UBC Building Operations: Strategic Consultation

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Team 2

UBC Building Operations

STRATEGIC CONSULTATION

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EXECUTIVE SUMMARY

Introduction

Reducing GHG emissions to zero is an ambitious but essential goal that UBC wishes to achieve. Our strategy is to utilize top of the line technology to collect data while creating a sense of accountability across departments and individuals to make it their personal goal to achieve zero-emissions. While increasing collaboration opportunities with UBC departments, we also suggest Building Operations to transition from their existing fleet to electric vehicles and ultimately to autonomous vehicles. These initiatives will allow UBC to not only maximize efficiency of their fleets, but also bring down GHG emissions to the zero level that they aim to achieve.

Situational Analysis

To better understand the current scenario, we conducted a SWOT and an ERRC analysis. Building Operations' biggest strength is their E3 Platinum fleet certification that provides them with credibility. A prime weakness is that Building Operations currently constitutes for only 2% of total UBC emissions and have not been able to utilize their practices across other UBC departments. A major opportunity is for UBC to adopt industry leading practices and technologies that have been listed in the case studied discussed later in this document. Finally, there is a threat of other UBC departments competing for a budget increase for their specific needs which could hinder progress towards GHG reduction. Our aim is to create a strategy that allows Building Operations to leverage their major strengths and opportunities, while tackling their weaknesses and threats. This entails creating a strategy that would eliminate under-utilization of vehicles while creating a centralized system that integrates the most updated technology to achieve emission reduction. A complete SWOT and ERRC grid is present in [Appendix A]

Transition to electric and autonomous vehicles

The vision is to make Building Ops the epicenter of transportation innovation at UBC. The two greatest technological advancements which can drastically reduce GHG emissions of vehicles and maximize their efficiency are electric vehicles (EVs) and autonomous vehicles (AVs).

We've created a two-fold strategic approach to help UBC adopt both of these advantageous technologies to simultaneously reduce BOp's overall GHG emissions, improve fleet efficiency, and become the sandbox for initiatives to test new innovative vehicle technologies. By becoming an incubator and a proving grounds for these promising initiatives, BOp's successes will be a testimony to persuade the rest of UBC's department to follow suite.

Implement Gamification using Local Motion

Local Motion builds both a software application and the hardware solution to enable vehicle-sharing across user groups and departments, increase fleet utilization, and streamline fleet management operations using keyless access and cloud-based motor pool management technology. Implementation of Local Motion to replace ARI's Telematics presents potential cost-savings of up to $11,000 as fleet size increases.

Local Motion's ability to track user-level data regarding GHG emissions is foundational in establishing a culture where there is accountability for emissions at every level. To incentivize the change in culture and mindset of individuals within BOps and UBC, we recommend two gamification-oriented approaches: (1) creation of a campus-wide dashboard for performance tracking at department and individual levels to provide intrinsic motivation for employees and communicate individual impact on GHG emissions and (2) quarterly report cards for each department regarding GHG emissions to encourage a collaborative discussion regarding reductions.

Centralization of fleet management across UBC Departments

While implementing gamification improves Building Operations' efficiency, the broader aim is to align departments across UBC to collaborate with Building Operations. We recommend a 3-step process to achieve this change: create a sense of urgency, engage and involve key stakeholders and communicate the vision. Currently, Building Operations have found it difficult to convince departments about the benefits of working with them. This has been due to 2 primary reasons: lack of sufficient relevant data and absence of incentives to collaborate. We propose creating a sense of urgency by analyzing the data and providing evidence that suggests how good BOps is at fleet management. Student Housing and Hospitality Services (SHHS) is the key stakeholder that we wish to engage early on. They have the second largest fleet after BOps and are one of the bigger stakeholders whose involvement could be positive for BOps in the long run. Lastly, the vision will be communicated on a tailored basis, whereby each department's incentives will be taken into consideration. These recommendations will allow for BOps to centralize UBC's fleet management and essentially get more departments to buy into BOps' practices.

Implementation

Execution is extremely essential, as Building Operations would prefer to have departments on board as soon as possible to increase their chances of achieving their goal. Thereby we have prepared a detailed timeline for the next 2 years outlining a plan to allow BOps to approach departments. That entails installing the Local Motion device on existing vehicles and creating a case study to present. This will allow for BOps to back their efficiency claims while raising urgency. Having early buy-in will also allow for BOps to gain feedback from departments to improve their centralization services in the future, while gaining testimonials that can be utilized to bring more departments on board in the longer run. These implementation plans along with vehicle transition will allow for BOps to achieve their mission.

Key Performance Indicators and Conclusion

The key performance indicators (KPIs) were divided into 4 segments: financial, departmental satisfaction, internal processes and growth. These will allow BOps to keep track of their progress. We have also taken into consideration the risks that may follow with implementing our strategy and how to effectively mitigate them. Eventually, we strongly believe that our strategy will allow BOps to reduce the GHG emissions to zero by 2050 across all of UBC's fleets in a timely and effective manner.

Prior to coming up with a strategy for Building Operations' (BOps) Fleet, our team began with a strategic analysis of BOps' current situation. This allowed us to better understand what opportunities BOps had to maximize its strengths, minimize its weaknesses, and ultimately help us form the overarching issues. The details of the SWOT and ERRC are outlined in appendix A).

Through the analysis, it was evident that although BOps achieved Canada's first E3 Platinum fleet certification, the fleet itself represented only 2% of UBC's overall emissions. An apparent pain point was that BOps found it difficult to leverage its successes to create a valuable business case for UBC to follow suit and implement BOps' processes campus-wide. Without the collaboration between departments regarding communication, utilization and management of vehicles and the communal effort campus-wide to lower fleet GHG emissions, the 2050 goal to reach 0 GHG emissions is going to be a difficult goal to accomplish. Change management is required, and BOps can spearhead this change.

With that being said, BOps must leverage the opportunities it has to not only push for new technologies that will aid in its ability to build a stronger business case for the rest of UBC to adopt its excellent processes, but also change the mindset to allow each UBC employee to be individually accountable for the overall GHG emissions. Only with the entirety of UBC campus on board will 0 GHG emissions in 2050 be realized.

Issue 1: Building Ops having low leverage amongst UBC

As Building Ops is only 2% of campus-wide emissions, they are not a strong enough force to convince UBC to listen to its needs, requests and ideas. Whether Building Ops is looking to get more funding to implement new technologies and utilize its resources as a testing ground for novel GHG emission processes, or looking to convince UBC to implement BOps' processes campus-wide, it has found difficulty doing so. BOps' E3 platinum showcases its evident knowledge and ability to reduce GHG emissions effectively and efficiently, yet the other departments are finding it challenging to follow suite to reduce emissions.

The implications associated with this issue is that BOps is unable to persuade the rest of UBC to follow suit and to believe in its metrics and processes in GHG reductions. UBC will thus have difficulty creating a significantly more efficient and cost effective fleet of vehicles and reducing fleet vehicle greenhouse gas emissions.

