problems, the report recommends (among other things) greater planning in delineating where development should occur, more efficient use of land that has already been developed, and the use of technology to combat rather than encourage "sprawl" (e.g. using telecommunications to provide jobs in urban areas).

The table below summarizes the report's list of the costs of sprawl:

<i>IMPACT OF "SPRAWL" ON...</i>	<i>COSTS OF "SPRAWL"</i>
Business	<ul style="list-style-type: none"> • higher costs • loss of worker productivity • underutilized investments in older communities • less favorable business climate compared to other states
Residents of suburbs	<ul style="list-style-type: none"> • heavy taxes (e.g. infrastructure) • automobile expenses
Residents of older suburbs and inner cities	<ul style="list-style-type: none"> • loss of access to jobs • loss of social stability and political power
The natural environment	<ul style="list-style-type: none"> • loss of agricultural land, crops and open space • deterioration of ecosystems (e.g. from air pollution and destruction of natural habitat)

Source: Bank of America et al. 1995. Table constructed by authors based on source.

⁸ Bank of America, California Resources Agency, Greenbelt Alliance and Low Income Housing Fund. 1995. "Beyond Sprawl: New Patterns of Growth to Fit the New California."

⁹ Sprawl is difficult to define precisely, but the term generally refers to low-density development in the form of either commercial strips along single arterial roads or in large expanses of low-density, single use residential tract homes. These developments typically lie along the fringes of urban centers, but sometimes "leapfrog" development occurs that adjoins no major urban area. See Longman (1994).

The second report, an article authored by Bob Cervero and recently published in *Scientific American*,¹⁰ argues that ITS could exacerbate the problems of “sprawl” identified in the Bank of America report. The following quote captures his critique of ITS:

The past 150 years has been a self-perpetuating cycle of urban transportation advances and decentralization. New transportation technologies have stretched the envelope of urban development, raising per capita fuel consumption, consuming farmlands and open space, and dirtying air basins. White flight to the freeway-laced suburbs and exurbs has left many inner cities in a state of near collapse and divided by race and class...By failing to pass on the true social costs to motorists, we encourage excessive auto travel and subsidize sprawl. The so-called Intelligent Transportation System stands to worsen this state of affairs by orders of magnitude (p.93).

Instead of investing in ITS, Cervero advocates increased telecommuting and the construction of “neotraditional” communities: “self-contained towns in which people live, work and shop.” The design of such communities “[reduces] the need to travel and, in doing so, helps to conserve resources, protect the environment and promote social justice” (p.93).

Cervero’s concern that ITS could exacerbate “sprawl” is echoed in a few other environmental analyses of ITS. Some believe, for example, that congestion relief from supply-side ITS strategies could reduce average commute times and thus increase demand for development farther away from urban and suburban job centers (Lowe, 1993; Replogle, 1994).

It is important to note, however, that considerable debate exists among scholars over the implications of “sprawl” and the relationship between land use patterns and transportation. Gordon and Richardson (1995), for example, argue that attempts to reverse “sprawl” through “neo-traditional” compact development may be neither feasible nor desirable, and that the costs of “sprawl” have never been well demonstrated. In addition, Giuliano (1995) concludes that the relationship between land use and transportation has weakened over time, and that “efforts to influence land use patterns by making transportation investments have little chance of success” (p. 16). Like Gordon and Richardson, Giuliano believes road pricing strategies -- not high-density development -- is a potentially effective means of managing the transportation system.

In addition to debating over the impacts of “sprawl” and connection between land use and transportation, analysts also express differing views on the impact of ITS on land use patterns. Indeed, some believe strategic ITS deployments could enhance land use efficiency. For instance, “transit-oriented communities” would be more attractive if combined with publicly accessible real-time traffic and transit information (Sperling 1995). ITS technologies within the Travel Demand Management bundle and Public Transportation Operations bundle have the potential to reduce vehicle usage by encouraging alternative transportation modes. Two projects studied by the Surface Transportation Policy Project (STPP), the Hunter's Point community in San Francisco and the Fruitvale community in Oakland, propose using ITS technologies as part of projects to improve air quality, promote economic development and increase housing options through urban design (Olsen,

¹⁰ Bob Cervero. 1995. “Why Go Anywhere?” *Scientific American* (September 1995). New York: Scientific American, Inc., pp.92-93.

1995). Although still in the planning stages, these projects could utilize ITS to pursue land use efficiency goals.

Social Equity

ITS deployments, particularly those involving public funds, raise concerns about “equity,” or the distribution of ITS benefits and costs across both geographic areas and socio-economic groups. With respect to ITS impacts on different socio-economic groups, studies suggest the poor currently pay a disproportionate share of transportation taxes in California (UCLA, 1992; UCLA, 1993). Some fear ITS products and services -- such as the sale of on-board traffic information or congestion pricing schemes -- may only be available to the affluent. At the national level, the ITS system architecture could address these equity concerns by ensuring that the core infrastructure for the ITS program provide user benefits for the widest distribution of people. Richardson (1995) suggests that advanced public transit technologies will enhance access by the disadvantaged, reduce isolation, and foster neighborhood viability, and that electronic payment technologies will have positive effects on the quality of life within residential neighborhoods.

In addition to impacts on the poor, ITS deployments raise issues related to the geographic dimension of equity. Many traffic management technologies, for example, could increase traffic on arterial streets from vehicles seeking to avoid congested highways. While this could lead to lower ambient air pollution from congestion relief, much of the pollution from the highways could simply be transferred to arterial streets. As a result, the quality of life for residents living on or near these arterials would be diminished.

Sustainability

“Sustainability” refers to attempts to understand environmental impacts and conduct environmental planning in a long-term, holistic manner. It has been defined as the ability to meet “the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987: 8). “Sustainable transportation” applies this concept to understanding the environmental impacts of the transportation system. A sustainable transportation system should not “result in environmental impacts that exceed the carrying capacity of the region in which they occur” (Horan and Hempel 1994: 2). Attempts to more precisely define sustainable transportation are currently underway.¹¹

While ITS alone cannot create sustainability, as an amplifier of transportation trends ITS could promote significant positive or negative long-term environmental impacts. Debate centers on whether ITS technologies could enhance or hinder efforts at promoting sustainable transportation and communities. Replogle (1994) argues that strategic ITS investments could serve sustainability goals such as multi-modal transit networks, demand management strategies, and more efficient use of existing system resources. Cervero (1995) disputes this, citing ITS as a major impediment to both sustainable transportation and more livable communities.

¹¹ Organizations such as the Transportation Research Board (TRB), the Volpe National Transportation Systems Center, and the Battelle Seattle Research Center have recently grappled with defining sustainable transportation. Debate has emerged in deciding between a narrow definition or broadly-based definition of sustainable transportation. A narrow definition would consider only the long-term environmental effects of transportation on the environment. A broad-based definition would include a range of environmental, economic and social impacts of transportation. Each would have different perspectives on policy design.

Environmental Policy

Federal, state and regional environmental policies provide a legal framework that is shaping the ITS planning and deployment process in California. This section highlights 1) specific federal and state environmental laws pertinent to ITS; 2) the potential impact of these laws on ITS deployment; and 3) planning and intergovernmental issues

Two comprehensive federal policies -- the Clean Air Act Amendments (CAAA) and the Intermodal Surface Transportation Efficiency Act (ISTEA) -- regulate the environmental effects of transportation, and their reach extends to ITS technologies. The CAAA sets air quality standards for transportation and provides regional milestones for improvement. ISTEA provides federal funding for transportation improvements, links transportation planning with air quality goals through Conformity Rules, and encourages energy efficiency (EPA/DOT, 1993).

In addition to federal policies, many California laws and initiatives influence the state's ITS deployments. The California Clean Air Act (CCAA), for example, sets more stringent air quality standards than the federal CAAA. Also, California's *Transportation Blueprint for the 21st Century* (1989) plans and funds state transportation improvements included in the *State Transportation Improvement Program (STIP)* (CBT, 1995). Table 2 below lists significant federal and state government policies and initiatives that affect ITS.

The emerging nature of many ITS technologies makes it difficult to gauge the impact of environmental policies on ITS deployment. The environmental review process is the primary method through which transportation projects are judged for the "significance" of their environmental impacts. Since environmental review can often be a lengthy and costly process, Lockwood (1994) and others believe it could be one of the major institutional barriers to ITS deployment and private sector participation in ITS research and development.

To address the need for an integrated environmental and transportation planning process at the regional level, ISTEA allowed Metropolitan Planning Organizations (MPOs) to take a leadership role in federally-funded transportation projects to ensure such projects meet federal and state environmental standards (Horan et al., 1995). This mandate to MPOs, however, raised the issue of whether ITS planning conducted by MPOs and that within the National ITS Program and California ATS program is sufficiently coordinated. Research indicates that federal, state and local roles in transportation projects remain confused following the paradigm shift of ISTEA (Castle Rock, 1994).

Table 2: ITS/Transportation Policy FrameworkAir Quality Legislation (federal and state)

- **Clean Air Act Amendments of 1990 (CAAA)**
 - Emissions targets, SIPs
 - TCM strategies
 - AQMD regulations
- **Federal I&M program**
- **California Clean Air Act of 1988 (CCAA)**
 - SmogCheck program
- **California Air Resources Board LEV program**
 - ZEV mandate

Transportation-Related Legislation (federal and state)

- **Intermodal Surface Transportation Act of 1991 (ISTEA)**
 - ITS Field Tests and congestion pricing pilots
 - CMAQ funding
 - STP funding
- **"Clean Car" Initiative** (Partnership for a New Generation of Motor Vehicles)
- **Project California**
- **Transportation Blueprint for the 21st Century**

Broad-Based Legislation (federal and state)

- **National Environmental Policy Act of 1970 (NEPA)**
- **Americans With Disabilities Act of 1990 (ADA)**
- **Energy Policy Act of 1992 (EPACT)**
 - CAFE standards
 - alternative fuels provisions
- **International Climate Change Accord**
- **California Environmental Quality Act of 1970 (CEQA)**

Public/Private Issues

The private sector's central role in the provision of ITS goods and services places unique opportunities and constraints on governments generally and on the role of environmental regulations in particular. The need for strong private sector participation in ITS is particularly acute due to government downsizing. This section addresses 1) public/private roles and partnerships, and 2) market acceptance issues

The distribution of public and private sector roles in ITS remains a central issue. The National ITS Program targets private sector ITS funding at 80%, non-federal funding of ITS field operational tests, for example, has rarely reached 80% and in some cases has been as low as 20% (FHWA, 1994b). Analysts cite many factors that might increase private sector participation, including deployment of the "core" ITS system architecture and the setting of national standards, government funding of initial market exploration data, and streamlined bureaucratic procedures (FHWA, 1994a, 1994b; Horan et al 1995; ITS America, 1995a; Davis, 1995).

The market for ITS products and services is also a critical unknown. Rockwell International identified a number of key market acceptance issues for the full range of ITS user service bundles (FHWA, 1994a). Among these issues were privacy, providing timely travel information on-demand at low cost, reliability and safety, and system interoperability. In addition, others emphasize that ITS deployments must offer clear benefits to potential customers, and these customers could include individual consumers, governments, and a wide range of industries and organizations (Burwell, 1993).

Congestion Pricing

Congestion pricing and other forms of road pricing are controversial yet potentially effective means of improving traffic flow and reducing congestion-related pollution. Such strategies use pricing (e.g. during peak driving periods) to create incentives to change travel behavior. Many researchers strongly endorse road/congestion pricing as a potentially effective demand-management strategy, and believe ITS technologies such as electronic toll collection can facilitate such a strategy. This section overviews 1) the potential environmental benefits road/congestion pricing strategies, and 2) the potential political barriers to implementing such programs.

Pricing road use provides financial signals that would encourage ridesharing, mass transit, and less driving, while improving traffic flow and reducing environmental impacts (Replogle, 1994; Cameron, 1991, 1994; BAEF, 1990). It has been estimated that pricing strategies would provide four to eight times more emissions reductions than traditional TCMs (Burbank, 1995). Indeed, recent research in New Jersey and at UC Davis has shown that electronic toll collection can result in significant air quality benefits. (Lampe & Scott, 1995; Washington & Guensler, 1994). In terms of congestion reduction, the Metropolitan Transportation Commission (MTC) in the San Francisco Bay Area estimates that raising the Bay Bridge toll from \$1 to \$3 (excluding low-income drivers) during the morning rush hour would reduce traffic by 7% (Marshall, 1994).

Despite the potential environmental benefits of these pricing mechanisms, political realities suggest that enacting such strategies is currently difficult at best (Wachs, 1994). For instance, as of February 1995 no California legislator was willing to carry a state bill to enact a congestion pricing pilot project on the San Francisco/Oakland Bay Bridge (Fagan, 1995). Opposition to congestion pricing stems from concerns that it favors more affluent drivers, and that widespread road pricing will divert traffic to unpriced arterial streets and disrupt residential neighborhoods (Gordon, 1992).

SECTION 2. OVERVIEW OF FOCUS GROUPS

Methodology

This study utilized focus groups to obtain empirical data on the attitudes of environmental stakeholders about ITS. Widely used in both academic and market research settings, “focus groups” are a special class of group interviews that use group interaction in response to research questions to collect qualitative data. A “moderator” leads the group, posing questions and guiding the discussion (Morgan et al., 1993). The moderator uses the focus group “instrument” -- a detailed agenda of discussion topics -- to focus the discussion on specific themes or research questions.

Focus groups offer significant advantages and some limitations compared to other research methods (Stewart and Shamdasani, 1990). Among the advantages include the ability to collect large and rich amounts of data in relatively short time, and the opportunity to allow for interaction among participants. A drawback of focus group research is the limited ability to generalize results to the population from which participants were drawn.

Background

Three focus group meetings were conducted in separate regions throughout California:

Los Angeles: September 22nd, 1995, at the Streisand Center for Conservancy Studies in Santa Monica

San Francisco: October 23rd, 1995, at the Presidio in San Francisco

Sacramento: November 15th, at the State Capitol in Sacramento

The Los Angeles and San Francisco meetings highlighted regional issues related to ITS and the environment, while the Sacramento meeting focused on state-wide issues. The focus groups consisted of activists and professionals from the business, government, and non-profit sectors (see Appendix A for a complete list of attendees). Participants possessed either an interest or expertise in ITS-related environmental, social and economic issues, and we chose individuals from professionally diverse backgrounds in an attempt to generate a range of responses representative of the environmental community. Each meeting had between eight and twelve participants, and lasted approximately two hours. Dr. Tom Horan was the moderator for each meeting, and the proceedings were tape recorded.

Each focus group began with an introduction which consisted of the meeting’s agenda, ground rules for the meeting, and participant introductions. We then provided the group with an overview of ITS-related environmental issues, consisting of both a brief discussion (assisted with an overhead slide) and an approximately 12 minute *ITS America* video entitled “Moving Transportation Into the Information Age.” Following the overview, we began the discussion of environmental challenges facing ITS deployment. This included a discussion of ITS policy and research priorities. The sessions’ final segment asked participants to draw implications from the group’s discussion. This included recommendations for future ITS policy, appropriate ITS deployment strategies given the environmental context, and any other comments participants wished to make on environmental challenges facing ITS.

The seven issues highlighted in the review of ITS-related environmental issues -- air quality, land use, social equity, sustainability, environmental policy, public-private issues, and congestion pricing -- provided the discussion framework for the focus groups. We structured the focus groups around these issues for two reasons. First, our previous research (the two conferences and research paper conducted as part of this report, and an extensive review of the literature on ITS-related environmental issues) revealed the salience of these issues to environmental stakeholders. Second, practical constraints related to conducting a focus group --such as the time needed for detailed discussion of topics -- required that we target the discussions on core issues.

Focus Group Summary Results

We divided the summary results from the focus groups into two parts: 1) general assessments and crosscutting themes and 2) topic-specific observations. Listed below are summary results from the three meetings (see Appendix A for complete summaries of each meeting) .

