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How Multi-worksite Employers can Use Secondary Data to Assess Commute Trip Reduction (CTR) Opportunities

Abstract

Studies demonstrate that reducing long commute trips should provide many benefits. Commuters benefit from time and financial savings, and from improved physical health and emotional well-being. Employers benefit from increased productivity, better retention, improved morale, enhanced reputation and therefore improved profitability. Society benefits from less pollution and greenhouse gas emissions, less stress on infrastructure, reduced congestion and fewer accidents. Tools such as TRIMMS exist for estimating these benefits on a macro level – across a metropolitan or county area. This paper describes a new tool that an individual employer can use to predict the potential for, and benefits of, implementing its own customized commute trip reduction (CTR) program, possibly as part of a regional Trip Reduction Program (TRP).

Typically, employers who are encouraged and/or required to establish a CTR program start by gathering detailed primary data on employees' individual commuting practices. However, such bespoke and intrusive surveys are expensive and often flawed (non-participation, timeliness, incomplete, inaccurate). When an employer operates multiple work sites, the primary data collection requirements and analyses can be even more complex and costly.

This paper shows that there is potential instead in using existing secondary human resources (HR) data to generate useful information for CTR strategizing and priority setting. By starting with only the readily-available postal codes of employees and their worksites, privacy can be respected. A simple-to-use spreadsheet tool that interfaces with Google Maps can provide first approximations on employee commuting patterns and potential changes. For example, total commute burden can be estimated, along with assessments of opportunities such as revised staffing/deployment policies, job

swaps, worksite relocation/consolidation, carpooling, bicycle/walking accommodation and transit promotion.

The intent of this methodology is to reveal those opportunities quickly and simply, and thus overcome institutional inertia by identifying 'low-hanging fruit'. If, on the other hand, potential seems limited for any particular commute reduction tactic, resources can be focussed on more promising interventions. This methodology is designed for use by employers of any size, and to be supported by do-it-yourself toolkits for CTR program implementation. Data from one region of a Canadian bank were analyzed as a demonstration and proof-of-concept.

Keywords

Commute trip reduction, trip reduction program, transportation improvement strategies, sustainability, congestion reduction, reducing greenhouse gases, reducing carbon emissions, work-life balance, worker health and safety, productivity, commute mapping methodologies, human resources strategies, employee retention, transportation demand management

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Introduction

The authors have been conducting research and developing practical tactics that could significantly reduce unnecessary, unwanted and unfair commute travel in British Columbia. The goal is commute trips that are shorter, cheaper, healthier, gentler on the environment and better for employees, employers, the economy and society. The team's research findings, designs and tools may improve the efficiency and efficacy of existing and proposed Transportation Demand Management (TDM), Commute Trip Reduction (CTR) and Trip Reduction Program (TRP) initiatives in other jurisdictions.

Employers typically control two important factors that determine an employee's commute options – worksite location and work schedule. These factors can affect the employees' quality of choices with regard to affordability, safety, convenience and mode of travel. This paper presents a methodology the team developed to allow a multi-worksite employer to use secondary data quickly to self-assess the potential in implementing various CTR tactics, including CloserCommutes (a tactic inspired by proximate

commuting[1]). Example multi-worksite employers are financial institutions, school districts, municipalities, health authorities, retail and hospitality chains, etc.

A spreadsheet application linked to the Google Maps traffic database can analyze commutes using existing data obtained from the employer's payroll records, avoiding the expense and privacy complications of conducting a bespoke employee survey. The app estimates a baseline score (the annual total employee commuting burden of CO_2 emissions, also called the 'burden score'), identifies outliers with the longest commutes, and suggests the potential applicability and scale for peer job swapping and other tactics.

The burden score and analyses from the secondary data are first-order approximations that can be improved if/when the employer opts to gather and enter primary data. The intent of this methodology is to reveal the potential, quickly and simply, and thus overcome institutional inertia by presenting some 'low-hanging fruit' that is clearly in the employer's interest.

This methodology is designed for use by individual employers who will be supported by do-it-yourself toolkits for many CTR tactics. The methodology was pilot tested with all 241 employees at the 16 branches in one region of a Canadian bank. Results are presented below. The development of the support program and tactic toolkits awaits development funding. A draft blueprint for a re-imagined provincial CTR initiative (Batchelor BT 2020) is available[2] along with a draft corporate close commute policy (Batchelor JT 2020)[3] to illustrate one potential component of a DIY tactic toolkit.

