Moving People

Presentation by Paul Minett

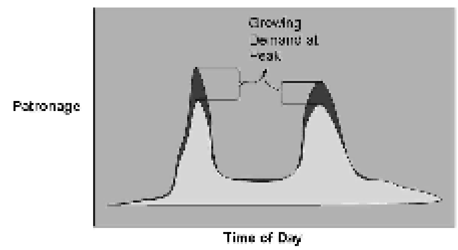
Trip Convergence Ltd

13 November 2008

How are we going to move people?

- – Populations are growing
- – Congestion is increasing
- – Public funds are limited
- – Energy security is an issue
- – Global warming is real

Demand for public services at peak hours exceeds capacity



Solutions have long lead times

- Increasing infrastructure takes time and is unpopular
- Energy efficient engines take years to work through the fleet
- Alternative fuels are coming but the technology is still evolving
- Teleworking uptake is increasing
- It takes time to increase bus services

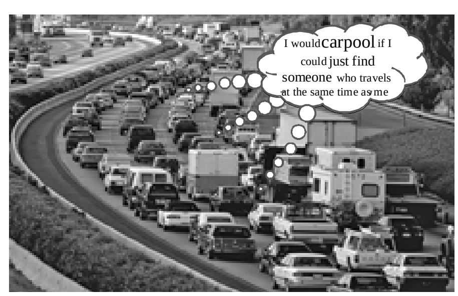
Transit services cutting back

- Absorbed the recent fuel price spike
- Facing shrinking budgets
- Fare box rises face stiff opposition
- Over 30% of transit systems are reducing services in the coming year

“Carpooling” could be a good answer

- Better use of existing infrastructure
- Better use of private vehicle investment
- Carpools are as energy and ghg efficient as bus services
- Carpooling could deliver ‘now’!

Carpooling has not delivered

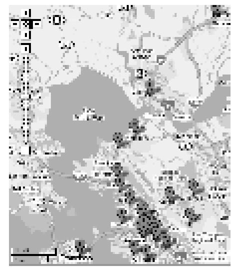


Even sophisticated databases deliver few carpools

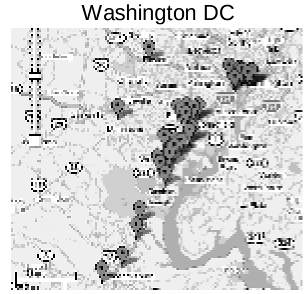
- Probability of a match is low
- Personal effort to ‘pre-arrange’ carpools is high
- The need to match schedules to others’ schedules makes carpools unattractive
- People hate letting other people down
- It looks like an information problem

‘Casual carpooling’ works

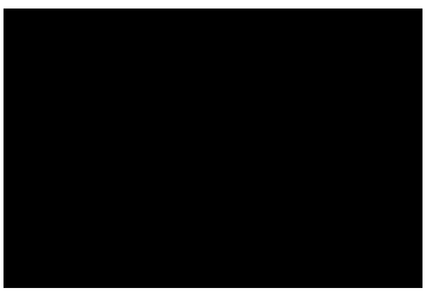
San Francisco



Washington DC



Casual carpooling video



Casual carpooling has never been ‘implemented’

- Grew organically from the early 1970s
- It didn’t get shut down, and it got some support
- No cost benefit analysis has ever been done
- No implementation manual

Our hypothesis: Carpools need meeting places, not databases

- The key is the absence of pre-arrangement
- It is an assembly problem, not an information problem

Research Project: 6 routes to test our hypothesis

- $2 million to cover six routes
- Each route 200 participants
- Seeking routes of 6+ miles from convergence point to destination
- Variety of conditions
- Goal is to establish implementation and operating manual
- Seeking two routes in Oregon

Potential Oregon Routes

- CRC
- Portland to Salem
- 2005 study identified 30 routes with over 18,000 potential commuters,
- Study didn't include SW Washington

2005 Rideshare Research

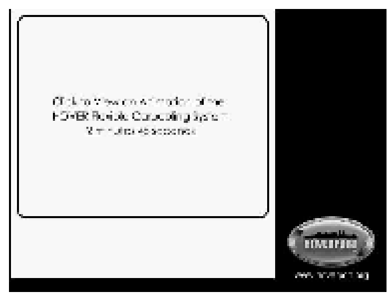
Employment Area	Potential Market Area	Commuters
Downtown Portland	US 30 to St Helens	800
Downtown Portland	NE of I-205/SR 500	700
Downtown Portland	Sherwood	1000
Downtown Portland	Wilsonville	500
Downtown Portland	Oergon City	900
Beaverton	Forest Grove	1300
Beaverton	Sherwood and South	1000
Clackamas	NE of I-205/SR 14	450
Clackamas	Beaverton	500
Clackamas	Canby	300
Clackamas	Molalla	250
Columbia Corridor	Salmon Creek	500
Columbia Corridor	Beaverton	750
Columbia Corridor	Oregon City/West Olinn/Gladstone	500
Columbia Corridor	Estacada	250
Hillsboro	Forest Grove and NW	650

Employment Area	Potential Market Area	Commuters
Oregon City	Outer SE Portland/Gresham	400
Oregon City	Molalla	200
Rivergate	NE of I-205/SR 14	700
Rivergate	Outer SE Portland	500
SMART/Wilsonville	Beaverton	850
SMART/Wilsonville	Salem	1000
Swan Island	E of I-205/SR 500	300
Swan Island	Oregon City/Gladstone	250
Tualatin	South Hillsboro	1000
Tualatin	Wasington County (north of US 26)	400
Tualatin	Newberg	500
Tualatin	Woodburn	500
Tualatin	NE/SE Portland	650
Washingtong Square	Newberg	800
Total		18400

Envisioning a Solution

- No pre-arrangement
- Origin end parking by destination
- Pre-screening and membership
- Member ID and tracking technology
- Ride credits
- Coffee
- Branding
- Marketing

Our proposed starting point



Key performance indicators for flexible carpooling

- <$0.30 per boarding
  - regardless of trip length,
  - assuming 5 year life for technology
  - not including cost of origin end parking
  - not including security at origin end parking
  - assuming $1.00 per trip service fee from all participants
  - Fuel savings for participants and rest of traffic
  - Emissions savings, carbon credits
  - Safety savings, community savings, infrastructure savings

Other buttons it pushes….

- Supportive of congestion pricing
- Enables insurance rebating system based on 'miles not driven'
- Enables incentivising participation with high quality audit trail
- Origin end convergence parking has 'built in energy efficiency'
- Reduces VMT per person
- Increases capacity at almost no cost

Where is this already happening?

- 'Under development' only so far
  - Auckland NZ, two routes being nominated
  - Seattle WA, Transit IDEA shortlist
  - UC Davis report almost complete: "no real barriers, good energy savings"
  - Similar workshop with Caltrans next week

What is the return on investment?

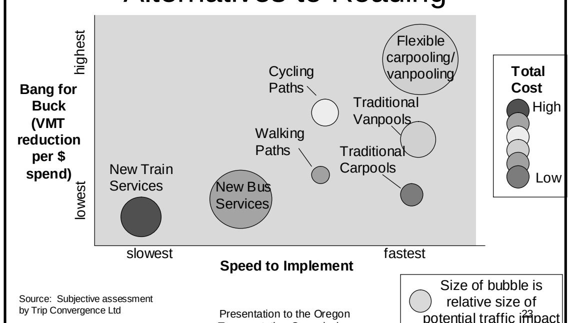
- To keep people moving, we need innovation
- Innovation involves risk
- Cost of two routes: $750,000
- Two Auckland routes: combined return $3.3 million per year
- Savings to participants: about $2,000 per year in after tax money

KPIs for the Auckland Routes

			Direct Participant Impact				Regional Impact		
Route	Dis-tance	VKT Reduc-tion (000 km)	Fuel Saving (000 litres)	Emis-sions Reduc-tion (tonnes)	Parking Costs Saved ($,000)	R&M costs saved ($,000)	Wear and Tear Saved ($,000)	Fuel Saving (000 litres)	Emis-sions Reduc-tion (tonnes)
Te Pai Place to CBD	12.1 km	**557**	**56**	**117**	**$207**	**$56**	**$28**	**166**	**351**
Hooton Reserve to CBD	15.1 km	**695**	**69**	**146**	**$207**	**$69**	**$35**	**208**	**438**
Total		**1,251**	**125**	**263**	**$414**	**$125**	**$63**	**375**	**789**
Value ($,000)			**$219**	**$4**	**$414**	**$125**	**$63**	**$657**	**$12**
			$762				**$731**		

Add time savings for 'rest of traffic', total gain exceeds $3.3 million per year.

