Getting to the Truth About "High-Occupancy" Vehicle (HOV) Standards

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Transport 2000 Canada
August, 2007

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A major deficiency in the debate about "High-Occupancy" Vehicles and "High-Occupancy" Vehicle Lanes is the absence of logical, reasonable definitions of what the concepts mean. As a result, in many parts of Canada, and elsewhere in the world, the "HOV" debate is characterized more by rhetoric than by solid thought, and more by pronouncements from promoters and proselytizers than by logical derivations that are understood by parties on all sides of the debate.

To assist in promoting a more informed, productive, and honest debate, this brief report uses several widely-held perceptions to put the defining process in context, and then defines the HOV concepts in operational terms. I hasten to add that I have not seen a discussion of this nature in the literature, including government documents. If there is such a discussion in the open literature, then I apologize for the oversight and welcome having the document(s) brought to my attention at the earliest moment.

Putting HOV Perceptions in Context

No doubt a number of perceptions are held as to what HOV means or might mean, or could be construed to mean. Four perceptions, two con and two pro, are sufficient to for the purposes of this paper to put HOV in context, and to provide a framework for the HOV-defining task which is a core feature in understanding vehicle occupancy measures and standards.

First, it appears fair to say that many members of the public are skeptical about the utility of high-occupancy vehicle lanes. In their view this is an inefficient and wasteful expenditure of taxpayer money which supports and promotes vehicle driving at the expense of the walk, cycle and transit modes. Moreover, whether HOV lanes are dedicated from existing lanes, or HOV

lanes represent new lanes, it is perceived that so-called "HO vehicles" add to the contribution that the transport sector makes to the greenhouse gas problem, which is part of the climate change problem, which is part of the global warming problem, and on it goes.

Clearly, it is going to take serious evidence to persuade these people that there are significant social, environmental, economic, and financial benefits that outweigh the financial, administrative, enforcement and other costs of an HOV program. Further, since they are likely to suspect that political support for the HOV initiative has far more to do with vote-getting than sustainable transport best practices, they are not going to be appeased by vague promises about benefits. They want the facts.

Second, many members of the public suspect that HOV is a fancy phrase that sounds good in principle, but fails when it comes to actual practice. That is, they like the idea behind the HOV concept: if the driver-passenger loads per vehicle are sufficiently increased and become large -- thereby warranting the term high-occupancy -- then there is a decrease the number of private motor vehicles on the road, which in turn reduces congestion, reduces overall fuel consumption, reduces pollution, and so on. However, they have yet to be convinced that the driver-passenger load will be significantly increased, and sense that the "HOV bar" will be lowered along the lines of business as usual. That is, lots of talk, but no real change in vehicle loadings.

Since this group consists of those who are dubious about the validity of the claims behind the HOV idea, the task of persuading them to join the HOV parade is actually more difficult than might be thought. In particular, these people are likely already aware of HOV 'hype' through statements in the media by politicians, bureaucrats, consultants, and other HOV promoters, so they have already seen and heard the exhortation side of the HOV idea.

Clearly, exhortation alone is not enough to carry the argument for the doubters. Their focus is on the demonstration side, and they want to see **hard evidence** that establishes the merits of an HOV program as an effective, efficient, and readily enforceable means to decrease the number of Low-Occupancy Vehicles (LOVs) that are deemed to be a significant contributor to the apparently unacceptable levels of congestion that are purportedly afflicting some of the country's major highways.

As for the third group, these are students of the "if you build it they will come" school of thought. To their way of thinking, if HOV lanes are provided, then a number of LOV drivers and passengers will combine their trips with those of other LOV drivers and passengers and create HOVs. The anticipated result of this combining activity is perceived to be a net reduction in the overall number of vehicles during peak or off-peak hours, and more room to manoeuvre for the drivers and passengers of LOVs and HOVs alike.

Indications from media reports and public meetings is that for this group the driving factor behind support for the HOV notion is self-interest. That is, they appear to believe in building the capacity for vehicles to move freely in uncongested conditions, which in turn would accommodate a proclivity to drive that exceeds a willingness to walk, cycle, or use transit.

Further, if it is perceived that adding or building HOV lanes causes a migration from the LOV group to the HOV group, and the HOV lanes relieve overall congestion in some way, then these people support the HOV idea, even though they may not be users of these lanes. Or, to re-phrase, if the HOV lanes free up road space for LOV drivers and passengers, then the LOV people are onside because they perceive that their situation will improve as the HOVs move from the LOV lanes to the HOV lanes.