[1] See Mullins & Mullins 1995. The proximate commuting strategy was developed by Mullins & Associates, Inc. and offered as a service called ProximateCommute[SM].

[2] May be downloaded at www.trelawnyconsulting.com/DraftBlueprintCTR.pdf

[3] May be downloaded at www.trelawnyconsulting.com/DraftModelCloseCommutePolicy.pdf

Literature Search and Key Informant Survey

To support an employer's business case for reducing long commuting, a literature search of peer-reviewed research studies was conducted. Annotated bibliography entries were amassed in *The Effects of Long Commutes and What to Do About Them: An Annotated Bibliography* (Batchelor & Litman 2019).[4]

Research from many countries indicates that longer commutes are linked to increased worker stress, unhappiness, sedentary living (lack of exercise) and obesity, and pollution exposure, leading to reduced productivity and job dissatisfaction, illness and absenteeism, and domestic conflicts among other impacts. Specifically, studies have identified correlations between long commutes and the following outcomes:

Physical health

- obesity or adiposity [severe or morbidly overweight] (Jacobson et al. 2011) (Jilcott et al. 2010) (Lopez-Zetina et al. 2006) (Hoehner et al. 2012) (Sacker et al. 2014) (Sugiyama et al. 2016)
- higher daily exposure to particulate matter and black carbon (Karanasiou et al. 2014) (Shekarrizfard et al. 2016)
- more visits to general practitioner (Künn-Nelen 2016)
- lower cardiorespiratory fitness (Hoehner et al. 2012) and higher cardio-metabolic risk (Hoehner et al. 2012) (Sugiyama et al. 2016)
- higher blood pressure (Novaco et al. 1979)
- chronic fatigue (Kageyama et al. 1998)
- diabetes mellitus (Tsuji et al. 2015)
- self-reported poor health, serious backache, headaches, sleep disorders and fatigue (Hämmig et al. 2009)

Mental health

- anxiety and depression, lack of energy and optimism (Hämmig et al. 2009)

[4] May be downloaded at www.trelawnyconsulting.com/closecommute/Effects_of_Long_Commutes.pdf

- chronic stress, being in a sympathodominant state (Kageyama et al. 1998)
- increased stress and anxiety (Pohanka et al. 2004)
- lower sense of well-being (Stutzer et al. 2008)

Activities

- reduction in sleeping, physical activity and food preparation which over time may contribute to obesity and other poor health outcomes (Christian 2012)
- less physical exercise (Künn-Nelen 2016) (Hoehner et al. 2012) (Nomoto et al. 2015)
- fewer sleeping hours (Nomoto et al. 2015)

Work Performance

- increased sickness absence (Ala-Mursula et al. 2006) (Künn-Nelen 2016)
- longer average paid time loss days due to work-related injury (Fan et al. 2013)
- fewer working hours (Nomoto et al. 2015)
- more accidents (Pohanka et al. 2004)
- lower job satisfaction and decreased intention to stay with same employer (Steinmetz et al. 2014)

Social life

- less access to social capital (Besser et al. 2008); less time with friends (Sandow 2011); and social isolation (Pohanka et al. 2004)
- higher time- and strain-based work-life conflict [WLC] (Hämmig et al. 2009)
- strain on relationships and likelihood of divorce (Sandow 2011)
- low social participation and low general trust (Mattisson et al, 2015)

In *Part 2* of the annotated bibliography, various approaches are documented for quantifying the benefits that accrue to various stakeholders from reducing commute distance and duration. *Part 2a* introduces methodologies for commuting vehicle costs, mostly focused on the commuter personally ('internal costs'). In *Part 2b*, calculators are presented for the 'external costs', including transportation system

infrastructure, greenhouse gases, reduced commercial productivity due to transport congestion, regional economic impact, etc.

Studies on ROI for the employer typically emphasize savings from reduced parking space requirements (e.g. , Jaffe 2015). A UK study (VitalityHealth 2017) has suggested that orchestrating a shorter commute for an employee could gain the employer seven extra days of productivity.

Tools exist for central planners to calculate benefits from TDM programs on a macro scale, such as Mobility Lab's TRIMMS 4.0 and TDM ROI Calculator (Mobility 2020). We did not find any tools for the individual employer to assess potential and benefits, beyond static density maps (Liberty 1942).

Unstructured interviews were conducted with over 100 key informants.[5] Specifically, interviews with dozens of c-suite executives and human resources directors at financial institutions, school districts, municipalities and other large multi-worksite employers in British Columbia revealed a widely-held perspective that employees' commutes were not the employer's responsibility or concern. From a marketing perspective, that creates a significant challenge—getting key people to act on a need or want that they do not acknowledge exists.