Comparative Pay-off Table: Alternatives to Roading

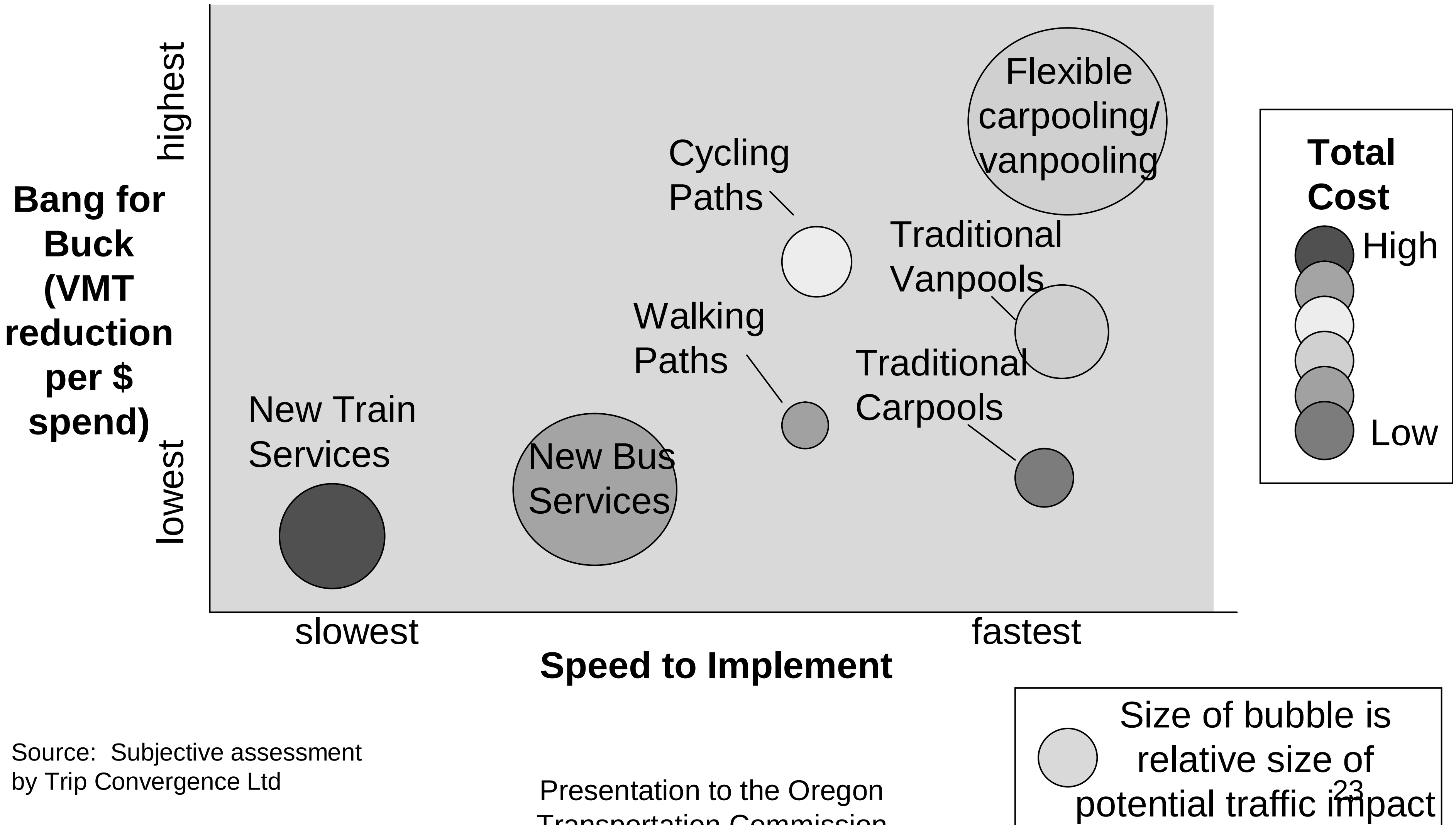


Source: Subjective assessment by Trip Convergence Ltd

Who is Trip Convergence Ltd?

- Private sector company based in Auckland New Zealand
- Team of professionals committed to making a difference: Finance, engineering, marketing, systems development, technology, transport, research
- Team of advisors in USA, NZ, Canada
- Global perspective to spread best practice
- A green initiative, seeking equity
- Currently owned by Paul Minett and John Pearce

Comparative Pay-off Table: Alternatives to Roading



Source: Subjective assessment by Trip Convergence Ltd

Achieving High Volume Carpooling by Eliminating the Need for Pre-Arrangement: A Case for Research Funding

"it isn't what you don't know that gets you in trouble, it's what you know for sure that isn't so" **Mark Twain**

Introduction

Casual carpooling is a system that operates in San Francisco, and is estimated to save Bay Area residents and businesses in the order of $30 million per year, between reduced gasoline, reduced public transport subsidies, and reduced time wasted in congested traffic. The benefit is felt by the participants as well as the wider traveling public and the broader community. This amount is saved in the morning commute: a similar amount could be saved in the evening if it was encouraged as a two way system. This valuation doesn't include reduced greenhouse gases, local pollution, and improved safety that also results from less traffic.

Each morning an estimated 3,000 three person carpools are formed between people who did not previously know each other, and with no pre-arrangement. There are about 23 pick-up points in the East Bay, and two drop-off points in downtown San Francisco where all the rides terminate. By participating in this system some of the traffic that would otherwise be in the general use lanes on the freeways of the east side of the Bay Bridge is able to go in the HOV lanes, allowing all the traffic to move a little more freely. The carpool formation happens at curb-side pick-up points that are like 'taxi stands for carpoolers'.

This is high volume carpooling that has no need for pre-arrangement. It is in stark contrast to all other carpooling systems, in its million plus trips per year, it's thirty plus years of resilient operation, it's incredibly low cost, and the distinct fact that all other carpooling is established with pre-arrangement as its core feature. Transport planners and travel demand professionals work to a paradigm that says all carpooling should be pre-arranged.

This paper calls for public funding of a research effort to capture the essence of casual carpooling to enable it to be implemented in new locations. Using savings in San Francisco as a guide, if 100 cities implemented high volume carpooling with similar uptake to San Francisco, the benefits on a national basis could be as much as $6 billion, with a five million tonne reduction in green house gas emissions.

Background

In response to the need stated in many cities' and regions' transportation strategies for reduction in single occupant vehicle driving, Trip Convergence Ltd[1] is researching a high volume route based 'flexible'[2] carpooling solution that could provide a realistic daily choice for commuters who would share rides but for whom traditional pre-arranged carpooling does not work due to varying working hours and changing travel needs.