Finally there is fourth group that, for sundry other reasons, advocates on behalf of HOV lanes and related privileges for operators and passengers in HO vehicles. This group includes people who think that they are already in the HOV mode; those who are currently in the LOV class but would go the HOV route if it meant trips were made at higher speeds with less hassle; and, also in this group, are private motor vehicle operators and users, and special interests, who for various philosophical, pecuniary, business, or ideological reasons support increases to highway capacity either by physically enlarging highways, or by manipulating the expanding number of vehicles competing for increasingly less road space per vehicle.

Also among this group of HOV advocates are engineers, consultants, the automotive industry, members of the road-building industry, bureaucrats, and others who brought us and continue bring us ever-enlarging highway networks. And, of course, more and more vehicles. They are looking at the HOV angle as a means to deal with growing criticisms, initially launched decades ago, that highway network expansions have not worked and will not

work, and that better transportation alternatives to the private motor vehicle must be identified, adopted, and implemented. For these people the HOV notion serves many purposes, such as buying time to try to figure out how to keep the road-building empire from crashing, providing a way of being seen to be doing something (the media are very useful here), and creating at least a temporary diversion to forestall pressure for action while the overall transportation situation continues to deteriorate.

There are other groups that could be discussed, but the four identified above provide a context which is appropriate for this brief search for truth regarding HOV concepts. For readers who want to read more about HOV and LOV groups, the web may assist. Courtesy of Google, the phrases 'high occupancy vehicle' and 'low occupancy vehicle' yield 1,980,000 and 1,890,000 hits respectively, so there are numerous other sources of opinion about HOV and LOV contexts.

What Is Meant by HOV, LOV, and Vehicle Occupancy Level?

With a context in place, it is now appropriate to address the central questions of this report:

> **What is meant by High-Occupancy Vehicle (HOV)?**

And,

> **"In operational terms, how does a low-occupancy vehicle (LOV) differ from high-occupancy vehicle (HOV)?**

In the next several pages I address these questions at a basic, fundamental level using common language and simple arithmetic. As the reader may be aware, honesty is not only the best policy, it is the easiest policy to explain when there is no hidden agenda, and there is no need to cover off or cover up complications that are introduced to befuddle.

Based on my experience, the HOV concept does not involve rocket science, and we should all be wary of anyone who attempts to use high-level mathematical equations to demonstrate that 2+2=4. As a case in point, the next several pages illustrate how to get down to basics and define HOV, LOV, and related concepts in straightforward, operational terms.

Simple Numeric (or Body Count) Vehicle Occupancy Rating System

A vehicle occupancy rating system that is based solely on the number of people in a vehicle is about as simple as this kind of rating system can get. That is, there are no assumptions, and no 'red herrings". Moreover, all that is required is to be able to count to seven, and to then see where the body count for a vehicle fits in the rating scale. Child's play, you might say.

This system is illustrated by Table 1. As shown, there are six terms that describe the levels of vehicle occupancy which range from seven or more to two or less, and the terms are arrayed in relative in order as follows:

Highest
Higher
High
Low
Lower
Lowest

The highest to lowest classes are distinct, the terms are brief and to the point, there is no overlap between or among the terms, their logical relationship is unambiguous, and the language is straightforward with no room for arbitrary interpretations. In summary, this is more than just a very neat little package of terms, it is one that is impossible to manipulate or obscure by 'smoke'.

As for the two variables, Number of Occupants and Description of Occupants that are used to create the ratings, all the same attributes apply. That is, the language is straightforward with no room for arbitrary interpretations, there is no overlap between or among entries in the cells, and the arithmetic relationship is logical and unambiguous.

From a methodological perspective, this is a valid approach to illustrate where the term "High" fits relative to the other terms referring to vehicle occupancy levels. Bearing in mind that most private motor vehicles on the road in Canada tend to have a lowest level of two seats and a highest level of seven seats, this is a very realistic representation of the relative occupant loadings that can be achieved by vehicles that have as few as two seats (seatbelts) to those with as many as seven or more seats (seatbelts).