General Assessments and Cross-Cutting Themes

- **As expected, participants in the Los Angeles and San Francisco meetings highlighted ITS-related environmental issues of considerable importance to their respective regions, while the Sacramento meeting took a more state-wide outlook.** Los Angeles attendees, for example, considered at length how ITS could address air quality and congestion problems, while the San Francisco group considered the implications of the Bay Area’s Clean Air Act attainment status for ITS deployments. Participants in Sacramento, on the other hand, gave considerable attention to the potential impacts of partisan politics on funding for ITS initiatives. However, each meeting covered a mix of regional, state, and more general issues related to ITS and the environment.
- **On the whole, the Los Angeles and San Francisco groups exhibited greater support for ITS than the Sacramento group.** Whether discussing ITS impacts on air quality and land use, or the likelihood that ITS would encounter success either commercially or as a government program, the tone in the Sacramento meeting was decidedly more negative compared to the other meetings. Two reasons may account for this. First, Sacramento participants gave particular attention to partisan politics within the state, and many felt that legislators (particularly Democrats in urban areas) would encounter difficulty in “selling” ITS to their constituents. Second, Sacramento participants exhibited a general skepticism that Caltrans could adequately address environmental issues in the ITS program. The tone in Sacramento contrasted most sharply with that in Los Angeles, where attendees seemed to assume that ITS (and technology in general) would play a large role in achieving transportation and environmental goals.
- **The discussions of equity engendered strong feelings and often vigorous debate among many participants, reflecting the political sensitivity of these issues.** Most attendees agreed that ITS deployments could and should serve the needs of low income and disadvantaged groups, but some questioned whether ITS was the best means to do so. For example, some participants wondered whether the poor would be better served by increased investment in “low-tech” transit (e.g. more buses to serve inner city areas) rather than by increased ITS investment.

- **A recurrent theme was that the ITS program should be “goal-driven” rather than “technology-driven,” with clear transportation goals (e.g. reducing vehicle trips) guiding ITS development and deployment decisions.** Participants in San Francisco and Sacramento seemed especially concerned that the current ITS program was “technologically-determined,” and that non-ITS approaches (e.g. investment in “low-tech” buses” instead of “high-tech” ITS) might be a better means of achieving some transportation goals.
- **Attendees generally, though not unanimously, gave remote sensing technologies and Advanced Traveler Information Systems (ATIS) solid endorsements on environmental grounds.** Both remote sensing and ATIS were seen as potentially facilitating air quality benefits, either through targeting gross polluters (in the case of remote sensing) or by making vehicle trips more efficient (in the case of ATIS). In addition, many participants believed a viable market exists for ATIS. These sentiments were not shared by all attendees, however, as a Sacramento air quality expert expressed strong opposition to the notion that remote sensing would improve air quality. In addition, some participants (mostly in San Francisco and Sacramento) felt that the market prospects for ATIS remained uncertain.
- **In all three meetings, general consensus emerged that ITS-enabled road pricing strategies would benefit the environment but that the barriers to their implementation were formidable.** Various pricing strategies (e.g. congestion pricing, emissions pricing, VMT charges) were discussed in the context of many topics (e.g. air quality, land use, social equity), and almost everyone agreed that pricing strategies could reduce both pollution and traffic congestion. Yet participants also expressed serious concerns about the obstacles facing the implementation of such strategies, particularly the current “no new taxes” political climate and the perception of road pricing programs as elitist and unfair to the less affluent.
- **General consensus prevailed in all three meetings that California’s current environmental policy context differs from that in the recent past, and that this change bodes poorly for attempts to use ITS deployments to facilitate environmental benefits.** The concerns expressed over this issue echoed those associated with congestion pricing: many attendees wondered whether expensive or controversial ITS programs touted as serving environmental goals could garner support in an era of both government downsizing and less political will to pursue environmental objectives.
- **Participants repeatedly cited the lack of data about the environmental impacts of ITS as detrimental to informed discussion about the technologies and as a potential obstacle to ITS deployment.** Particularly when discussing topics related to air quality and environmental policy, the groups often concluded that more data was needed before definitive statements could be made. An environmental/transportation expert highlighted this area during the Los Angeles meeting, arguing that sound empirical data and models would be critical if ITS deployments faced legal challenge on environmental grounds.

Topic-Specific Observations

Air Quality	<p>⇒ Consensus that air quality goals of ITS should not be considered in a vacuum</p> <p>⇒ General consensus on the benefits of remote sensing of emissions and ATIS</p> <p>⇒ Problems with emissions models</p>
Land Use	<p>⇒ No consensus on ITS impacts on suburban “sprawl”</p> <p>⇒ ITS could help revitalize urban areas</p>
Social Equity	<p>⇒ Equity/ITS issues are politically sensitive and will require coalition-building</p> <p>⇒ Consensus that ITS could and should serve the needs of low-income people</p> <p>⇒ Broad agreement that ITS benefits would concentrate in more affluent, suburban areas</p>
Sustainability	<p>⇒ Many participants expressed concerns or gave suggestions consistent with sustainability principles</p>
Environmental Policy	<p>⇒ Discussion of environmental policy varied substantially across groups</p> <p>⇒ Each meeting discussed the extent to which environmental policy and ITS should focus on technological solutions vis-à-vis behavioral change</p> <p>⇒ Participants felt innovative ITS regulatory regimes needed to be devised.</p>
Public/Private Roles	<p>⇒ Overriding concern at each meeting with the opportunities and risks of public/private ITS partnerships</p> <p>⇒ Regulations governing ITS must encourage private sector investment</p>
Congestion Pricing	<p>⇒ General consensus on the technological feasibility and potential environmental benefits of congestion pricing, but political obstacles viewed as formidable</p>

Air Quality

- **It was either explicitly stated or implicitly acknowledged in each group that the pursuit of air quality goals should not take place in a vacuum.** Efforts to improve air quality should be balanced with efforts to secure economic well-being, be sensitive to non-ITS technological developments (e.g. “clean vehicle” technology), and remain cognizant of regional differences in the severity of air quality and congestion problems. As one business representative put it, “You cannot forget the congestion issue (when discussing the Los Angeles region’s air quality)...If in 2010 we’re operating at an average 12mph and we have perfect air, then we have a huge economic problem.”
- **Perhaps the most common topic during the ITS and air quality discussions was emissions monitoring, particularly through ITS-enabled remote sensing.** General agreement emerged in all three groups that although significant efforts at garnering public support would be necessary, remote sensing could be a cost-effective means of dealing with “gross polluters” and a generally effective tool for improving air quality. Participants in Los Angeles were especially convinced that continued technological innovation was necessary to address the region’s air quality problems. Only one participant (in Sacramento) voiced strong opposition to this consensus, expressing skepticism about the efficacy of remote sensing technology. This participant also believed that a new remote sensing program would do little to improve the current state Inspection and Maintenance program, would involve new bureaucracies and exacerbate institutional complexities, and ultimately hinder state air quality improvement efforts.

- **Like remote sensing, Advanced Traveler Information Services (ATIS) received endorsements on the belief that it could improve air quality by making vehicle trips more efficient (e.g. by reducing the amount of driving time spent looking for destinations) or by encouraging transit use.** A business representative in Los Angeles argued in favor of early deployment of ATIS due to its technological feasibility, its applicability across transportation modes, demonstrated consumer demand for some ATIS services, and because the private sector is already marketing these services. In addition, some attendees believed ATIS could encourage transit use, but at least a few participants at each meeting were skeptical about ATIS's ability to affect mode shifting.
- **Each group emphasized the problems with current emissions models and stressed the need for improved modeling techniques to better gauge the potential air quality impacts of ITS technologies.** Reliable models -- both of potential air quality impacts and environmental impacts generally -- could be especially important if ITS deployments face legal challenges on environmental grounds.

Land Use

- **The most common issue in the land use and ITS discussions, and one on which no consensus emerged, was whether ITS would amplify, mitigate, or have no measurable impact on the continuing trend of low-density development further away from city centers (often referred to as suburban "sprawl").** At each meeting, the group split on this issue: some participants argued that ITS could further encourage "sprawl" by smoothing traffic and enabling longer commutes. Others argued that the myriad of powerful variables shaping land use patterns outweigh any potential ITS impacts.
- **At the Los Angeles meeting, both a business representative and a land use expert believed ITS deployments could serve as a tool for urban renewal.** These participants thought "smart transit" or ATIS applications could make inner cities more "consumer-friendly" and better able to compete with suburbs for new investment. The notion of ITS assisting urban renewal countered the assertion, commonly made during discussions of social equity, that ITS benefits would concentrate in suburban areas.

Social Equity

- **The discussions of equity engendered strong feelings and often vigorous debate among many participants, reflecting the political sensitivity of these issues.** During one such debate, a Sacramento participant succinctly described the need for ITS planners to build support for ITS deployments across socio-economic groups: "The only way [ITS] is going to work is if it is put together brick by brick through a coalition at the local level."
- **Most attendees agreed that ITS deployments could and should serve the needs of low income and disadvantaged groups, but some questioned whether ITS was the best means to do so.** Many felt that ITS could facilitate more demand-responsive transit that could increase access to the transportation system for poor, elderly, and handicapped individuals. Disagreement emerged, however, on whether the poor would

be better served by increased investment in “low-tech” transit (e.g. more buses to serve inner city areas) rather than by increased ITS investment. A legislative representative in Sacramento, for example, argued that “[if] you give me the choice of \$10 million for information (e.g. ATIS) and \$10 million for five more buses on the road, I’ll take the five buses in a second.” Other participants wondered if some ITS-facilitated programs (e.g. road pricing) would disproportionately impact less affluent drivers.

- **Many participants argued that that suburban residents (especially commuters) would be the primary beneficiaries of ITS and that neglecting the needs of urban areas could engender political resistance to ITS programs.** A perception existed among some participants that ITS merely served affluent suburban residents or, as one San Francisco attendee expressed it, “white flight to the suburbs.” Conversely, many believed that urban residents would benefit the least: participants in Sacramento, for example, argued that many urbanites would prefer traffic in their neighborhoods to go *slower*, and that the mostly Democratic state legislators who represent urban districts are less likely to support ITS investments as a means to benefit their constituents.

Sustainability

- **Although the groups discussed sustainability either indirectly or only briefly, many suggestions and concerns reflected a vision for ITS consistent with sustainability principles.** For example, general agreement prevailed that ITS deployments should not reverse the gains made in reducing transportation-related pollution over the last several decades. It was also suggested that discussions of transportation policy should shift from singular concern with efficiencies to more general concerns of quality of life. To accomplish this, a transportation consultant in San Francisco argued that ITS professionals and policymakers must adopt broad sustainability principles into their decision-making processes and “participate in a multi-disciplinary effort to improve the livability of our communities.”

Environmental Policy

- **Among the diverse range of topics discussed with respect to ITS and environmental policy, an overarching theme was whether environmental policy should focus on technological solutions to environmental problems or on behavior modification strategies, and how ITS might fit within either strategy.** Most agreed that changing driver behavior is difficult, but no consensus emerged on the appropriate balance of behavioral change and technological initiatives. Consensus did emerge, however, that regardless of the mix of strategies pursued, the ITS program should be “goal-driven” rather than “technology-driven,” meaning that policy priorities should guide ITS development and deployment decisions.
- **Participants had many ideas about how best to regulate the ITS program and/or specific ITS applications.** For example, a transportation consultant suggested that like the airline and telecommunications industries, ATIS could involve an initial period of government involvement that would diminish over time. This would reduce the uncertainty associated with complete private control of these services (e.g. the possibility that profit motives might outweigh the provision of quality traveler information and reduce public confidence in ITS). Another participant envisioned the future transportation system transformed by ITS into a powerful advertising medium,

and argued that any government regulatory regime would have to allow this form of commercial activity to attract private ITS investment.

Public/Private Issues

- **“Ambivalence” probably best describes the tenor of each group’s discussion of public/private ITS issues.** The overriding concern was the opportunities and risks associated with public/private partnerships. On the one hand, many participants believed the private sector could provide the capital and marketing expertise necessary to advance ITS deployment in an era of government downsizing. To attract that investment, however, would require incentives, including the elimination of regulatory barriers that might inhibit private ITS investors from earning a profit. A business representative expressed this concern as follows: “We have to think about incentives and regulatory barriers to private sector participation. We’ve seen it on the transit side: the public sector says ‘We want you to run the transit operation for us, but you have to do it this way.’”
- **While acknowledging the need for incentives to attract private sector investment, many attendees feared “under-regulation” of public/private ITS partnerships.** Insufficient government regulation, they believed, could increase the risk that ITS projects -- particularly those involving public funds -- might not adequately serve public and/or environmental goals. “The danger of ITS,” a Los Angeles environmental representative argued, “is that it simply takes public funds and puts them into the troughs of a new ‘transportation-industrial complex’ that’s waiting to be fed.”

Congestion Pricing

- **General consensus emerged that ITS technology could facilitate congestion pricing, yet participants also agreed that any such program would face formidable political obstacles.** Participants were divided on whether these obstacles to congestion pricing were insurmountable, but certain variables were cited as crucial for congestion pricing’s political prospects. Among these variables were timing (e.g. proposing and implementing a program in a favorable political climate), framing (e.g. selling the program to the public in a positive way), and keeping the number of goals associated with such a program to a minimum. A transportation consultant in San Francisco used the Bay Bridge as an example of the political challenges facing congestion pricing: “[Opposition to congestion pricing] shows how the interpretation of public will comes down to soundbites. The reason we don’t have congestion pricing on the Bay Bridge is because you can call it a tax.”

Comprehensive Overview of Focus Groups

Los Angeles ITS and Environmental Policy Focus Group Streisand Center for Conservancy Studies, Santa Monica September 22nd, 1995

Focus Group Attendees

Sarah Siwek; Transportation Consultant
John Cox; *President*, Southern California Economic Partnership
Richard Spicer; *Principal*, Southern California Association of Governments (SCAG)
Walter Baer; *Deputy Vice President*, Domestic Research Division, RAND
Tim Carmichael; *Research Analyst*, Coalition for Clean Air
Madelyn Glickfeld; California Coastal Commission
Adam Relin; *Lawyer*, Nossaman, Guthner, Knox & Elliot
Matt Cahn; *Professor*, Political Science, California State University, Northridge

Focus Group Discussion by Topic

- **Air Quality**

“Where to focus effort (related to air quality) depends on your assumptions...If the assumption is that there will be a zero emission vehicle in sufficient quantity by 2010, then the emissions problem is different.” Source: Business Representative

“When you look at emissions, you find that a small percentage of the vehicles are responsible for a fairly large percentage of the emissions.” Source: Environmental Representative

“If you can make a trip more efficient (through ATIS), then you may have some VMT and emissions reduction opportunities.” Source: Transportation/Environmental Representative

“You cannot forget the congestion issue (when discussing the Los Angeles region’s air quality)... If in 2010 we’re operating at an average 12mph and we have perfect air, then we have a huge economic problem.” Source: Business Representative

The group discussed five issues related to ITS impacts on air quality:

- 1) **The use of technology to address air quality problems**
- 2) **Emissions monitoring, particularly through remote sensing**
- 3) **ATIS**
- 4) **Potential air quality tradeoffs**
- 5) **Considering the larger context when discussing air quality**

In its discussion of ITS impacts on air quality, the group acknowledged the continuing need for technological innovations to address the Los Angeles regions’ air quality problems. Participants were especially interested in technologies that enabled remote sensing of emissions. Some believed that remote sensing could be both relatively

inexpensive to implement and particularly cost-effective during the next ten to fifteen years. Indeed, there was general consensus within the group that “gross emitters” -- that small percentage of automobiles which account for large percentages of vehicle emissions -- should be dealt with immediately and that ITS could assist in this effort. It was also suggested that both toll collection and emissions sensing could be conducted using the same facilities. There was acknowledgment, however, that remote sensing raises complex political and social issues. In particular, some wondered whether a remote sensing program should be voluntary or involuntary, or whether a remote-sensing assisted vehicle scrappage program should be instituted. It was also noted that a robust public education program would probably be necessary to garner support for remote sensing.