We found that although an employer's annual total employee CO2e commuting burden can be quite significant, typically it is not accounted for in an employer's environmental sustainability self-reporting. For example, Canada's 'big five' banks do not include employee commuting GHG emissions in their annual audit of corporate environmental footprint.[6] Vancity Credit Union, an exception in the financial industry which does include employee commuting emissions in its annual environmental audit, reported for 2019 that its employees' commuting releases more emissions (55.5%) than all other sources combined (44.5%).[7]

[5] A list of most key informants can be found at http://closecommute.com/who-we-are

[6] For example, see Appendix II, page 67 of *Royal Bank of Canada Environmental, Social and Governance (ESG) Performance Report 2019*, available at: www.rbc.com/community-social-impact/_assets-custom/pdf/2019-ESG-Report.PDF
also see page 18 in Scotiabank's *2019 Environmental, Social and Governance (ESG) Report*, available at: www.scotiabank.com/content/dam/scotiabank/canada/en/documents/about/Scotiabank_2019_ESG_Report.pdf

[7] See page 16 of *Vancity 2019 Annual Report Accountability Statements*, available at: www.vancity.com/SharedContent/documents/AnnualReportArchives/2019_Accountability_Statements.pdf

Most interviewees had minimal awareness about what CTR tactics exist or how an organization might get started. Further, they cautioned that if/when key people within a large organization were convinced to try changing existing policies and procedures, they would face the considerable challenge of overcoming organizational/institutional barriers and cultural inertia. For example, a national bank's regional vice-president may not have the authority to alter human resources procedures established by head office in Toronto or Montreal.

These key informant interview responses underscored the importance of the appropriate authorities making it *mandatory* for all medium and large employers to initiate a CTR program – *to provide responsibility and authority to key individuals in all organizations*. The responses also underscored the need for an introductory analysis tool that would be simple for an employer to use, would not require a bespoke survey and would identify the quickest, high-ROI actions (aka 'the low-hanging fruit') to get every employer jump-started.

CloserCommutes – inspired by ProximateCommute^{SM}

Early in our research, a 1990s CTR tactic – *proximate commuting* (Mullins & Mullins 1995) – in particular caught our interest. In part because it seemed so 'common sense' and powerful from a management consulting and HR perspective. Indeed *TIME Magazine (TIME 2007)* cited proximate commuting as one of "the planet's best ideas to address global warming." Yet curiously our investigations and interviews did not find this tactic being promoted by any transportation management association/agency.

In the mid-1990s, with funding and oversight by the Washington State Department of Transportation and the University of Washington, Mullins & Associates, Inc. conducted the first demonstration project of their employer-based transportation and work/family benefits program called ProximateCommute^{SM}.

The demonstration project with Key Bank in the Seattle area involved 500-plus employees working at 31 branches. Gene Mullins postulated that, over time, multi-worksite employers (in this case, Key Bank) could significantly reduce employee commute distances by:

1. Communicating/clarifying to all staff and managers that working from a worksite closer to one's home is considered to be in both the company's and the employee's best interest.
2. Improving efforts to match employees with positions close to their homes **at the time of hire.**

3. Establishing a proximate commuting "**waiting list**" to enable eligible employees to remain "in line" for future openings at alternate, shorter-commute branches. (This meant that transfer requests could be submitted *before* an opening existed.)
4. Matching two or more long distance commuters who could **"trade" comparable jobs**.[8]

Mullins & Associates provided Key Bank's HR managers with home/worksite proximity distances and branch commute maps, using Cartesian coordinates and employee home zip codes – essentially 'as the crow flies' measurements.

By proactively matching new- and existing- employees to closer-to-home branches, Key Bank very significantly reduced commute miles and auto emissions for participating employees. Remarkably, some branches realized employee commute mile reductions of up to 65%, and the longest individual commute distances per branch decreased 33%. ***After 15 months, total commute miles traveled for all employees at test-site branches, including non-participants, decreased 17%. In contrast, control branches experienced increased commute miles over the same time period.***

Encouraged by the strong results of the 1990s ProximateCommute[SM] demonstration, our consulting team developed a modified tactic, dubbed CloserCommutes. To encourage use of this tactic, we needed a new methodology to provide employers with a simple way to determine accurate home-worksite commute proximities (distances *and* durations) for multiple people/worksite scenarios. The initial calculations would require existing HR data only, but analyses could be enhanced if the mode (car, bus, bike, foot) and other data were also known. We also wanted the methodology to support a wide range of other commute trip reduction tactics.

