Final Report to Canada Mortgage and Housing Corporation

Project: Action Research on Transportation Housing Affordability

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Executive Summary

This research tests the hypothesis that housing choice and affordability, in large Canadian cities, particularly for marginalized groups, can be significantly enhanced by the right municipal transportation policy choices. Transportation is one of the central policy levers available to municipal governments and is typically the largest spending item in city budgets. It is also typically second only to housing as a percentage of private household spending.

This research estimates total transportation spending in Calgary by all levels of government and by private households; it proposes a model for explanation of households' mobility perceptions, attitudes, preferences and behaviours with particular emphasis on households at risk. It maps changing spatial patterns of affordable living across Calgary using car-owner and car-free scenarios and proposes a structure for a housing-transportation affordability index; and it reports on a workshop in which some of Calgary's key housing and transportation policy actors identified the most promising transportation policies in support of affordable living.

The research team provided as comprehensive a picture as possible of transportation spending over the 10-year period from 1998 – 2007. Total cost of transportation for Calgary is estimated to be 66.6 billion dollars. Private household spending of 52.5 billion dollars represents 79% of the total. The provincial and federal governments spent 1.75 billion dollars and 75 million dollars respectively. Municipal spending is by far the largest portion of government spending at 5.2 billion dollars. Surprisingly the social costs of transportation – 7.1 billion dollars - exceeds spending by all levels of government.

The research team sought to understand the phenomenon of household decision-making with respect to housing and transportation choice. The study found that housing and travel decisions cannot be treated separately as they are intimately linked and often co-determined. Housing and travel choice is largely activity-based and results from a complex interaction of constraints, imperfect knowledge and complex activity patterns. The research demonstrated that household housing and travel choices are co-determined while at the same time neither public nor private policy considers these two phenomena to be bundled.

Based on householder interviews the study concluded that private automobile ownership is impossible or burdensome for many households. It also found that there are many constraints to walking and bicycling in Calgary, including: 1. Distances to destinations are often too great for these modes. 2. Infrastructure for safe walking and bicycling is very limited. 3. Parents with children can only employ these modes over very short distances. 4. There are many days when weather precludes walking and cycling.

The study concluded that to be effective transit must be affordable, comfortable, rapid, reliable, frequent and legible. Legibility and reliability have particular meaning in the context of this research. A transit system is legible when the user can easily understand routes and timetables. Reliability refers not only the conventional idea that a route is on time, but that the route has some permanence over time.

Based on these research findings the following recommendations were proposed:

1. Canadian cities should calculate and publish an affordable living index. (housing+transportation/income) on a community by community basis and make this information

2. Canadian cities should calculate and publish a cost of transportation index on a community by community basis. In this way home-buyers and renters will have better information about affordable living when choosing a home to buy or rent.

3. Canadian cities should integrate the concept of affordable living into its process for municipal land use and transportation planning.

4. The city should implement policy to support carsharing cooperatives and investigate the possibility of city-run carsharing as a part of its transportation policy

5. The city should make transit infrastructure in industrial and retail employment districts a priority.

6. City of Calgary Transportation planning should incorporate a full cost benefit accounting in its transit capital spending planning process to capture characteristics like legibility and ability to attract investment.

Mapping Affordable Housing

The affordable house purchase mapping showed that, according to the 2006 census data, if a household was able to avoid the purchase of an automobile, the number of census tracts in which it could afford the purchase of the average house increases up to 1700%, with the greatest numeric increase in choice (93 of 202 tracts), occurring for household incomes at $80,000.

Based on MLS data between 22% and 1100% more 'homes sold' would have been available to a home-buyer based on 2006 sales data. The greatest percentage increase in choice occurs for the 60,000 income bracket (1100%); followed by the $50,000 income bracket (327%) and the $80,000 income bracket (207%). The greatest numeric increase in affordability of sold homes occurs at $80,000 income (6069 homes) and at $100,000 income (6171 homes).

Based on MLS data, depending on income level, between 26% and 1800% more 'homes for sale' would have been available to a home-buyer based on June 2011 data. The greatest increase in choice occurs at 60,000 income (1800% or 1677 homes), followed by the $50,000 income bracket (1570% or 848 homes) and the $80,000 income bracket (125% or 2228 homes).
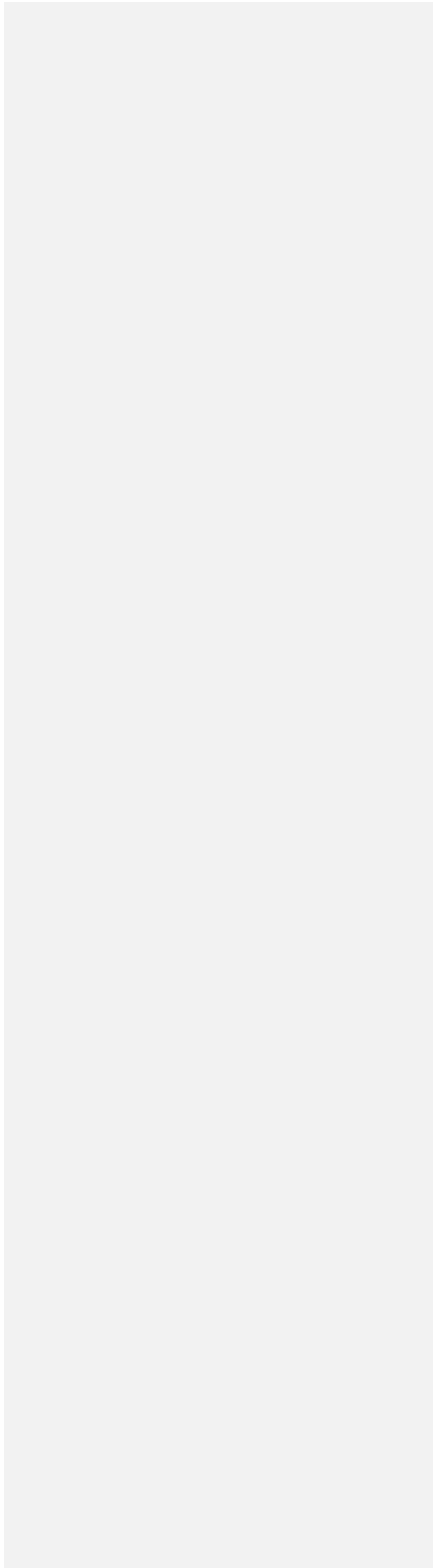
In Calgary, the four city quadrants (NE, NW, SE, SW) are significant descriptors of where you live. The 2011 Calgary Real Estate Board data (Table 6) shows that in the car ownership scenario, for an 80,000 dollar income household, in only one of those quadrants would the average home price is affordable. In the car free scenario, that same home-buyer has a choice of several communities in every quadrant of the city.