Table 1. Simple Numeric or Body Count Vehicle Occupancy Rating System

Number of Occupants	Description of Occupants	Vehicle Occupancy Rating
7 or more	Driver + 6 or more passengers	Highest
6	Driver + 5 passengers	Higher
5	**Driver + 4 passengers**	**High**
4	Driver + 3 passengers	Low
3	Driver + 2 passengers	Lower
2 or less	Driver with or without passenger	Lowest

As shown by Table 1, according to this approach a "High-Occupancy Vehicle" contains five people, that is, the driver and four passengers.

5	**Driver + 4 passengers**	**High**

There are no ifs, buts, or maybes, and no wriggle room: **HOV by this method means a vehicle transporting <u>five</u> people.**

Similarly, and again obtaining information from Table 1, a "Low-Occupancy Vehicle" contains four people, that is, a driver and three passengers. And again, there are no ifs, buts, or maybes, and no wriggle room: **LOV by this method means a vehicle transporting <u>four</u> people.**

The difference between a High rating for an HOV and a Low rating for a LOV is one person: five versus four. As the careful reader will have noted, however, this is far more than a mere playing-with-numbers exercise.

That is, questions immediately arise about proposed schemes or regimes in which an HOV is established to be three persons and even as low as two persons. What, one might well ask, is going on with those numbers?

As shown by Table 1, those numbers are at the "bottom of the rating barrel', and to assign them a rating of High is not only arbitrary, and perhaps even nonsensical, it is a form of misrepresentation. Moreover, assigning bottom-of-the-barrel numbers a rating of High suggests that a remedial course in Grade One arithmetic is in order: **the relative term 'High' in this scale of discrete numbers can <u>not</u> stand for 2, 3, 4 and 5 at the same time**.

By the body count method of vehicle-occupancy rating, High means 5 occupants. No more, and no less.

As people with a scientific bent who design rating systems are aware, it is always appropriate to attempt to ascertain whether there may be another way or a better way of doing the calculations. In this particular case, the objective could be to design a rating system that logically justifies applying the High label to private motor vehicles containing 4, 3, or 2 occupants. Again, I do not recall ever seeing such a system, so I would welcome having it called to my attention.

However, the purpose of this commentary is neither to attempt to justify nor to attempt to 'deep six' the HOV concept. Rather, I am concerned about the design of rating systems that inform rather than obscure the debate on HOV issues. Towards that end, a second rating system is presented as a further contribution to the discourse on how to <u>honestly</u> assess where HOV fits in the vehicle occupancy scheme of things. Of particular interest here is the question of whether the second rating system supports or counters the findings derived from the Simple Numeric or Body Count Rating System.

Percentage of Seats Occupied Approach

The Percentage of Seats Occupied approach adds a significant dimension to the occupancy rating system by introducing the variables Number of Seats Occupied and Percentage of Seats Occupied. That is, the rating system has moved from a simple body count to taking into consideration the vehicle itself and the extent to which the available seats (seatbelts) are being utilized. The result of incorporating these variables in a rating system is shown in Table 2, which yields a detailed statement about vehicle loadings.

Table 2. Percentage of Seats Occupied
Vehicle Occupancy Rating System*

# of Seats	# of Seats Occupied	% of Seats Occupied	Level of Occupancy
	7	100	Highest
	6	86	Higher
7	**5**	**72**	**High**
	4	57	Low
	3	43	Lower
	2	29	Lowest
	6	100	Higher
6	**5**	**83**	**High**
	4	67	Medium
	3	50	Low
	2	33	Lower
	5	100	Higher
5	**4**	**80**	**High**
	3	60	Low
	2	40	Lower
4	**4**	**100**	**High**
	3	75	Medium
	2	50	Low
3	**3**	**100**	**High**
	2	67	Low
2	2	100	Highest

* According to the Simple Numeric or Body Count approach, a vehicle with two occupants receives the rating of Lowest, that is, a two-occupant vehicle is designated "Lowest Occupancy Vehicle" and is at the bottom of the six-class rating system. By any logical explanation, a two-occupant vehicle is not an HOV. A two-seat vehicle is included in Figure 2 to make a critical point. That is, if only two seats are occupied in the other vehicles, the Level of Occupancy Ratings are Low, Lower, Lower, Lowest, and Lowest respectively. Further, a three-occupant vehicle fares only marginally better than a two-occupant vehicle when the number of available seats is 5, 6, or 7, as it receives ratings of Low, Lower and Lower. Clearly, there is not a High rating in either the 2-occupant or 3-occupant case involving vehicles with 5, 6, or 7 seats, so the notion of using HOV in association with vehicles containing two or three occupants is beyond illogical; it flat-out contradicts the idea of sustainable transport best practices. And common sense.