2: Getting UBC departments on board with BOps' processes or allow Bops to manage its fleets to effectively reduce emissions

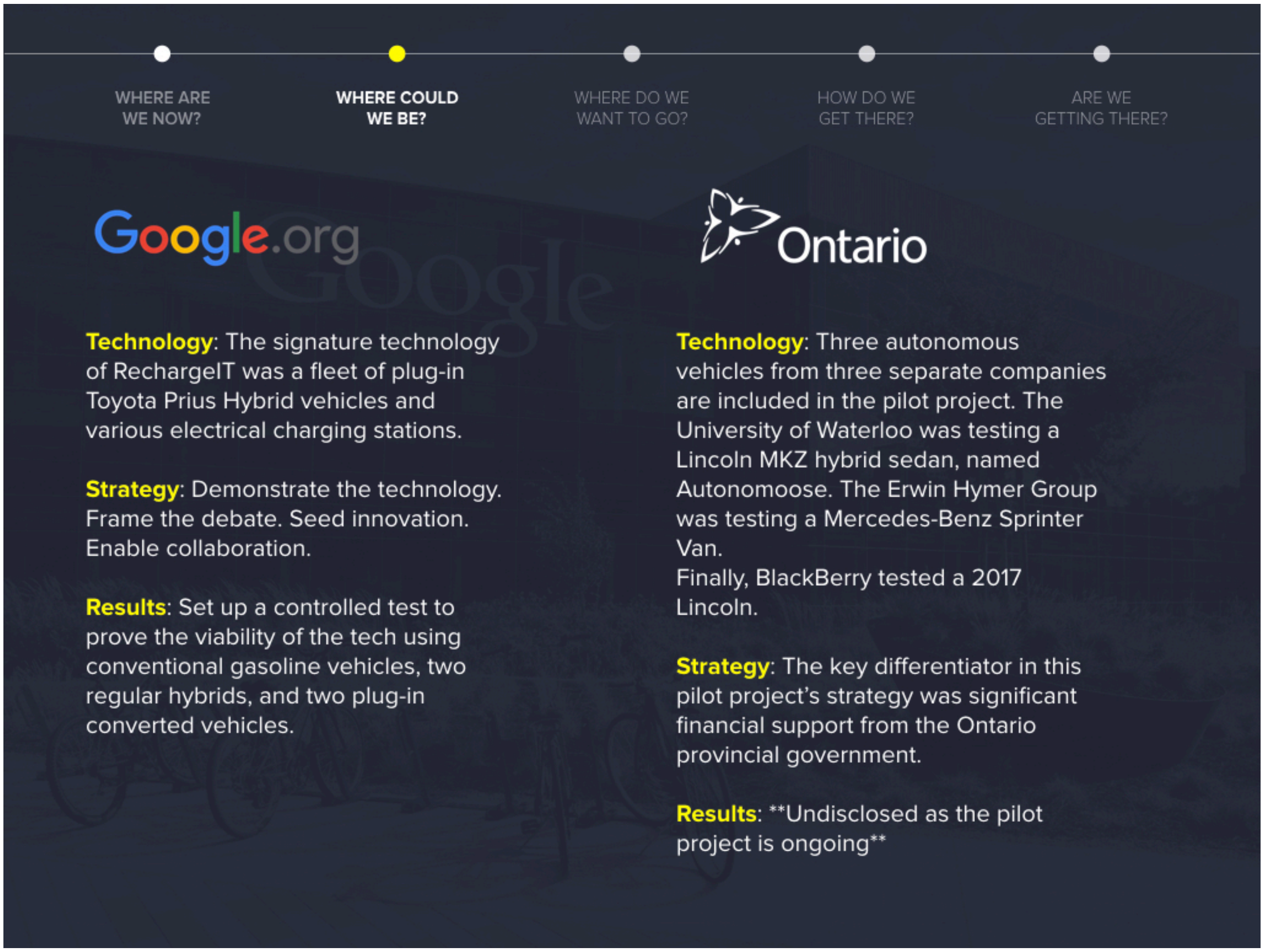
Although Building Ops uses telematics and other data analytics to track their emissions, other departments have legacy restrictions and/or are unable to justify costs of standardizing its processes with Building Ops. This means that the ability to have a UBC-wide departmental standard for data tracking is a huge challenge for UBC, making it difficult to keep each department (including BOps) perfectly accountable for their own contribution to UBC's emissions. On top of this, even with BOps outstanding credentials in GHG reduction, there is no individual data generated that can track each employee's GHG emissions, preventing individual accountability of GHG reduction.

This becomes a large issue when social loafing occurs, leading to a diffusion of responsibility. This means that although the campus-wide goal to reduce GHG emissions is implemented, nobody feels particularly inclined to personally make a difference. If we are able to align each employee's incentive towards this goal through intrinsic and extrinsic motivations, everyone within Building Ops and UBC will be able to collaboratively work towards reaching 0 emissions in 2050, aligning the university's overarching goals to the individual employees' goals.

3: Unable to reach 2050 goal of 0 emissions with current fleet

The 2050 goal of reducing GHG emissions to 0 cannot be reached with the current technology and existing fleet for both Building Ops and the rest of UBC. In order to reach 0 GHG emissions, a new set of electric vehicles will need to replace the existing GHG-emitting vehicles on campus. This means that the capital expenditures will increase when the decision to replace such vehicles be implemented.

Key assumption: With UBC's original decision to implement this goal, our assumption is that UBC has already justified the costs of funding a new fleet of electric vehicles in return for 0 GHG emissions campus wide. We are working under the assumption that the university understood that 0 emissions can ONLY be reached with electric vehicles or other technologies similarly equivalent in cost.



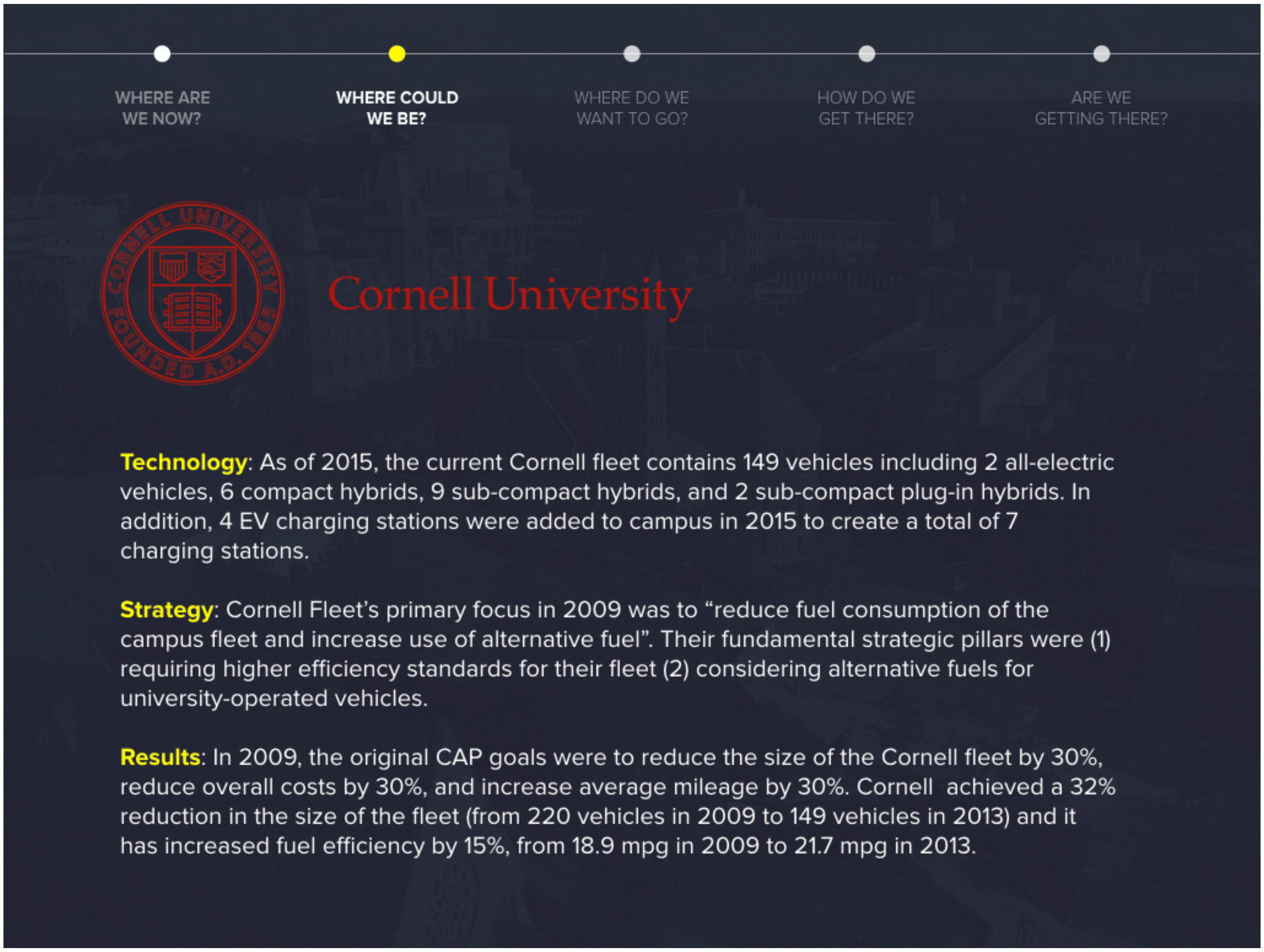
Case study 1:

RechargeIT was an initiative within Google.org, the charitable division of Google, which was created with the aim to "reduce CO2 emissions, cut oil use, and stabilize the electrical grid by accelerating the adoption of plug-in electric vehicles". It was announced in 2007, and was implemented onto the Mountain View Google Campus shortly thereafter. Created after the successful results of RechargeIT's controlled test, Gfleet is a corporate car-sharing program for the Google campus which lets employees drive plug-in hybrid vehicles for free. They even brought on Enterprise Rent-a-Car to manage the fleet. Gfleet was also introduced and communicated as a perk for Google employees to use alternative methods of transportation.