Methodology Development

Employers' needs and potential organizational impediments meant a methodology would have to:

- Be simple to initiate by an HR supervisor with some database and spreadsheet proficiency and without relying on consultants
- Provide reasonable precision in the projections of commute durations and distances

[8] pp. 20-21, Mullins & Mullins 1995.

- Generate results in real time 24/7 at essentially no cost
- Require only existing data and maintain confidentiality
- Not require interaction with employees or their associations and unions for a first 'scoping' iteration
- Yield immediately useful results including:
    - calculating a *single central baseline measurement* for the organization (we would call this the 'burden score' or simply the 'burden')
    - identifying and quantifying potential for quick wins or 'low-hanging fruit'
    - identify and quantify potential (and/or lack thereof) for other tactics that could involve longer timelines and more financial resources.

The single central measurement (the burden score) would:

- have scientific validity/objectivity
- be comparable to sector norms
- demonstrate a baseline position and progress at reducing this measurement.

In the trade-off between obtaining high accuracy and ease of use, the team felt that ease of use was more important in order to make it super simple for an employer to get started. As noted above, the methodology should allow for increased accuracy if/when needed, for example when data become available on individual employees' mode of travel.

The Design

The team identified two key assets:

1. The employer's existing human resources/ payroll database
2. Access to traffic databases, such as Google Maps[9].

[9] We used Google Maps for our development, but expect data could be accessed in similar fashion from INRIX, TomTom, Here, and possibly other providers.

An employer's human resources or payroll system will have, for each employee, the presumed starting point (home postal code[10] is sufficient), arrival point (postal code of the employee's usual worksite) and job classification, and may also have typical daily work starting and quitting times.

Accurate data for commuting duration and distance can be dynamically accessed using APIs (application programming interface calls) to Google Maps's traffic database, simply by providing a starting point, destination point, mode and expected start or arrival time. The Google Maps dataset would arguably be even more accurate than commuters' self-reported durations and distances if they were answering a survey. Given a time and day, Google Maps will also recommend the quickest route (not necessarily the shortest).

Creating a cloud-based app was not an option: that would require the employer to entrust confidential employee data to an outside party, especially if more specific parameters such as mode, class of employment and willingness to swap were added. Creating an unfamiliar, special-purpose program that the employer would have to install and learn to use was also rejected as creating a barrier.

The team created instead an app that is a Microsoft Excel spreadsheet template using macros to access the Google Maps traffic database in real time to ascertain each employee's current single occupancy vehicle commute duration and distance. The spreadsheet app then uses the results from Google Maps to estimate the maximum annual total employee commuting burden. The burden is essentially a measure of how much carbon dioxide is emitted annually. The app also estimates the total cost to employees of SOV commuting. (Burden and total cost are re-calculated and will be more accurate if mode of travel data are entered later.)

The app also can be used to provide projections for multiple 'what-if' scenarios, such as duration and distance if employees worked at other worksites and/or with a different work schedule, and/or used a different travel mode.

The employer may wish to analyze its employees' commutes in job function cohorts, especially if worksite swapping potential (the third of the three components of the ProximateCommute[SM]/

[10] The USA equivalent to Canada's postal code would be the ZIP+4 code.

CloserCommutes tactic) is to be assessed. For example, customer service positions might be considered fungible at a financial institution. Primary grades teachers might appreciate the opportunity to shorten their daily commutes by switching to work at a closer school and so on. The app will generate duration and distance estimates for all other possible commutes if employees were to be allowed/encouraged to swap locations with peers.

The Pilot Test of the App

During the summer of 2016, the team worked with a Canadian national bank on data for the home and work postal codes plus the job classification of all of the employees working in one urban region for the purposes of studying their commutes, including the environmental burden and the potential for improvement with various CTR tactics.

Starting with just the postal codes of 16 bank branches and 241 employees in this region, and a default of everyone using a single-occupancy-vehicle, a surprising amount of analysis can be generated. The total one-way commuting is 2,724 km. The range of current estimated SOV commutes begins with 10 employees who live less than 1 kilometre from their jobsites all the way to two who travel more than 50 km daily in each direction. The average estimated SOV commute is a bit more than 11 km and the median is about 7.5 km. There are five branches where the average commute is more than twice that median. Those five account for about 45% of the total travel. Another analysis shows that five of the 16 branches account for 51% of the total commute – largely because those branches have the most employees.