The group discussed topics besides remote sensing during the discussion of ITS impacts on air quality, although with less frequency. One such topic was Advanced Traveler Information Systems (ATIS), and some participants believed these systems might improve air quality by making vehicle trips more efficient (e.g. by reducing the amount of driving time spent looking for destinations). An environmental representative cautioned, however, that emissions reductions may involve tradeoffs: reductions in one pollutant might be offset with increases in another -- perhaps due to increased vehicle speeds facilitated by ITS-induced traffic smoothing.

A business representative also noted that the pursuit of ITS-related air quality goals should be balanced with other goals and not take place in a vacuum. In particular, the Los Angeles regions’ congestion problem, and the threat this problem poses to the region’s economic well-being, must not be dismissed in the wake of California’s recession. In addition, developments in “clean vehicle” technology could alter the region’s future air quality problems, particularly if zero emission vehicle (ZEV) market penetration is significant by the year 2010.

- **Land Use**

“If you’re going to think about land use (in designing an ITS program), the concern would be to not further exacerbate the tremendously powerful forces that are encouraging continued sprawl out further in to the suburbs.” Source: Land Use Representative

“The idea that simply reducing congestion will alter land use patterns is a big jump. There are a lot of other influences.” Source: Transportation/Environmental Representative

“If the goal is to revitalize aging cities and suburbs, I think this can be done through ITS.” Source: Business Representative

The discussion of ITS impacts on land use focused on two issues:

- 1) ITS impacts on the continuing trend toward low-density suburban development (e.g. “sprawl”)**
- 2) ITS as a tool for urban renewal**

The group generally agreed that irrespective of ITS, land use patterns will continue toward low-density development further away from city centers (often called suburban “sprawl”). No consensus emerged, however, on whether ITS could amplify, mitigate, or have no impact on this trend. An environmental representative noted that ITS technologies could encourage further “sprawl” by smoothing traffic and increasing vehicle throughput, thus providing an incentive for individuals to live further from work places. This was

especially likely in the absence of countervailing strategies (e.g. congestion pricing). Others questioned this assertion, believing it unlikely that reduced congestion alone could significantly influence the powerful economic and social forces shaping land use patterns.

A second issue raised in this discussion was how ITS could serve as a tool for urban renewal, and broad consensus emerged that ITS could serve this purpose to some degree. A business representative believed that properly deployed ITS systems -- particularly ATIS and “smart” transit -- could make aging inner cities more accessible and attractive to both consumers and businesses, allowing these areas to compete with suburbs for investment and residents. This individual conceded, however, that encouraging urban re-development would also require a wide range of political and policy changes beyond the scope of ITS deployment.

- **Social Equity**

“What do we do when we have communities with people of differential means...When talk about congestion pricing, we are essentially saying that the ability to pay will determine who can have a nice, efficient highway and who can’t.” Source: Environmental Representative

“There are ITS technologies that could be deployed that could open up more opportunities for mobility to people who do not have access to an automobile.”

Source: Environmental/Transportation Representative

“Five percent of the population are never going to work. What we’re trying to do (with ITS) is deal with the 95 percent who do work.” Source: Business Representative

The group’s discussion of ITS impacts on social equity addressed two major themes and specific issues associated with each of these themes:

1) ITS impacts on various socio-economic groups

-road/vehicle pricing strategies

-vehicle scrappage programs

2) Equal access to mobility

-more demand-responsive transit

The group engaged in considerable debate over how ITS could affect different socio-economic groups. On the one hand, a business-oriented participant argued that the ITS program should attempt to serve the majority of people who use the transportation system to commute, support their families, and sustain their living standards. In other words, equity -- at least in terms of accommodating the least affluent citizens -- should not alone guide ITS deployment decisions. On the other hand, an environmental representative expressed specific concern over ITS-facilitated road or vehicle pricing schemes and vehicle scrappage programs. This participant believed that pricing schemes essentially declare that the more affluent deserve a pleasant, efficient transportation system while the less affluent do not, and that any such program would engender political opposition. In addition, some believed that few mobility options would remain for the generally poorer people whose cars would be targeted in vehicle scrappage programs.

The group expressed concern over a second dimension of equity: how ITS might facilitate more equal access to mobility, particularly for poor, elderly, and handicapped individuals. In this context, some hoped that ITS could promote more demand-responsive

transit services for shoppers, commuters, and those who need personalized transit services at specific times and places. There was some concern, however, that the degree of demand for personalized, “smart shuttle,” or similar transit services remains unknown.

- **Sustainability**

“The challenge in designing ITS systems is to go in a direction that does not counter all the progress we have been making (in improving the transportation-related environmental impacts).” Source: Transportation/Environmental Representative

The group did not raise the issue of ITS and sustainability directly. However, many of the participant’s suggestions and concerns reflected a vision of ITS consistent with sustainability. For example, there was broad agreement that ITS deployment not reverse gains made in environmental quality (i.e. reductions in mobile source emissions) over the past several decades. In addition, many participants believed ITS could and should facilitate road/emissions pricing programs that reflect the full environmental and social costs of driving: often a central component of strategies aimed at sustainability.

- **Environmental Policy**

“There is some consensus that the behavioral approaches to reducing driving and influencing travel behavior are an extremely difficult way to achieve a measurable level of success.” Source: Transportation/Environmental Representative

“Given the SCAG estimates of 40-45% increase in VMT by 2010...it seems that the issue becomes getting people out of their cars...We need a long-term strategy aimed at shifting behavior patterns of commuters.” Source: Environmental Representative

“Often, models neglect the behavioral response of individuals and firms to changes in regulations and prices.” Source: Environmental Representative

“To me, ATIS is probably the most do-able today.” Source: Business Representative

In its discussion of environmental policy issues associated with ITS, the group explored three topics ranging from general themes to specific policy areas:

- 1) **Technological solutions versus behavior change**
- 2) **Emissions modeling an ITS performance indicators**
- 3) **ATIS for early deployment**

With respect to general themes, considerable discussion and debate centered on whether environmental policy should focus on technological solutions to environmental problems or on behavior modification, and how ITS might fit within either strategy. On the one hand, many in the group agreed on the difficulty in changing driver behavior, citing the mixed results of reduced driving and rideshare programs, and the difficulties in getting drivers to use transit. There was disagreement, however, on the extent to which behavior modification policies should be a policy focus. Many participants believed ITS technologies could address environmental problems, either through encouraging some degree of changes in driver behavior or improving transportation system efficiency (e.g. through traffic smoothing). In this regard, ITS was viewed as part of a balanced environmental policy

strategy aimed at improving system efficiency, managing demand, and promoting technological advances in other areas (e.g. clean cars).

Others contested this vision of environmental policy. An environmental representative expressed concern that ITS programs assumed technology would address environmental problems, and believed ITS alone might not adequately address driver behavior issues such as single occupancy vehicles (SOVs). Another participants argued that ITS should contribute to an overall transportation demand management strategy, and cited the success of behavior modification in solid waste management as a possible model for addressing driver behavior. From this perspective, it was hoped that ITS could both help get drivers out of their cars and improve what was viewed as the currently inadequate transit services in the Los Angeles region.

In addition to discussing general themes associated with ITS and environmental policy, the group addressed more specific issues as well, particularly the current inadequacies with modeling the environmental impacts of ITS technologies. Indeed, many believed that poor emissions and/or performance models present a formidable barrier to ITS deployment, as such models will be particularly important if new ITS projects face legal challenge on environmental grounds. In this regard, one participant pointed out that opponents of such projects may claim that an ITS program should not be implemented because no reliable environmental impact models exist. Thus, it was suggested that both models and pilot tests of ITS technologies should reveal how the technologies are likely to perform and what their environmental impacts are likely to be. Better models would ensure that ITS deployments do not reverse the improvements in the environmental area made by the transportation sector during the last two decades, something the entire group believed was important.

Another topic discussed during the ITS and environmental policy discussion was advanced traveler information systems (ATIS). A business representative viewed ATIS as a strong candidate for early deployment due to its current technological feasibility, its applicability across modes of transportation, demonstrated consumer demand for some ATIS services, and because the private sector (e.g. rental car companies) is already marketing these services.

- **Public/Private Issues**

“One could make the case that if the public sector is putting in sensors and making some basic data available, then the private sector can be relied upon to do most of what is necessary from that point on.” Source: Environmental Representative

“The danger of ITS is that it simply takes public funds and puts them into the troughs of a new ‘transportation-industrial complex’ that’s waiting to be fed.” Source: Environmental Representative

“We have to think about incentives and regulatory barriers to private sector participation. We seen it on the transit side: the public sector says ‘We want you to run the transit operation for us, but you have to do it this way.’” Source: Business Representative

The discussion of public/private issues associated with ITS centered on two broad topics:

1) The Opportunities for and Concerns Associated with Public-Private ITS Partnerships

2) Incentives for Private Sector Participation in ITS Projects

The group's discussion of public-private issues associated with ITS deployments addressed public-private partnerships, both the opportunities for mutual benefits and the complexities and potential pitfalls such partnerships entail. In terms of opportunities for mutual gain, some believed that partnerships could benefit the public sector by harnessing the private sector's entrepreneurial energies toward public goals, while the private sector could benefit by gaining access to new transportation markets. Yet, others cautioned that such partnerships must be carefully constructed to ensure that public goals are served when they involve public funds. An environmental representative noted that if the public sector were to install remote sensors, for example, should the private sector be allowed to operate an emissions sensing or pricing system? Should the private sector be allowed to charge for their services and make a profit? The group suggested no definitive answers to these questions, but agreed that such issues could be politically sensitive.

Participants also expressed concern about partnerships that involved aerospace companies shifting their operations from defense to transportation industries. Might partnerships with these firms, a transportation specialist asked, evolve into a "transportation-industrial complex" capable of squandering public funds on ITS technology projects with little public value? The ability of companies converting from defense industries to adapt to the culture of the transportation sector was also questioned, particularly because the transportation sector places particular importance on environmental and other broad social concerns.

The second broad topic discussed in relation to public-private ITS issues was incentives for private sector participation. A business representative expressed concern over regulatory or other barriers to private sector involvement in ITS projects, especially barriers which might inhibit private investors from earning a profit. If such barriers were in place, it was argued, the private sector might refrain from investing in certain projects, particularly those with public mandates that precluded private investors from making a profit.

- **Congestion Pricing**

"I don't agree that congestion pricing is politically unpalatable. I think its the way it is positioned...a 'premium lane' might be a better word for it." Source: Business Representative

"A key policy issue is whether congestion pricing is implemented and designed solely to minimize congestion or to change travel behavior as well...The more 'bells and whistles' you add to an ITS program, the harder it is to get it done."

Source: Transportation/Environmental Representative

"The same technology that can identify license plates and send a bill could provide a refund if you're driving with a carpool." Source: Environmental Representative

The group's discussion of congestion pricing covered three issues:

- 1) Whether Congestion Pricing is Politically Acceptable**
- 2) The Factors Influencing Congestion Pricing's Political Prospects**
- 3) Congestion Pricing as an Early Deployment Candidate**

The group discussed -- at considerable length -- whether a comprehensive congestion pricing program could win political support. No consensus emerged on this issue; however, there was considerable agreement that certain variables were crucial for congestion pricing's political prospects. One such factor was timing. Attempts to implement congestion pricing would have to coincide with a favorable political environment, and many felt that the present environment was not such a time. One participant believed that opponents of congestion pricing could exploit current public sentiments to frame the program as a new government-imposed tax or an assault on individual freedom. In addition to timing, many considered the marketing of congestion pricing -- or how it was framed and positioned to the public -- to also be critical for its political prospects. A congestion pricing program had to be sold to the public in a positive way: a business representative suggested it be called "Premium Lane" rather than congestion pricing, for example. Another suggestion was to supplement congestion pricing's economic "stick" with a "carrot by giving people a refund for carpooling while giving others a bill for driving alone in the "Lexus Lane."

A final issue deemed important for the political acceptance of congestion pricing was the number of goals such a program was touted as serving. A transportation specialist argued that attaching numerous goals to congestion pricing (e.g. as a program for congestion relief, for air quality benefits, to alter land use patterns, etc.) would increase the political obstacles facing such a program. Thus, those marketing congestion pricing should attempt to reduce the amount of "bells and whistles" associated with the program which, in turn, might require that some goals be abandoned in exchange for others. In this context, it was noted that the largest constituency in favor of congestion pricing seeks to reduce congestion, not solve environmental problems.

While acknowledging the potential political difficulties, some participants nonetheless viewed congestion pricing as a strong candidate for early deployment in the ITS program. This belief stemmed from two reasons: not only is congestion pricing technology immediately available, but it is also an area where private sector interests (e.g. potential for profit) and public sector goals (e.g. revenue, reduced congestion, reduced emissions, etc.) are likely to merge.

**San Francisco ITS and Environmental Policy Focus Group
Golden Gate Club, San Francisco
October 23, 1995**

Focus Group Attendees

Jeff Georgovich; MTC
 Jim McCrank; CALTRANS
 Bob Piper; Sierra Club
 Cameron Yee; Earth Island Institute
 Jean Rogencamp; Bay Area Air Quality Management District
 Bruce Riordon; Rides for Bay Area Commuters
 Don Dey; City of Menlo Park
 Deborah DaGang; JHK & Associates
 Gary Edson; Metro Dynamics
 Ellen Williams; Ellen Williams and Associates
 Brian Albee; Sonoma County Transit

Focus Group Discussion by Topic

- **Air Quality**

"You cannot build your way out of congestion. Congestion is a reality. The best you can do is manage the system you've got."

-- Transportation Representative

Discussion of ITS and air quality issues centered on two main areas:

- 1) **The distinction between access and mobility as transportation policy goals**
- 2) **Strategies for air quality improvement**
- 3) **The air quality benefits of ATIS**
- 4) **The need for more data on the air quality impacts of ITS**

An environmental representative began the air quality discussion by objecting to the glorification of mobility as the primary goal of transportation policy. He believed the environmental community sees access as a much more beneficial goal, both for air quality and for the society in general. Furthermore, any project that becomes a substitute for another highway lane (i.e.: increases the supply of the transportation network) will be destructive to the environment. This representative had not seen an ITS technology yet that would significantly reverse negative environmental trends in transportation, although there is promise in many transit applications.

Potential positive and negative effects of ITS strategies for air quality improvement were discussed. Two of the most potentially positive strategies were introduced by a government representative, who noted that incident relief efforts will be extremely positive from an air quality standpoint. Another environmentally valuable ITS application would be to track vehicle emissions. This could feed into I&M programs, education programs, modeling improvements, and other applications. A local government representative noted that local government involvement in ITS has so far been primarily engaged in signal coordination/optimization measures; the traditional notion is that the resulting reduction in traffic delay will improve air quality. In many cases, throughput efficiencies are so low that any ATMS improvements are positive.

There was consensus that ATIS applications are among the most environmentally friendly ITS options. The group also agreed that any ITS strategy that helps the flow of transit and ridesharing would be positive. A transit representative noted that the primary task of transit advocates is to attract the first time rider; that is one way to get air quality gains. A consultant believed that ATIS is therefore necessary to make that first trip useful and reliable enough to continue using transit.

Despite being encouraged by several ITS applications, transportation and environmental representatives noted several times that we won't exactly know the extent of ITS benefits or harms until they are implemented. This speaks to the lack of data available on air quality impacts of transportation projects. To this date, CALTRANS has only been required to do environmental analyses on ramp metering ATMS applications.

- **Land Use**

"We're experiencing an extremely profound paradigm shift, not unlike what happened at the beginning of the 20th century with the advent of the automobile and the surface transportation system; we're in the midst of that right now with information technologies. It has as much potential to create sprawl as the interstate highway system and we are ill prepared to understand it ... there is not one transportation model out there that reflects that explosive growth of telecommunications."