The affordable rental mapping exercise showed that if a household was able to avoid the purchase of an automobile, the number of available rental units within an affordable range increased up to 1300% with the largest increases occurring at a household income of $20,000 (423 units). At $20,000 income the percentage of all rentals available increases from 1.7% in the car ownership scenario to 23.4% in the car free scenario. At 30,000 income the percent of all rental offerings available increases from 11.4% to 44.7%. For $40,000 income the increase is from 42% to 71.7% of all rental units.

Housing and transportation stakeholders who participated in a February, 2011 workshop, estimated that the most promising policy interventions identified by this research are the creation of a housing-transportation index by community; a transit access rating by community; and greater investment in bicycle and pedestrian infrastructure. The preferred policy options were chosen with an eye to the probability of achieving the policy. The more significant transportation system investments, that would actually increase transit availability above existing conditions, were considered to be difficult to achieve. Based on this research, such changes could result in significant improvements in affordable living and in doing so increase housing affordability and choice under existing housing market conditions in Calgary.

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1. Introduction and Background

This research is motivated by the proposition that housing choice and affordability in large Canadian cities can be enhanced by appropriate sustainable transportation policy. The city of Calgary was chosen as the location to investigate this claim.

The research has been inspired by extensive research undertaken in the United States exploring the relationship between housing affordability and transportation. Between 2005 and 2010 the Center for Neighbourhood Technology published three research reports exploring the link between housing costs and transportation costs. The research challenged the assumption that suburban living is less expensive than inner city living.

Why look to transportation policy for solutions to housing affordability? Transportation is one of the central policy levers available to municipal governments and is typically the largest spending item in city budgets. According to the annual Statistics Canada Household Spending Survey transportation is the second largest private household expenditure, exceeded only by shelter costs. The trade-off of less expensive housing is often increased transportation costs. Yet, typically, the issue of affordable housing has been addressed in isolation from transportation expenditures.

In order to understand and communicate the potential of municipal transportation policy to increase the ability of households to obtain affordable housing, this research focuses on three distinct aspects of the phenomenon. First, we develop a Calgary transportation system profile to understand the size and scope of the transportation spending lever policy-makers have at their disposal including expenditures at all levels of government as well as private household spending. Second, through a survey and a series of in-depth interviews we propose a model of households' mobility perceptions, attitudes, preferences and behaviours with particular emphasis on households at risk. Third, using census data, and real time real estate and rental listings we map changing spatial patterns of affordable living across Calgary using car-owner and car-free scenarios and propose a structure for a housing-transportation affordability index. Finally, we report on a workshop in which some of Calgary's key housing and transportation policy actors identify the most promising transportation policies in support of affordable living, based on consideration of the data gathered in this three-stage investigation.

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2. Research Questions and Objectives

Research Questions

What is the potential for increasing housing choice and affordability in large Canadian cities through the application of sustainable transportation policy?

This research will test the hypothesis that housing choice and affordability, in large Canadian cities, particularly for marginalized groups, can be significantly enhanced by the right municipal transportation policy choices.

This research is important for three reasons. First, municipal governments have much more direct control over transportation policy than they do over affordable housing policy. Second, transportation spending is the single biggest expenditure of municipal governments. Third, municipal government transportation policy focuses almost exclusively on the municipal transportation budget. Left out of the equation are the single biggest transportation system expenditure – what households spend on the purchase and operation of the private automobile – and, provincial governments' significant transportation infrastructure investments.

Research Objectives

Our research had four main objectives:

1. Assess the scale of resource flows associated with transportation in Calgary by establishing a transportation system profile for Calgary including private household expenditures and public expenditures by all levels of government.

2. Define a housing-transportation affordability index. Housing affordability is typically assessed on the basis of housing cost in isolation of all other variable costs a household has to manage. This research set out to define an alternative affordability index that could account for not only housing rental and ownership but also mobility using multiple cost scenario combinations including car ownership, car-sharing, car-free/transit, car-free/walking-biking.

3. Increased understanding of the subjective, lived experience of Calgarians with respect to mobility patterns, costs and barriers. In order to identify potential transportation policies that would positively impact housing-transportation affordability we wanted to understand housing location and mobility attitudes and behaviours with a focus on lower income households facing affordability challenges.

4. Identify potential transportation policies with the potential to increase housing affordability and choice and security and make some determination of the likely success of these policies in the Calgary context.

3. Existing Research

Center for Neighborhood Technology (USA)

In 2005 the Center for Housing Policy published *A Heavy Load*, a study of housing and transportation costs in 28 municipalities across the United States (Lipman, 2006). It found that transportation and housing combined typically consume close to 60% of household budgets and transportation can often exceed housing in household expenditures. In related research, The Center for Neighbourhood Technology developed a Housing Affordability Index (Haas et al, 2006; Center for Neighbourhood Technology, 2006) that compared the ratio of household spending on transportation and housing to household income across neighbourhoods in dozens of metro areas of the United States.

In its most recent report, *Penny Wise, Pound Fuelish*, (Centre for Neigbourhood Technology, 2010) the Centre for Neighbourhood Technology found that the number of communities considered affordable drops dramatically in most regions when combined housing and transportation costs are examined; that the "drive 'til you qualify" strategy often results in more strained household budgets as transportation costs more than offset house cost savings; and that longer distances for "drive 'til you qualify" households results in more road congestion, less leisure time and higher greenhouse gas emissions. Living in more compact neighbourhoods was found to result in annual combined transportation and housing cost savings of for example $1830 in Minneapolis and $3850 in Boston.

The CNT study also addressed the policy implications of their research. Policy recommendations are generally consistent with smart growth policy prescriptions (e.g. more density, mixed use and transit investment) but they also suggest reforms that include a definition of affordability as a function of housing and transportation and legislation that requires home-sellers, real estate agents and landlords to provide transportation cost information to prospective buyers and renters.

Canadian Research

There is relatively little Canadian research on the relationship between mode of transportation and housing choice and affordability but there is a clear need to improve housing affordability.

Between 1997 and 2007 housing affordability deteriorated in Calgary more than in any other Canadian city with housing prices increasing 250%. In that period, prior to the economic recession, Calgary faced the fastest growing housing market in the country. In 2006 over 17,000 new housing starts were registered in Calgary, a 25% increase from the previous year. But housing supply had not kept pace with housing demand. The RBC Affordability Index, calculated quarterly shows fluctuations between census years. The index for Calgary has averaged about 40% since 1985 and exceeded 50% for periods in 2007-08 and in 2009 was approximately 36%. (Sustainable Calgary, 2011) The average house cost $460,000 in the second quarter of 2007, a 41% increase over the previous year. Annual household income would have to be over 100,000 to "afford" such a house.