Identifying outliers in this way can allow the employer to concentrate on branches or even individuals where the largest potential is evident. This could avoid region-wide measures with spotty applicability.

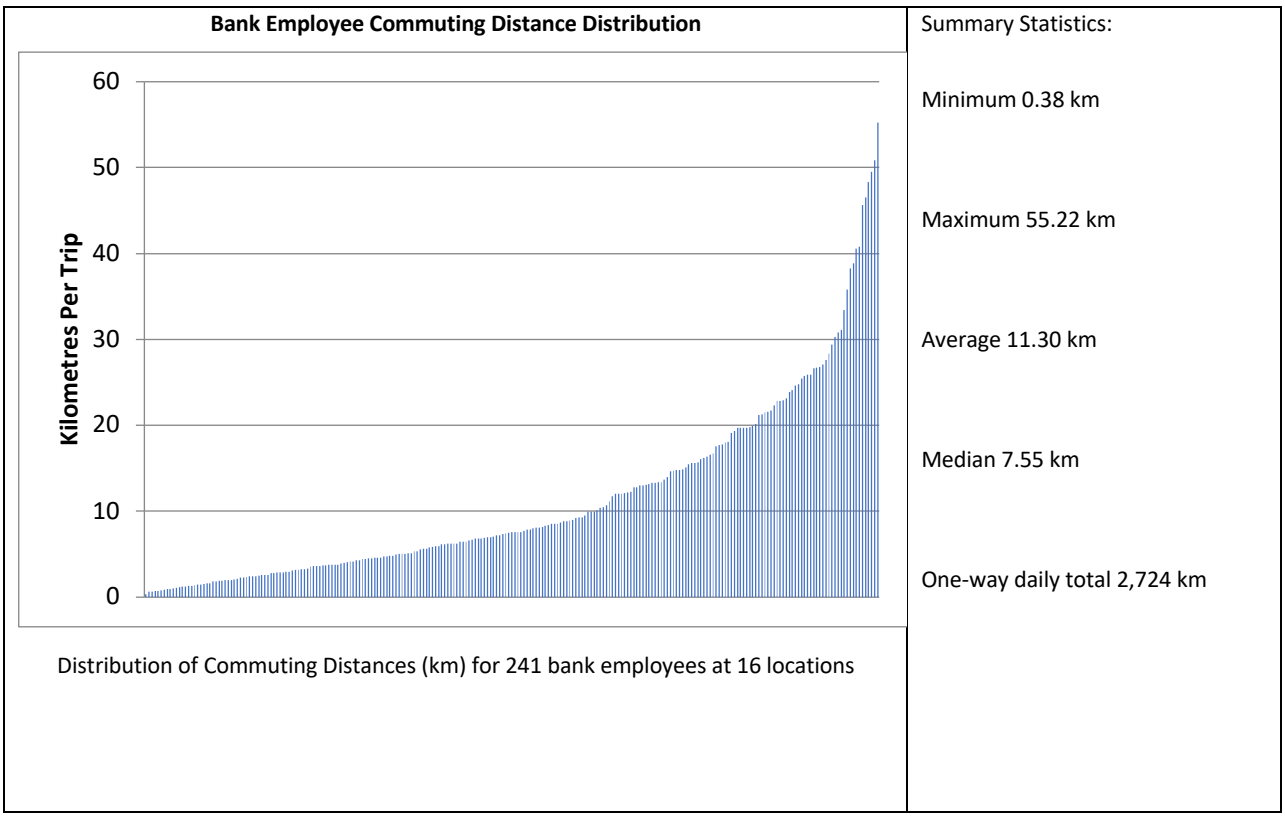


Figure 1. Distribution of Bank Employees' Commuting Distances

If each employee commutes 484 times per year, the total distance to be travelled is about 1.3 million km. If we assume that all commutes are in single-occupancy gasoline vehicles, at a conservative 33 cents (Canadian) per km, commuting would be costing employees more than $400,000 annually or almost $1,800 each on average. The total distance corresponds to a burden of about 180 Tonnes of CO_2 per year. This burden score measure is a baseline that few employers would know. This estimate is likely high because some employees will already use greener modes. However, that likely applies to the shortest commutes, so the over-estimate is minimized.