Similar to Table 1, the array of variables and numbers in Table 2 are easy to follow, and easy to interpret. Indeed, because of the straightforward design used, the contents of Table 2 speak for themselves to such a degree that all I need to do is offer several interpretive comments to ensure that the materials are not misconstrued in some other document or circumstance.

To briefly return to the point made earlier, this is not rocket science, and every effort is being made to keep the discussion as simple as possible. That is, hold the commentary to a high standard of rigour, but make it easy to understand.

I believe that due to its logical organization, and its very straightforward vocabulary, Table 2 satisfies the conditions of rigour and understandability. However, there are several deeper methodological questions about what the numbers and relationships mean that require elaboration. Further, these elaborations may contribute to making the report more self-contained, and may also be of assistance to those who are called upon to analyze or comment on what is presented in Table 2.

To begin this brief comment on Table 2, it is recalled that emphasis in government pronouncements and media stories is on "HOV"; that is, vehicles which are classified as having a High Occupancy level. As a result, the rows in Table 2 for which a rating of "High" is assigned are compared. For ease of analysis and discussion, the pertinent rows have been extracted from Table 2 and are presented in Table 3.

Table 3. Specifying the Number of Occupants in a High-Occupancy Vehicle (HOV)

# of Seats	# of Seats Occupied	% of Seats Occupied	Level of Occupancy
7	5	72	High
6	5	83	High
5	4	80	High
4	4	100	High
3	3	100	High

(Vehicles that can accommodate only two occupants have already been assessed as failed HOV candidates, so they are excluded from the elaboration of Table 2.)

A point of interest here is that in order to achieve a rating of High, at least 72 per cent of the seats in any vehicle must be occupied, and the number of seats occupied must be at least 3, 4, 4, 5, and 5 in the respective number-of-seats categories. It appears fair to say that these conditions would generally be regarded as significantly increasing driver-passenger loadings relative to existing loads, and could well find favour with members of the four groups used to establish a context for the report.

Further, although High is not up to the standards set by the Higher and Highest ratings presented in Table 2, it is a step forward towards achieving sustainable transport best practices. Indeed, in comparison to the current situation on major highways, or attempts to set or lower the bar so as to rate two-occupant vehicles as HOVs, adoption of these conditions would be a major step in the direction of achieving sustainable transport.

Moreover, as the benefits of becoming occupants of HOVs using HOV lanes are established, and attitudes adjust, it would be a relatively simple matter to raise the bar to the Higher rating. Indeed, even the Highest rating could be set as the standard under selected conditions, such as special events, long holiday weekends, and other times when Highest Occupancy Vehicles transporting the largest number of occupants deserve to be treated with deference relative to those with fewer occupants and lower seat use levels.

As for the reference to sustainable transport best practices, examination of various literatures (learned popular, professional, interest group, etc.) reveals that this concept is held in high regard. However, analysis of results from a survey to gather evidence for a presentation at the National TravelWise Association conference in Belfast in November indicates several major differences among the respondents from municipal governments. (As of this writing, the responses of provincial and federal agencies are apparently still "in process"). The difference of import to this paper is one of **standards**. That is, proposed or purported best practices by some governments are regarded by others as run-of-the-mill activities, and are not included in their lists of sustainable transport best practices.

Table 4 is designed to ensure that there is no confusion about how occupancy levels and sustainable transport practices are related in this analysis. It appears fair to say that Table 4 is transparent, the language is explicit, the terms are readily understood, and there is no room to honestly take issue with what is presented.

Table 4. Matching Levels of Vehicle Occupancy and Levels of Sustainable Transport Practice*

Vehicle Occupancy Rating	Sustainable Transport Practice Rating
Highest	Best
Higher	Better
High	**Good**
Low	Bad
Lower	Worse
Lowest	Worst

As shown, **Highest** is the vehicle occupancy rating that **matches** sustainable transport practice at the level of **Best**. And, the vehicle occupancy rating of High matches sustainable transport practice at the level of Good.