After the Gfleet was rolled out, they soon discovered that typical campus driving behavior and usage was drastically different than typical US driving habits. There were lots of short trip, cold starts (i.e. no daisy-chaining), and lower observed MPG. Because Gfleet trips weren't optimal for demonstrating the plug-in hybrid vehicle benefits, Google commissioned another road test to measure the efficiency and CO2 savings of plug-in hybrid vehicles versus regular combustion vehicles. The results demonstrated that their plug-in hybrid vehicles generated in upwards of 93.5 MPG, over 6 times as efficient as the lowest MPG of a traditional gasoline vehicle. The cost savings were also drastic, with the most efficient plug-in hybrid costing $6.90 per 100 miles, compared to the $31.50 of a regular vehicle, and producing 72.9% CO2 savings.

http://www.bc3sfbay.org/uploads/5/3/3/9/5339154/rolf_schreiber_-_google.pdf

In 2016, the Ontario provincial government launched an autonomous vehicle testing pilot project as part of it's $2.95M investment towards Canadian AV adoption. The test took place at the University of Waterloo's Automotive Research Centre.



As part of Cornell's 2009 climate action plan (CAP), the university focused on improving the fuel efficiency of the campus fleet while simultaneously exploring new fueling alternatives like electrical energy.

http://www.sustainablecampus.cornell.edu/initiatives/greening-the-fleet

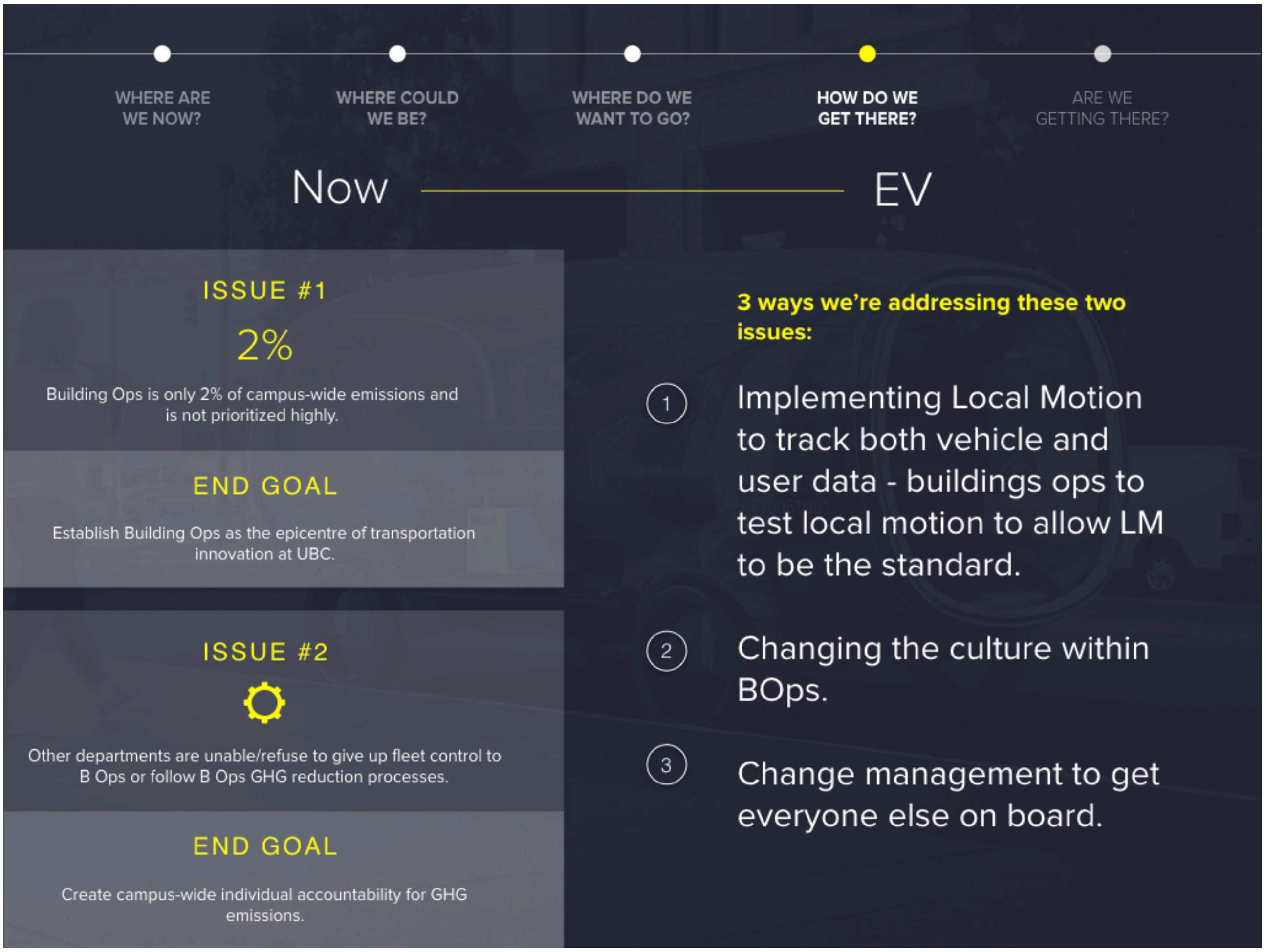
The vision is to make Building Ops the epicenter of transportation innovation at UBC. The two greatest technological advancements which can drastically reduce GHG emissions of vehicles and maximize their efficiency are electric vehicles (EVs) and autonomous vehicles (AVs). By becoming an incubator and a proving grounds for these promising initiatives, BOps' successes will be a testimony to persuade the rest of UBC's department to follow suite.

Our team has developed a two-fold strategic approach to help UBC adopt both of these advantageous technologies to simultaneously reduce BOps' overall GHG emissions, improve fleet efficiency, and become the sandbox for initiatives to test new innovative vehicle technologies:

1. Now – EV: At this moment, it is important to establish Building Ops as the epicenter of transportation innovation at UBC and to change the culture within BOps (and eventually campus-wide) to be individually accountable for the emissions each person is emitting with each utilization of a vehicle on campus.

   Simultaneously, as the technology for electric vehicles are quickly advancing, more electric vehicles will become popularized. As electric vehicles become the norm in the market, we recommend a gradual shift of BOps existing fleet to an all electric fleet. This will allow BOps (and eventually the rest of UBC) to completely revamp the fleet on campus to become an all electric fleet, and by 2050, together reach 0 GHG emissions campus wide.

2. EV – AV: After a cultural shift towards individual accountability and 0 GHG emissions, we recommend a long term strategy for BOps to invest in a fleet of autonomous fleet in the future. With a projection of technological advancements, we see a future where autonomous vehicles will be able to complete the jobs of BOps. Idealistically, in the future, our team foresees a fleet of AVs that are able to make routine delivery and maintenance trips around UBC campus, drastically improving the efficiency of not only Building Ops, but for UBC as a whole.