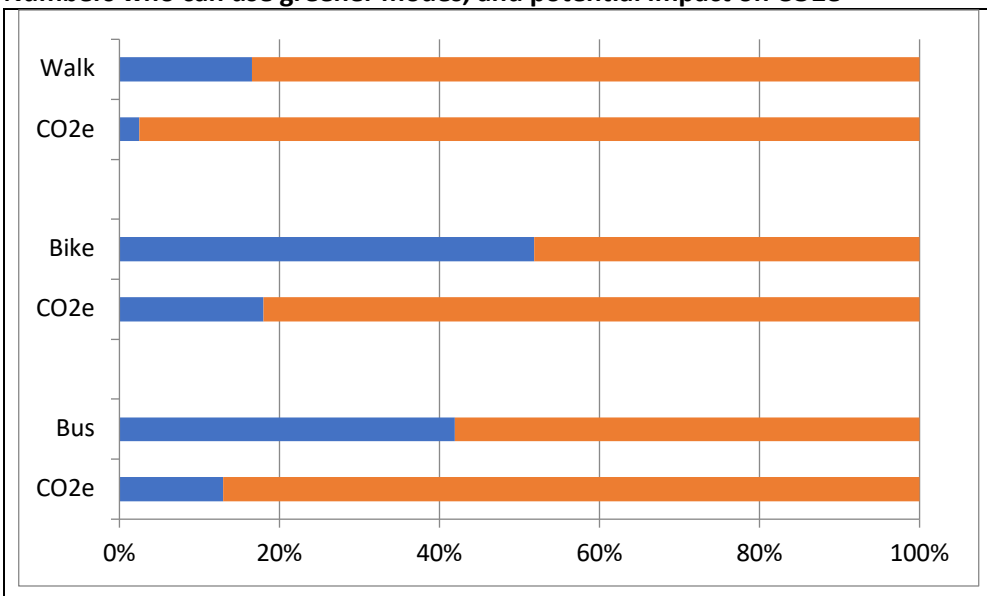
In this region, only 60 people are working at the closest branch to their residence. That expands to 93 if the difference between current and closest is less than 2 km. It is obviously impossible to reassign all employees to their closest branches, but that scenario sets an upper bound on improvements. This theoretical minimum daily total one-way commute burden is 895 km – about two thirds less than the status quo baseline 2,724 km.

Knowing the baseline commute burden also helps estimate the effect of strategies such as work from home. For example, if half of the staff worked from home two days a week, commuting could be reduced by 20% or almost 40 T of CO_2 per year, assuming they had typical journeys.

The commuting statistics can also generate insights into the potential for measures that promote walking or biking to work, such as lockers, showers and secure storage racks. In this dataset, only 40 people are within a half-hour walk. Many of these already may be using 'greener' modes than single-occupancy gasoline vehicles. But even if they were all driving, they would represent only 2.5% of the total CO2e burden. Even more are within a half-hour bike ride – 125. If they are all driving, then they would have accounted for just 18% of the CO2e estimate. But, since some of these may already be cycling, walking, bussing or carpooling, the potential for saving is certainly less. Only some of the other employees would be interested in biking and maybe only in decent weather. That portion is only a guess at this point, but it sets an upper bound on the payoff of even the most ambitious bicycle promotion program. The employer now can decide if it would be worth asking employees for personal details on their commuting modes to refine these crude estimates.

By modifying the API calls to Google Maps to specify public transit, the employer can also see how many of the staff have a reasonable alternative to their cars. Many may already be using transit, but this calculation gives an upper bound to the applicability of bus pass subsidies, for example. The complement to this group is the cohort of employees who do not have good access to public transit. They might be candidates instead for subsidized charging stations for electric vehicles, for example. In this region, public transit could be attractive to 101 staff (up to 30-minute duration). They represent 13% of the bank's estimated employee commute burden. There are 10 employees for whom transit is not even possible and for whom other options might be needed, such as carpooling, work-from-home, job transfer to a closer branch or green vehicle support. The remaining 130 commuters would face bus rides over 30 minutes up to 2 hours one-way.

Numbers who can use greener modes, and potential impact on CO2e



40 might walk but account for just 2.5% of potential CO2e

125 might bike but account for only 18% of maximum CO2e

101 might take the bus but account for only 13% of maximum CO2e

Figure 2. Numbers who can use greener modes, and potential impact on CO2e

All of the preceding analysis was based on current commuting patterns. Financial institutions typically experience a sizable annual turnover of staff, in the range of 15% of total employees.[11] The spreadsheet tool could be used by HR staff to determine optimal assignment of a cohort of new trainees to their branches – the first CloserCommutes practice. This practice alone will reduce the burden score considerably over time; it was the major contributor to Key Bank's success[12].