Between 1994 and 2006 the number of private rental units in the city had fallen by 17,000 and by a further 1000 units by 2009. (Sustainable Calgary, 2011) Rental stock decreased due to conversion of existing stock through 'condo-ization' and the absence of any new rental construction. The rental vacancy rate decreased from 4.4% in 2003 to 0.5 in 2006. In the spring of 2007 in the midst of a crisis in rental

accommodation, with some renters experiencing 200 and even 300 percent rent hikes, the average two bedroom suite in Calgary rented for over $1000 a month with rents increasing by over 25% on the year. At the extreme end of affordability, from 2003 to 2008, homelessness increased over 400% in Calgary, with homeless families representing the most pronounced increase in the ranks of the homeless. (Poverty Action Coalition, 2007) Research suggests that in the absence of strong public policy, housing problems are a significant contributor to the marginalization of low-income households (Dewilde and De Keulenaer 2003) and that the dominant factor in homelessness in North America is poverty (Quigley and Raphael 2001).

Canadian research also shows that low income households tend to move much more than the average household and are faced with complex and shifting mobility challenges as a result (Skelton 2002; CMHC 2007). The variable patchwork of transit access across quadrants of Calgary and between inner city, established and suburban communities makes the simultaneous acquisition of stable housing and access to transit an even more daunting task for many Calgarians (Vibrant Communities Calgary, 2007).

Smart growth research conducted in Calgary (Keough et al. 2006) suggested a strong relationship between housing affordability and transportation policy and that many land use and transportation policy options can have a positive effect on housing affordability: legalization of secondary suites, laneway conversion, off-street parking relaxation, fair-fares initiatives, car-sharing, transit oriented design, mixed use land-use policy and aggressive reallocation of transportation budgets away from road infrastructure and into transit, bicycle and pedestrian infrastructure.

A 2005 study conducted by the University of Winnipeg, Institute for Urban Studies found that "Transportation Saving Mortgages may be well-suited to Winnipeg context along major transportation routes (and not be limited just to inner city areas), but should be administered carefully and in concert with other measures to reduce the risks to homebuyers in lower income brackets". (Dudley et al, 2005)

In 2006 and 2007 Sustainable Calgary collaborated on two national research projects comparing sustainability across diverse neighbourhood types. The community archetypes research project lead by National Resources Canada (Natural Resources Canada, 2009) examined energy consumption patterns, including transportation costs and mobility behaviour in several Canadian communities, including seven geographically diverse Calgary communities. In a CMHC sponsored research project (CMHC, 2010) Tomalty studied the transportation behaviours in new urbanist and conventional new communities across Canada, including four Calgary communities. In both instances the research demonstrated that automobile usage and transportation costs are significantly less in inner city neigbourhoods compared to suburban neigbourhoods and in new urbanist neighbourhoods compared to conventional neighbourhoods.

The data does not exist to calculate actual housing + transportation costs by community in Calgary in the way the Centre for Neighbourhood Technology was able to do for its US research.

The CMHC study comparing New Urbanist (NUD) and Conventional (CSD) communities found reduced car dependence in several areas. NUD households walked and biked to local services more frequently (51% versus 19%); walked and biked for leisure more frequently (61% versus 54%); are less likely to own two or more cars (61% versus 80%); had 20% less vehicle kilometres traveled and took a smaller percentage of trips by car (78% versus 85%). This research is a weak corroboration of the thesis of this present research in that its concern was to compare NUD and CSD community form rather than proximity to city centres and thus sought to compare NUD and CSD communities of similar proximity to the core.

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The NRCan research provides stronger support for the thesis of this present research. It demonstrated that in fact there are significant differences between the travel behaviour of households as you move further from the city centre. The vehicle kilometres traveled in the community closest to the central business district was 35% of vehicle kilometres traveled in the most car dependent suburban community.

Transportation analysis from the 2006 census shows that in fact as you move further from the city centre car dependence increases significantly. In Calgary for example more than half of those living within 5 kilometres of their workplace walk, bike or take transit. At 10-14 kilometres that percentage drops to less than a quarter. (Statistics Canada, 2007)

4. Findings

Phase 1 Transportation cost profile: Calgary 1998-2007

Method

The purpose of this phase of the research was to create an accurate picture of the scale of all resources devoted to supporting the transportation system. It was in response to two questions: How much do we actually spend on transportation? What is the potential resource we can redeploy to address issues of affordability at a household level?

There are four distinct actors in the system: municipal, provincial and federal governments and private households and businesses. Typically there is little coordination among them with respect to strategic decision-making or policy design that supports a sustainable transportation system and a sustainable city. Many of the costs of transit are not included in traditional financial calculations. Costs borne by the society, for example pollution, are usually discounted because they are hidden in other costs such as insurance policies and user fees.

The creation the transportation system profile involved the gathering of transportation spending data from the transportation departments in each level of government responsible for transportation planning and spending and infrastructure services; and gathering household transportation spending data via Statistics Canada databases – predominantly the Annual Household Spending Surveys. The objective was to provide as comprehensive a picture as possible of transportation spending over the 10 year period from 1998 – 2007.

The private cost of transportation was derived from "Spending Patterns in Canada" (Statistics Canada 2009) in which the average household spending on transportation amounted to $11,997. In 2009 there were approximately 439,000 dwellings in Calgary.

A 2008 Transport Canada study provided the basis for the calculation of the social costs of transportation paid by Calgarians (Transport Canada (Economic Analysis Directorate) and Full Cost Investigation Task Force 2008).

This information was collated in a single profile to provide a clearer picture of societal resources devoted to transportation in Calgary that can be used as a tool by government policy-makers, budget crafters and individual householders to make better informed decisions about land use, housing and transportation.

Findings

Federal and Provincial transportation spending

The cash contributions to transportation infrastructure (capital and operations and maintenance) from federal and provincial sources are detailed in Figure 1. The federal contribution was in the form of a one-time grant toward the cost of the Stoney Trail ring road.

Provincial contributions were in the form of capital upgrades and operating funds for Deerfoot Tr. (which was taken over by the province in 2001) and the construction of the north segments of Stoney Trail. Municipal Infrastructure grants are non-program injections of cash for urban infrastructure projects in Alberta. The province directs certain portions of these grants towards public transportation.

	Amount	Capital Project	O & M
Federal	$75,000,000	Ring road	
Provincial	$330,000,000	NW Stoney Trail 2004 – 2008	
	$170,500,000	Deerfoot Trail 2001 – 2008 -	
	$224,000,000	NE Stoney Trail[1]	
	$985,000,000	Municipal Infrastructure Grants 1999-2008[2]	
	$44,700,000		Deerfoot Tr. 2001-2008[3]
Total Federal and Provincial Contribution	$1,829,200,000		

Figure 1 Federal and provincial contribution to transportation 1998-2007

Municipal transportation spending

The cash contributions of the City of Calgary towards transportation are detailed in Figure 2. Values were derived from City of Calgary budget documents for the years 1998-2007.