While the transition from our current vehicle fleet to a more energy-efficient fleet of electric vehicles is a step in the right direction, it is anything but straightforward. We have identified two major issues, or roadblocks, that need to be overcome:

Issue #1:

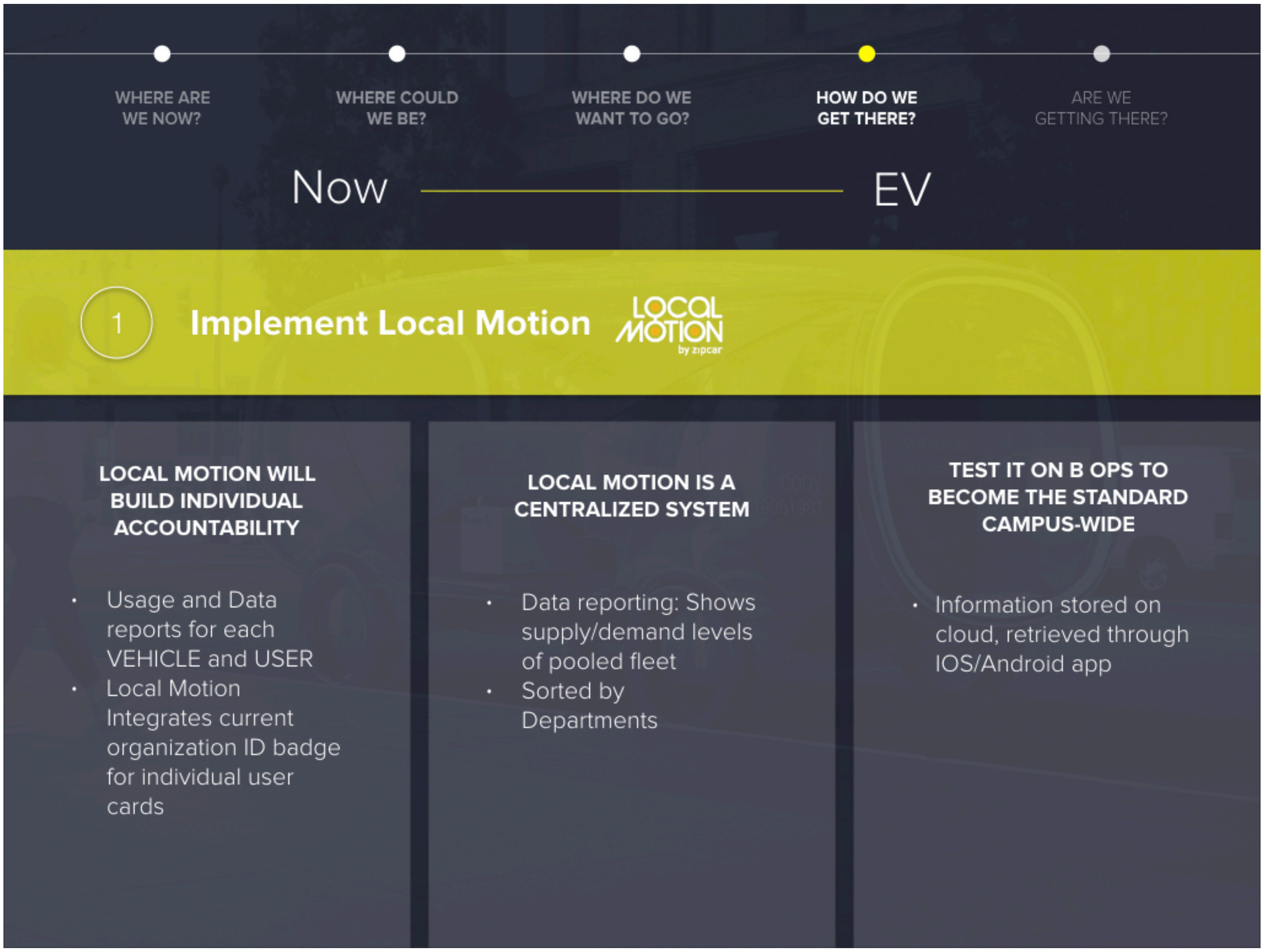
- Issue: Low priority. With a GHG emissions contribution of just 2% to total campus emissions, UBC fleet operations is a relatively low priority item.
- End goal: Our end goal is to shift the conversation away from emissions contributions, and into one about innovation. Specifically, we want to establish BOps as the epicenter of transportation innovation at UBC. This will allow BOps to gain leverage despite a low emissions percentage.

Issue #2:

- Issue: Fleet fragmentation. While 2/3 of UBC's fleet is managed by BOps, the other 1/3 of vehicles are still operating independently. This is significant because while BOps has efforts in place for idling reduction, fuel data management, and training and awareness, other vehicle-owning departments may not. Without centralized control or collaboration across departments, UBC sacrifices fleet efficiency and GHG emissions reduction.
- End goal: We want to establish a culture where there is accountability for emissions at every level, all the way to each individual that utilizes a vehicle on campus.

There are three ways that we plan to to tackle these issues and arrive at our end goals:

1. Local Motion enables tracking of vehicle and user data, which is integral to our strategy. In terms of implementation, it will first be tested within BOps, and later scaled to include the rest of UBC fleet operations.
2. If we establish a culture that extends accountability for emissions reductions to an individual level within BOps, we will then have a blueprint, and more importantly, a business case for implementation across campus.
3. Despite having a business case to back up our initiatives, we have to remain cognizant of how we implement change and get the rest of the campus community on board. Our approach to change management covers everything from creating a sense of urgency with key stakeholders, to sustaining change within UBC fleet operations.



How Local Motion Works (Video):
The company builds both a software application and the hardware (as shown in picture on slide) to connect vehicles together to share vehicles, increase fleet utilization, and streamline fleet management operations using its keyless access and cloud-based motor pool management technology. The platform provides fleet managers with advanced analytics and reporting capabilities to make actionable, data-driven decisions for their fleet.

Local Motion will install its hardware with Building Ops' existing vehicles and interact with users and other vehicles, gathers data about transportation patterns, user behavior and transmits charge, health and location information back to the central network that will be owned by the Fleet Managers. It will focus on two-way information flow and interactivity between users and vehicles. Local Motion by Zipcar supports a wide variety of vehicle types including sedans, utility trucks, electric vehicles and even golf carts.

For the users: The online application will let users view schedules of vehicles, book reservations on the spot and share rides, all available on the Local Motion by Zipcar website, iOS app or Android app. A separate platform allows fleet managers to monitor the status of vehicles, add or
each user on-demand access to a vehicle by scanning their RFID-enabled badge on any available car – no booking required.

Why this is specifically helpful to Building ops:

1. Not only will this increase the ability for **the fleet manager** to track the utilization rates of vehicles and collect individual data for each of the cars AND user (as users tap their access cards for each ride). This allows the department to be able to determine how much GHG each individual is emitting per shift, and keep individuals accountable for their own usage and award those who are more efficient.
2. The data accumulated from this software will allow **the fleet manager** to quantify the data to build a business case to persuade UBC to push other departments to either adopt Steve's current plans in order to reduce UBC-wide emissions and/or transition department fleets over to Building Ops to manage.

