Policy Brief on the Impacts of Traffic Incident Clearance Programs (Freeway Service Patrols) Based on a Review of the Empirical Literature

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Policy Description

Traffic incident clearance programs deploy fleets of roving tow trucks on highway routes to reduce the time needed to assist and clear stalled or inoperable vehicles, reducing incident related traffic congestion. Traffic incident clearance programs are one of many traffic management tools; other traffic management policies include highway call boxes, video monitoring of traffic conditions, ramp metering, and, in some cases, traveler information systems. The evidence in this brief is from studies of the impact of roving tow truck fleets deployed in urban areas during peak hours. Importantly, the link from traffic incident clearance programs to reduced emissions is through reducing travel delays. The impacts in Table 1 do not account for any increases in traffic induced by the higher travel speeds associated with incident clearance programs.

Impacts of Incident Management

Effect Size

Most studies on traffic incident clearance programs focus on quantifying cost savings, rather than environmental benefits. As part of larger cost-benefit analyses, some studies have examined the connection between improved traffic flow and reduced criteria pollutant emissions, and that evidence is summarized here.

One of the earliest incident clearance program studies was the Skabardonis et al. (1995) research, conducted both before and after implementation of the Freeway Service Patrol program in the Bay Area. Following the Skabardonis et al. (1995) study, other research examined the effect of traffic incident clearance programs on freeway travel delay and vehicle criteria pollutant emissions. The results are summarized in Table 1. Generally, those studies have two sequential parts – first estimating travel delay reductions and then inferring emission reductions from an emissions model.

The range of reductions in incident clearance time is from 5 to 22 minutes for the programs in Table 1. The studies were conducted in urban areas during congested time periods. Roadways with excess peak period capacity (e.g. in rural areas) would experience less benefit from traffic incident clearance programs, and there is little evidence of any impact of such programs in eliminating non-recurring incident-related congestion outside of urban areas.

The reduction in criteria emissions per incident cleared is in the range from 1.46 kg hydrocarbons (HC) in Los Angeles to 24 kg HC in D.C.-Baltimore, from 11.51 kg carbon monoxide (CO) in Los Angeles to 269.75 kg CO in D.C.-Baltimore, and from 2.97 kg nitrous oxides (NOx) in Los Angeles to 11.48 kg NOx in D.C.-Baltimore. The incident results of the study by Skabardonis et al. (1998), when compared with same-year vehicle emissions in Los Angeles County, imply that the traffic incident clearance program reduced CO emissions in Los Angeles County by 0.75 percent and NOx emissions in Los Angeles County by 1.45 percent. Details for that calculation are in the background document that accompanies this brief.

Table 1: Summary of Traffic Incident Clearance Program Studies

Study	Study Location	Study Year(s)	Results	
			Incident Delay Reduction	Emissions Reduction
Skabardonis et al. (1995)	Freeway Service Program: I-880, Alameda County, CA	Before: Spring 1993 After: Fall 1993	Response time for FSP-assisted breakdowns reduced 57% (12.6 minutes)	3.51 kg HC/incident 35.84 kg CO/ incident 8.85 kg NOx/ incident
Skabardonis et al. (1998)	Freeway Service Program: Los Angeles County, CA: I-10 near Santa Anita exit	1996-1997	7-20 minutes 35% longer	1.46 kg HC/ incident 11.51 kg CO/ incident 2.97 NOx/ incident
Guin et al. (2000)	Georgia NaviGAtor Atlanta metropolitan area; studied entire regional system	2003-04	Not Available	5.775 kg HC/ incident 75.58 kg CO/ incident 8.059 kg NOx/ incident
Chang et al. (2003)	C.H.A.R.T. data system: Analyzed database covering Washington, D.C. & Baltimore regions	2001	21.9 minutes savings 43% reduction	24 kg HC/ incident 269.75 kg CO/ incident 11.48 kg NOx/incident
MTC FSP Raw Data (2007)	33 highway segments in Caltrans District 4 Bay Area, CA	2004-05	Not Available	51.1 kg ROG / day 1219 kg CO/ day 260.79 kg NOx/ day

Abbreviations:
HC is hydrocarbons; CO is carbon monoxide; ROG is reactive organize compounds; H.E.L.P. stands for Hudson Valley Emergency Local Patrol; C.H.A.R.T. is Coordinated Highways Action Response Team.

Each study cited in Table 1 calculated emission reductions, usually by applying emission factors to estimates of changes in travel speed. The studies in Table 1 sometimes reported emission reductions on a “per incident cleared” basis and sometimes per day or per year. For consistency, we converted annual or daily emission reductions into “per incident” amounts based on the number of peak-hour incidents cleared, which was reported in every study except the raw data provided by the MTC. An additional study, by Haghani et al. (2006) for a program in New York State, decomposed emission reductions based on level of service at the time of the incident, the change in incident duration, and (from a traffic simulation model) assumptions about driver behavior. The resulting emission changes in Haghani et al. (2006) were consistent with the results shown in Table 1, but because Haghani et al. (2006) reported results in several categories, rather than an overall program summary, that study is not shown in Table 1.