Transit		Roads	
O & M	Capital	O & M	Capital
$1,771,956,000	$782,299,000	$1,081,260,000	$1,548,478,000
Total Municipal Transportation Spending 1998 – 2007: $5,183,993,000			

Figure 2 Municipal contribution to transportation 1998-2007

Private transportation spending

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[1] Amount paid by the province to a public-private partnership in 2008 as stipulated in the terms of a 30-year "plan/ build/ finance/ maintain" contract for NE Stoney Tr. The exact amount of the private contribution is confidential.

[2] An additional $804M was received in Municipal Infrastructure Grants during this period that was not specifically designated for transit infrastructure but could be used for such.

[3] Operations and maintenance for the NW segment of the ring road did not begin until 2009.

This value of the private contribution to transportation was derived for the year 2009 by multiplying the average household spending on transportation (Statistics Canada 2009) by the number of households in Calgary. The final calculation ($12,000/year X 438,633 dwellings) amounted to $5.25 billion. For the purpose of establishing the order of magnitude of private spending on transportation (vehicle purchase costs, maintenance, depreciation, parking, transit passes, etc.) we can multiply the annual amount by 10 years to arrive at a total of $52.5B.

Social costs of transportation

In 2008 Transport Canada (Transport Canada 2008) prepared a synthesis report to estimate the full costs of transportation in Canada. In it, social costs associated with the impacts of transportation were estimated for the year 2000. The analysis identified five social costs of transportation: accidents, air pollution, congestion, greenhouse gas emissions and noise.

In Canada in the year 2000 estimates of these social costs ranged between a low of $24.4B and a maximum $39.5B. Using the smallest figure in the range, for a national population of 30,689,000 in the year 2000, the total social costs of transportation incurred by Canadians amounted to $795 per capita. In 2000, the population of Calgary was approximately 899,000. Using the Canadian average of the social costs of transportation, Calgarians incurred $714,770,764 in the year 2000. Extrapolating for the ten-year study period (without accounting for population increases or other changes which would make the total higher) Calgarians incurred $7.1B in social costs of transportation, a figure about the same as spent by all levels of government combined during the same period.

Summary

Total transportation spending for Calgary during the period 1998-2007 is summarized in Figure 3.

Source	Amount
Federal government	$75,000,000
Provincial government	$1,750,000,000
Municipal government	$5,200,000,000
Private Spending	$52,500,000,000
Total Spending	$59,525,000,000
Social Costs	$7,100,000,000
Total Cost	$66,625,000,000

Figure 3 Transportation spending profile Calgary 1998-2007

Phase 2 Grounded Theory: The Co-Determination of Housing and Transportation Choice

Methods

The purpose of this stage of the research is to identify transportation policies that would positively influence travel decisions and housing choice. A qualitative methodology was chosen for this investigation – grounded theory – a method of theory making rather than of theory testing. Provisional theory is derived deductively from the study of the phenomenon of interest. In depth interviews are analyzed through a process of open coding and axial coding. Open coding identifies key concepts and the dimensions and properties of those concepts. Axial coding establishes the nature of the relationships among the concepts. . Based on grounded theory analysis, the most promising policies for more affordable living (housing + transportation costs) were identified.

A total of thirteen interviews were conducted. The researchers sought out households for which affordability is a significant issue. Interviewees were recruited with the assistance of the Forest Lawn Car Sharing initiative in lower income working class neighbourhoods in East Calgary. The researchers also recruited interviewees in other Calgary communities – the rationale being to conduct the investigation in communities where both Canada Mortgage and Housing Corporation and Natural Resources Canada had sponsored previous mobility-related research so that a richer dataset would be available for future analysis.

Findings

The goal of this step in the research program was to understand the phenomenon of household decision-making with respect to housing and transportation choice. The qualitative survey and interview approach was informed by previous work by Jones et al (1983) that challenged the conventional engineering transportation modeling approach to travel behaviour. Jones et al used a sociological approach to understand the decision-making processes informing travel behaviour. This study extended Jones' et al approach by not only probing the travel behaviour of households but also the housing location decisions.

The study (Schryvers, 2010) found that housing and travel decisions cannot be treated separately as they are intimately linked and often co-determined. Housing and travel choice is largely activity-based and results from a complex interaction of constraints, imperfect knowledge and complex activity patterns. The research demonstrated that household housing and travel choices are co-determined while at the same time neither public nor private policy considers these two phenomena to be bundled.

Based on the householder interviews the study concluded that private automobile ownership is impossible or burdensome for many households. It also found that there are many constraints to walking and bicycling in Calgary, including:

1. Distances to destinations are often too great for these modes.
2. Infrastructure for safe walking and bicycling is very limited.
3. Parents with children can only employ these modes over very short distances.
4. There are many days when weather precludes walking and cycling.

The study concluded that to be effective transit must be affordable, comfortable, rapid, reliable, frequent and legible.

Legibility and reliability have particular meaning in the context of this research. A transit system is legible when the user can easily understand routes and timetables. Reliability refers not only the conventional idea that a route is on time, but that the route has some permanence over time.

Based on these research findings the following recommendations were proposed:

1. The city should provide transportation information to new homebuyers.

2. The city should implement policy to support carsharing cooperatives and investigate the possibility of city-run carsharing as a part of its transportation policy

3. The city should make transit infrastructure in industrial and retail (big box) employment districts a priority.

4. The characteristics of effective transit favour railed-based transit over bus transit. Rail-based systems are particularly appropriate in terms of legibility, ability to attract investment (jobs creation in proximity to Transit) and permanence. Housing location choices are less likely to be influenced by an impermanent bus route versus a more permanent rail route.

Phase 3: Maps Housing Affordability and Choice Under Car Ownership and Car Free Scenarios

Methods

This phase of the research investigated the potential for the provision of increased housing choice and affordability (both ownership and rental) through transportation policy. The purpose was to test the sensitivity of housing affordability and choice to various household transportation spending choices and decisions – specifically the decision to reduce or eliminate household car ownership. The question asked: If the necessity of car ownership can be reduced, through the provision of appropriate transit alternatives, and cost savings can be redirected toward the provision of housing, how much more affordable choice would a home-buyer or renter have?

Home-buyer choice is defined as the percent of census tract communities in which the household could afford the average priced house (2006 Census), the percent of 'homes for sale' that the household could afford (June 2011), the number of communities in which the household could afford the average 'home for sale' price (June 2011); and the number of sales the household could have afforded (June – August 2006). Renter choice is defined as the percent of rental offerings that are affordable for a given household income. (December 5, 2009)

Appendix A, contains the calculation chart (Table 1) showing how affordable house price was derived for annual incomes ranging from 20,000 to 160,000, for both car ownership and car free scenarios. A four step process was used to derived the house price thresholds in this table.