By way of brief comment, an HOV regime (where H=High) does not constitute a best practice. That is, setting the vehicle occupancy bar at High is not a best practice. Rather, it is barely passable, recalling from Table 1 that the Simple Numeric Vehicle Occupancy Rating System assigned the rating of High (HOV) to vehicles with five occupants and Low (LOV) to those with four passengers. The addition of one vehicle occupant to move from LOV to HOV is not the stuff of a best practice under any circumstance.

To close off the comment on Table 4, it may be instructive to discuss the relationship between **Lowest** vehicle occupancy rating and the **Worst** sustainable transport practice.

Based on the information in Table 1, the Lowest rating is assigned to vehicles with two occupants. Linking Table 1 to Table 4 through the descriptor Lowest, the corresponding sustainable transport practice is Worst. That is, achieving a level of two vehicle occupants amounts to hanging on to the bottom rung in the sustainable transport practices challenge.

And as for Table 2, at the 100% occupancy level, two-person vehicles are carrying fewer occupants than any other class of vehicle. Indeed, even at 100% occupancy for two-person vehicles, these vehicles carry fewer occupants than other vehicles with lower to much lower levels of seat occupancy. Once again, achieving two-occupant vehicles levels matches up as a sustainable transport worst practice.

Those several comments appear sufficient to demonstrate that the Percentage of Seats Occupied Vehicle Occupancy Rating System is straightforward, transparent, and makes an honest, unvarnished case. Further, it is clear that the results from applying this rating system are consistent with the materials presented for the Simple Numeric Rating System in Table 1.

It is appropriate to close this section by referring specifically to the questions posed at the start of the paper:

"What is meant by High-Occupancy Vehicle (HOV)?"

"In operational terms, how does a low-occupancy vehicle (LOV) differ from high-occupancy vehicle (HOV)?"

First,

"What is meant by High-Occupancy Vehicle (HOV)?"

Based on the two rating systems designed for this report, there are several aspects to the definition of a High-Occupancy Vehicle (HOV):

- Using the Simple Numeric or Body Count Rating System, an HOV is defined as a private motor vehicle carrying at least five occupants, that is, a driver and four passengers.
- Using the Percentage of Seats Occupied Rating System, HOV varies according to the number and percentage of seats occupied, as follows;
  - 7 seats and 5 occupants = HOV
  - 6 seats and 5 occupants = HOV
  - 5 seats and 4 occupants = HOV
  - 4 seats and 4 occupants = HOV
  - 3 seats and 3 occupants = HOV.
- Using both the Simple Numeric Rating System and the Percentage of Seats Occupied Rating System, vehicles with two occupants are at the bottom the occupancy ladder. It defies logic, and common sense, to associate HOV with a two-seat vehicle or any other vehicle containing only two occupants.
- There is a strong, logical connection between vehicle occupancy levels and sustainable transport practices. The best sustainable transport practices match the highest occupancy levels, and the worst practices match the lowest occupancy levels. Further, achieving a high occupancy level is the standard for a good practice, not a best practice.

With the HOV definition in place, we can now respond to the question**,**

> **"In operational terms, how does a low-occupancy vehicle (LOV) differ from high-occupancy vehicle (HOV)?"**

According to the Simple Numeric Rating System with its six classes that are based on number of vehicle occupants, there are 4 occupants in an LOV and 5 in an HOV. The difference is one passenger. I hasten to add that the LOV-HOV difference of one person is the difference between four and five occupants, and **NOT** the difference between one and two occupants. To recall Table 1, vehicles with one or two occupants cannot be logically justified as high-occupancy vehicles and are excluded from the analysis.

This completes the main body of the text. The next several paragraphs address issues that involve evaluation of the effectiveness of vehicle occupancy programs, and the enforcement of vehicle occupancy programs.

Continuing the Emphasis on Obtaining Honest Answers

First, the Auditor of Ontario and the Environment Commissioner of Ontario have an interest in the economic, financial, environmental and other aspects of HOV policies, programs, and standards. These offices have significant experience and expertise to bring to bear in evaluating HOV proposals and activities. The tax-paying public needs to know that HOV programs will be scrutinized by these independent authorities.

Second, proper enforcement of HOV lane usage is crucial to the success of HOV programs, but there are numerous difficulties associated with the enforcement aspect. These include obtaining accurate counts of occupants in moving vehicles with tinted windshields and windows, stopping vehicles during times of high vehicle volumes, and reading dirty license plates in order to issue citations as an alternative to pursuits. Such enforcement matters need to be publicly resolved before launching an HOV program.

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