-- Consultant

"Over the past several decades the vast majority of public funds have gone to benefit 'White Flight.'"

-- Environmental Representative

Participants discussed how ITS deployments could affect land use patterns and urban form, acknowledging the critical nature of this issue but reaching no consensus. Typifying the discussion was an exchange between an environmental representative and an expert on local government. The environmental representative argued that the beneficiaries of suburban sprawl are rich white people, and as the economy grows, sprawl grows with it. Thus, efforts must be made to ensure that ITS systems don't make driving more attractive. The local government representative disagreed, stating that too many variables influence land use patterns for ITS to have any significant impact.

- **Social Equity**

"Environmental deterioration does have an effect on our businesses, but our economic models don't account for that."

-- Consultant

Discussion of social equity and ITS centered on questions of access to the transportation network, and participants were generally skeptical that the ITS program could adequately address these concerns.

The environmental representatives agreed that the key issues involving social equity is access to the transportation network. Doubts were expressed that the private sector alone can adequately provide this access, or that ATIS would enhance access for less affluent individuals.

- **Sustainability**

"ITS can be part of an effort for sustainable communities, but only if it's a conscious effort up front and only if ITS professionals participate in a multi-disciplinary effort to improve the livability of our communities."

-- Consultant

Without a common definition to agree upon, the issue of sustainability was not addressed in much depth. However, a consultant noted that since environmental issues are long-term, they often deserve special consideration beyond short-term public concerns. However, the goals of safety and productivity are equally valid in the public's eye. In regards to ITS, one consultant cautioned that the behavioral roots of transportation and environment problems should be addressed first rather than first looking for technological fixes. This is especially true if reducing travel demand is considered a primary goal.

- **Environmental Policy**

"Misperceptions about air quality and this region are incredible. You have a huge educational hurdle."

-- Transportation Representative

"Convenience is what got someone to change their mode from driving alone to (an alternative), but cost savings is what kept them."

-- Government Representative

"There is a systems orientation by CALTRANS ... I'm not sure we have a lot of clarity with (ITS) goals ... if we did have a clear sense of that I think environmental issues would rise higher than they are now."

-- Consultant

"The big thing for (transit) is that we need to improve our image."

-- Transit Representative

The group discussed a number of issues related to environmental policy, including:

- 1) The implications of Clean Air Act attainment on regional transportation priorities and transportation project funding**
- 2) The need for a goal-driven ITS program**
- 3) Representation in the ITS decisionmaking process**
- 4) The needs and desires of transportation system users**

Attendees disagreed on the implications of the Bay Areas recent achievement of CAAA attainment status. One participant noted that since the Bay Area is currently in a CAAA "maintenance mode," a loss of CMAQ funds through ISTEA could result. In regards to funding of environmental programs, a transportation representative noted that Bay Area traffic engineers aren't "in tune" with air quality improvement projects. As a result, air quality project funding often gets lost in the competition for scarce budget resources. A local government representative noted that this begins a vicious circle among local agencies that once CAAA attainment is achieved, funding dries up, which lets the

transportation system deteriorate, threatening attainment. A consultant also noted that private sector reaction to attainment is for government to loosen regulations affecting them.

The subject of regional transportation priorities came up in response to issues of funding. A transportation representative noted that there is an erosion of environmental commitment in Bay Area. Members of the Bay Area Partnership have only served to checkmate each other; they need to come together to agree on a set of goals and work to implement them. No focus existed in the group as to what those goals should be, however, the environmental representatives believed reducing vehicle trips should be the overriding policy goal of ITS.

While not agreeing upon specific goals of the ITS program, many in the group agreed that the ITS program should be goal driven, as opposed to technology driven. For instance, a government representative argued that ITS efforts are driven by availability of public dollars rather than any set of goals; this is a testament to the lack of a goal-driven decisionmaking process. A consultant was concerned about the dangers of technology-driven ITS deployment, citing the regional ITS Early Deployment Plan as an example. A transportation representative countered, saying that ITS is a complex program with multiple projects and services; multiple goals can be served and priorities need to be made with these multiple goals in mind. In the meantime, ITS needs to be experimented with to realize the possibilities.

Another consistent theme throughout this discussion was that the inclusion of affected stakeholders in regional transportation planning processes is important to successful program implementation. The local government and environmental representatives noted that one reason why conflict exists in the ITS program is that representation has been lacking in the decisionmaking process, especially among local government, community groups, pedestrians and bicyclists. The issues important to these groups need to be pushed at the state level, and these issues need to be taken more seriously by decisionmakers. A consultant added that a more educated public is needed if affected stakeholders are to agree upon regional transportation goals. Furthermore, a local government representative added that there are too many government agencies handling transportation/environmental issues to make significant gains toward any particular goal.

The discussion of public education led to a focus on the needs and desires of transportation users. Convenience was echoed among many participants as a primary consideration of the traveling public when referring to mode choice. For example, a transit representative questioned whether or not ITS tools mean anything to the average customer wanting to catch a bus/train. ITS benefits need to be significant if they are to be successful. This representative also believed that transit needs to improve its image before it can be successful; Sonoma County Transit improvements over the past five years have made a difference in image, with ridership slowly increasing. Low-tech applications have been a big part of this change. In the future, increasing service efficiencies will be the primary transit goal, but ITS deployments such as GPS systems are too expensive right now. In a decade this may be different, when ATIS and information dissemination will be more important. A consultant added that customer-focused transportation projects could bring down the decade estimate of ITS affordability, but these technologies are indeed expensive.

- **Public/Private Issues**

"ITS is unique, it isn't just technology-driven, we're inviting the private sector to participate in our transportation system. We've never really done that before. We've been underwriting it."

-- Government Representative

"I look at the transportation system as a new kind of advertising channel."

-- Consultant

"In the absence of good multi-modal information is there enough (of a need) to support a private sector market? Right now the conclusion you have to draw looking around the country is no."

-- Transportation Representative

"The marketplace says that no one is going to pay for bad information, but there was this thing called Pet Rocks, and there were sure a lot of people buying those."

-- Transportation Representative

The discussion of public/private issues and ITS applications focused on the following:

- 1) How to regulate public/private ATIS partnerships**
- 2) Public/private roles, particularly the benefits and dangers of private participation in ITS**
- 3) Partnerships with high-tech industries as the key driving force for ITS technologies.**

Many participants discussed ATIS in the context on public/private ITS issues, particularly how to regulate partnerships in this area. A consultant cited the airline and telecommunications industries as possible models where an initial period of government regulation was later reduced. This consultant believed that total private control of ATIS is too risky because of many unknown variables. A transportation representative added that a major investment is needed to collect a useful amount of traffic and transit data. Currently there is good information on highways, little on arterials, virtually none for transit. Many in the group saw these risks as too great to currently support a private ATIS market.

Transportation funding levels again surfaced as a key issue in determining public/private roles in ITS deployments. A consultant explained that state and federal money has been reduced, shifted to the MPO through ISTEA, then reduced again. Many in the ITS field have suggested that the public sector should build an ITS infrastructure and the private sector should do the rest. This was echoed among transportation representatives and consultants in the form that a market-driven ITS industry is important. However, the question remained, how can the private sector remain engaged when environmental goals are a priority?

To answer this question, a consultant suggested that ATIS can reach a broad market by requiring a baseline service. TravInfo, a proposed regional ATIS service for the Bay Area, will have a baseline service. The consultant continued by noting that there will always be two tiers of information services, but there should always be a way to call in and receive transit information.

The private sector will only participate in ITS deployments if profitable market opportunities exist. A transportation representative noted that businesses have opportunities both as a consumer as well as a provider. As a provider, one consultant suggested that many ITS systems could become powerful new advertising mediums. As a consumer, many businesses currently offer alternative transportation programs as an employee benefit. ITS could amplify the convenience and attraction of those programs.

This consultant noted, however, that there is a danger of long-term private operation of transportation services. For example, casinos might give false traveler information to get people to visit and gamble. Another example would be stadiums not wanting bad traffic information released in order to get people to attend the event. Reliability of traveler information is therefore necessary to build public confidence in ITS.

- **Congestion Pricing**

"It shows how the interpretation of public will comes down to sound bites. The reason we don't have congestion pricing on the Bay Bridge is because you can call it a tax."

-- Consultant

Although only briefly discussed, ITS-enabled congestion pricing was viewed as a potentially effective environmental strategy. Nevertheless, the participants agreed that the political obstacles to implementing such a program were formidable. One consultant blamed the current stall of the Bay Area's congestion pricing programs on electoral politics, particularly the political opponents of such a program who successfully framed it to the public as a tax..

**Sacramento ITS and Environmental Policy Focus Group
State Capitol Building, Sacramento
November 15, 1995**

Focus Group Attendees

Jim Knox; *Urban Affairs Director*, Planning and Conservation League
Ann Gerahgty; *Manager of Trans. Strategies Group*, California Air Resources Board
Tad Widby; *Planning Manager*, Parsons-Brinckerhoff, Quade & Douglass, Inc.
Jude Lamare; *Director*, Cleaner Air Partnership
Allan Gordon; *Transportation/Environmental Consultant*, Senate Office of Research
Tom Whitney; *Senior Graphic Designer*, Regional Transit
Wesley Lum; CALTRANS
Howard Sarasohn; *Program Manager*, Environmental Program, CALTRANS

Focus Group Discussion by Topic

- **Air Quality**

"Seems to me we can use all the tools we can get."

-- Environmental Representative

The discussion of ITS and air quality focused on the following:

- 1) **Broad speculation about ITS impacts on air quality**
- 2) **Pricing strategies, commercial vehicle operations, and AVI**
- 3) **The merits of Remote Sensing Devices (RSD)**

The group's discussion of ITS and air quality began with speculation on the cost efficiency of ITS with respect to air quality, and few positive remarks about ITS surfaced in this context. A government representative believed (and the group as a whole concurred) that ITS was never designed to maximize air pollution control. The ITS program has evolved on its own, and has served as an amplifier of transportation trends. Living with the reality of limited public funding makes utilizing the most efficient method of air quality improvements especially important to the group. An environmental representative added that current transportation planning trends are SOV dominated, which is premised on the myth that congestion relief equals air quality benefits.

Remote sensing devices (RSD) were discussed at considerable length, with participants disagreeing on its usefulness. A government representative noted that within a 10-15 year timeframe getting gross polluters out of use would be extremely beneficial. RSD could identify those vehicles, provide valuable modeling data, as well as air quality benefits when linked to enforcement actions. This representative added that vehicle scrappage programs can be inefficient, since old and new cars can both pollute badly when started cold or run at high speed. However, an environmental representative countered that RSD is currently a single lane monitoring device and cannot be used as a modeling tool worth the cost within 10-15 years. Public funding would be better spent preventing pollution rather than studying pollution. The current state I&M program is adequate without the need to spend public funds on RSD. Furthermore, vehicle emission regulations are doing an excellent job in reducing mobile emissions. This representative's sense is that too many bureaucracies being involved in ITS will hurt all environmental

protection efforts. In any case, cars engines are becoming cleaner fast enough to make RSD unnecessary within ten years. A consultant cautioned that RSD should not be used to condemn the entire ITS program.

The remainder of the air quality discussion focused on CVO, AVI and pricing strategies. CVO and AVI applications were seen as particularly promising ITS technologies from an efficiency standpoint. CVO could help make freight movements more efficient, while AVI could enable pricing strategies. An environmental representative noted that pricing strategies have the most potential for environmental benefits, and that supply-side congestion management strategies are detrimental. While pricing strategies have great potential, a consultant added that few political "champions" exist for these policies. The State of Delaware is an exception; the Delaware Transportation Plan was able to include pricing strategies by emphasizing environmental protection and reinvestment in their inner cities.

- **Land Use**

"If suburban sprawl is a problem on the East Coast, it is a nightmare here."

-- Legislative Representative

The discussion on land use and ITS focused on one central topic:

- 1) The impact of ITS on land use patterns**

A legislative representative raised a central question related to ITS and land use and set the agenda for the group's entire discussion of the issue: if highways become more efficient movers of vehicles with ITS, won't suburban sprawl become worse and increase pollution? A consultant echoed the feelings on many in the group that ITS certainly won't be able to affect land use patterns significantly within the next 10-15 years. General Plans outline land use patterns for the next 20 years, and as long as those plans show suburbanization then ITS can only tinker around the margins. However, there are plenty of ITS applications (such as ATIS, APTS, CVO) that won't aggravate the problems of induced demand or sprawl, which are worthy enough goals on their own. An environmental representative added that improving land use decisions will go much farther than ITS applications in fostering environmental protection. A number of cities that implemented urban growth boundaries (such as Portland and Sacramento) were cited as examples.

A consultant noted that technology has always been a part of urban management strategies; deployed properly, ITS should be seen as providing ways to help improve land use decisions and environmental protection. Pricing strategies were noted by an environmental representative as an important tool for urban reinvestment and as an effective countervailing strategy against ITS-induced "sprawl."

- **Social Equity**

"I have a problem that we are trying to substitute information systems for public education. We have a deficit in our education system about transportation."

-- Environmental Representative

"You give me the choice of \$10 million for information and \$10 million for 5 more buses on the road, I'll take the 5 more buses in a second."

-- Legislative Representative

Discussion on the issue of social equity centered on:

- 1) ATIS impacts on access to the transportation network**
- 2) ITS and the interests of legislators (and their constituents) in urban areas**
- 3) The equity implications of ATIS and ATMS technologies.**

An environmental representative began the discussion by noting that access to the transportation network is a much more valuable goal for transportation policy than mobility. This representative was skeptical of many ATIS applications, however, feeling that public funding would be better spent on teaching kids to make use of available transportation resources (such as reading route maps, planning a route, using alternative transportation systems, etc.) rather than expensive high-tech ATIS that only those who can afford the technology will use. A consultant partially disagreed. Reliability of traveler information is important; ATIS can reduce the uncertainty of information to make transit more attractive. The consultant added that some ATIS systems are not expensive at all, with resistance to their use breaking down over time.

A legislative representative spoke to the issue of transit accessibility to jobs. Legislators who represent urban districts want to know what their constituents get out of the ITS program, and this representative does not currently perceive much value. Constituents in urban districts do not seem to be concerned with high-tech applications in their buses, they simply want more buses. A transportation representative didn't understand the trade-off between more buses and more traveler information. There is an existing infrastructure that we are committed to maintain, yet ATIS doesn't preclude investment in other transportation strategies. This representative believed that additional traveler information will always be of value to users of the existing transportation system. A consultant noted that the quality of the investment in ITS will be especially important; benefits will need to be immediately obvious to those served by ITS projects.

In regard to ATMS, the issue of traffic smoothing elicited a number of responses. A legislative representative noted one example of conflict in transportation planning that could be aggravated with ITS. Many urban neighborhoods want average speeds slowed down, not sped up with ATMS. Those systems help suburban residents get into urban jobs quickly. Many urban residents are concerned with the safety hazards of more vehicles moving faster through their neighborhoods, as well as being concerned with matters of investment in ITS technologies which benefit suburban residents at their expense. An environmental representative noted that urban residents depend more heavily on public transit and are already more multi-modal than suburban residents. By speeding up arterial roads, alternative transportation becomes less attractive to suburban residents (those that transit is most anxious to attract).

- **Sustainability**

Discussion of sustainability was brief, with an environmental representative explaining that transportation planning discussions should broaden to include sustainability as well as efficiencies. This representative argued that transportation decisionmakers need greater awareness of sustainability principles before the concept level for sustainability an operational transportation strategy.

- **Environmental Policy**

"It isn't the technology question, it's the application ... the purpose to which it is put."

-- Consultant

"What it comes down to is, who votes?"

-- Transportation Representative

The ITS and environmental policy discussion centered on three issues:

1) ATIS

2) Transportation/environmental decisionmaking

3) The preference for a goal-driven ITS program.