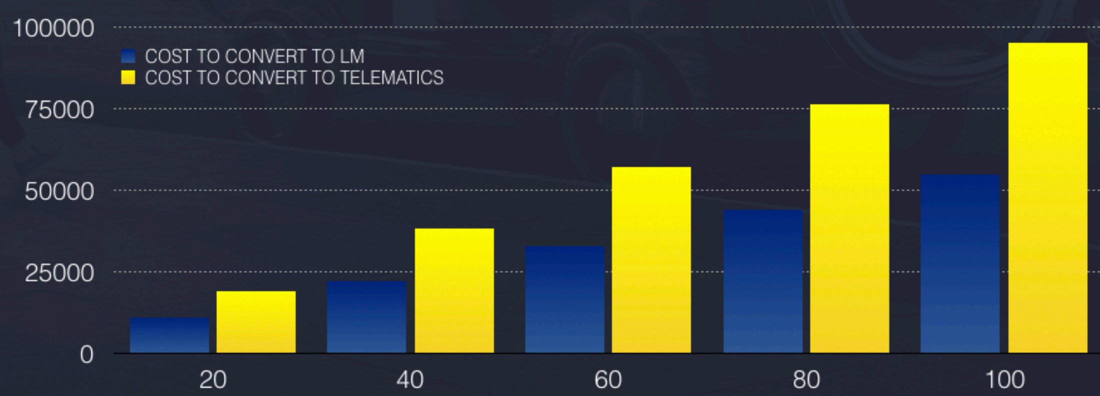
Local Motion's Features include: LMZ major features and capabilities include: Reservation system; Keyless, Smart Badge(RFID) and Mobile Device access; Usage and Data reports for vehicles and for individual users; 24/7 GPS and vehicle status communication; ride replay on past trips; custom codes for department and job billing

References: https://www.getlocalmotion.com/, http://www.government-fleet.com/news/story/2016/08/local-motion-by-zipcar-helps-agencies-maintain-motor-pools.aspx

WHERE ARE WE NOW? · WHERE COULD WE BE? · WHERE DO WE WANT TO GO? · **HOW DO WE GET THERE?** · ARE WE GETTING THERE?

Now —— EV

% OF FLEET	COST TO CONVERT TO LM	COST TO CONVERT TO TELEMATICS
20	$11,000	$19,090
40	$22,000	$38,180
60	$33,000	$57,270
80	$44,000	$76,360
100	$55,000	$95,450



Key assumptions:

- Monthly telematics cost of $30-80 based on vehicle grouping of size and utility
- Installation cost taken from TRACKER Fleet cost; conversion rate 1GBP:1.66CAD (http://www.telematics.com/fleet-tracking-prices-the-hidden-costs-types-of-contracts-pricing-examples-and-things-to-watch-out-for/)
- Door actuator cost based on fleet vehicles produced 2000 or prior

To calculate the cost to increase the amount of telematics within the fleet, we first separated the vehicles within the fleet into three different classes, depending on size and frequency of use. From this classification, we can assign a monthly telematics cost from $30 to $80 to each vehicle, as indicated by the client. We assumed that this does not include any installation cost, which we factored in as about $406 CAD as based on the prices from Tracker - another fleet telematics competitor. From this, we obtained an initial month conversion cost of $95,450 to install telematics devices within the entire fleet. To make costs more realistic, we broke this amount up into percentages, reflecting the cost for each chunk of the fleet that we deem necessary for conversion.

Costs for Local Motion are much more straightforward, with each vehicle subject to both a $150 charge for hardware installation, and a $75 monthly monitoring fee. Older vehicles requiring actuators are also subject to an extra $250 fee for door actuator installation, which we included for all models in production prior to 2001. All in all, this yielded a Local Motion conversion cost of $55,000 for the entire fleet - results for other percentages of the fleet are displayed above.

The biggest takeaway from this information is that conversion to Local Motion is cheaper in every case. On one hand, the difference in cost between telematics and Local Motion rises exponentially with a higher percentage of the fleet to be converted, and on another hand, Local Motion's tiered pricing allows for a reduction in monthly costs as the number of vehicles to monitor increases - this could yield a potential savings of an extra $11,000 from these figures once the fleet grows past 750 vehicles. Based on this analysis, we highly recommend the services of Local Motion over continued telematics costs through ARI.

WHERE ARE WE NOW? | WHERE COULD WE BE? | WHERE DO WE WANT TO GO? | **HOW DO WE GET THERE?** | ARE WE GETTING THERE?

Now ———— EV

2 Using a gamification approach to change internal culture

Dashboard and Rewards:

Showing Eco-Score for Individuals. Improvements lead to bonuses

What this does: Aligns employee and university goals and incentives
How will this work? Intrinsic motivation: Allows employees to see positive impact on GHG emissions. Extrinsic motivation: Incentive for potential rewards and bonuses for reaching milestones.

Quarterly Report Cards

on departments/subsections and pair good departments with bad departments to reduce emissions together

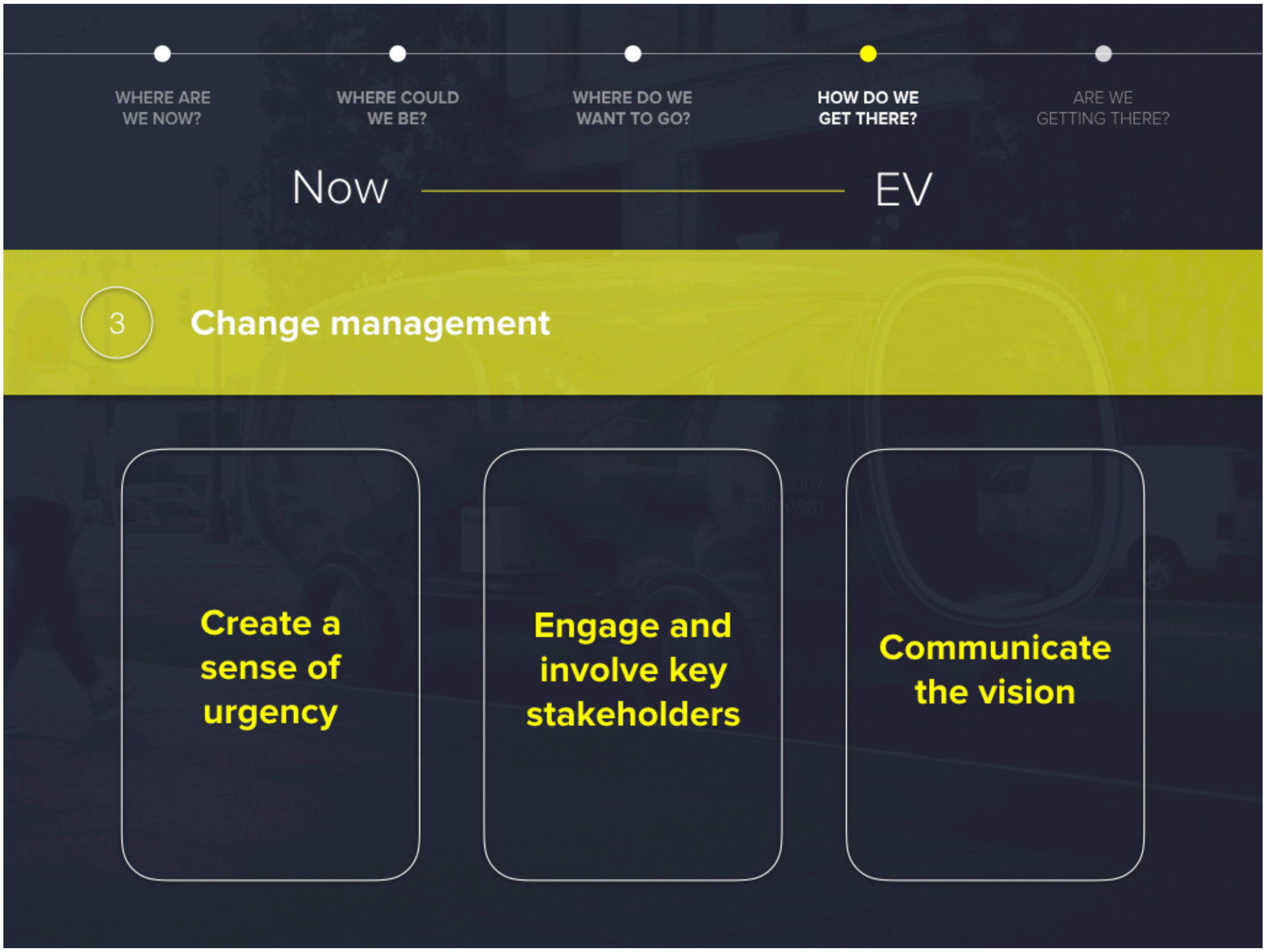
What this does: Brings the issue to the forefront, forces departments to focus on the issue and communicate processes TOGETHER Increases inter-departmental communication and collaboration.