In our demonstration, if CloserCommutes transfers and swaps are considered (the second and third practices), there would be opportunities for significant travel reduction. Employees (and managers)

[11] Industry benchmark provided on page 10 of Vancity 2020.

[12] Per telephone interview with Gene Mullins on 05 May 2014.

might react strongly (for and against) to transfer/swap programs. Even if strictly voluntary and applying only to a minority of employees, perceived potential disruption may evoke negativity. Some staff might welcome the chance but be disappointed when their wishes cannot be accommodated. Therefore, the employer may want to help the outliers (those with the longest commutes) without introducing an all-employee program. All this to say the employer should have a good estimate of the potential numbers and payoffs before beginning consultations. The Google Maps-linked spreadsheet can provide this estimate.

A relevant complication is that employees will have different experiences and responsibilities. Swaps in particular require matching. In our Canadian bank demonstration, the postal code data were supplemented with job classes (e.g., customer service, financial planner). All possible interbranch pairings were examined to see if both employees were in the same job class and both would benefit from a swap by reducing their commutes.

In this demonstration, only 60 employees out of 241 (less than one quarter) are working at their closest branch. At three branches, everyone could find another branch closer to their home. Moreover, more than 50% of employees had a mutually positive opportunity to swap positions with another person in the same job class at another branch, although some improvements were quite small. Many had multiple opportunities that could not, of course, happen at the same time. Still, there were standout possible swaps.

For example, encouraging just 14 of the longer commuters to swap would reduce the bank's regional environmental burden by 8.6%.

In one example swap, two financial planners would save 52.0 km and 52.8 km respectively daily by swapping locations. That would eliminate approximately 25,200 km of commuting annually in total. The CO_2 equivalent reduction from this one swap would be almost 3.5 tonnes, over 1.9% of the bank's regional burden. The first person would save about 170 hours a year (42.4 minutes a day) and about $4,160 in after-tax expenses (assuming 33 cents per km vehicle operating costs). The second person would save about 150 hours a year (37.2 minutes a day) and perhaps $4,220 annually if continuing to drive. Given that the new commute would be less than 3 km, he or she might consider walking or biking for even greater financial savings.

Conclusions and Discussion

This study demonstrated that the new methodology could be useful, relying on only existing secondary HR data at an employer with over 240 employees working at 16 locations. It set a maximum baseline GHG burden for the employer to reduce. This methodology could be used to estimate the benefits of revised general working conditions such as working from home or shorter work weeks. By highlighting outliers (employees and locations), it showed where trip reduction tactics could have the most potential benefits. The methodology permitted analysis of the scope and possible benefits of encouraging 'green' modes such as walking, cycling or public transit.

The results also showed that the scope for potential CloserCommutes job swaps can be quite large (opportunities identified for over 50% of all employees for this bank), and that there could be very significant savings in time, money and greenhouse gas emissions. The demonstration would also have been deemed successful if it had shown instead that there was only limited potential, thereby avoiding disruption and expense.

The methodology accommodated a trade-off between quick and simple *versus* accuracy on the first approximation, but it can be made increasingly accurate if more detailed data become available to improve the default parameters:

- the mode used by individual commuters was defaulted to single-occupancy vehicle
- trips were assumed to be directly between home and worksite. No allowance was made for dropping off a child at daycare, for example, or visiting an elderly parent, or going to a second job or to the gym, etc.
- all employees were presumed to use the same start and quitting times on a typical work date.

In terms of accuracy, functionality, use of existing secondary data, etc., this app is clearly a massive improvement over the static density maps introduced in the WWII era (Liberty 1942) and still being recommended.

Recommendations for a Re-imagined CTR/ TRP Program

This DIY spreadsheet tool may open possibilities to rethink how provincial or state Commute Trip Reduction program and Trip Reduction Programs could function. As more jurisdiction announce targets to cut vehicle-kilometres-traveled and boost mode share of biking, walking and transit use, it appears that TRPs will be essential – with trip reduction action being mandatory for all large employers and major trip generators.[13] A TRP supporting action by tens of thousands of such employing organizations will need to use apps and a DIY approach.