ATIS was identified as a particularly useful ITS technology with potential environmental benefits. Some in the group questioned the usefulness of high-tech kiosks in light of the large amount of transit stops and the reality of vandalism. ATIS kiosks might be valuable to new riders, but not to experienced riders; the value of ATIS may only be marginally more useful than printed schedules with a significantly higher cost. Furthermore, in-vehicle ATIS may only be marginally more useful for route planning than radio traffic reports. A consultant countered, convinced that current services are not adequate and that more money must be spent on improving traveler information. The consultant noted that studies have shown new ATIS systems to be useful and marketable. A government representative agreed, noting that transit must be made more attractive to survive and prosper, and high-tech applications can help in this effort. ATIS can be especially helpful for infrequent users or in areas where transit service is not frequent.

Discussion on ATIS turned to a more general discussion of transportation decisionmaking and environmental policy. A transportation representative pointed out that our system of governance ensures that legislators fight for the interests of their constituents rather than state or national interests. Furthermore, the trend in transportation policy has been to put decisionmaking at the local level or MPO level. As a result, planners don't have a sense of the "big picture" anymore, and inter-regional transit suffers. An environmental representative added that as the voting population ages, more people will vote against any transportation improvements because that population is less likely to use the transportation system.

A consistent theme throughout the focus group was that ITS should not be a solution looking for a problem, and that particular ITS applications are appropriately used when recognized as the most efficient and effective solution to a commonly perceived transportation/environmental problem. Trip reduction, accident reduction, and increasing transit ridership are all goals in which ITS could play a significant role. An environmental representative added that since ITS is a collection of techniques rather than a monolithic program, ITS applications should be evaluated on a case by case basis. A consultant noted that to be effective, ITS must be put into the proper decisionmaking framework to ensure that it is applied to worthy goals. Many in the group questioned the ability of CALTRANS to perform this function. Since the past and current strength of CALTRANS has been in highway development, they should leave the choices of ITS deployments to a more appropriate decisionmaker. One suggestion was the legislature.

- **Public/Private issues**

"Be careful what you privatize, you might get it."

-- Consultant

The discussion of public/private issues relating to ITS addressed:

- 1) **Suggested public/private roles**
- 2) **The dangers of privatization**

The group was cautious about the trend of transportation service privatization. A consultant saw opportunity for benefits in transportation service privatization, but only if the project had a firmly agreed upon purpose among all stakeholders. A legislative representative was extremely concerned about privatization, using rail systems in Europe as an example. This representative claimed that the British rail system significantly deteriorated following privatization, while French rail systems have prospered under public sector control. This example was used to argue for more public investment in American public transit. A government representative used this rationale to suggest increased public and private support for ITS research to keep ITS technology on the cutting edge.

A government representative noted that the appropriate public sector role in the environmental area of ITS is to maximize the potential for multi-modal and ITS applications in the transportation infrastructure. The private sector should not perform this function since we cannot predict how that development would unfold. An environmental representative partially disagreed, saying that very little state and federal funds should be spent on ITS, although seed grants for technology development would be appropriate. This argument was based on the premise that the public sector tends to waste funds on inefficient programs. The private sector will identify and contribute to infrastructure development, as well as show what ITS technologies would sell in a private marketplace.

- **Congestion Pricing**

"The only way this (ITS) is going to work is if it is put together brick by brick through a coalition at the local level."

-- Environmental Representative

As discussed previously, the group discussed pricing strategies, noting their great potential for environmental benefits using AVI technology as an enabler. While the technology is available, the political will to enact such programs is not.

SECTION 3. PUBLIC ACCEPTANCE OF ITS: SELECTED ISSUES

The degree to which the public uses and/or purchases ITS goods and services has direct environmental implications. Zimmerman (1994: 1) best articulates this point, arguing that debates over ITS's likely environmental impacts include

assumptions, expectations, and projections about the users of [ITS] technologies. These [ITS] users will, by virtue of the travel behavior they exhibit, have an impact on environmental quality. Despite this fundamental linkage between users and the environment..., basic questions remain unanswered, such as how many people will use [ITS] technologies, how will they change their travel behavior, what motivates those changes, and what are the impacts of those changes on environmental conditions?

Results from ITS operational tests underscore the importance of user acceptance in projecting ITS impacts. For example, the SmarTraveler project in Boston (an ATIS operational test) found that nearly half of those who used the services changed their travel behavior in ways that could reduce traffic congestion. Nevertheless, system usage remained "too low by any measure to provide noticeable impacts on congestion" (Multisystems, 1995: viii), thus precluding the opportunity for significant environmental benefits through congestion relief.

The importance of user acceptance in environmental analyses of ITS -- as demonstrated by the attention given this issue in both the environment literature on ITS and during this study's focus groups -- prompted our review of the literature on public acceptance of Advanced Traveler Information Systems (ATIS). In addition, we supplemented this review with shorter reviews of the public acceptance literature on congestion pricing, telecommuting, and advanced telecommunications technologies.

Among the myriad ITS technologies, we reviewed user acceptance of ATIS and congestion pricing for three reasons. First, the limited scope of this study required that we narrow our review to selected ITS applications. Second, compared to many other ITS applications, a relatively large literature exists on user acceptance of ATIS and AVI-based congestion pricing, making a literature review in these areas a means of gaining information on user acceptance of other ITS applications. Finally, consumer acceptance of ATIS and congestion pricing could be especially important to environmental stakeholders, as many analysts speculate that these applications could have significant environment impacts (Juster et al., 1994; Zimmerman, 1994; Replogle, 1994).

In addition to examining public acceptance of ATIS and congestion pricing, we went beyond the traditional purview of ITS and reviewed public acceptance literature pertaining to select telecommunications technologies, with a focus on telecommuting. As with ATIS and congestion pricing, public acceptance of new telecommunications technologies was a salient topic during this study's focus groups, with participants believing that these technologies might have important implications for transportation-related environmental impacts. Furthermore, public acceptance of emerging telecommunications technologies and applications may hold lessons for ITS, as all involve the public's interface with the continuing revolution in telematics.¹²

¹² "Telematics" refers to the merging of telecommunications and computer technologies.

Public Acceptance of ATIS¹³

Our review of the public acceptance literature on ATIS divides into three parts. The first deals with public acceptance research related to advanced traveler research information in pre-development stage. Such research focuses on preferences about how traveler information should be developed in the future. The second part addresses revealed preferences from users who have actually used operational ATIS services. The third part examines the literature on willingness-to pay for advanced traveler information. We conclude with a profile of California projects addressing public/consumer acceptance of ATIS.

Pre-Development Findings

Research on advanced traveler technologies during the pre-development phase has focused primarily on two areas: 1) the type of information drivers want, and 2) safety concerns related to ATIS.

In various studies conducted across the country, drivers express a primary interest in information relating to accident sites, traffic congestion and alternate routes, as well as in mass transit and parking information (Gourdin & McIntyre, 1992; Beaton & Sandana, 1995; Harris & Konheim, 1995). In the TravTip project, for example, a survey of commuters revealed that information about freeway congestion, incident location and its impacts, road closure and construction was considered critical for a traffic information system (Rockwell, 1995). Information about city street congestion and available alternate routes was considered desirable, and participants also reported that in-vehicle radio information was the most-desired medium for delivering information.

Safety has also emerged as a primary issue in pre-development findings on ATIS. Boice Dunham Group (1994) has identified salient safety concerns, including 1) the concern that ATIS features could distract drivers while their cars were in motion, 2) concerns over returning drivers to their primary “safe” commuting route after being diverted to an “unsafe” alternate route, and 3) consumer interest in ATIS technologies that increase driver safety or provide emergency notification when the driver is in trouble.

Actual Use of Product Findings

This section discusses three operational tests of ATIS: SmarTraveler, Pathfinder, and TravTek. Information on additional California projects examining public acceptance of ATIS is provided at the end of this section

SmarTraveler operational tests continue to produce data on consumer acceptance of ATIS. SmarTraveler in Boston, for example, was one of the first operational tests of ATIS, providing real-time traffic and transit information to anyone in eastern Massachusetts via a touch-tone telephone. Among the findings from this test were the following:

- Among users, average use was 5 times per week
- 82% of the users considered the system very useful.
- 97% considered the service more useful than radio, and 71% consider it much more useful than radio.

¹³ Our review of the public acceptance literature on ATIS is partially derived from other research being conducted by Claremont Graduate School for the Automobile Club of Southern California.

- 96% of the users changed their time, route or mode of travel at least occasionally based on the information their received. 30% changed one of these aspects of their commute frequently.
- 63% ranked information received about alternate routes as very important.

Southern California SmarTraveler (currently in Phase II) has found that kiosks which provide traveler information are frequently used when located in areas with large pedestrian traffic, while kiosks in office areas are rarely used (Horan et al, 1996). In addition, users most frequently request transit information, while information on ridesharing is requested the least (Sacramento SmarTraveler recorded similarly minimal demand for ridesharing information).

Another early operational test of an advanced traveler system was Pathfinder, conducted in southern California and concluded in June 1992 (Whitworth et al, 1994). This tested an in-vehicle navigational system with real-time traffic information. Nearly 80% of the drivers reported reduced travel time when driving with the Pathfinder system compared to driving without the system, even though there were no statistically significant time-savings differences found in the evaluation.

A third operational test on traveler use of an advanced traveler system was the TravTek project conducted in Florida from March 1992 to March 1993. This project compared three types of advanced informational systems:

- Services Only** which included information about services and attractions in the area as well as emergency assistance.
- Services and Route Guidance** which included the services above as well as a dynamic navigational guide.
- Services, Route Guidance, and Traffic Information** which included the services, the dynamic navigation and real time traffic information.

Participants were AAA members who were also the primary drivers of AVIS rental cars.¹⁴ Measures of satisfaction and use of the ATIS were compared among the three types of users. According to Perez et al (1993), the users who had the additional technologies of route guidance and/or traffic information rated these products at higher levels than the services only drivers; the ratings for the services and Route Guidance and Services, Route Guidance, and Traffic Information users were approximately the same. Finally, like the Pathfinder test, many TravTek participants reported reduced travel times despite statistical evidence that no such reduction occurred.

Willingness to Pay for ATIS

Beyond questions of interest in and use of advanced traveler information lies the important question of whether the public is willing to pay for these services. This section addresses 1) general findings on willingness to pay for advanced traveler information, 2) specific estimates of willingness to pay, and 3) criticisms of the current state of the research in this area.

¹⁴Since these participants were self-selected members of specific groups instead of randomly selected from the overall driving population, their findings may not be generalizable to the larger traveling population (Whitworth et al, 1994).

One of the strongest conclusions about this issue thus far is that drivers would like to have the services advanced traveler information provides, but they are reluctant to directly pay for them (Boice Dunham Group, 1994; Multisystems, 1995). One reason for this is that drivers can already obtain traffic information via radio reports without having to directly pay for it (Lappin et al, 1994). Although the information provided by radio traffic reports is modest in comparison to what advanced traveler information could provide, this increase in quantity and quality of information may still not be enough to incite consumers to pay for the services.

The marketing research on willingness to pay is summarized below. It is divided into up-front estimates (e.g. when consumers pay one relatively large price for the system) and monthly estimates (e.g. when consumers pay monthly for access to advanced traveler information)

Up front Estimates

- 66% of the users of the Pathfinder system were willing to purchase such a system for “the price of a car radio” (Whitworth et al, 1994).
- 50% of the TravTek users were willing to pay \$1000 or more for a system for their car and 30% were willing to pay over \$1195 (Perez et al, 1993).
- Focus group participants were willing to pay an average of \$1500 for an advanced traveler information system that included a collision avoidance system (Turrentine et al, 1992).
- The threshold price for a route guidance system is approximately \$1200 for the initial market. Prices need to be about \$500 for market volume (Boice Dunham Group, 1994).

Monthly Estimates

- Charlotte residents were willing to pay an average of \$14 per month for traffic information and preferred a flat monthly fee to charges per call (Gourdin & McIntyre, 1992).
- 78% of drivers in the Tri-State New York area were willing to pay for enhanced traveler information. The range of prices indicated by these participants was from \$15 per month (of which 30% were willing to pay) to \$5 per month (of which 53% were willing to pay). Approximately, 64% were willing to pay 50 cents per call (Harris & Konheim, 1995).
- New Jersey residents were willing to pay for a monthly service fee of \$3.00 to \$4.00 (Beaton & Sandana, 1995). This estimate was produced by a logit model based on participants’ preference choices of prices and services.

Americans may be more willing to pay for monthly services than for a substantial, up-front fee (Parrish, 1994), as well as for bundled services than simply an advanced traveler information only product (Lappin et al, 1994).

The uncertainty surrounding consumer willingness to pay for ATIS reflects in-part the flaws in the research on this topic. Many research projects and operational tests, for example, do not include an explicit market research component (Whitworth et al, 1994). In addition, some research involves using vague prices and single item responses (Whitworth et al, 1994) which are not accurate ways of assessing what consumers will pay for a product. Also, consumers may not totally understand what the advanced traveler

information system can do when they are asked to estimate (Ben-Akiva et al, 1993). This may mean that consumers may underestimate how much they would be willing to pay for such a service. Boice Dunham Group (1994) reports that upon seeing live demonstrations of the products, consumers double their estimates of how much they would be willing to pay. Finally, this research has not been conducted in a real market environment (Ben-Akiva et al, 1993). Consumers may state a willingness to pay a certain price for the services but may not actually be willing to pay when the service is available.

Conclusion

Our review of the literature on public acceptance of ATIS yielded many key findings. First, consumers express interest in ATIS products and services, yet their willingness to pay for them remains largely unknown. At present, consumers seem satisfied with the travel information they obtain for “free,” and thus may perceive little added value in paying for additional information. Consumer reluctance to pay for advanced traveler information may also derive from unfamiliarity: the research suggests consumers are often unaware of the benefits ATIS offers. Second, consumers may be more willing to pay for advanced traveler information that is bundled with other services and which permits a monthly payment instead of a large up-front fee. Third, drivers appear most interested in advanced en-route information (or a combination pre-trip/en-route information package) that provides specific information about traffic congestion, travel time estimates and alternate routes. Finally, safety features offered by ATIS are highly valued by consumers, particularly technologies that prevent accidents, increase drivers’ ability to request assistance (e.g. mayday systems), and navigate through unfamiliar areas. Thus, the safety components offered by ATIS may prove pivotal in initiating user acceptance of these technologies.