There are three informal flexible carpooling systems in operation in US cities:

- Casual carpooling in San Francisco, 9,000 participants daily (3,000 carpools) (1998)
- Slug lines in Washington DC, 10,500 participants daily (3,500 carpools) (2006)
- Slug lines in Houston, 900 participants daily (300 carpools) (2007)

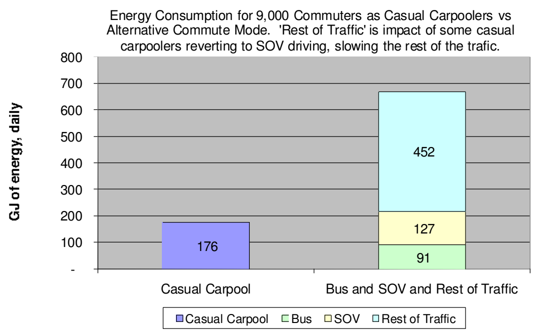
The first two of these systems have been in operation for over thirty years. The systems cost almost nothing in operational terms. Until recently they have been perceived as non-beneficial to the transport system, largely because it has been thought that it would be better if the participants took a bus. Over 80% of riders in San Francisco would take the bus if casual carpooling was not available, and the majority of them take the bus for the evening journey.

[1] Trip Convergence Ltd is a New Zealand company owned by John Pearce and Paul Minett.

[2] We use the term 'flexible carpooling' to refer to the casual carpooling, slug-lines, and any adaptations of these systems.

However in a recent paper[3] prepared by Paul Minett and John Pearce for submission to the international Energy Policy journal, it was calculated that the casual carpool alternative uses about 500 gigajoules less energy daily (see chart) to move the 9,000 participants than would be used if a bus alternative was created.

The reason for this is that it would take many buses, together with their operating costs and 'dead-head miles' to serve these commuters, and many of the casual carpooling drivers would continue to drive (putting them back into the mixed use lanes, further slowing traffic in those lanes).



It turns out that it is not a foregone conclusion that the bus is more environmentally friendly than a car. If the car is HOV4, the bus needs to be more than 40% full, on average, every mile that it operates to achieve the same fuel and emission efficiencies on a per passenger mile basis.

Trip Convergence's research effort has led to the specification of a prototype for a more formalized flexible carpooling system. It would be low cost compared with the alternatives of new public transport and road building. It involves

- more formal establishment of origin and destination facilities and definition of routes,
- membership with pre-screening, and
- the use of technologies for membership identification and tracking participation.
- the use of 'ride credits', an alternative currency that enables the 'give-a-ride/get-a-ride' aspect of carpooling to exist in a system where each person each day may not know the identity of the people they share a ride with.

Testing and refining of this prototype are central to this proposal for funding.

The payback from flexible carpooling

Estimates prepared by Trip Convergence suggest that flexible carpooling could provide the equivalent of a passenger transport service at a net public cost of about $0.69 per boarding. This would compare favorably with bus systems that have a net public cost of well over $2.50 per boarding, and train systems that are even more expensive.

However, it is the congestion beating potential of flexible carpooling that should make it an even more attractive option. By attracting single occupant vehicle drivers to form fuller cars, the system could reduce vehicle counts in a way that has proven elusive for bus systems. Reducing vehicle counts is the only way to reduce congestion and its deleterious impacts. As congestion is reduced and the traffic speeds up, the amount of fuel used (and the carbon emission) per unit of distance is reduced, and the amount of personal non-productive time is also reduced.

Case Example: In Auckland, New Zealand, the Auckland Regional Council applied estimated take-up rates on a route by route basis (provided by Trip Convergence), against the traffic model for Auckland. The analysis showed that the time savings alone (not including fuel and greenhouse gases) for Auckland, (a city of 1 million), would range between $120 and $220 million per year, at an estimated one-off cost of $200 million (for technology and park and pool facilities on the periphery of the city), plus operating costs of less than $1.00 per boarding, an estimated net present value of well over $1 billion.

Flexible carpooling will work

There is doubt amongst some transportation professionals about whether flexible carpooling will work. They have observed (or even participated in) attempts to make traditional carpooling work and have seen those efforts fail. They have discounted the examples from San Francisco, Washington DC/Northern Virginia and Houston TX as being successful only due to local conditions (in particular 3+ HOV lanes), and not applicable elsewhere.

[3] See http://www.flexiblecarpooling.org/NERI20080407d.pdf

There are no records of attempts to emulate these informal systems in other locations, to test theories about why they work where other initiatives have failed. It is likely that there has been no evaluation of these systems because they were never part of an initiative themselves, they were established by commuters during interruptions of normal transport, and managed to sustain themselves.

Trip Convergence hypothesizes that the key feature that enables casual carpooling and slug lines to work (compared with traditional carpooling, for example) is its flexibility: the fact that there is no need for daily pre-arrangement or making of any commitment. People show up and they get a ride. Hence the use of the generic term 'flexible carpooling' to describe these examples and the proposed adaptation.

In all other carpooling examples pre-arrangement is the standard paradigm. The need for 'pre-arrangement' seems to define the way by which such systems are designed and operated.

In an internal report about flexible carpooling (which went on to recommend against funding the system because it had not yet been proven to work) the Auckland Regional Transport Authority's Anna Percy said:

In summary, the practical concept behind flexible carpooling is basically sound and could work. To find out whether it will work, and whether the actual benefits exceed the costs, the next step would be to undertake a trial involving a single convergence point where parking would be provided, and a system of encouraging ridesharing introduced which would need to include a CBD system and/or facility to enable ridesharing for the return journey.

While there is little question that flexible carpooling will work to some extent, there are uncertainties regarding the steps needed to implement the system on a new route, (it has never been done before) and it is possible that several attempts will be necessary with different features and benefits before a definitive implementation manual can be published.

Uncertainties exist that need to be resolved. These include:

- understanding whether a public authority would attract liability through supporting a flexible carpooling initiative (preliminary work by researchers at UC Davis suggest not), and whether insurance could be secured to deal with any such liability.
- determining whether users of the system will be prepared to pay for the service, and if so how much (and therefore how much the net subsidy would need to be)
- learning what proportion of a potential SOV market would use the system once it was available, and what the uptake pattern looks like under different circumstances
- determining the extent to which public transport users would switch and become flexible carpoolers, and the extent to which this would damage public transport or create space for additional passengers
- learning what impact external influences such as weather or holidays have on the operation of the system
- learning if the system can be implemented where there are no HOV benefits such as HOV lane or dedicated parking
- learning how difficult the system is to manage, and what ongoing costs would be incurred to keep it operating over time

How flexible carpooling research and development should be funded

Assuming that the business case exists for further research and development of flexible carpooling, how should it be funded?

In the study of casual carpooling in San Francisco, mentioned above, the benefit to the wider community far exceeds the benefit felt by the participants in the system. In a case study for putting flexible carpooling on a busway on Auckland's north shore, 20% of the benefits would go to the participants, and 80% to the wider community.

To access the potential carbon emission reductions, and improved energy security that would come from successful development of flexible carpooling, there seems little question that it would be a justifiable investment for public funds.

The next question is, which level of government should fund it? The amount, and the quantum of the benefits suggest that government organisations at a national level should take responsibility. The amount of funding required for the system seems to exceed the capability of most local level transportation organisations, especially if they perceive that there is any risk involved in the project. Experience to date seeking funding and support from local transportation organisations is that they are happy to be cheerleaders but have little discretionary time and no discretionary funding to trial an untested mode.

Research Partners

Trip Convergence Ltd has a single-minded focus on finding ways to make it easier and more rewarding to share rides. We have the drive and interest to carry out research and to commercialize the results. We are the ideal partner to expedite this project. We have several organizations who we would most likely involve, depending on the location of the trials. These include UC Davis, California PATH, SMART (University of Michigan), Commuter Challenge (Seattle), Cascadia Center (Pacific Northwest), Sound Transit (Seattle), King County Metro (Seattle), Puget Sound Regional Council (Seattle), Washington State DOT, and the Urban Age Institute.

Proposed way forward

The easiest way to improve the energy productivity of private vehicles is to get more people riding in them. There is significant 'low hanging fruit' available, right now, that is being overlooked in the search for ways to reduce dependence on foreign oil and reduce greenhouse gas emissions. Flexible carpooling is available with very little up-front cost.