The second issue we identified earlier is the challenge of getting everyone else from different departments to follow suit and adopt the processes used by Building Ops that allowed them to receive the E3 certification. With Local Motion's ability to track individual data regarding GHG emissions, the ability to establish a culture where there is accountability for emissions at every level will become available, all the way to each individual that utilizes a vehicle on campus. However, simply having the technology to leverage individual accountability isn't enough – there needs to be a system put in place to change the culture and mindset of the individuals within BOps and UBC. Only when we align the goals of the individual to the goals of UBC will individual accountability to achieved.

The idea is to showcase where an individual is placed so that collaborative conversations occurs and a community of reduction-oriented individuals. To do so, we recommend implementing two gamification-oriented approaches to change the internal culture of both Building Operations and the rest of UBC:

1. Create a campus-wide, public dashboard for data tracking for both departments and individuals and reward employees with weekly improvements. An issue that is currently hindering GHG reduction is that there's no individual incentive for employees to watch their GHG emissions, as compensation and objectives of employees his aligns employees and departments to the university's goal of reducing emissions campus-wide.

   This provides an intrinsic motivation to allow employees to see their individual impact on GHG emissions, and watch how their actions affect their own levels of emissions. It also provides an extrinsic motivation for individuals to improve their scores as improvements in scores will lead to year end bonuses or other forms of rewards for reaching certain milestones such as % decrease that can be determined department wide depending on departments' individual budget allocations. Note that rewards are not based on relativity of one's reduction comparative to another department/individual.
2. Generate quarterly report cards for each department regarding GHG emissions (for Building Ops – subsections within Building Ops). Building Ops will spearhead this by creating report cards for each subsection within Building Ops (potentially by job groups), and each quarter, the best subsection will be paired with the worst performing section in BOps and have them discuss what they're doing to reduce emissions, hopefully encouraging collaborative discussion regarding reductions and working together instead of in siloes. This is intended to be rolled out UBC wide after BOps successfully showcases effectiveness of this program. There is an integral lack of communication between departments, and this will allow UBC to provide a platform for collaborative discussions to occur.



Change doesn't happen in a vacuum. While this initiative will be started and championed by Building Operations, it is meant to impact all UBC-owned vehicles operating within the UBC campus. What approach does UBC BOps take to get other UBC departments to buy in?

1. Creating a sense of urgency.

By implementing Local Motion into the departments' fleets, BOps will be able to precisely show why they have achieved the E3 platinum status and how it would be in the best interest of UBC to have BOps guide the fleet management scenario for all the other departments.

When engaging with other departments, it is important to have an emotional element to the message - simply providing data is not enough. Data collected can be used to help other departments internalize the negative impacts GHG emissions can have on the environment through examples and visualizations. Using data to show the harm that the current inefficiencies in departments' fleets has on the environment will allow BOps to pull an emotional cord and create the sense of urgency that will spur change.

2. Engaging and involving key stakeholders

To instigate a drastic operational and behavioural change in staff mobility, cross-functional collaboration is necessary. Building Ops. will need buy-in from key stakeholders across campus early on - well before execution.

Given the level of collaboration needed, one that involves planning, coordinating, and communicating activities, we identified three areas when selecting key stakeholders:
involvement with campus sustainability efforts (i.e. Campus + Community Planning, UBC CAP)
subject matter expertise (i.e. professors, researchers)
direct impact (i.e. end-users such as Student Housing and Hospitality)

One of the departments that would be impacted the most is SHHS. With 38 vehicles, this group controls the second largest vehicle fleet after BOps. Getting SHHS to buy in would give BOps a key ally in implementing change with the rest of the departments across campus. With involvement in initiatives tackling sustainability (i.e. 20-Year Sustainability Strategy) and carbon emissions reductions (UBC Climate Action Plan 2020), we believe that there will be a willingness from SHHS to participate.

3. Communicating the Vision

Involvement in this project should be uniquely appealing to each key stakeholder. A one-size-fits-all, mass communication approach will not work. However, the following key messages need to be repeatedly reinforced across all channels.
The vision of an emission-free 2050 - What needs to be continually reiterated is every employee's individual accountability and contribution to the attainment of the 2050 emissions goals.

Operational benefits - certain fleet management processes such as vehicle acquisition, maintenance, and disposal will be eliminated. This entails opportunities to reallocate employee hours away from administrative tasks to more impactful functions.
Department cost savings - if there is a reallocation of employee hours to more impactful tasks, this presents opportunities to reduce costs.

WHERE ARE WE NOW? | WHERE COULD WE BE? | WHERE DO WE WANT TO GO? | **HOW DO WE GET THERE?** | ARE WE GETTING THERE?

Now ———— EV

What would it cost to replace priority 1 vehicles with electric vehicles?

Zero Truck Unit Price	$231,965
Zero Truck Total Cost	$927,860
eNV200 Unit Price	$21,330
eNV200 Total Cost	$703,890
Estimated Salvage Value	$451,975
Level 2 Charger Price	$1,000
Charger Total Cost	$6,000
Net Implementation Cost	**$1,185,775**

As mentioned previously, the goal by 2050 is to reach 0 GHG emissions campus-wide. However, with the existing fleet, even with the entire UBC campus on board and a shift towards individual accountability, the only way this target can be realized is changing the existing fleet to an all electric fleet. This is under the assumption that no other technology will arise that will allow our existing fleet to do so. Therefore, changing the fleet is an imminent process.

With the processes of UBC, we believe that Building Ops should spearhead the electric fleet change, as per their existing ABC process to slowly phase out the existing fleet. We believe that BOps ABC process is an accurate measurement. Given the aforementioned, our recommendation is for Building Ops to begin its replacement of existing fleet size by following the ABC process to determine which vehicles are in need to be replaced first. This will allow BOps to spearhead the change to 0 emissions by 2050, and alongside the culture changes and change management processes, will build a strong business case for UBC to persuade the other departments to follow BOps processes or for UBC to allow BOps to take control of other departments' fleets.

The costs underlined in this slide showcase the projected costs of replacing the fleet for BOps. The assumptions included in this cost calculations include:

1. 48 total vehicles identified as best candidates for priority replacement tiers with ABC analysis, of which 5 are truck models
2. Fleet salvage value of $5 million spread between 48 vehicles, equaling about $451,977
3. New chargers at a ratio of 1 charger per 8 vehicles, assuming that existing charging stations within UBC are used at capacity