Step 1: Begin with an estimated car payment, PT&Heat, Mortgage Rate, Amortization and Downpayment

Step 2: Calculate affordable Mortgage, Monthly payment and House Price using CMHC affordability calculator (row 1)

Note: The calculator arrives at a number that allows for 32% shelter cost ceiling and a 40% of monthly income total debt ceiling

Step 3: Remove the car payment and recalculate Mortgage, Monthly payment and House price (row 2)

Note: The calculator arrives at a number that allows a 32% of monthly income shelter ceiling and 40% of total debt ceiling

Step 4: Use the calculator to arrive at a monthly mortgage payment/house price that creates a 40% ceiling for both shelter and total debt. (row 3)

Appendix B contains the calculation chart (Table 2) showing how affordable rent was derived for annual incomes ranging from 20,000 to 160,000, for both car ownership and car free scenarios.

The with-car scenario is calculated based on an estimate of the "car cost diffential", the difference between car and non-car transportation costs. Mortgage rate and amortization period are held constant across all income levels. Car costs, down payments and P.T. and heating costs are assumed to increase gradually as household income increases.

Using the affordability price points derived from the car ownership and car free calculations and 2006 Statistics Canada census data of average house price by community, maps comparing housing choice for car ownership and car free scenarios across Calgary communities were generated. For each income level a pair of maps illustrating the communities in which a household at that income level could afford an average-priced house (under conventional conditions of affordability amounting to 30% of income devoted to housing) and those which would be affordable if transportation expenditures (the cost of vehicle purchase, operation and maintenance) could be reallocated to housing are shown in Appendix A. The maps were generated with the assumption that a conservatively estimated threshold for housing costs (the Housing + Transportation Affordability Ratio), in the scenario where there was one less car, would be 40% of households income, equal to the current total monthly costs threshold used in the CMHC mortgage calculator.

Using rental offerings from the most popular on-line rental website on a specific day (December 5, 2009), the number and location of affordable available rental units across the city was determined. These maps are displayed in Appendix B.

To simulate a home-buyers experience data was also generated, for each income level, to compare choice in the car free and car ownership scenarios for actual June –August 2006 house sales[4] for Calgary (derived from MLS database) and June 2011 homes-for-sale data (derived from the MLS database) and the June 2011 average sale price by community data (Calgary Real Estate Board District Sales database).

Using the mortgage calculation algorithm, a prototype transportation-housing affordability calculator was developed that would allow a calculation of affordable housing costs at variable levels of income devoted to combined housing and transportation expenditures.

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[4] Houses for sale data was not available for 2006.

Findings

Affordable Home-Ownership

The affordable house purchase mapping showed that, according to the 2006 census data (Table 3, Appendix C) if a household was able to avoid the purchase of an automobile, the number of census tracts in which it could afford the purchase of the average house increases up to 1700%, with the greatest numeric increase in choice (93 of 202 tracts), occurring for household incomes at $80,000.

Table 4 of Appendix C shows that between 22% and 1100% more 'homes sold' would have been available to a home-buyer based on 2006 sales data. The greatest percentage increase in choice occurs for the 60,000 income bracket (1100%); followed by the 50,000 income bracket (327%) and the 80,000 income bracket (207%). The greatest numeric increase in affordability of sold homes occurs at 80,000 income (6069 homes) and at $100,000 income (6171 homes).

Table 5 of Appendix C shows that depending on income level, between 26% and 1800% more 'homes for sale' would have been available to a home-buyer based on June 2011 data. The greatest increase in choice occurs at 60,000 income (1800% or 1677 homes), followed by the 50,000 income bracket (1570% or 848 homes) and the 80,000 income bracket (125% or 2228 homes).

In Calgary, the four city quadrants (NE, NW, SE, SW) are significant descriptors of where you live. The 2011 Calgary Real Estate Board data (Table 6, Appendix C) shows that in the car ownership scenario, for an 80,000 dollar income, only one of those quadrants has communities where the average home price is affordable. In the car free scenario, that same home-buyer has a choice of several communities in every quadrant of the city.

Affordable Home-Rental

The affordable rental mapping exercise (see data in Table 7, Appendix C) showed that if a household was able to avoid the purchase of an automobile, the number of available rental units within an affordable range increased up to 1300% with the largest increases occurring at a household income of $20,000 (423 units). At $20,000 income the percentage of all rentals available increases from 1.7% in the car ownership scenario to 23.4% in the car free scenario. At 30,000 income the percent of all rental offerings available increases from 11.4% to 44.7%. For $40,000 income the increase is from 42% to 71.7% of all rental units.

Affordable Living Calculator

Using the standard mortgage calculation algorithm an Affordable Living (transportation+housing) algorithm was derived. In the US studies, 45% on gross household income was proposed the threshold for combined housing + transportation affordability. The Affordable Living Calculator herein, proposes a 40% threshold. This algorithm would allow affordability testing using a range of percent of household income devoted to transportation+housing.

The algorithm also allows for a more detailed calculation of affordable living through the inclusion of real transportation costs from all modes. Equation 1 yields affordable house price assuming 5% mortgage rate with a 25 year amortization. Equation 2 is the mortgage algorithm solved for House price. Equation 2 assumes only housing affordability, the conventional calculation, is included in the calculation of the affordable house price. Equation 3 assumes a 40% of income threshold for housing and transportation. Equation 4 allows calculation of actual percentage of housing spent on housing and transportation.

Standard mortgage calculation: $M = P [i(1 + i)^n] / [(1 + i)n - 1]$ where **M** is the monthly payment.

Equation 1: $P = M / [0.004167(1.004167)^{300}] / [(1.004167)\,300 - 1]$

Equation 2 (standard mortgage affordability calculation: $M = .32$ (annual salary/12)

Equation 3 (transportation+housing at 40% of income) $M = .40$ (annual salary/12)

Equation 4 (Housing Transportation Index) Housing Cost + Transportation Cost/Household Income[1]

1. Transportation Cost = Car Ownership Costs[2] + Car Rental Costs + Transit Cost[3] + Bike/Walk[4] Cost

2. Car Ownership Cost = monthly payment + **monthly fuel**[5] + monthly parking + annual tickets/12 + annual insurance/12 + annual repairs and maintenance/12.