The chart below profiles major California projects examining public/consumer acceptance issues related to ATIS. It includes a description of how each project addresses public acceptance, the current status of the project, its methodology, and findings on consumer/public acceptance:

Profile of California Projects Addressing Public/Consumer Acceptance of ATIS

ITS Project	In what way does the program/project address public or user acceptance?	What stage/phase is the project in?	What method (surveys, travel log, natural use) is being used in this project?	Have any results been obtained and what do they show? (particularly on willingness-to-pay for technology)
Pathfinder	Uses technology that would not be considered up-to-date currently no route guidance	Completed; a more advanced program is Travtek in Orlando, Florida which used 100 AVIS rental cars and is evaluated by 4,000 surveys	Surveys (not a good measure of user acceptance)	Drivers perceived getting to destination faster, although technology did not save them much time; February 1993 evaluation report received
Southern CA Smart Traveler	Examined how well did people use Smart Traveler (Phase I); trying to do consumer research to see what information would be effective for them (beginning of Phase II)	Completed Phase I (testing to see if system would work); beginning Phase II. Working with Caltrans, no consumer research done yet	Surveys, interviews, site visits, software records ; Focus groups completed in late October; methods most likely used in consumer research are surveys, focus groups - contract out to consultants (for Phase II)	June 1995 Draft Final Report of Los Angeles Smart Traveler (received); Regarding kiosks, those in areas with large pedestrian traffic was frequently used; those in office areas were hardly used; transit info most often requested, ridesharing used the least; ARMS did not work
Advance Fare Payment, Media II, Phase II	Tested for reliability and use of radio frequency card and smart card - Phase II	Technology is not mature, Ventura, Lompoc tests ongoing; testing of radio frequency card (Torrance bus line and LADOT Route 448) and smart card (Gardena) with substantial discount to users	Surveys, interviews, site visits; on-board survey during six-month trial run on the three routes	Public willing to use because of convenience, safety; results not yet finalized; Phase III of Smart Card project to evaluate contact-free radio frequency card in Ventura just beginning

ITS Project	In what way does the program/project address public or user acceptance?	What stage/phase is the project in?	What method (surveys, travel log, natural use) is being used in this project?	Have any results been obtained and what do they show? (particularly on willingness-to-pay for technology)
(Orange County) TravelTIP	Evaluation conducted on user needs assessment, with traveler information systems goals outlined	Design of experiment to be completed in March 1996; Solicit bids in June 1996	Focus groups (dominated by business community), surveys (general public, opinion leaders, AAA, seat drop at Metrolink, Rockwell employees)	Received OCTA TravelTIP Task 1 Report (May 24, 1995) and Task 3-Potential Technology of User Services Summary Report (June 26, 1995)
Smart Corridor	Not specifically addressed	Currently evaluating hardware and developing software; plans are that ATIS system will be fully operational by October 1996	No research done on public/user acceptance regarding the implementation of ways to deliver info to the motorist	Evaluation has not started; used basic traffic engineering techniques in implementing the methods of delivering info to the motorist
Yosemite Project (in conjunction with Caltrans, TRW)	Project consists of a traveler information system under a formed non-profit corporation; Includes CMS, HAR, Travel advisory telephone system, WWW site, kiosks; demonstration project will be operational December 1995/February 1996	Not yet in progress; all options will be operational within a 2-3 week period by December 1995	Performed an outreach to local citizens of 5 County area to discover what their requirements for system were; prior to implementation plans, 20 public hearings within the 5 County area; a variety of methods will be used (surveys, focus groups) to collect data on public perception of demonstration project	Demonstration on WWW involves business advertisement, with the \$ allocated to non-profit corporation to be recycled back into the system (300 businesses already signed up)

ITS Project	In what way does the program/project address public or user acceptance?	What stage/phase is the project in?	What method (surveys, travel log, natural use) is being used in this project?	Have any results been obtained and what do they show? (particularly on willingness-to-pay for technology)
Consolidated Transit System at Lake Tahoe	Formal signing on November 14, 1995 to start incorporation of tourism transit operations	Intent is to create a centrally dispatched demand-responsive system, wherein visitors are shuttled for free (as they are now by the three major casinos); Intent is to utilize automatic vehicle location, install kiosks on lodging properties	In process of preliminary work (contacting suppliers, software, hardware); doing parking management survey (unrelated to CTS specifically)	System not yet in operation; In informal straw poll with business members of the community, an elevated system (for moving persons) was overwhelming chosen against the options of light rail, highway alignment, bus alignment
TransCal	A line item budget for outreach program; not much has been done with project, running 4-5 months behind schedule; during the first 2 weeks of December a program plan will be written up and presented to the TransCal Management Board	Completed architecture phase; just beginning design phase, Phase III	Hope to do focus groups of stakeholders interests early next year; this year 3 public forums were held (South Shore Lake Tahoe, Reno, North Shore); planning to do brochure/hand-outs; hope to examine ways to develop revenue resources; 50 Clarion in-ehicle navigation display are expected to be used in the operational test; research interviews of business stakeholders on frequent passenger program ongoing into Jan 1996	No results have been obtained since test is not operational; marketing of project to public considered an important aspect; a serious challenge to the deployment of this concept lies in how other transportation issues are given priority

ITS Project	In what way does the program/project address public or user acceptance?	What stage/phase is the project in?	What method (surveys, travel log, natural use) is being used in this project?	Have any results been obtained and what do they show? (particularly on willingness-to-pay for technology)
El Dorado ATIS	N/A	All of the funds are not in place yet. Contractors Rockwell and NETC hired.	N/A	N/A
TravInfo (San Francisco Bay Area)	Vision driven project not based on market research; TravInfo set up as a market research test in itself; Public meetings where mostly business interests participate;	Still working on software, will be operational in March 1996; advertising/marketing expected to run in February 1996	11/15/95 + 1 week, random digit-dialing survey to 1000 people; 4,000 mail-back survey of transit users; surveys serve as baseline study for current awareness and perception of travel info; 3 focus groups planning during 2-year run; post evaluation in December 1997 expected	Ask willingness to pay on users of phone system survey, not on modem access survey (2 outreaches to TravInfo); free during operational test;
Santa Clara County Smart Vehicle	Technology project developed as an add-on to existing service for those with disabilities; this project was designed and funded prior to any market research; Outreach Inc. operates as a broker, relating to customers on a daily basis, 14 yrs. of experience, maintains Client Advisory Committee for input	Phase I - introduced GEO-database provided by Navigation Technologies; Phase II automated scheduling and routing system completed Feb. 95 and operational: currently in Phase III development of automated vehicle locator. Expected date of completion February 1996; operational test will begin March 1, 1996	Videotape, interview, surveys regarding customer service of existing prog.; General surveys of customers with existing service has been recently completed; no questions on this technology on satisfaction survey; automatic next-day evaluation of 2% of clients	A pre- and post-evaluation team via University of California at Berk. with Ted Chira-Chavala; \$100,000 budgeted for evaluation; the paratransit service itself costs \$2.20 per one-way trip throughout the County for the disabled; doing 39% more business in December 1995 than one yr. earlier

ITS Project	In what way does the program/project address public or user acceptance?	What stage/phase is the project in?	What method (surveys, travel log, natural use) is being used in this project?	Have any results been obtained and what do they show? (particularly on willingness-to-pay for technology)
Sacramento Real-Time Ridesharing (currently part of Sacramento Smart Traveler)	In Phase I (last fiscal year), which was non-ITS based, attempted to integrate the Sacramento database with local databases, 300 participants registered as drivers; program was to operate as a one-time match, with response 1hr; Phase II is geared toward those who show an interest in the program; respondents are allowed to make inquiry for match without specifically signing up for a program	Phase I operation test did not work; currently in Phase II which involves WWW site (Sacramento Smart Traveler) and 1-800-COMMUTE; project ongoing; real-time ridesharing is very infrequently used; system capability is in place; automated menu can be accessed via WWW or via live operator; 2 WWW sites, Sacramento Smart Traveler, or SACOG page	Phase I survey evaluation done of 300 registered participants 6 mo. after recruitment, asking why they signed up; many did not remember that they signed up and those who did remember had done so because of survey itself; people would not have used it even if they were placed in a situation of needing transportation; there are requests for real-time services, frequently from Chico to Sacramento; Sacramento to San Francisco, but sample size is very small	Less than 10 requests for rides and no matches (Phase I); Phase II is going well; GIS system to assist traveler in getting from point A to point B through other means than ridesharing not yet operational; sample size for real-time riders too small to conduct a meaningful evaluation (4 or 5 people within 3 mo. period)
Sacramento Smart Traveler	Contest currently running asking for feedback (winners receive free bus passes); responses have been positive, with respondents noting that it is good to have a WWW site to introduce different options to them	Operational; implementation phase in place for Los Angeles and San Diego Smart Traveler systems; ultimate goal is to have a state-wide system with links to each other; post research phase currently underway (also consists of cold-calls to see if respondents have used site)	65,000 hits in the past 2 months since site begun on WWW on 9/12/95; many of those who use site are in the Sacramento region, SOVs and commuters; telephone surveys on 1-800-COMMUTE and WWW sites to begin mid January 1996 until June 30, 1996	Looking to put kiosks out w/ Internet accessibility; when contract is done, Southwest Airlines will provide funds to maintain WWW site, monthly maintenance \$150/site; more sponsors to be added; very cost effective

ITS Project	In what way does the program/project address public or user acceptance?	What stage/phase is the project in?	What method (surveys, travel log, natural use) is being used in this project?	Have any results been obtained and what do they show? (particularly on willingness-to-pay for technology)
Ontario Smart Vehicle (ATHENA)- Personalized Public Transit	Employees who work for large companies located in Ontario, and who live in or near Ontario are targeted for the operational test; no detailed analysis of supply and demand (drivers and riders) done; 100 vehicles equipped with technology are expected in operational test	Stage 1 completed; Stage 2 (consisting of final subsystem and system design, integration and installation, marketing and participant recruitment and the operational test period) is in progress; not yet implemented	Inventory of user data on attitudes, perceptions, and needs from annual State of the Commute Survey conducted in November and December 1993 by Commuter Transportation Service applied to ATHENA project	April 1995 Report from October 31, 1995 Preliminary Design Review of ATHENA held in Ontario; suggestion in the report of \$1 per trip via a debit (cashless) card
Southern California Showcase (microplan)	Deals with examining public needs; public outreach	Gathering information from different public constituencies (taxpayers, League of Women Voters, experts etc.)	2,000 surveys from different public constituencies (survey process ongoing)	Data collection process ongoing

Public Acceptance of Congestion Pricing

This preliminary review of the literature on public acceptance of AVI-based congestion pricing highlights three overarching issues: 1) the public's general reaction to the concept of congestion pricing; 2) equity issues; and 3) the politics of congestion pricing.¹⁵ Summaries of selected literature on each topic are provided below.

General Public Reactions

Polls indicate a willingness by the American public to consider congestion pricing in principle, yet their willingness to actually implement such programs is difficult to gauge. A Transportation Research Board report (1994), for example, reviewed numerous national and regional public opinion polls on congestion pricing and concluded that :

Public opinion polls in the United States suggest a receptivity to congestion pricing among motorists confronted with congestion. What people say in answer to abstract question in polls and how they react to actual proposals may well vary, but the poll data do imply an openness to consideration of the policy (p.66).

In addition, a September 1995 poll of San Francisco area residents found that nearly 60% of those polled responded favorably to congestion pricing on the Bay Bridge (a major artery between San Francisco and the East Bay) when car and van pools were still allowed to cross free and revenues were used to improve public transit and other alternatives to driving across the bridge (Bay Area Council, 1995). However, this same poll found that 57% of Bay Area residents opposed electronic toll collection during peak hours for Bay Area highways, and that 58% opposed an additional \$2 in bridge tolls for drive-alone commuters during peak commute hours.

Further research on public sentiment toward congestion pricing was conducted during the "Citizens Jury on Traffic Congestion Pricing." The "Citizens Jury" -- twenty-four people selected from the Minnesota's Twin Cities area who convened for a week to discuss congestion pricing -- yielded general findings relevant to public acceptance of congestion pricing (Humphrey Institute, 1995). Among these were the following:

- Jurors' support for congestion pricing may have risen if positive environmental impacts had been demonstrated.
- Jurors rejected the use of congestion pricing as a means of raising revenue, believing this was a "sneaky" attempt at raising money.
- Fairness and equity issues were important to Jurors, as they believed congestion pricing would impose disproportionate costs on the poor while benefiting the rich. Nevertheless, Jurors believed it possible to sell congestion pricing on fairness grounds (e.g. those who cause need for extra road capacity should pay their fair share to obtain it).
- Jurors were concerned with who would implement congestion: greatest support when decisions were locally based and when revenues went toward corridor improvements.

Equity

¹⁵ This framework for assessing public acceptance issues related to congestion pricing is adopted from the Transportation Research Board's report on this topic; see TRB. 1994. Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion. Washington D.C.: National Research Council.

Equity “refers to the distribution of costs and benefits resulting from a policy decision” (Giuliano, 1994: 251). The distribution of policy costs and benefits can fall in various ways, often differing along geographic lines, over time (e.g. certain generations benefit more than others), or along population subgroups or income categories (e.g. by race, gender, poor vs. nonpoor, commuters with schedule constraints vs. those with flexible schedules). When considering the equity impacts of congestion pricing, two issues must be kept in mind. First, the “distributional impact of congestion pricing would vary considerably depending on the design of the pricing system and the uses of the revenues to compensate those disadvantaged” (Transportation Research Board, 1994: 67). Second, congestion pricing’s equity impacts should be evaluated within the context of the current road-financing system which, according to some research, imposes disproportionate costs on poorer groups and subsidizes richer groups (Hayward and Elliot, 1990).

Yet even with the contingent nature of congestion pricing’s equity impacts and the inequities of the current road financing system, there is a strong public perception that congestion pricing is unfair to certain groups (Humphrey Institute, 1995; Elliot, 1994). Indeed, some analysts argue that equity issues pose the greatest obstacle to public acceptance of congestion pricing (Transportation Research Board, 1994). According to Giuliano (1994), concerns about equity and fairness impacts raise obstacles to public acceptance for several reasons. For example, those most likely to be negatively impacted would be from a broad spectrum of lower and middle income working households who form a major voting block. In addition, congestion pricing impacts would be most negative on households least able to make changes in their driving schedules. These impacts, seemingly arbitrary and enforced over long periods, would appear unfair.

Not all research, however, concludes that congestion pricing will impose disproportionate costs on lower income individuals. Elliot (1995: B9) argues that many studies suggest both rich and poor would benefit from congestion pricing, and that “even the 1% of the poor who might find full-scale emissions charges a burden could only be helped by [congestion pricing programs] which give everyone a free alternative and...get everyone where they want to go faster.”

The Politics of Congestion Pricing

Researchers generally agree that political resistance to congestion pricing is formidable (Downs 1992; Rom 1994). Downs (1992), for example, argues that elected officials will not support road pricing until the public feels that the congestion problem is intolerable and that “painful cures” such as congestion pricing offer the only solution. Other researchers argue that, irrespective of the perceived severity of the congestion problem, implementation of congestion pricing programs will only occur if pro-congestion pricing individuals and groups mount a robust political campaign. Rom (1994) highlights this point, arguing that attempts at selling congestion pricing on analytic grounds alone will fail without concerted political action:

Congestion pricing becomes politically possible only through political action. Congestion pricing is likely to be rejected, or to fail if adopted, if it is designed, ratified, and implemented by experts. No analytical framework can replace a political system that allows participation, debate, and voting by the affected parties. No analytical cleverness can replace dedicated, persistent advocacy (p. 295).

A strong pro-congestion pricing political campaign is especially important in America’s political system because

the American political system is organized in a way that makes change difficult. Proponents of change must be willing to advocate their cause successfully before state agencies, city and county councils, state legislative committees, and high-level government officials. Opponents of change, however, can stymie, if not block, progress by winning at any of these points (Transportation Research Board, 1994: 77).

Indeed, strong political forces in California have already voiced their opposition to congestion pricing and vowed to block future road pricing programs through legislative means.¹⁶

An essential element of an effective pro-congestion pricing political campaign, according to some researchers, is a coordinated public relations campaign. McMullen (1993) argues that such a public relations campaign must emphasize the true costs of automobile travel, the benefits of congestion pricing (e.g. reduced congestion, time savings, environmental gain), and must develop a rapport with the media. In addition, McMullen and others (e.g. Walcoff and Associates, 1992) argue that congestion pricing's political prospects will be enhanced only if it is part of comprehensive area transportation plan.

¹⁶ For example, Senator Bill Lockyer called toll roads 'un-Californian' and 'a form of highway robbery', and State Senator Tom Hayden (D-Santa Monica) plans to introduce legislation to block new toll roads and thwart what he calls efforts at 'behavior modification.' See Simon, Richard. "As Toll Roads Gain Toehold in Southland, Critics fear 'Highway Robbery'." Los Angeles Times, Section B, P. 2

Public Acceptance Advanced Telecommunications Technologies: Telecommuting

ITS impacts on the environment depend in part on the extent to which the public uses and purchases the products and services made available by the telecommunications revolution. As one report put it (Humphrey Institute et al., 1995):

The possible environmental impacts of ITS needs to be considered in light of other technological developments...Advances in 'information highway' technologies could provide commercially viable platforms for disseminating a variety of ITS-related information. At a more macro level, these technologies will probably continue to allow for metropolitan decentralization, with telecommunications systems permitting spatially - free access (p.17).