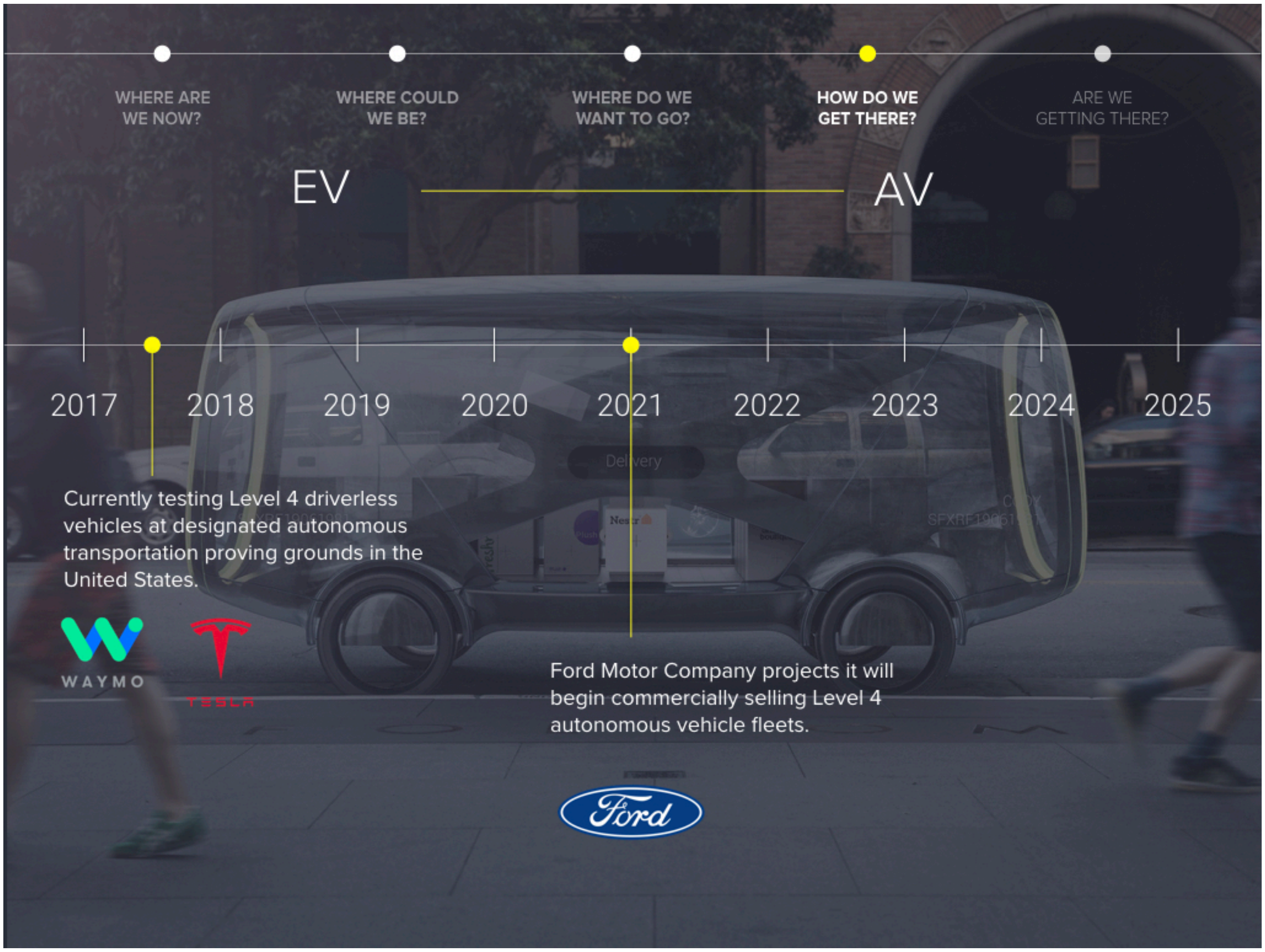
The aforementioned ABC analysis takes three main variables into account – five year average maintenance costs, annual fuel costs, and annual GHG emissions per vehicle. These variables split the fleet into four tiers, with the most expensive and GHG-heavy vehicles grouped into a tier prioritized for prompt replacement. From the information available about vehicles within the Building Operations fleet, we estimated 48 vehicles to fit two or more of 5-year maintenance costs above $8000, annual fuel costs over $5000, or annual GHG emissions over 5 tons.

Of these 48 vehicles, about 5 closely resembled the heavy frame of a truck, whereas the other 43 were closer to large vans like a Sprinter or Transit Connect. To attain our eventual goal of 0% emissions, we found the Zerotruck to best fit our needs as a fully electric truck, and the Nissan eNV200 to replace the smaller vehicles. We used the client's conservative estimate of $5 million for the salvage value of the entire fleet, and of the 531 vehicles we were provided information on, we identified that about $452,000 was the salvage value of the priority replacement vehicles.

Yet while there are 6 available charging stations throughout UBC, we assume that they are all being utilized close to full capacity, as a number are open to the public. Included in our calculations is a line item for purchasing six extra charging stations, with an assumption that one charger is suitable to service eight vehicles. All in all, with the purchase price of the Zerotrucks, Nissan vehicles, and charging stations, minus the salvage value of the existing 48 vehicles, we have a net implementation cost of about $1.185 million

When calculating savings after converting to electric vehicles, two categories are to be considered - the 5 vehicles converted to Zerotrucks, and the remaining 43 vehicles converted to the Nissan eNV200. For the latter, we can perform a rudimentary calculation based on the estimated amount of gas savings from switching to electric vehicles minus the costs associated with charging the vehicles using a Level 2 charger. Assuming the average BOps driver travels about 20 kilometers per day during the work week, we can multiply the average mileage associated with the 43 vehicles of 14.3 L/100km by the bulk gasoline cost of $1.0935/L for a weekly savings of $15.64, or an annual gasoline savings of 813.13 if using EV technology. As UBC purchases electricity at $0.0629 per kilowatt hour, we can project our annual electricity costs to be just $57.57, which amounts to a savings of $755.56 per eNV200 - for the entirety of Tier 1 vehicles, this adds up to $32,489.02.

However, due to the relatively recent adoption of Zerotrucks, we have no detailed data on their performance - in turn, we must factor in qualitative factors into our savings analysis. The most striking non-gasoline factors are the savings on direct operating costs; in this case, the Zerotruck requires no oil changes, tune-ups, air filters, or exhaust system. This translates to a drastically decreased maintenance cost over the lifetime of the vehicle. These maintenance costs are minimized further with Zerotruck's featured regenerative braking, which lends itself to a vastly extended brake life. In the end, while we may not have enough dependable numeric data to completely quantify the department's savings, we have a very good idea that it would be a net positive for both cost savings and reducing GHG emissions.



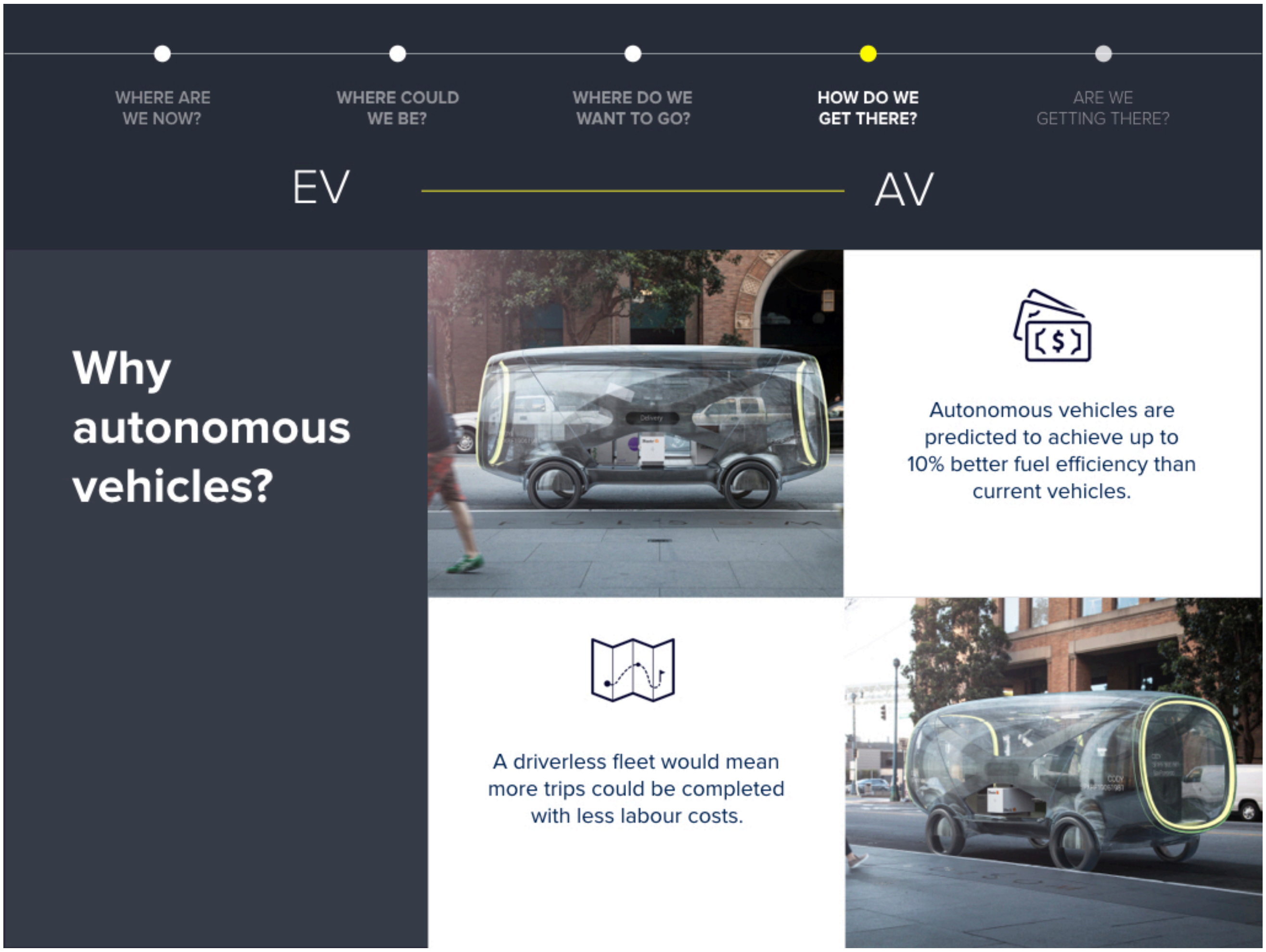
Autonomous vehicle manufacturers like Waymo (Google) and Tesla are currently testing Level 4 driverless vehicles at designated autonomous transportation proving grounds in the United States. Currently, many labs and pilot projects are in the training phase of driverless car development. The foundational machine learning and real-time visual processing technology used by the vehicles have been created. The next step is systematically training this software with real-life driving scenarios so the software can learn how to handle the vehicle in any given circumstance.