3. Transit Costs = monthly pass x months purchased + occasional transit ticket costs

4. Bike/walk = cost of bike + bike maintenance + walking shoes

5. **Monthly fuel** = kilometres traveled x car fuel economy rating(km/litre) x fuel price ($/litre)

Example Ownership Map

Legend

■ With Car
■ + ■ Car-free

Kilometers
0 — 10

Projection: NAD 1983 3TM 114
Datum: North American Datum, 1983
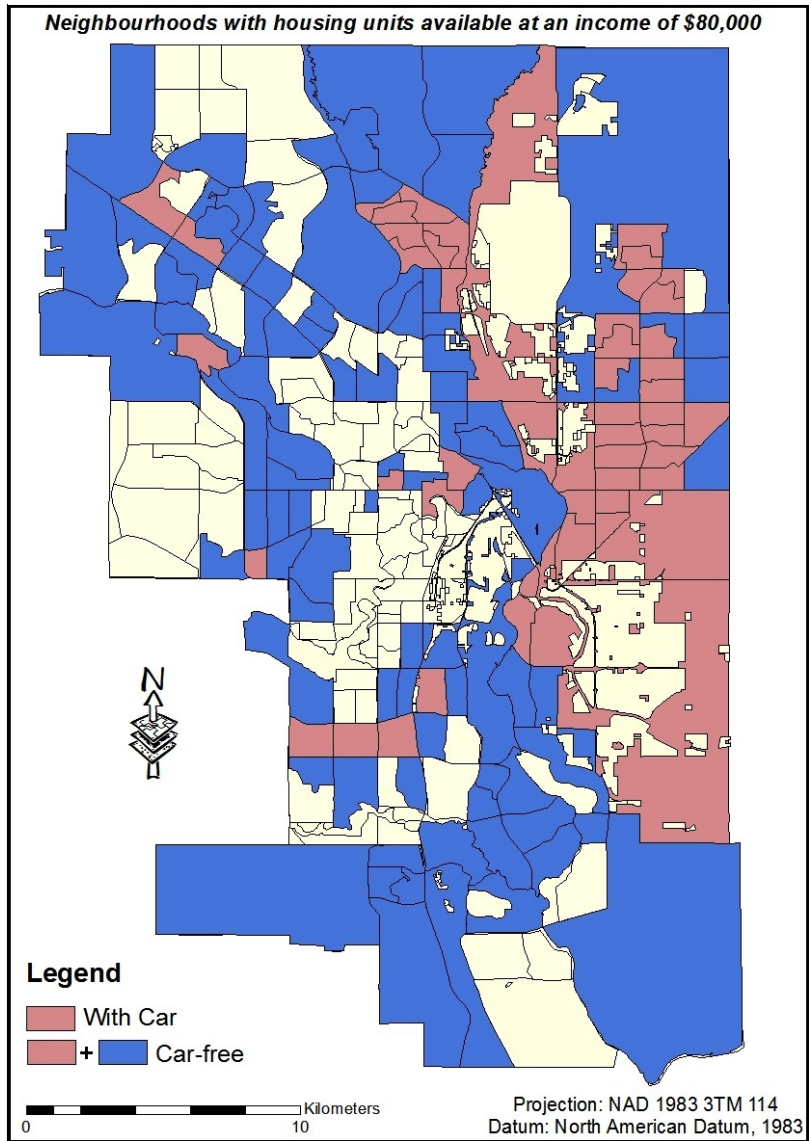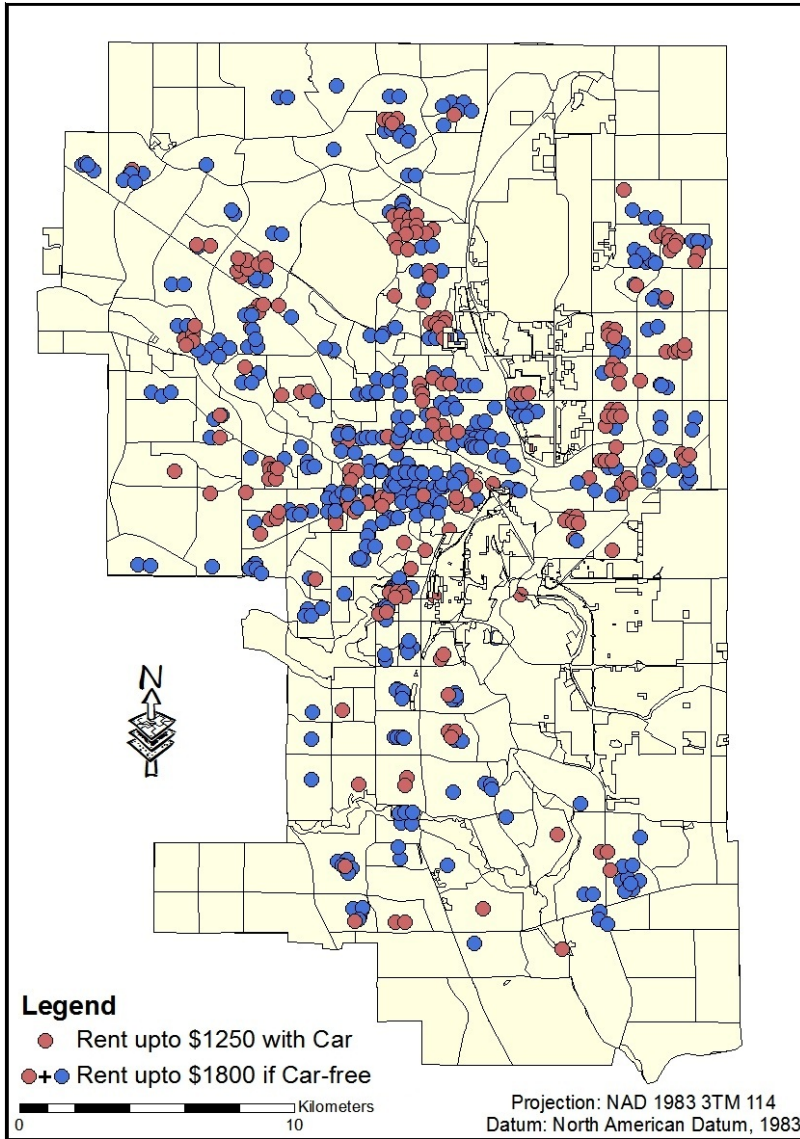
Average house price affordable by households owning a car: $294,324
Average house price affordable by households not owning a car $414,598

Example Rental Map

Rental Opportunities $1250 vs. $1800

N

Legend
- Rent upto $1250 with Car
- Rent upto $1800 if Car-free

Kilometers
0   10

Projection: NAD 1983 3TM 114
Datum: North American Datum, 1983

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5. Transportation-Housing Affordability Policy Workshop

Based on the findings of the transportation system and housing-transportation index analysis and the survey of housing and travel choice, draft transportation policies were prepared by the research team and presented for discussion and debate at a one-day policy-experts workshop .

On February 27, 2011 a half-day workshop was organized to present the research to a diverse group of local stakeholders representing municipal government, housing and transit planners, non-governmental organizations, the business community and others interested in transit and affordable housing. A flash drive containing all the day's presentations and a library of key readings was distributed to each participant.