Given the connection between potential ITS impacts and the broader trends in public acceptance of information technologies, we thus extended our review of public acceptance literature beyond specific ITS applications to include telecommuting . Presented below are preliminary observations on this topic.

Telecommuting

“Telecommuting” refers to the “total or partial elimination of the daily commute through the use of telecommunications technology” (Caltrans, 1994: 3). Depending on how they are counted, there are currently between 7 and 12 million telecommuters in America (Center for the New West, personal communication, 1-17-96). Of these, perhaps 7 to 10 million workers participate in formal telecommuting programs, while maybe a third or more of all telecommuters do so informally. Projections of future telecommuting rates range as high as 50 million by 2020 (US DOT, 1993).

Both speculative and empirical studies suggest telecommuting reduces the negative environmental impacts associated with transportation (e.g. emissions), although factors such as latent demand and increased suburban sprawl could offset such environmental gains (US DOE, 1994; Mokhtarian et al., 1994). Some of the most comprehensive empirical modeling work on telecommuting appears in Henderson and Mokhtarian (1995). Based on data from the Puget Sound Telecommuting Demonstration Project and using the EMFAC7f and BURDEN7F, they found that center-based telecommuting¹⁷ reduced VMT significantly without a significant change in the number of personal trips. Thus, on telecommuting days participants reduced Nox emissions by 49% and Particulate Matter Emissions by 53%.

In addition to producing environmental benefits, telecommuting may be a bridge to other transportation strategies aimed at improving the environment, some involving ITS:

By creating an alternative to the traditional peak-hour journey to work, telecommuting should reduce the cost of other strategies, such as congestion pricing and parking fees, that tax or discourage travel during peak periods. Thus, technological advances or investments in telecommunications infrastructure that facilitate telecommuting should not only lead to direct and indirect transportation benefits, but they may also

¹⁷ “Center-based” telecommuting refers to replacing the work commute with a commute to a “telecenter”, a facility where employees (from a single or multiple organizations) share workspace and equipment to reduce the length of the commute from an employee’s home to the usual workplace.

have a synergistic beneficial effect on other transportation strategies that may be required to cope with growing traffic congestion, urban air pollution, and national petroleum dependence (US DOE, 1994: xiii).

Public acceptance of telecommuting hinges on factors in the marketplace, on government incentives and programs, technological capacities, social factors and on the local transportation and environmental context. Our review will explore some of these issues, as outlined below:

Marketplace Factors

- employee-employer relations (e.g. trust)
- individual firm characteristics: culture, organizational dynamics
- Macro-factors: employment demographics (e.g. percentage of jobs which could be accomplished off-site)

Government Incentives and Programs

- ISTEA and CAAA (federal)
- County of Los Angeles telecommuting program

Technological Capacity

- adequate telecommunications services
- computer ownership

Social Factors

- Isolation
- In-home distractions/problems

Local Transportation and Environmental Context

- degree of congestion
- degree of air pollution

SECTION 4. CONCLUSIONS AND RECOMMENDATIONS

The summary results and recommendations draw upon information contained in each element of this report: the review of environmental issues associated with ITS, the literature review on public acceptance of ATIS, and, most of all, from the three focus groups. We offer these recommendations to assist the development of ITS deployment strategies that will garner environment stakeholder support in California:

Programs and Policies

Recommendation: Methods of implementing remote sensing, ATIS, and congestion pricing as environmentally beneficial ITS programs should receive particular attention.

Among the myriad of ITS applications discussed during the focus groups, remote sensing of emissions, ATIS, and congestion pricing received particularly strong endorsements on environmental grounds. The potential for ITS to enable remote sensing of emissions was the most common topic during the focus group discussions of air quality, and participants generally felt that although significant efforts at garnering public support would be necessary, remote sensing could be a cost-effective means of dealing with “gross polluters” and a generally effective tool for improving air quality. Participants in Los Angeles were especially convinced that continued technological innovation was necessary to address the region’s air quality problems. Similarly, focus group attendees believed ATIS could improve air quality by making vehicle trips more efficient (e.g. by reducing the amount of driving time spent looking for destinations), reducing congestion, and by encouraging transit use. Finally, most participants felt congestion pricing and various other road pricing strategies (e.g. emissions pricing, VMT charges) could reduce both pollution and traffic congestion.

It should be noted, however, that not every focus group participant believed these applications held great promise for the environment. A few attendees felt, for example, that remote sensing technology was currently insufficient, that no market existed for ATIS, and that congestion pricing was politically unpalatable in the current “no new taxes” political climate. The challenge, then, is to construct creative programs that use these ITS applications to serve environmental goals. One such proposal comes from Sperling and Replogle (1994), who advocate the introduction of road/congestion pricing together with other services (e.g. ‘smart’ paratransit and electric vehicles) to afford alternatives to driving and to reduce public opposition to pricing strategies.

Recommendation: ITS should be framed within the context of how these technologies address transportation problems or serve clear policy goals.

Many focus group participants viewed ITS as a “technology solution looking for a problem,” or the ITS program as “technology-driven” rather than “goal-driven.” Many attendees seemed particularly troubled with descriptions of ITS as a collection of arcane acronyms or “technology bundles” devoid of any reference to broader transportation policy strategies. As a transportation consultant argued, “The key public policy issue is what kind of framework should [ITS] exist in. The question is not the technologies themselves; the key question is how they are going to be applied.” Substantial efforts should therefore be made to position the ITS program as offering tools that address specific problems (e.g. traffic congestion) or goals (e.g. improving transit) consistent with broader policy concerns.

Research

Recommendation: There remains a need for regional forums to discuss environmental issues associated with ITS.

The focus groups uncovered important regional differences in how environmental stakeholders viewed ITS. Of all such differences, perhaps the most significant was that the Los Angeles and San Francisco groups exhibited greater support for ITS than the Sacramento group. Whether discussing ITS impacts on air quality and land use, or the likelihood that ITS would encounter success either commercially or as a government program, the tone in the Sacramento meeting was decidedly more negative compared to the other meetings. Two reasons may account for this. First, Sacramento participants gave particular attention to partisan politics within the state, and many felt that legislators (particularly Democrats in urban areas) would encounter difficulty in “selling” ITS to their constituents. Second, Sacramento participants exhibited a general skepticism that Caltrans could adequately address environmental issues in the ITS program. The tone in Sacramento contrasted most sharply with that in Los Angeles, where attendees seemed to assume that ITS (and technology in general) would play a large role in achieving transportation and environmental goals.

Another regional distinction was the relative attention each group gave to various ITS-related environmental issues. Los Angeles attendees, for example, considered at length how ITS could address air quality and congestion problems, while the San Francisco group considered the implications of the Bay Area’s Clean Air Act attainment status for ITS deployments. Participants in Sacramento, on the other hand, gave considerable attention to the potential impacts of state politics on funding for ITS initiatives.

These regional differences underscore the need for continued region-specific forums and research to both understand why such differences exist and to ensure that ITS deployments garner regional stakeholder support.

Recommendation: Both ITS field tests and empirical modeling studies that generate data on the environmental impacts of ITS technologies should continue.

Focus group attendees repeatedly cited the lack of data on ITS impacts as inhibiting their ability to appraise ITS and as a source of apprehension about the technologies in general. Furthermore, better empirical data and more reliable models related to ITS impacts (especially on air quality) could be invaluable if ITS deployments face legal challenges on environmental grounds. Thus, information gathering on the environmental effects of ITS should continue with the hope of reducing the role that perceptions and speculation currently exert over the ITS program (joint research currently underway by Claremont Graduate School and UC Davis will address some of these concerns).

Recommendation: Research needs to be conducted on how ITS could impact land use patterns.

The focus group discussions of potential ITS impacts on land use patterns mirrored the academic debates on this issue: no consensus emerged on whether ITS would amplify, mitigate, or have no measurable impacts on settlement patterns and urban form. Some focus group attendees believed ITS could exacerbate suburban “sprawl” while others argued that the myriad of powerful variables shaping land use patterns outweigh any potential ITS impacts. This lack of consensus underscores the controversy surrounding the

relationship between transportation and land use, the consequences of continued low-density, decentralized development (e.g. “sprawl”), and the how ITS might impact both these issues.

The public debate over land use and ITS has attained particular salience with the publication of two widely-circulated reports that assert California’s current land use patterns threaten the state’s economy and quality of life and that ITS could exacerbate these patterns.¹⁸ ITS is now central to the debate over transportation investments and land use patterns, and because this issue will continue to surface as ITS deployment proceeds, continued research in this area is critical.

Recommendation: Research needs to be conducted on public acceptance of ITS applications.

Both the focus groups and the review of the literature on public acceptance of ATIS suggest a continuing need for public acceptance research on this specific ITS application, and it is likely that similar research needs to be conducted on other ITS applications. With respect to ATIS, our literature review uncovered significant information about public/consumer acceptance issues. It seems clear, for example, that the public exhibits an interest in having advanced traveler information, and that safety -- both the reliability of the technology and as a means to increase personal safety (e.g. “mayday” systems) -- is important to drivers. On the whole, however, much remains to be learned about which ATIS products and services people want or, more importantly, their willingness to pay for them. Thus, future research on public acceptance of ATIS (which likely applies to consumer/public acceptance research on other ITS applications) should address willingness-to-pay issues, aim for more generalizable results by using samples that better represent the broad driving public, and should build upon past research findings. Not only will such research assist in efforts to market ATIS and other ITS applications, but it will also provide information on the degree to which ITS deployments (and other telecommunications technologies) could affect the environment.

Outreach and Public Education

Recommendation: Caltrans should enhance its image as a socially and environmentally responsible organization through continued inclusion of environmental stakeholders into ITS policy discussions.

The focus groups revealed a palpable skepticism among many participants about the ability of Caltrans to adequately address environmental and social issues as part of its ITS program. This skepticism animated the Sacramento meeting in particular, where one attendee stated flatly that the social/environmental consequences of Caltrans setting ITS

¹⁸ The two publications include a report compiled by Bank of America and several environmental groups entitled “Beyond Sprawl: New Patterns of Growth to Fit the New California,” and an article by Professor Bob Cervero in *Scientific American* entitled “Why Go Anywhere?” The Bank of America report argues that California’s ongoing trend of low-density suburban development (e.g. “sprawl”) threatens the state’s economic vitality and overall quality of life. The Cervero article asserts that ITS could exacerbate the trend toward sprawl “by orders of magnitude” and that, instead of making ITS investments, policy-makers should create urban designs that reduce the need to travel. For contrasting views on the consequences of “sprawl,” see Gordon and Richardson (1995). In addition, Giuliano (1995) provides a good review of the literature on the relationship between land use patterns and transportation, and asserts that this relationship is probably weakening over time. Our report gives a more detailed review of all these articles in the review of ITS-related environmental issues (under “Land Use”).

deployment priorities “scares the hell out of me.” Whether Caltrans deserves such skepticism is irrelevant: Caltrans must address the *perception* that it is incapable of integrating environmental and social goals into its ITS program. Addressing this perception will require continued efforts by Caltrans to incorporate environmental stakeholders into ITS policy deliberations and decision-making forums. By doing so, Caltrans will not only improve its image within the environmental community, but will also ensure that the perspective and concerns of environmental stakeholders continue to inform the ITS program.

While enthusiasm for the ITS program varied across the three focus group meetings, it is important to note that participants never voiced a fundamental or “radical” critique of ITS *per se* as environmentally destructive. This is not to say that such a critique does not exist within the environmental literature on ITS (see Cervero, 1995) or that focus group attendees refrained from criticizing specific ITS technologies or elements of California’s ITS program. It does mean, however, that participants did not view ITS in monolithic terms (e.g. equating ITS solely with automated highway systems) or as all “good” or all “bad.” In general, attendees viewed ITS as a group of technologies whose environmental and social impacts would vary according to technology and with the way that technology was deployed. This conclusion corroborates one of the major findings of the National ITS and Environment Conference in Arlington (Horan, 1995: 201), and is a positive sign as the ITS program goes forward.

Recommendation: The ITS program should adequately address social equity issues by conducting outreach efforts across a broad range of communities.

Some of the strongest feelings and debates among focus group participants surfaced during discussion of social equity. Many attendees argued that ITS would serve only white, affluent, suburban residents, that ITS-enabled congestion pricing was “elitist,” or that less affluent urban residents would benefit more from investment in “low-tech buses” rather than in “high-tech” ITS. The intense feelings surrounding the issue of social equity, as well as recent legal activity related to transportation and equity,¹⁹ suggests that the ITS program ignores equity concerns at its peril. We thus recommend outreach into communities with diverse socio-economic groups to elicit input from citizens, community organizations and elected officials about how ITS deployments can be made consistent with community needs and concerns. In addition, public education efforts should emphasize the

¹⁹ A recent civil rights law suit failed against Caltrans and the California Transportation Commission by community groups in El Sereno, California over the planned 4.5 mile extension of the Long Beach Freeway illustrates the linkage of transportation and equity issues. The suit alleges the planned extension imposes disproportionate environmental and housing burdens on their neighborhood compared to the impacts on the more affluent Pasadena communities through which the extension will also run. The lead attorney for the plaintiffs called the proposed extension “a stark case of environmental injustice” (see *BNA State Environmental Policy*. “Latino Groups File Civil Rights Law Suit Over Freeway extension in California.” The Bureau of National Affairs, Inc., September 25, 1995).

The nature of this suit exemplifies what Bosso (1994: 43-44) labels the “new environmentalism” and demonstrates the kinds of political groups and issues that almost certainly will impact the ITS program. The “new environmentalism,” according to Bosso, is non-elite, grass-roots activism that links environmental issues to social, economic and environmental justice, often through legal means. Bosso believes this “immense and inchoate” collection of non-traditional environmental groups are “spiced by a lingering suspicion that they are pitted against institutions and forces mostly beyond their control, [and this] makes these activists particularly wary of government and industry experts and skeptical about science and technology generally.” Bosso sees such groups as the locus of “real energy” in 1990s environmentalism.

potential benefits of ITS for low-income individuals and/or urban areas. This could include marketing ITS as a tool for urban renewal, as a means to more efficient and demand-responsive transit, and explaining how congestion pricing could benefit affluent and less affluent drivers alike.

APPENDIX A. Summary Results from Prior Conferences and Research Paper

National IVHS and Air Quality Workshop, Diamond Bar, California, March 29-30,1993: Recommended Courses of Action

The workshop participants identified a host of research, testing, and related actions that could be taken to improve technical understanding of IVHS impacts on air quality and, consequently, improve the ability of IVHS to contribute to air quality goals. Key recommendations fall into four general classes: research studies, operational tests, crosscutting issues, and institutional steps.

Research Studies

Workshop participants agreed that it was important to separate short- and longer-term expectations of research, regardless of the supporting or performing organization. And in a related sense, workshop participants recognized that some of the research needs of IVHS - particularly in the modeling area - were embedded in the broader research needs of the transportation community. Nonetheless, efforts were made to identify those items that were particularly germane to the IVHS/air quality issue. These are:

Reduced Versus Induced Traffic Demand. The extent to which deployment of IVHS strategies will encourage, versus discourage, use of alternative transportation modes is a central research question of IVHS. If IVHS systems can be devised to aid in achieving multimodal use, this would bode well for their deployment in nonattainment areas. (Many participants were particularly interested in the use of IVHS for demand management and congestion pricing applications.) Conversely, the extent to which IVHS generates added trips would create significant problems for metropolitan areas struggling to reduce mobile emissions. Moreover, a greater understanding is needed of which IVHS system “bundles” can best aid achievement of clean-air standards versus those bundles which do not positively affect air quality. Research is needed to resolve existing uncertainty about these demand aspects, and a reliable and longitudinal database needs to be developed to track the various impacts of IVHS on VMT and on emissions.