It is proposed that government organisations at a national level enter into a partnership with Trip Convergence Ltd, and fund up to $2 million for up to six trials to develop flexible carpooling, in a three year programme. Trip Convergence Ltd has marketing capability and potential funding for commercialization subject to successful trials.

It is further proposed that the funds be advanced to Trip Convergence Ltd in accordance with the following budget.

Budget

Item	Cost	Cumulative	Advance date
System Devt.	$350,000	$ 350,000	On signing
Trial 1	$275,000	$ 625,000	after 3 months
Trial 2	$275,000	$ 900,000	after 6 months
Trial 3	$275,000	$1,175,000	after 9 months
Trial 4	$275,000	$1,450,000	after 12 months
Trial 5	$275,000	$1,725,000	after 15 months
Trial 6	$275,000	$2,000,000	after 18 months

Different conditions to test in the trials:

1. Dense traffic area with HOV lanes and existing public transport running to employment destination with multiple employers
2. Residential area with focus on carpooling to the transit station, in large urban area, with satellite parking in the residential area
3. As for two but without the residential area parking
4. A rural residential area that is poorly served with existing public transport, or perhaps none exists
5. As for 1 but with the employment destination being a single employer campus (company, university, airport)
6. Reserve for additional trial the same as one of the others in case of a poor result, or to meet needs of partner organisations for variations.

Detailed budget for each trial:

–	Technology	75 K
–	Parking	60 K
–	Project Mgmt	40 K
–	Incentives	25 K
–	Marketing	25 K
–	Misc & Contingencies	50 K
	Total	275K

System development and admin costs (as part of first trial only)

•	Software	50 K
•	Management and reporting (36 months)	175 K
•	IP/Legal	40 K
•	Insurance	10 K
•	Marketing/PR	35 K
•	Contingencies	40 K
•	Total	350 K

Flexible Carpooling: Saving Energy by Making it Easier to Share Rides

By Paul Minett and John Pearce, Trip Convergence Ltd

Transportation plays a significant role in energy consumption, accounting for over 40% of New Zealand's total energy use. A large part of transport energy is consumed during the peak commuter periods and is essentially wasted through slow running in congested traffic. Strategies to increase average vehicle occupancy could be expected to be at the forefront of policies to reduce energy use. Informal flexible carpooling (known both as 'casual carpooling' and 'slugging') has been found to reduce traffic in three US cities. This paper examines casual carpooling, considers the reasons for its success, and calculates its energy impact in San Francisco. Noting that casual carpooling has never been 'implemented' (it grew organically), the paper proposes adaptations that could enable introduction into new locations. It explores New Zealand energy and transportation strategies seeking references to carpooling and a framework for trialing an innovative solution. It suggests that Auckland's new North Shore Busway would be an ideal location to test these adaptations and estimates the energy savings that are available. It outlines policy implications resulting from the work.

1. Introduction

The transportation sector is a significant user of energy. Transportation accounts for up to forty percent of New Zealand's total energy consumption. Of this, land transport (road and rail) represents around 90 percent and private motor vehicles account for almost 90 percent of the total passenger transport share (EECA, 2008).

According to the New Zealand Energy Strategy to 2050, New Zealand oil imports cost $4.4 billion per annum (Ministry of Economic Development, 2007). Energy prices are increasing, and the spectre of energy shortages looms. The Energy Strategy and the more recent Transport Strategy 2008 both seek mechanisms to reduce traffic.

Our own interest in traffic reduction had led us to hypothesize a high volume 'flexible' carpooling solution that would look like 'park and ride' but without the buses, using carpoolers' own vehicles instead, and leaving two thirds of the carpoolers' vehicles in the suburban parking lot. The key difference between the system we envisage and existing carpooling systems would be that the flexible carpooling system would need no pre-arrangement of rides. It would operate to high volume destinations on routes that were attracting lots of single occupant vehicles (SOV) drivers, and people would form fuller cars in whatever order they arrived at the parking facility. We know that one of the main reasons that commuters give for not carpooling is that they have varying schedules, and we believe removing pre-arrangement as a pre-requisite to sharing rides would make it a more popular mode.

We had found that our approach resembled the casual carpooling systems which arose, apparently spontaneously, in Washington DC and in San Francisco, California, during the early 1970s, and had spread to Houston, Texas during the 1990s and that continues to operate successfully in all three cities. However, perhaps because these were not initiatives of public authorities, but systems that had grown of their own accord, we had found that casual carpooling appeared to have been overlooked as a model that could be replicated in other cities.

We had proposed to the Auckland Regional Council that they introduce 'flexible carpooling' in Auckland, and they had estimated the impact on local congestion costs using the Auckland Traffic Model, using as inputs the origins and destinations of the 5,000 SOVs we predicted the system could take off the road. In spite of the large predicted benefit stream (a total value of over $100 million per year), our efforts to establish a trial of flexible carpooling had made no progress.

Our goal in writing this paper was to put the potential impact of a new approach to transporting commuters into an energy saving context. We wanted to bring together the many threads of our work and present it in such a way that it made sense and would perhaps lead to testing the system. We wanted to make the point that the conventional wisdom of 'predict and provide', that used to and perhaps still leads road building, based on peak levels of demand, would arrive at a different answer if the average occupancy assumption for private vehicles during peak could be raised a few points. We wanted to gently suggest to the adherents to the 'theology of buses' that perhaps the bus is not always the best answer, if there could be a high volume carpooling alternative, and that utilising that alternative could save public transport dollars to be spent on routes where peak demand was not so high. We wanted to present the case that while most attempts to grow carpooling had failed, (or at least not lived up to their promoter's expectations), it would be better to learn from three that are being successful than to write off the mode based on thousands that were not.

We didn't realise just how much ground we would be trying to cover, until we had spent some time trying to cover it. The way the paper has turned out we know that someone else will do a better job of the energy savings calculations. But the resources for building a proper traffic model for San Francisco (or running our assumptions against an existing one) were beyond our means, and would probably suggest a level of accuracy that wouldn't change the answer at an 'order of magnitude' level. We hope that the information we present will inspire someone with the resources to carry out more precise analysis.

In our research for the paper, we found that the newly created New Zealand Transport Agency has identified casual carpooling as a potential strategy for dealing with the challenges of rising oil prices. This is a glimmer of hope in the context of our goal for a trial of flexible carpooling in New Zealand, because if it is going to be a strategy, we can expect that there will be some effort put into figuring out how to introduce it into a new location. We don't think it is something that should be left to chance.

We hope you enjoy our thought process. In Sections 2 and 3 we review the literature on traditional and casual carpooling, respectively. In Section 4 we calculate the energy benefits of casual carpooling. In Section 5 we describe the hypothesized formalized version that we think could enable other cities to get the benefits that San Francisco and Washington DC are achieving. In Section 6, we scan New Zealand energy and transportation strategies for their vision of carpooling. In Section 7 we look at the potential impact for New Zealand of trialing flexible carpooling on Auckland's North Shore busway. Section 8 draws conclusions, and Section 9 suggests policy implications.

2. The Literature on Carpooling

The traditional carpool is usually an ongoing arrangement among a group of individuals to regularly share rides for a particular purpose, often for traveling to work. Carpooling systems typically involve ‘turn about’ driving (each person taking a week in turn, for example), or sharing of costs. There is a relatively permanent relationship between members of the carpool, which may involve two, three, or four people. Members must be ready at the agreed time and place to ride with the carpool, regardless of what else is happening. Establishing a carpool involves finding people with matching schedules and routes. Other criteria may also be considered, such as matching tastes in radio stations. Vanpooling is considered to be a less flexible extension of the same approach, with the need for an even greater number of convergent trips.