Workshop participants included members of the research team and representatives of other stakeholders including major affordable housing and transportation funders and policy-makers (e.g. The United Way, Calgary Homeless Foundation and the City of Calgary Community and Protective Services and Transportation). A consensus process was designed to characterize, rank and prioritize the policy options based on potential impact and risk analysis with respect to ability to implement.

The task for the day was "to identify promising municipal transportation policies and actions that would increase housing affordability, choice and security for Calgarians." The idea of the workshop was to elicit reactions to the content and findings of the research from an elite group of local urban practitioners and, based on that discussion, identify promising policy options and estimate their chances of success.

The workshop opened with presentations detailing the underlying rationale for the research, the context for each of the three research phases, and an overview of the results and conclusions.

After a break participants were divided into groups and asked to discuss a set of ten policy options suggested by the research (Figure 4). Two additional policy options (11 and 12) emerged from group discussions.

Policies suggested by the research	Votes	Blue Sky	Black Hat
1. Support/develop/manage/fund a Calgary-wide car-share program	1	1.0	2.3
2. Create, maintain and make available a housing-transportation index for every Calgary community	5	8.0	6.5
3. Create, maintain and make available a transit access rating system for every Calgary community	7	9.3	7.5
4. Rethink rail in a comprehensive framework that includes lifecycle analysis, climate change impact, marketability, public/ private/ community partnership and local economic development	2	5.8	8.0
5. Establish transit priority for commercial and retail access	0	7.5	8.5
6. Investigate the cost-benefit of concentrated versus dispersed transit coverage	4	7.0	8.5
7. Invest in transportation behaviour modeling	2	5.5	7.5
8. Create a family-friendly transit fare policy	1	6.5	5.5
9. Invest in infrastructure for bike and pedestrian safety	6	7.5	8.5

10. Design for transit priority in industrial district planning	0	6.0	8.5
11. Encourage greater concentration of housing and services in areas with good transit access	2	n/a	n/a
12. Lead development with transit	4	n/a	n/a

Figure 4 Policies suggested by the research

Each option was discussed from two perspectives. The first, "blue sky" thinking, asked: If we had this policy, what impact would it have on achieving the workshop goals? The second, reflecting "black hat" thinking, asked: What is the likelihood of successful implementation of this policy? The first centred on opportunity and impact, the second on barriers and likelihood of success. Groups rated each policy on a scale of 1-10 with the values shown in Figure 1 representing the average of the groups. Finally, after all the options had been presented each participant voted for one option they would immediately pursue, based on the likelihood of its implementation, its impact, and its chance for success.

An informal analysis of the workshop results suggests a high level of approval for the majority of the recommended options. In particular it was felt that making consumers aware of the added costs of transportation on household budgets would provide important and valuable information for consumers considering their housing options. It was felt that creating a housing-transportation index and a transit accessibility index for Calgary neighbourhoods would be relatively easy to implement and have a high impact.

Many of the options suggested by the research are already under consideration or underway (in one form or another) which accounts for the high "black hat" ratings of policies 4, 5, 6, 7, 9, and 10.

6. Synthesis

The premise of this research is that municipal transportation policy, as the largest policy lever of municipal governments, can have a significant impact on housing affordability. To understand the potential represented by transportation policy leverage this research attempted to quantify the financial resources devoted to transportation in Calgary over a ten-year period, investigate qualitative factors in housing and transportation choice and quantify potential affordability and choice implications of transportation policy.

Typically the discussion of transportation in municipal policy debates is confined to municipal government spending on transportation. The more holistic and systemic sustainability approach of this research reached beyond the legislative boundaries of various levels of government and beyond the isolated public and private domains of spending.

This research determined total cost of transportation in Calgary to be approximately 66.625 billion dollars over ten years. Over that time period all levels of government have spent almost seven billion dollars on transportation in Calgary. Not surprisingly, the dominant government player is the municipal government, with over five billion dollars in spending over that period of time. This in itself is important in that transportation spending is consistently the biggest single budget item for the City of Calgary representing 18% of the city's operating budget for 2009-11 and 35% of its capital plan for 2009-13. (City of Calgary, 2009a)

One of the most important findings of the research is that a systemic perspective highlights that the majority of Calgary's transportation system costs are borne by individuals through the purchase of private automobiles. Private spending, 90% of it on the purchase, maintenance and operation of private automobiles, is ten times the total municipal government spending on transportation and seven and a half times total spending by all levels of government. Ignoring private transportation spending diminishes the effectiveness of transportation policy debate and design.

A surprising finding is that estimates of the social costs of transportation, just over $7 billion, is equivalent to total transportation spending by all levels of government. As just one example of how these social costs are manifest, in 2006-07 the Calgary Health Region reported that 10, 271 transportation related injuries and 105 transportation related deaths resulted in 4,100 potential years of life lost. (Calgary Health Region, 2007)

Another finding of interest is that direct federal and provincial spending is directed predominantly to road infrastructure. This is at odds with and potentially counterproductive to the policy and spending shift in municipal spending toward transit.

Government transportation policy is a substantial municipal policy lever. Recognizing the importance of private spending in policy debates would help realize the potential leverage of transportation policy. Smart Growth, New Urbanist and Sustainable City literature recognizes the important linkages between municipal transportation policy and land use. For example in a submission to the City of Calgary Standing Policy Committee on Land Use Planning and Transportation, Sustainable Calgary Society estimated that the proposed compact growth scenario developed by the City's long-range planning team (PLAN IT) could save Calgary taxpayers 2.5 billion dollars annually in transportation related costs in addition to reducing by 10 the number of transportation related fatalities and saving 23 million dollars in avoided traffic accident costs annually. (Sustainable Calgary, 2008) A housing market study commission

by PLAN IT concluded that the compact scenario would result in significant improvements in housing affordability and choice compared to business as usual. (Tomalty and Haider, 2008) Making land use, and specifically housing affordability, an integral part of transportation policy debate and design, has the potential for positive impact on affordability.

The objective of the second phase of this research project was to qualitatively investigate daily household level decision-making about housing choice, transportation mode choice and the relationship between those two phenomena. The researchers sought out interviewees for whom affordability is an issue. Most significantly, the research found that for transit to be effective and to increase the opportunity for housing location decisions to be made in concert with transportation decisions, transit must be affordable, comfortable, rapid, reliable, frequent and legible.

Legibility and reliability seem to have particular importance and meaning. A transit system is legible when the user can easily understand routes and timetables. Reliability refers not only the conventional idea that a route is on time, but that the route has some permanence over time. Permanence is a necessary condition for an individual to include transit access in their housing location choice. Households are less likely to make the significant decision of where to live based on a transportation option that may not exist in the future. Individuals are also less likely to rely upon transit when routes are confusing or when routing changes from time to time. Both permanence and legibility considerations favour rail-based transit over bus-based transit.