Evidence Quality

The Skabardonis et al. (1995, 1998) studies used before-after variation, and the “before” and “after” time periods were close enough that changes in economic conditions likely did not affect travel volumes or congestion. Those two studies have the strongest research design for purposes of inferring the impact of incident clearance programs. The other studies in Table 1 compared travel delay reduction to other measures, such as clearance times when incident clearance service was not offered (e.g. nights and weekends, as in Haghani et al. 2006), or incident duration when cleared by tow companies or others not affiliated with the incident clearance program (e.g. Change et al., 2003).

Once changes in travel delays are inferred, the studies in Table 1 used emissions models to estimate corresponding reductions in criteria pollutants. The emissions models assume that vehicle fleet composition (vehicle make, year, and emissions factors) does not change in response to the Freeway Service Patrol programs.

Caveats

The calculations of emission reductions in the studies in Table 1 do not account for induced traffic. As a result of reduced congestion, additional drivers might be “induced” to travel by car, or divert trips from other modes or surface streets to highways. Traffic incident clearance programs are, in that respect, analogous to increases in highway capacity. While incident clearance programs deliver many benefits and co-benefits (described below) from the perspective of greenhouse gas reduction, the fact that increased travel speeds may induce more travel, and that such induced traffic is not reflected in Table 1, is an important consideration.

Additionally, each region has different freeway conditions—wide shoulders versus almost nonexistent shoulders, frequent exits versus sporadic ones, etc.

Locations with narrow shoulders, where incidents would interfere with traffic flow, likely benefit more from freeway service patrols. Similarly, places with high peak period congestion and relatively fewer on- and off-ramps would benefit more from incident clearance programs. On the whole, this suggests that urban areas, and more centrally located parts of urban areas where freeways are congested and possibly lack wide shoulders, would experience the greatest benefits from traffic incident clearance programs.

Greenhouse Gas Emissions

None of the studies in Table 1 measured the impact on greenhouse gas (GHG) emissions. The studies in Table 1 estimated changes in criteria emissions by inputting travel delay reductions attributable to the traffic incident clearance programs into an emissions model. In concept, one could do the same exercise for GHG, using travel delay reductions as an input to a GHG emission model. That modeling step would require substantial work and access to underlying data on fleet characteristics and traffic flow, and so goes beyond the summary of the literature presented in Table 1. The conditions that lead to higher emissions of criteria pollutants typically lead to higher emissions of GHG, and vice versa. Therefore, traffic incident clearance programs that reduce congestion delays, shorten travel times, and lower criteria emissions likely also reduce GHG emissions. Yet to make more precise statements would require GHG emissions models tailored to the fleet composition and roadway characteristics that apply to the studies in Table 1, in addition to accounting for induced traffic.

Co-Benefits

Emission reduction is a secondary benefit of incident management programs. Incident management programs are intended to reduce non-recurring traffic congestion by assisting drivers when they are stranded on the roadside. Other co-benefits include time savings, more reliable travel times, and increased safety.

Examples

Often referred to as the Freeway Service Patrol, this traffic incident clearance program was started in California in mid-1993 in order to relieve congestion in a more cost-effective way than building new vehicle lanes. As of 2009, the program was assisting 600,000 motorists per year (www.dot.ca.gov). Program funding originates from the State Highway Account. Funding also comes from federal transportation authorization legislation, money from the vehicle license fee, Congestion Mitigation and Air Quality Program (CMAQ), as well as Transportation Management Plan (TMP) funds from reconstruction projects (Skabardonis, 1995). The Freeway Service Patrol program is administered from Caltrans through local Metropolitan Planning Organizations or in some cases county transportation commissions, and the local agency typically contracts with private towing contractors.

Suggested Further Reading

Chang, Gang-Len Chang; Lin, Pei-Wei; Zou, Nan; Liu, Ying. “Performance Evaluation of CHART, The Real-Time Incident Management System Year 2001.” Department of Civil and Environmental Engineering University of Maryland. College Park and Office of Traffic and Safety State Highway Administration of Maryland. March 2003.

Guin, Angshuman ; Porter, Christopher ; Smith, Bayne; Holmes, Carla. “Benefits Analysis for Incident Management Program Integrated with Intelligent Transportation Systems Operations.” Transportation Research Record. No. 2000, pp. 78–87. Transportation Research Board of the National Academies. Washington, D.C. 2007

Haghani, Ali; Iliescu, Dan; Hamedi Masoud; Yang, Saini “Methodology for Quantifying the Cost Effectiveness of Freeway Service Patrols Programs—Case Study: H.E.L.P. Program.” University of Maryland, College Park. February 2006.

MTC-SAFE, Metropolitan Transportation Commission. Raw Data. Compiled 2007.

Skabardonis, Alexander; Noeimi, Hisham; Petty, Karl; Rydzewski, Dan; Varaiya, Pravin P.; Al-Deek, Haitham. “Freeway service patrol evaluation.” California PATH Program. Institute of Transportation Studies. University of California, Berkeley. 1995.

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