Reducing Emission Levels. There were a variety of other areas in addition to travel demand where IVHS could affect emissions levels, and consequently these represent areas for further analysis. For example, nonrecurring traffic congestion can add to emissions levels, especially in areas with inadequate capabilities for rapid incident removal and overall management of such events. The magnitude of emissions buildup and the effectiveness of incident management techniques is not known. This information could be used to help formulate broader air quality improvement strategies.

Further, there is not a uniform distribution of emissions across vehicles, and IVHS could contribute by helping to reduce super-emitter and comically generated emissions. There is increasing data that suggest that a small percentage of vehicles (known as super-emitters) are responsible for a disproportionately high percentage of emissions. Using IVHS to identify these vehicles would be a significant contribution to air quality. Research in this area would focus on the conditions that contribute to super-emitting vehicles (e.g., aggressive or high-speed driving patterns, cold-engine driving) and what detection techniques are available for short-term and long-term emissions control (e.g., remote sensing and on-board diagnostic display).

Trucks and buses have been omitted from all the emissions estimates and most data collection efforts by public agencies. However, research has indicated that their

hydrocarbon emissions (per vehicle driven) may be 10 to 20 times greater than that emitted from passenger cars. From the IVHS point of view, this suggests that routing of these commercial vehicles may be more important than originally believed. Procedures for commercial vehicle evaluations are not in place, and facilities for conducting tests have not been constructed, though much of what has been learned in the testing and mapping of engines for passenger cars can be applied to these larger vehicles. The initiation of a systematic set of studies would involve fleet operators and the manufacturers of trucks and buses.

Concerns were raised that emission reduction strategies that focus on increasing motor vehicle speeds and smoothing traffic flow produce increased NO_x and only short-term reductions of VOC, which may be replaced by longer-term VOC increases as travel demand grows to re congest facilities. Controls on NO_x, rather than only controls on VOC, will be needed to meet Clean Air Act ozone standards in many cities. Thus, effective emissions reduction strategies will need to focus on accommodating economic growth without increased motor vehicle dependence. IVHS technologies could play a vital role as the enabling strategy for such demand management: for example, by facilitating road pricing, substitution of telecommunications for travel, more efficient routing and logistics, increased efficiency of public transportation and real-time rideshare matching.

Integrated Traffic-Air Quality Planning Models. The need for improved models and linking of models was a major issue for workshop participants. The limitations of all existing traffic, emissions, and planning models were discussed, as were the difficulties of linking existing models. The strongest candidates for integrated model sets were presented by Volpe National Transportation Systems Center (VNTSC), but it became clear that the efforts by the VNTSC team should be viewed as a stop-gap procedure.

It was agreed that an “accepted” or “standardized” integrated model would allow traffic engineers, urban planners, transit planners, and air quality specialists to work with the same set of assumptions and definitions, rather than continue the current independent developments that make it difficult even for modellers to communicate. Participants were hopeful that a macroscopic model that is not data-intensive would suffice for evaluation of alternative congestion mitigation or air quality improvement strategies and planning efforts, although it is unclear whether a model can be developed that will meet the objectives of all programs represented at the workshop.

One specialized area for development is modeling of “nonsteady state” systems. Much of IVHS attempts to provide information and control processes that aim at disequilibrium adjustment. Knowing the extent to which such adjustments can in fact reduce disequilibrium - and its consequent effect on emissions - would greatly assist in the accurate determination of air quality benefits. For traffic modeling, this calls for the development of accurate simulation models. For emissions modeling, it calls for development of a modal emissions model.

IVHS Operational Tests

It became apparent during the workshop discussions that IVHS operational field tests, while widely viewed as being an important source of empirical data, had not explicitly focused on obtaining data to aid in understanding the air quality impacts of IVHS. Several recommendations were made to improve the extent to which operational field tests contribute to this area, and would involve both revising existing plans and developing new operational test plans.

Modify Existing or Planned Tests. There are nearly 50 federally supported operational tests currently being conducted or planned. Most, if not all, have not focused on air quality aspects. However, since many of the evaluation plans for these projects are still being formulated, the opportunity exists for inclusion of air quality analysis. Without such information, it is also clear that there will be resistance to deploying IVHS from those charged with implementing air quality provisions of federal and state laws. Workshop participants strongly encouraged the explicit assessment of candidate operational test proposals and the monitoring of such projects to ensure that they have adequately considered air quality implications.

In addition to the Federal Highway Administration (FHWA) operational field tests, there are a variety of other opportunities to obtain needed information. For example, the Federal Transit Administration (FTA) is conducting demand management-related field tests as part of its APTS program. And ISTEA has authorized congestion-pricing demonstration projects that could use IVHS-related technologies and could be measured for air quality purposes. Consequently, tests such as these should be considered for their value to the air quality issue.

Initiate IVHS/Air Quality Operational Field Tests. There was a strong consensus among the participants that an operational test specifically focusing on air quality impacts should be undertaken immediately. One specific recommendation was for a test focused on the use of remote sensing. As noted above, older cars and those which have been poorly maintained contribute substantially to emissions. Significant gains would be possible if such vehicles were either removed from the vehicle fleet or modified and maintained. An operational test that uses state-of-the-art surveillance and information-processing techniques could be used to detect excessive levels, notify drivers, and possibly notify enforcement agencies. This type of operational test would be most appropriate in a nonattainment area and should be solicited with participation by FHWA, NHTSA, and EPA. Some of the issues raised by such a project and recognized as sensitive. But these issues are not more difficult to deal with than other “privacy” issues related to IVHS implementation and should be considered in DOT’s assessment of institutional issues.

A second recommendation was for a Smart Communities field test. This recommendation broadens the concept of IVHS to test the use of a range of technologies that can aid in reducing the need for vehicle trips, particularly nonwork trips, which make up the majority of trips in the United States. The research would aim to get better understanding of the activities generating nonwork travel demand (through focus groups, etc.). Subsequently, a pilot test would assess if a host of smart technologies could satisfy these activity needs with less travel, or more efficient travel. The technologies could include ATIS for travel and location information, interactive computers for teleshopping, and perhaps GIS for developing information on trip patterns and travel reductions.

Crosscutting Research Issues

A number of research recommendations have application to research priorities outside of the IVHS program, demonstrating the interdependency between IVHS and other transportation research domains. Three items were identified: the need for accurate driving cycle information, the need to better understand broader societal implications of congestion pricing, and the need to consider opportunity costs.

Development of Realistic “Driving Cycles.” It was agreed that “driving cycles” used in the EPA Federal Test Procedures do not represent actual driving for current traffic and vehicle fleet conditions and consequently would not represent vehicle speed patterns under

ATMS and ATIS deployments. There was no agreement among workshop participants about either the direction or magnitude of effects due to the use of representative driving cycles. However, such information appears to be critical for modeling and understanding the effects of various air quality policies and IVHS deployment strategies. While there is some movement being made toward the development of more accurate modeling, supported by the EPA and DOT, such works have a low priority in these federal agencies. Further, it appears that no other organization is prepared to fill in this information gap. Accordingly, the development of a representative set of “driving cycles” needs to assume greater priority and should be closely coordinated by EPA and FHWA managers.

Congestion Pricing. There were several suggestions to investigate the effects of varied pricing strategies on travel behavior and emissions, to assess the political and institutional abilities to implement these pricing programs (e.g., travel taxes, fuel taxes), and to identify conditions under which different pricing mechanisms would be most effective. This would involve identifying IVHS technologies that enable pricing strategies (e.g., AVI, AVL, AVC, electronic tolls, Smart Cards, etc.); conducting cross-sectional surveys to assess willingness to pay by different socioeconomic groups; conducting field tests and pilot programs that implement IVHS pricing bundles supported by longitudinal survey data; and, finally, cycling results from surveys and pilot programs back into enhanced travel-demand models.

Opportunity Costs. Although broad economic analysis and assessment of opportunity costs were beyond the scope of the conference, several participants pointed out the importance of the economic aspects of IVHS and air quality strategies. For example, the relative cost-effectiveness of IVHS versus other emission-reduction strategies was raised. Also mentioned were the opportunities and costs to the private sector, both as end users of the services and as potential service providers. At the broadest level, the concept of access to services was suggested as a potential unifying theme for considering the economic purposes of mobility. In developing a framework for assessing the overall impacts of IVHS, such considerations are in light of the increasing attention being paid to the economic/investment aspects of technology support by the public sector.

Institutional Steps

Finally, there was a widespread consensus that the current make-up of institutions involved in the national IVHS program does not facilitate diverse inputs on the air quality and more general environmental issues. Several recommendations were made to improve the range of input, including using social decision analysis, developing Broad Agency Announcements, and enhancing interagency cooperation.

Social Decision Analysis. There are a number of analytic techniques that could be used to more systematically engage the participation of various stakeholders in IVHS. Known generally as social decision analysis, this methodology would permit potential IVHS strategies to be assessed by various groups, including not only environmental groups but also end users. This would provide a more systematic mechanism for obtaining tangible input as to how a proposed IVHS project or strategy could be augmented to allay concerns or objections.

Broad Agency Announcement. In order to take advantage of the planning, engineering and scientific technical expertise in the environmental community, it was recommended that Broad Agency Announcements be developed that would be targeted for viable scientific environmental interest organizations to further study the use of IVHS technologies to improve the environment, with a particular focus on air quality. This was seen as

diversifying the types of organizations that would have access and input to the IVHS research program.

Interagency Cooperation. Integrated technological approaches to transportation and air quality require interagency cooperation at the federal level. Therefore, a third institutional recommendation was the establishment of cross-sectional units of federal employees (DOT, EPA, DOE, etc.) with the primary assignment of expanding research and testing of advanced transportation technologies to improve the environment, with focus on air quality, noise quality, and community cohesion.

**National Conference on Intelligent Transportation Systems and the Environment,
Arlington, Virginia, Washington DC, June 6-7, 1994: Summary of Conference
Findings and Recommendations**

Among the important findings of this conference were those summarized below:

- An understanding that although the transportation and the environmental communities do not know share a common vision, there was affirmation to strive for a common vision of ITS.
- The visionary effort would begin by mainstreaming environmental and other public interest groups into policy discussions.
- Once the common vision was achieved, there must be a serious commitment to revisit the vision.
- This revisitation would be based on continual application of the new, broad-based, public involvement techniques mandates by the Intermodal Surface Transportation Efficiency Act (ISTEA).

Any commitment to revisit the ITS vision must be accompanied by further commitment to take action. Any action taken must be based on the results of public outreach. The willingness to take concrete action based on the results of outreach must also recognize the role of regional diversities. Thus, the conference recommended that ITS deployment be based upon local and regional decisions.

The conference also identified the need to broaden the constituencies involved in the ITS planning and implementation coalition. The broadening must be viewed from the perspective of the state, regional and local governmental institutions . Resources are required to make this process sufficiently participatory. Only then will there be meaningful dialogue and a working through to the goals of a shared vision.

The broadening process must include strengthening the MPO's role and using the MPO process for implementing the early deployment programs. It must include land use, quality of life, and social and economic issues. There is a need to think creatively about forging new institutional linkages; to change the way institutions do business. The parallel side to changing institutional cultures is that of equity issues. Equity issues include attention to consumer needs, including the non-traditional consumers, the disenfranchised as part of the planning and implementation process. The issue of "equitable bias," or that every party comes to a meeting with some bias, is important. In shaping the program for the future, those biases must be represented equitably and no preference given to one over another.

Conference attendees reinforced the importance of research and analytical tools. There is too little known about the very broad-based constituency for ITS. There is a need to strengthen the capabilities of the existing research centers and take advantage of them while reaching to other research centers to supplement our capabilities for the complex modeling and analysis that are going to be needed.

Finally, it was concluded that institutional, societal, and environmental issues and considerations must be included in early deployment plans and that there had to be teeth in

this requirement. It was deemed essential to avoid mistakes, even as the community builds upon its capabilities to learn more. Avoiding mistakes is only possible in an inclusive policy process that builds upon the broad constituency of both the environmental and transportation communities.

Executive Summary to “Institutional Challenges to the Development and Deployment of ITS/ATS Systems in California” (Research Paper)

Intelligent Transportation Systems (ITS) and related advanced transportation system technologies are increasingly seen as having great promise for improving the nation’s surface transportation system. At the federal level, support for the development and testing of ITS/ATS technologies has increased dramatically over the last few years and, through funds provided by the Intermodal Surface Transportation Act of 1991 (ISTEA), six year support could exceed \$1 billion. The state of California has also committed to aggressively pursue the use of ITS/ATS technologies and has been a major player in the advancement and deployment of these technologies.

For ITS/ATS products and services to be effective, they must be successful in resolving a broad range of institutional, legal, and societal challenges, collectively known as “non-technical” constraints. Recent research efforts have been undertaken to better understand and identify the range of these non-technical factors that could affect ITS/ATS deployment and, as a result, the literature is now replete with inventories of potential institutional constraints. However, this in itself does not help in organizing and prioritizing issues that need to be addressed through future research and policy action. This study was conducted to assess the *key* institutional and policy challenges confronting the California ITS/ATS program and, in the process, move toward a more integrated understanding of *specific* areas that warrant immediate attention.

This study entailed an extensive review of the emerging literature on “non-technical” issues in ITS/ATS, as well as approximately 15 in-depth interviews with experts representing both California and the national program. Based on information obtained about the status, direction, and unique features of the California program, three core areas are described as capturing major concerns at the institutional and policy level: research and development collaboration, regional management, and stakeholder acceptance. The research collaboration area addresses the challenges associated with public/private collaboration in developing and deploying ITS/ATS technologies. The regional management areas focuses on the challenges associated with testing and deploying these technologies within the context of complex metropolitan transportation systems. The stakeholder acceptance area recognizes the crucial role that multiple stakeholders play in ensuring or preventing the success of ITS/ATS systems.

For each of these areas, the study team also compiled and reviewed recent and ongoing related activities around the country that have implications for the California program, as well as identified a range of methodological approaches that can be used to study the issues involved. For example, in the area of research and development collaboration, there have been a series of national case studies addressing various strategies for achieving public/private sector cooperation in ITS. In the area of regional management, the challenges to regional deployment are being considered at both the corridor (e.g. I-95) and at the metropolitan level (e.g. early deployment studies around the country). And in the area of stakeholder acceptance, field tests evaluations (e.g. SmarTraveler) and related focus groups are beginning to uncover aspects of user and institutional acceptance.

The goal of this review was not only to identify important non-technical issues confronting the California ITS program, but to do this in a manner that could assist the California program in prioritizing its institutional research needs. Based on the discussions and feedback from the Caltrans/PATH sponsors, three decision criteria were developed to permit this sort of ranking. These criteria are: program relevance, research relevance, and cost-share potential. These criteria were used to rank 11 potential research subjects that

were identified as a consequences of the program review. Recognizing budget constraints, three issues, one from each core area, were further highlighted as warranting immediate attention. These are:

Research Collaboration - Identification of private sector interests and concerns on entering into partnerships in California,

Regional Management - Incorporation and synthesis of innovative institutional and market mechanisms in corridor and field operational tests, and

Stakeholder Assessment - Development of structured forum to solicit and consider CA environmental interests and concerns about ITS/ATS.

The study concludes with a series of program recommendations aimed at strengthening the analytical ability of the California program to address these and related institutional issues. The first recommendation follows the identified research needs and recommends that each of the major issues be addressed through the Caltrans/PATH program. The second recommendation notes the importance of addressing these and other institutional issues through partnerships, in order to access expertise in a variety of disciplines (such as social science and market research). The third recommendation notes the value of integrating institutional assessments with broader testing and deployment studies, so as to facilitate cost-effectiveness as well as close association with deployment. The fourth recommendation considers the need to conduct strategic exercises in areas not covered by this review, such as institutional challenges to the deployment of ITS in rural areas.

The study closes by noting how several system studies -- such as the national architecture program -- are finding that the technical and non-technical elements are inextricably linked: an understanding of one is not valuable without an understanding of the other. The major challenge for the California research program will be to develop information that can translate this generality into a practical deployment-oriented program of activities and policies.

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