In a re-imagined CTR/TRP program[14], the spreadsheet methodology would be provided to employers of all sizes and situations. The employers would not need a bespoke survey to get started, wouldn't need to schedule a consultant's personal assistance, and could explore a full range of tactics. DIY toolkits for the tactics would be made available in a wiki that could be updated by practitioners[15]. The carbon emission score (the "burden") provides a clear, central measure of the organization's baseline situation and progress. Reporting that burden to a government website could be required; this would identify employers who are reducing their burden faster or slower than others in their sector. Such public reporting is part of "benchmarking and transparency" [B&T].

The spreadsheet app currently provides the employer with actionable information for a wide array of tactics, including:

- whether and where a satellite office or co-working location might be viable
- where to consider creating cycling infrastructure
- who would benefit most from work-from-home arrangements, carpooling or transit passes
- how to deploy and reassign employees (CloserCommutes) so people can work closer to their homes

[13] For example, see Action Item 1.2.8 in Metro Vancouver's *Clean Air Plan 2021*.

[14] see draft blueprint (Batchelor BT 2020, also included as Appendix 1).

[15] see the model corporate Close Commute Policy (Batchelor JT 2020) as an example component of a toolkit.

- where and by how much parking requirements could be reduced if SOV-reducing tactics are introduced.

Other tactics could be added into the app, tailored to a region's overall TDM goals and strategy.

Future iterations of the spreadsheet tool could have ever-improving employer benefit/ ROI predictions if employer-users can be persuaded to track and report their experiences. This would be akin to the "citizen science" data collection that is valued in natural sciences research. Employers could be encouraged to quantify changes in any or all of productivity, sickness absenteeism, morale, retention, accidents, errors, recruiting, parking costs and other factors. For example, an employer could input existing HR data on absenteeism to quantify the extent that absenteeism has been correlated with long commutes, and then, after various interventions, check again to know if and by how much absenteeism has been reduced for those employees whose commutes have improved.

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Appendix 1: Blueprint for a CTR/ TRP Program (Draft)

Implementation Plan and Toolkits

The consultants/researchers envision a trip reduction program for British Columbia that includes the following components:

- Large and medium employers (~8,700 organizations) will be required to calculate their annual *total employee commuting CO_2e burden*, and report this amount online (through either the provincial Climate Action Secretariat or WorkSafeBC website). This will ensure awareness of the initiative and clarity of the role/responsibility/opportunity of all large and medium employers.
- Employers will be required to "make best efforts" to improve employee commutes, and report annually on those efforts and on the reduction in the organization's total employee commuting CO_2 burden.
- An app for easily calculating the burden in-house has been developed and will be provided, thus addressing privacy/security concerns because only the aggregate total is reported.
- Support will be developed and provided by a contracted consultancy or TMA. Employers will have access 24/7 to toolkits located in a wiki that will be updated/improved through crowdsourcing by practitioners, consultants, service providers, academics and NGOs.
- There will be an app an employer can use to determine which tactics could be appropriate to investigate, given that employer's and employees' circumstances:
    - closercommutes (awareness of home/work proximity at time of hiring and internal job openings, and for peer-with-peer worksite swaps)
    - supporting biking, walking and other active commuting modes (infrastructure, incentives, procedures, etc.)
    - connecting employees with carpool, vanpool & carshare services, possibly with incentive
    - promoting transit use with discounted passes & supportive work scheduling, etc.
    - guaranteed ride home for family urgencies
    - providing vehicles and/or taxi chits for errands
    - providing shuttle to transit stations
    - EV and e-bike charging stations
    - telework from home; work from remote/satellite offices and from co-working spaces
    - shift re-scheduling/ flexibility
    - longer & fewer "compressed" workdays
    - disincentives for unnecessary SOV use (e.g., charging extra for SOV parking, and/or 'cash-out')
    - selecting/moving locations of offices/branches

    - supporting/coordinating with other existing and planned transportation programs.
- Toolkits for each tactic:
    - explainer video
    - instructions
    - internal communications and policy templates
    - cost/benefit analysis template/app and app to assist with implementation if appropriate
    - experiences/advice/case studies from within this jurisdiction and elsewhere
    - annotated/reviewed links to resources within this jurisdiction
    - networking capability with other practitioners
- Certification/recognition will be orchestrated for the employer (possibly an ISO certification for robust program implementation and/or a rating similar to LEED in new building construction) and for HR professionals.
- Materials and support will be provided in multiple languages, corresponding to the regional demographics.

- After the CTR component is established, expand the program to include reporting and best efforts by the organizations to minimize inefficiency in two other key areas of transportation:
    1. Travel of organizations' clientele (students, patients, customers, tourists, event attendees, etc.)
    2. Shipping and delivery.

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