Fuel price rises and fuel shortages in the early and mid 1970s led to policy interest in carpooling. Several different initiatives were developed, including, in the USA, legislation requiring the practice to be encouraged. By the end of the decade, reports were suggesting that success was limited and complex. In the UK it was considered that carpooling schemes were unlikely to have more than a marginal effect on congestion, parking requirements or energy use. In the US it was concluded that unless several conditions were satisfied, including high occupancy vehicle (HOV) lanes, reserved parking, poor public transport, higher fuel prices, and efficient management of the system with strong promotion by employers, the benefits of carpooling would only ever be marginal (Cairns et al., 2004).

Carpooling systems have been studied several times over recent decades (Cairns et al., 2004; Ab Rahman, 1993), and the studies continue to conclude that while carpooling schemes can contribute to the array of modes available, they have only marginal impact and it is very difficult to get them started.

Cairns et al. (2004) surveyed ten systems in the UK that had been running for between four months and ten years. They highlighted two such schemes as exemplary, Buckinghamshire and Milton Keynes, with estimated daily participant counts of 60 and 1080 respectively. These are ride-matching systems, in which participants use the Internet to find partners with whom to share rides. They are promoted at workplaces.

In order for carpooling systems to have greater success, Cairns et al. recommended that the (UK) Government should provide:

- More national guidance (for example for local transport plans) about carpooling, including guidance on appropriate parking regimes and other complementary measures that can be put in place to ensure that carpooling forms part of the general sustainable transport strategy, and
- Advertising, particularly to businesses, about the benefits of carpooling. This should be associated with other publicity and marketing about workplace travel plans, or with raising general travel awareness (Cairns et al., 2004).

In spite of these conclusions there has been ongoing interest. Carpooling systems have been developed and refined to increase participation, particularly using matching over the internet, searching databases of interested commuters, and clever algorithms to find matching routes.

In the US there have been significant efforts to encourage employees to avoid commuting in SOV. Most large employers (over 100 staff) are required to have a Commute Trip Reduction program. Many states offer web-based ride-matching software, and from time to time offer incentives to encourage uptake.

In some cases, cash incentives have been successful. For example, a recent news article from New Jersey attributed an increase in the number of people carpooling to rising fuel prices and the payment of cash incentives:

$100 to carpool for 24 of 60 days, and a further $100 for sticking with it for six months (Smith 2008).

3. Casual Carpooling Literature and Research

Casual carpooling systems (operating only in San Francisco, Washington DC, and Houston TX, and called ‘slug lines’ in the latter two locations) are based around morning pick-up points. Riders queue at these pick-up points, as if they are waiting at a taxi stand. Drivers pick up the appropriate number of riders and drive to the pre-determined destination. Participants make no prior arrangements as to which seat they will ride in, whether they will ride or drive, or even whether they will travel on any particular day or at any particular time.

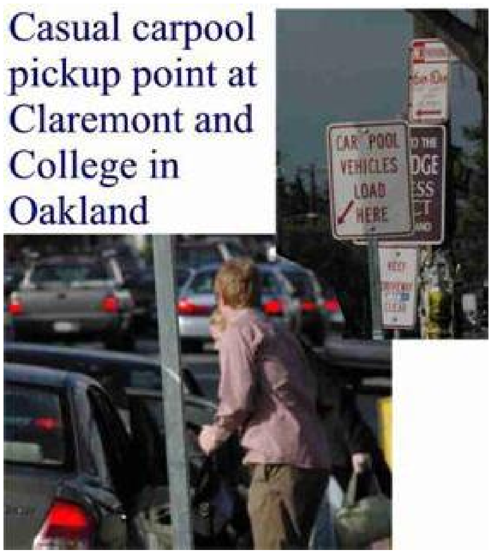


Figure 1: Casual Carpooling

Access to high-occupancy vehicle (HOV) lanes provides casual carpoolers with a faster journey, with less risk of delay, than SOVs. In these three examples, the HOV lanes are reserved for vehicles carrying a driver and at least two passengers, and are designated “HOV3” (TRB, 2006; Burris and Winn, 2007; Beroldo, 1999; Ridenow, 2008; Slug-lines 2008; VDOT, 2006).

Casual carpooling is observed as being an egalitarian activity (TRB 2006). There is no limit on who may participate, however there are some accepted etiquettes in most locations. It is characterized as being free for the riders, and saving the drivers time, with the belief that this represents a fair trade. In the Houston example about 50% of the participants are female (Burris and Winn, 2007).

The following table summarizes the characteristics of these casual carpooling systems. Note that these systems involve significantly more participants than the exemplars from the UK.

Location	Morning Pick-up Points	Afternoon Pick-up Points	Average daily carpools per pick-up point	Participants per day (year of last report)
Washington DC	24	16	134	9,689 (2006)
San Francisco, CA	22	1	approx 200	8,000 - 10,000 (1999)
Houston, TX	3	1	100	approx 900 (2007)

Table 1. Casual Carpooling Locations and Characteristics.

The Washington and San Francisco systems are supported by websites. Washington DC’s website (www.slug-lines.com) has information such as rules, etiquette, and the locations of pick-up points, which are generally located in commuter parking lots (parking lots provided for users of the transit system). A list of morning pick-up points for the San Francisco system is published on the Ridenow website (www.ridenow.org/carpool).

Studies of casual carpooling conclude that it works because of a very special confluence of conditions, namely (TRB, 2006):

- Significant travel time reduction and reliability gain for the driver through use of the HOV facility—enough to be worthwhile even subtracting out passenger pick-up and drop-off times.
- Need for additional riders to meet HOV access requirements (enhanced by a 3 or greater occupancy requirement).
- Well-known pickup locations having easy driver and rider access and offering good transit service available as backup for prospective riders.
- Very substantial employment concentration(s) as the focus for the morning commute, allowing quick and efficient passenger drop-off and dispersal to ultimate destinations.

We speculate that there must be other locations that satisfy these conditions, but casual carpooling has not arisen spontaneously in other locations, and extensive searching to date has found no evidence of any jurisdiction attempting to start it.

Although HOV lanes are an integral feature of existing casual carpooling systems, Kelley (2007) outlines a business case for paying carpoolers as an alternative to installing a new HOV lane. Kelly suggests that the operating and subsidy costs of this casual carpooling would be less than the operating costs of the HOV lane, and the entire capital cost of the HOV lane could be avoided.

According to Burris and Winn (2007) a major reason casual carpooling has not extended beyond the initial three cities is the perceived liability that public authorities could expose themselves to as a result of supporting a system where people share rides without sufficient pre-planning:

Casual carpooling has grown in popularity and should be considered when assessing potential corridor improvements. Although potential liability concerns would likely prevent agencies from actively promoting casual carpooling, they could encourage it passively by constructing park-and-ride HOV facilities that are conducive to the mode. Casual carpooling has the potential to improve the operation efficiency of HOV/HOT facilities by improving person movement. Although there are potential liability concerns, it may eventually become beneficial to promote casual carpooling as a viable mode alternative (Burris and Winn, 2007).

In the literature there is some concern that casual carpooling takes passengers from public transport, and that if it didn't exist there would be fewer cars on the road (for example Beroldo, 1999). This is supported by survey data from San Francisco that found that, if casual carpooling were not available, 87% of riders would otherwise be public transport passengers, and 46% of drivers would switch to the bus (Beroldo, 1999).

Almost every report about casual carpooling emphasizes that flexibility is a key reason that the system is used. For example: "*In addition to saving time and money, flexibility was identified as one of the main reasons respondents casual carpool*" (Beroldo, 1999) and "*The slug line is a direct result of needing to find a system that gives you the flexibility that your working environment requires.*" (Kogan, 1997), and "*Many saw casual carpooling as a winning option because it was flexible, fast, and free. Few had fears of riding with a stranger because they could choose to enter a car or wait for a different one, there were usually at least two unrelated riders in the car, and the experience with casual carpooling has been good for most*" (Shirgaokar and Deakin, 2005).