The third stage of this research sought to investigate various scenarios under the assumption that the potential leverage of municipal transportation policy could be realized. Specifically, if municipal transportation policy could reduce private spending on transportation (the single largest transportation spending item), what impact might it have on housing affordability. Comparing potential impact, for various household income levels, of scenarios of car ownership versus car free living this research suggests very substantial impacts on housing affordability in Calgary.

Calgarians' housing choice (ownership) increases significantly if avoided transportation costs are available for mortgage payments. Housing choice is defined as the number of census tracts or communities in which the average house price is affordable, or the number of homes available on the market for which the house price is affordable.

The most significant change in the number of census tracts in which the average house is affordable, almost triple the number, occurs at a household income of 80,000 dollars. Under the car ownership scenario such a household could afford the average house in just 27% of tracts. Car free the same household has a choice of 73% of tracts. This is significant in that the median family income in Calgary in 2006 was $82,363. It is also important to note that car free living has a significant impact on ability for lower income households to afford home ownership. A 50,000 dollar income household has less than 1% of census tracts available to it in the car owenership scenario (1 of 202 tracts). Car free, the same household can afford the average house price in 10% of Calgary's census tracts.

When we examine real time real estate activity in Calgary we find similar affordability advantages. For the period June to August 2006 there were 19,215 houses sold. Comparing the car free and car ownership scenarios for the 80,000 income scenario we find that the percent of houses sold that would be deemed affordable jumped from 15.3% of sales (2931 homes) in that time period to 46.8% of sales (9000 homes). It is also important to note that lower income households would also see significant increases in choice. In fact the number of homes sold that could have been afforded by a household with a 50,000 income

increased from 29 to 977 (3270%) and for a household income of 60,000 affordable houses increased from 238 to 2842 (1094%).

The same trend is observed when analyzing the homes for sale in June 2011. In a car ownership scenario an 80,000 dollar income household would be able to afford 25.2% of the 6315 homes for sale. In the car free scenario that same household would be able to afford 56.8% of the homes for sale. For households with 100,000 dollars income the choice increases from less than half (44.9%) of the homes for sale to more than three quarters of the homes for sale (78.9%). At the lower end of the income scale things improve significantly as well. A 50,000 dollar income household moves from affording less than 1% of homes for sale to 12.8% of homes for sale. A 60,000 dollar income household goes from being able to afford 1.6% of homes for sale to one quarter of all homes for sale.

Calgarians housing choice (rental) increases significantly if avoided transportation costs are available for rent. Rental housing choice is defined as the number of rental units available in the city. For rental costs, for a household income of 20,000 dollars, choice increases approximately 1300% from the car ownership (33 units) to car free (423 units) scenarios. This represents an increase from under 2% of total units for rent to almost 25% of total units for rent. At 30,000 dollars income choice increases from 12% of units to 45% of units if you can live car free. At 50,000 dollars income choice increases from 50% of total units to almost 90% of total units.

One implication of this data, based on comparison with the City of Calgary's *Cost of Market Rental Housing At a Glance: 2010* (City of Calgary, 2010), is that the almost 15,000 households making between 20- 30,000 dollars annually, that spend more than is affordable on rent would have significantly increased opportunity to find affordable rental accommodation. Based on the statistics provided in the 'At a Glance' report an individual making 18,000, who could live car free, could afford the average bachelor suite in Calgary. A 20,000 dollar income household living car free could afford the average one bedroom suite. A household with a 30,000 dollar income could go from affording only the average bachelor suite to being able to afford the average bachelor suite; 1 bedroom secondary suite, row home or apartment; 2 bedroom row home, secondary suite or apartment; and the 3+ bedroom apartment or row home.

Given the transportation system cost profile, the qualitative survey findings, and the choice and affordability implications of car free living, the housing and transportation stakeholders endorsed each of the policy proposals generated out of the research. In their estimation the most promising policy interventions were the creation of a housing-transportation index by community; a transit access rating by community; and greater investment in bicycle and pedestrian infrastructure. The preferred policy options were chosen with an eye to the risk associated with actually achieving the option with respect to the significance of the shift in transportation policy and/or spending pattern that would be required.

Both the housing-transportation index and the transit access rating by community are informational initiatives that provide market information to home-buyers and renters. Subsequent to the policy workshop Calgary Transportation has taken steps in this direction by publishing walkability and transit accessibility maps by community for the city of Calgary. (City of Calgary, 2011). These policy options would allow Calgarians to make more informed choices for affordable living under existing transportation system conditions. The bicycle and pedestrian investment is under review at the City and a Bicycling Strategy, including significant new investment, is under consideration by City Council for the Fall budget cycle.

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The more significant transportation system investments, that would actually increase transit availability above existing conditions, were perhaps seen as more difficult to achieve. Based on this research, such changes could result in significant improvements in affordable living, defined as the combined cost of housing and transportation and in doing so increase housing affordability and choice under existing housing market conditions in Calgary.

7. Recommendations

Policy

1. Canadian cities should calculate and publish an affordable living index. (housing+transportation/income) on a community by community basis and make this information available to renters, homebuyers and real estate professionals.

2. Canadian cities should calculate and publish a cost of transportation index on a community by community basis. In this way home-buyers and renters will have better information about living affordable living when choosing a home to buy or rent.

3. Canadian cities should work with local mortgage lenders and the real estate industry to promote location efficient mortgage lending.

4. Canadian cities should integrate the concept of affordable living into its process for municipal land use and transportation planning.

5. The City of Calgary should implement policy to support carsharing cooperatives and investigate the possibility of city-run carsharing as a part of its transportation policy

6. The City of Calgary should make transit infrastructure in industrial and retail (big box) employment districts a priority.

7. The characteristics of effective transit favour railed-based transit over bus transit. Rail-based systems are particularly appropriate in terms of legibility, ability to attract investment (jobs creation in proximity to Transit) and permanence. Housing location choices are less likely to be influenced by an impermanent bus route versus a more permanent rail route. City of Calgary Transportation planning should incorporate a full cost benefit accounting in its transit capital spending planning process.

Future Research

1. Effective affordable living policy will require a much more robust understanding of car ownership across communities in Canadian cities. Key questions for which data is hard to come by or does not exist include: How many citizens own cars? How many have a license? How many drive regularly? How many cars are there per household and what is their distribution by community?

2. This research raises the question about the efficacy, in terms of effect on ability to choose not to own a car, of intense transit improvement in strategically important sectors of the city versus the provision of universal transit improvement evenly across all Calgary communities – in particular the provision of transit service to existing far-flung suburban communities. Future research should try to answer this question.

3. This research highlights the dominant position of private transportation spending as a proportion of all transportation spending. This dominant spending category has been all but ignored in transportation planning strategies. Research on mechanisms to allow for, or incent, the transfer or investment of private transportation spending toward public transportation spending has the potential to save billions of dollars for Calgarians and increase housing affordability and choice.

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8. Appendices

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