However in none of these reports have we found the investigator raising the observation (of flexibility) to the level of a conclusion that might lead to design of a trial to emulate the flexibility of the system. When casual carpooling has been studied (Burris and Winn, 2007; Beroldo, 1999; VDOT, 2006) it seems to have been approached more from the perspective of describing an anomaly than as a basis for trying to exploit it. The reasons for not seeking to exploit casual carpooling are unclear, though there is some evidence that a preference by transportation authorities for bus-based or even traditional carpool-based solutions might have had some influence.

Conclusions that carpooling doesn't work appear to have been based only on analysis of systems that had poor performance, while these high-performing alternatives may have been left out of the mix for philosophical reasons.

4. Analysis: Energy Savings From Casual Carpooling

We wanted to estimate the energy savings associated with casual carpooling, including the savings for both the participants and the rest of the traffic. We knew that the savings for the rest of the traffic could be significant because modeling of the impact of 2,500 three person carpools in Auckland, carried out by the Auckland Regional Council using the Auckland Traffic Model gave this result: The savings for the rest of the traffic were several times greater than the savings for the participants.

In this section we explore three important relationships. In 4a we compare the energy efficiency of casual carpools to buses, in general. In 4b we calculate the savings for participants in a single casual carpooling route. In 4c we propose a simple model for estimating the impact on the rest of the traffic, and in 4d we apply that model to casual carpooling.

4a: Comparing the Energy Efficiency of Carpools and Buses

In studies of casual carpooling we have found that the investigators display a strong bias towards the public transport alternative, taking it as a given that public transport is superior to any form of car travel (the theology of buses), and speculating that one of the benefits of casual carpooling could be that participants might go on to formal carpool arrangements (Beroldo, 1999) with the implied belief that such arrangements would be superior.

Strickland (2008) compares the energy consumption per passenger-mile for cars and buses. Based on Strickland, we calculate that a 55 seat bus consuming 15 MJ/km in free flowing traffic would have to average at least 30% full all the time (including return journeys and off-peak services) to be as energy efficient as a 4 seat car consuming 2.73 MJ/km carrying 3 people (assuming they are traveling in the same traffic conditions). The bus would have to be 40% full all the time to be as energy efficient as a car carrying 4 people.

4b: Calculating the savings for the participants in a single casual carpooling route

Data from a survey of casual carpoolers (Beroldo, 1999) enables prediction of how traffic patterns would change if casual carpooling were discontinued. Based on that data, we calculated that a casual carpool pick-up point with 600 participants (200 carpools) would be replaced by 128 single occupant cars, 440 bus or train passengers, and 32 people who would either not travel, or would switch to traditional carpools. Hence there are currently 200 – 128 = 72 more cars (from such a location) with casual carpooling than there would be without it, (see Figure 2) or about 1080 more cars in total in the traffic in San Francisco than there would be without casual carpooling (from all locations).

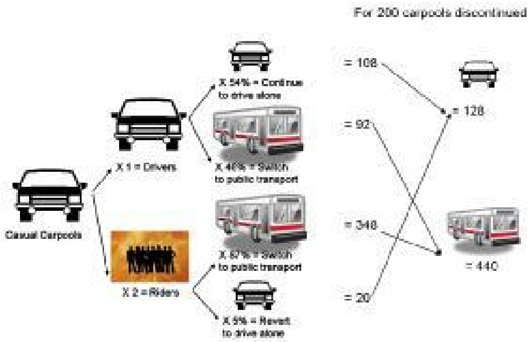


Figure 2: Alternative Mode for Casual Carpoolers (based on Beroldo, 1999). Note that 32 riders either stop commuting or revert to traditional carpools.

Figure 3 compares the energy requirements of casual carpooling from such a San Francisco casual carpooling location with the energy requirements for the combination of buses and single-occupant vehicles (SOV) that would replace them. It shows two scenarios, each of which involves 600 travelers.

1. 200 casual carpools, (600 travelers) and
2. 128 SOVs plus enough buses for 440 people, (600 travelers less 5.3% who indicated that they would change their commute if they didn't casual carpool. These 32 people have been excluded from the number of commuters who would switch to the bus).

The key assumptions are:

- Three 55-seat buses are needed[1],
- Buses deadhead three times each in order to carry the full number of passengers,
- Buses use 15 MJ of energy per km[2]. (Strickland 2008)
- The casual carpools use the HOV lane and travel at the average speed for the East Bay HOV lanes, 90 km per hour, while
- The SOVs travel in the East Bay mixed use lanes at 38.5 km per hour.
- Carpools consist of 10% hybrids (at 1.58 MJ per km) and 90% conventional internal combustion engines (at 2.73 MJ per km) (Strickland 2008).

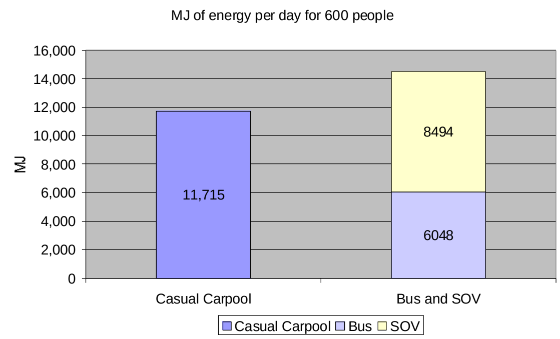


Figure 3: Comparative Energy Consumption of Travel for 600 People.

The bus and SOV combination uses 24% more energy than the casual carpool scenario.

It is the combination of the deadhead travel for the buses and slower travel in the mixed-use lane for the SOVs (and therefore greater energy consumption (Barth and Boriboonsomsin, 2007)) that leads to the counter-intuitive result.

Buses follow pre-defined routes and are required to make a return journey with few or no passengers. HOV cars can travel along an unconstrained HOV lane much of the way to the destination and are not required to "dead-head", or return to the starting point to repeat the journey.

This analysis does not include the energy impact on the rest of the traffic resulting from the casual carpools operating in the HOV lane instead of a subset or multiple of those vehicles operating in the mixed use lanes.

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[1] Some may argue that San Francisco commuters would switch to BART rather than to buses. We note that this could be correct, however there are capacity constraints on BART as described in Consider congestion Pricing for BART, (San Francisco Chronicle 2008), and while individual passengers would probably be able to make the change, a wholesale switch from casual carpooling would probably swamp the system.

[2] Energy conversion factors for NZ: Petrol, 34.9 MJ/liter; Diesel, 38.4 MJ/liter. (MED, 2008, pg. 159.)

4c: A Simple Model for estimating the impact of Reduced Traffic on Fuel Consumption

In order to estimate an order of magnitude impact on the rest of the traffic we present the following calculations which compare the energy use in the traffic flows with and without casual carpooling. The key variables are the speed in the mixed use lanes with and without casual carpooling, which in turn is driven by the proportion that the changed traffic has to the existing traffic. Energy impacts will be proportionally greater when the existing traffic speeds are low, resulting in high changes in consumption per unit distance.

Figure 4 is a simplified speed/flow diagram, based on regression analysis of HOV lanes in the San Francisco Bay Area (Caltrans, 2004), to enable an estimate of the impact. We assume that the traffic will run smoothly at an optimum speed for rates up to 1100 vehicles per lane per hour. When demand exceeds 1100 vehicles per lane per hour the traffic speed will degrade. We have used a constant rate of 12% speed change for each 100 vehicles added or removed per lane hour. We know that this will be incorrect at the boundaries, but are confident that the order of magnitude is reasonable. We know that some lanes move greater numbers of vehicles at lower speeds (there are reports of up to 2500 vehicles per lane hour, for example), and we know that stop-start traffic achieves well below these levels.

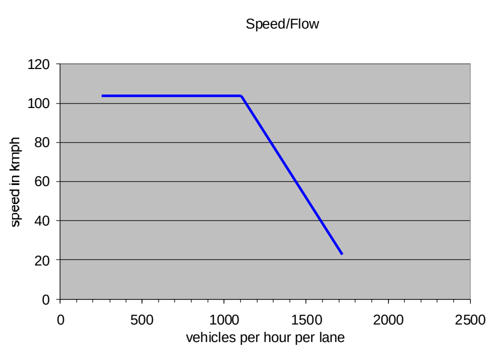

Figure 4: Simplified Model of Speed vs. Flow

Figure 5 models the energy consumption against changing traffic speeds, based on work by Barth and Boriboonsomsin (2007)[3]. As traffic moves at slower or higher speeds than the optimum of about 70 km per hour, energy consumption per unit distance increases.

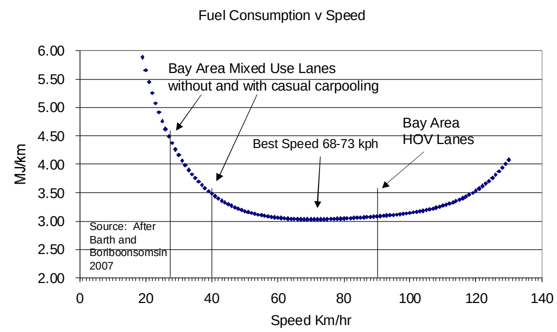

Figure 5: Consumption Impact of Different Traffic Speeds.

4d: Estimating the Impact of Casual Carpooling

We have used the above assumptions and models to estimate the impact on energy use by the traffic in the mixed lanes of the San Francisco Bay Area:

- With existing casual carpooling, and
- If casual carpooling ceased to operate from all locations, participants switching mode according to the survey findings reported by Beroldo, 1999.

Our analysis suggests that the 32,880 vehicles arriving at the Bay Bridge Toll Plaza in the mixed use lanes would consume 35% more energy as their speed (across the network of highways leading to the Bay Bridge) would be reduced from an existing average of 39.5 km per hour with casual carpooling to an average of 27 km per hour without casual carpooling. Casual carpooling therefore appears to save approximately 500 GJ per day (or the

[3] The work done by Barth and Boriboonsomsin (2007) focused on the carbon impacts of traffic at different speeds. We converted their carbon dioxide findings into energy impacts to derive the chart.

equivalent of 900,000 gallons (3.5 million liters) of gasoline per year). This saving would increase if congestion worsens, or if the average energy consumption of cars was greater than the figures used in the model.

Figure 6 shows the total energy impact of casual carpooling, combining the direct and indirect impacts.

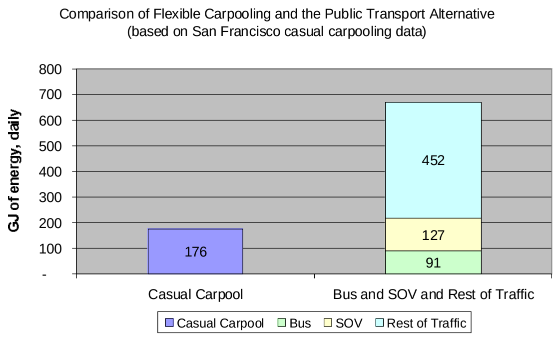

Figure 6: Comparing daily transportation energy impact of 9,000 San Francisco casual carpoolers with and without casual carpooling.

We have also estimated some of the non-energy benefits of casual carpooling for San Francisco. Allowing for the value of time saved, energy saved, buses not purchased and operated, and bus drivers not paid, we estimate that casual carpooling is saving the San Francisco community at least $30 million per year. This does not include any value for the reduced carbon footprint or improved safety or other community benefits. And it is only for the operation of the system for the morning commute.

Casual carpooling saves energy and reduces greenhouse gas emissions. This appears to be true even if participants would otherwise take the bus, because casual carpooling reduces deadheading of buses and increases the energy efficiency of traffic in mixed use traffic lanes. It may therefore be desirable to replicate the system in other cities.

5. A System for Replicating Casual Carpooling

The existing systems grew of their own accord without official intervention, and while local authorities have provided some support, for example by setting aside “no-parking” pick-up points in the East Bay area, and in downtown for the return journey, these seem to have followed rather than preceded the growth of the system. The supporting website for the Washington DC system has a page dedicated to helping people start a “slug-line”, or morning pick-up point, but this is aimed at expanding the existing system, leaves it up to commuters themselves to take the initiative, and doesn’t suggest it could be done in another city all together.

Our key research question is whether the introduction of the system into a new location would require all the conditions set out by the TRB (2006) or whether it could operate under different circumstances. Our hypothesis is that it is the flexibility of the system that is central to its success, and that (consistent with Kelly 2007) alternative benefits such as incentives, or even payments between participants, could provide a similar motivation to the HOV lane benefit.

We hypothesize that a formalized system (which we call flexible carpooling), could be implemented in other cities, retaining the desired flexibility. The hypothesized system is described as follows:

- Participants do not make any prior arrangements about who they will ride with, or even whether they will ride or drive on any particular day.
- Consistent with Burris and Winn (2007), park and ride facilities would be used to enable the mode.
- In the morning, participants would travel to the ‘flexible carpooling facility’ and decide whether they wish to drive or ride (perhaps responding to what others are doing).
- Riders park their vehicles in an area designated for their intended destination and wait by their vehicles.
- Drivers cruise through the facility, picking up riders waiting in the area corresponding

to their destination. After driving to the destination point, the drivers set down their riders and then drive to their usual parking space.

- During the evening commute, riders queue at pick-up points which may be near to the destination points used in the morning. Drivers swing by these inner-city pick-up points and pick up riders for the return journey.
- To join the program, an individual will be required to pass a pre-screening and approval process (for safety purposes)
- A system of tradable ride credits would ensure that drivers share in the savings gained by the riders who avoid driving and parking costs.
- Technology would support the identification of participants within the system, and enable transferring ride credits and other accounting details.
- The system would be capable of supporting an incentive scheme. If a city wanted to pay incentives to people to carpool, the system would help to ensure that incentives get paid to the right people, and limit fraud.
- The system would be branded and use commercial style marketing to build awareness and a consistent culture so that the system could spread,
- A revenue stream from within the system would support marketing spend,
- The system would operate to different types of destinations such as downtown employment districts, business parks, universities and transit stations.

Where HOV lanes exist, it is desirable to maximize their use. Flexible carpooling might increase the number of vehicles (and people) traveling in HOV lanes. (We note stories of HOV lanes being converted to mixed use because of being underused by HOV traffic in some centers).

Even without financial incentives people already carpool where there are no HOV lanes, for the financial savings and other reasons. This suggests that there might be significant additional numbers of people who ‘would’ carpool if it was a convenient choice.

One objection that has been raised in discussions about flexible carpooling is the cost of the proposed origin end parking facilities in or near suburbs or exurbs. We observe that parking at the journey origin will generally be more economically efficient (cheaper) than destination parking in the CBD. In the long run city center (and other destination) parking would be converted to more valuable uses.

As mentioned by Burris and Winn (2007), system operators might be exposed to some liability. It is normal for liability to exist. It is usually mitigated by sound business processes and appropriate insurance.

6. New Zealand Energy and Transportation Policy

Seeking a location to test adaptation of casual carpooling, we looked to New Zealand’s energy and transportation strategies in the hope that they would provide a framework for consideration of such a system. We found that current policy does not emphasize carpooling as a way of reducing energy consumption and greenhouse gas emissions from transportation.

The National Energy Efficiency and Conservation Strategy (NEECS), launched in 2001, identified several methods by which transport-related energy use and carbon dioxide emissions could be reduced, including measures to increase private vehicle occupancy rates (EECA, 2001). When the strategy was revised in 2007 (New Zealand Government, 2007 (1)), the policy option of increasing private vehicle occupancy rates was dropped, even though at least one submission argued against abandoning it (EECA 2007). The New Zealand Energy

Strategy to 2050 is also silent on the role of measures to increase private vehicle occupancy, though it does establish a target of reduced SOV trips. (Ministry of Economic Development, 2007).

The Auckland Regional Land Transport Strategy 2005 outlines proposed spending of $11 billion over ten years. About $380 million, or 4%, is allocated to 'travel demand management', and 4.2% of that amount (or about one fifteenth of one percent (0.015%) of the total spend) is allocated to strategies to increase vehicle occupancy on the journey to and from work, which coincides with the most serious traffic congestion (ARTA, 2006).

The draft 2008/9 Land Transport Plan for Auckland, published by the Auckland Regional Transportation Authority (ARTA), showed the priorities for budgeting for the following period to be:

1. Make the best use of the existing transport system, and
2. Manage travel demand (ARTA, 2008)

The budget for 'system use', (the travel demand management activities that would deliver to these priorities), was reduced compared with the budget for the previous year by about 10%, and for the budget year it is planned at about 2.5% of total expenditure compared with the 4% in the long term plan (ARTA, 2008; Auckland Regional Council, 2005).

The main transportation strategies in the New Zealand Energy Strategy include the development of alternative fuels, including bio-fuels and electric cars; increasing the use of LPG; exploring the role of hydrogen fuel cell vehicles; and improving vehicle efficiency standards (Ministry of Economic Development, 2007). These are essentially institutional strategies with long implementation time-frames that could take years to deliver tangible results.

The discussion paper for the recently released New Zealand Transport Strategy 2008 (New Zealand Government 2007 (2)) had no reference to ridesharing. The now released Strategy document uses the term occasionally, and significantly reiterates the call (from the NZES) for a "*10% per capita reduction in kilometres traveled by single occupancy vehicles, in major urban areas on weekdays, by 2015 compared with 2007*". (New Zealand Government 2008). Careful reading of the Strategy document suggests that there is little expectation that this reduction will come from increased ridesharing.

The guidance document for preparation of proposals for projects for inclusion in the National Land Transport Programme for 2009-2012 includes not a single reference to the terms carpool or rideshare. This seems to confirm that any decrease in single occupancy vehicle use is expected to come only from increases in public transport provision, walking and cycling. (New Zealand Transport Agency 2008).

It is difficult to access the rationale for omission of strategies to increase average private vehicle occupancy. Conversations with transportation officials suggest it is due either to an 'anti-car' theology (any initiative that supports car use is 'bad'), or it is from a belief that the benefits to be gained are not worth the effort, (based on experience of previous failed initiatives to increase vehicle occupancy), or a combination of the two.

When we proposed flexible carpooling as a partial solution to traffic congestion in New Zealand, traffic planners responded with statements such as: "Reducing traffic counts on existing congested roads will attract more traffic"; "Create a space and it will fill up again".

The recently created New Zealand Transport Agency released a research report entitled "Managing Transportation Challenges When Oil Prices Rise", and referred to casual carpools similar to those in San Francisco as a potential strategy for dealing with an oil shortage, by combining park and ride, HOV lanes, dedicated bus lanes, and casual carpool pick-up points to "maximise peak hour carrying capacities". (NZTA 2008). The paper did not go into any detail about how such a strategy would be implemented.

With the exception of the latter document, the conclusion to be drawn from this section is that current policy in New Zealand is not supportive of carpooling as a part of the solution to traffic congestion.

7. The Application of Flexible Carpooling to Auckland's North Shore

A busway has recently been built on Auckland's North Shore. The original approval for the funding of the busway included a provision for 350 HOVs per hour in addition to the buses.

The busway has opened, but the mechanisms have not yet been put in place to enable HOVs to use it.

The busway runs parallel to a very busy and congested state highway. Average speeds of less than 30 km per hour are normal for this route during the morning peak period. It is expected that the fleet of buses that are operating on the busway will draw some people from the mixed use lanes and provide some relief.

Our analysis suggests that there is a potential market for at least 1,500 flexible carpoolers who would park 1,000 cars in dedicated flexible carpool parking upstream from the busway, and drive 500 cars along the busway and over the Harbor Bridge into downtown Auckland, a weighted average distance of 18.7 km. Locations have been identified for pick-up and drop-off.

Figure 7 shows that the 1,500 direct participants would save 76% of their current fuel consumption (24 GJ vs 103 GJ). (This is more than the expected two-thirds because of the slow speed of the mixed use lanes used by SOVs).

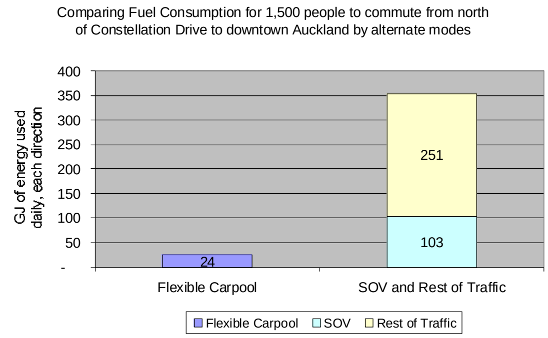

Figure 7: Energy Consumption of Different Modes for 1500 Auckland Commuters.

Using the same methodology that we used for estimating the energy impact in San Francisco, we estimate that the benefit to the rest of the traffic would be in the order of 251 GJ (See Figure 7), giving potential total savings in the order of one million liters of fuel per year for the morning traffic from Auckland's North Shore, at current prices (November 2008) worth about $NZ 1.8 million. 'Time savings' for the rest of the commuters (at $15 per hour) would add about $NZ8.0 million to this number. Savings of a similar order are available from implementing the system for the return journey. We estimate that the cost of implementation (for one direction or both) would be in the order of $1 million plus the land for origin parking.

We note that the magnitude of benefits modeled above might be reduced as other commuters switch to SOV use of the motorways when traffic flows improve. However this would create further benefits in other parts of the system not modeled. Indicative modeling of the Auckland traffic carried out by the Auckland Regional Council for Trip Convergence Ltd (ARC, 2005) showed a significant benefit (in the order of $NZ 120 million per year) from a proposed introduction of flexible carpooling Auckland wide.

8. Conclusions

Casual carpooling in three US cities moves high volumes of people at very low cost.

Using a simple model we have estimated that the benefit to San Francisco, for example, exceeds $30 million per year, including an estimated 0.9 million gallons of fuel, at almost no public expenditure. There have been no attempts to 'co-opt' the casual carpooling concept to achieve similar gains in other US or international cities.

A general belief amongst transportation planners that 'carpooling doesn't work' has not taken into account the potential for casual carpooling style systems.

We suggest that the success of casual carpooling systems grows out of the flexibility provided by the system, and suggest that if this could be copied into a new location there would be significant benefits in reduced energy consumption.

The New Zealand Transport Agency has included casual carpooling as a potential strategy for managing transportation challenges when oil prices rise, but without identifying the mechanisms by which it would be implemented.

We estimate that the potential energy and other savings from operating such a system on the North Shore Busway in Auckland, New Zealand would exceed $9 million per year for a capital cost in the order of $1 million plus land for origin end parking. The annual fuel savings of 1 million liters would exceed the capital cost of the project, if existing public land could be used.

The result of increased carpooling would be a reduction in SOV travel, an increase in average private vehicle occupancy. Raising assumptions about average private vehicle occupancy rates could reduce forecast demand for energy.

9. Policy Implications

We propose that as a matter of policy, research be encouraged to unlock the benefits of casual carpooling style systems for use in other cities.

We note that the New Zealand Transport Strategy 2008 calls for 'value for money' assessment of public transport. As a matter of policy we propose that this should take into account the potential for flexible car and van based pooling systems to provide more economical and energy efficient transportation (on a per person kilometer basis).

Since the New Zealand Transport Agency has identified use of casual carpooling as a strategy to combat rising fuel prices, we propose that urgency be put into developing the operational procedures for implementing such a system into a location in New Zealand, and based on the potential energy savings identified in this paper that the route be the North Shore Busway.

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