Many automotive manufacturers including the Ford Motor Company are aiming to have Level 4 autonomous vehicles in commercial production by 2021. The adoption of AVs into UBC Building Operation's fleet is a fundamental part of our team's proposed strategy. A fleet of AVs which are able to make routine delivery and maintenance trips around UBC campus would drastically improve the efficiency of the department. IDEO projects that autonomous commercial vehicles can save around $101 billion in oil and gas expenditures in the US alone.

Levels of vehicle autonomy:

- Level 0: Human controls all functions the vehicle.
- Level 1: Specific functional automation. Automatic control of certain features and actions like cruise control, lane guidance, and parallel parking.
- Level 2: Combined function automation. Usually considered as the ability for the driver to let multiple automated systems work in tandem to operate the vehicle in a specific and limited driving situation.
- Level 3: Limited self-driving automation. All safety-critical components of driving are autonomous. Driver is still present and can intervene when necessary. Vehicle monitors when to transition back to driver control.
- Level 4: Autonomous self-driving vehicles under specific conditions. Cars can automatically complete specified trips end to end without the need for a human driver.
- Level 5: Full autonomy. Vehicles can meet or exceed the performance of a regular human driver, and can function autonomously on trips of all types and conditions.

http://www.vtpi.org/avip.pdf

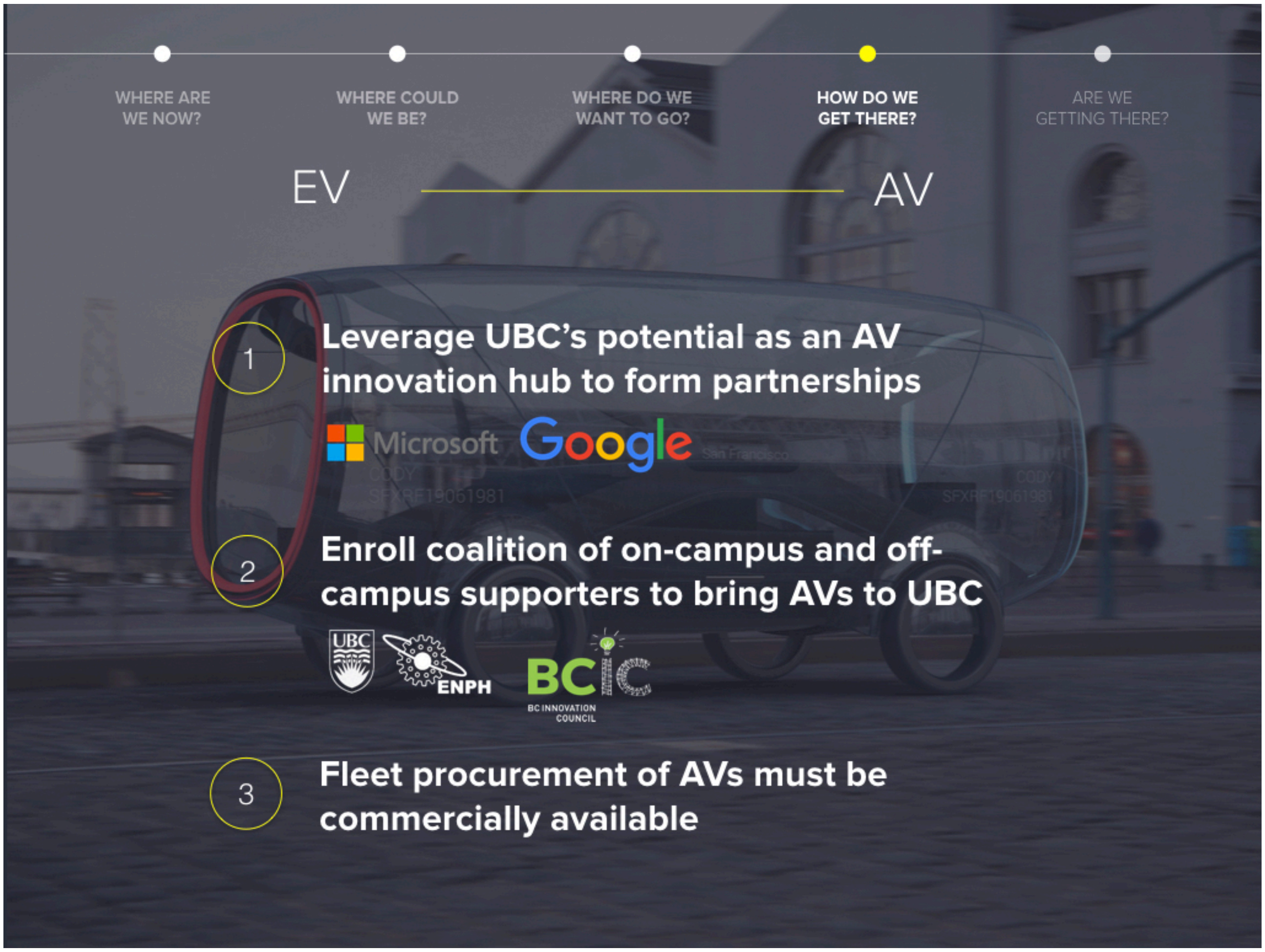


The entrance of driverless vehicle technology into commercial fleets is poised to drastically improve the efficiency of fleet management organizations. By actively preparing for the arrival of autonomous vehicles, UBC Building Ops will be able to rapidly integrate the new technology into it's fleet and start reaping the efficiency gains of driverless vehicles.

Autonomous driving technology is predicted to dramatically improve the driving experience in a number of areas such as safety, fuel economy, and emissions. As vehicles become smarter and more interconnected on the road, they will be able to actively improve their own acceleration and deceleration rates which will in turn lead to much better fuel use. According to a team of automotive engineers at Carnegie Mellon, AV technology could help vehicles achieve in upwards of 10% better MPG scores.

In addition, implementing driverless vehicle technology into UBC Building Ops' fleet would mean more trips could be complete around campus at a fraction of the labor cost. A successful integration of UBC autonomous vehicles into the Building Ops fleet would let the department achieve a smaller fleet size.

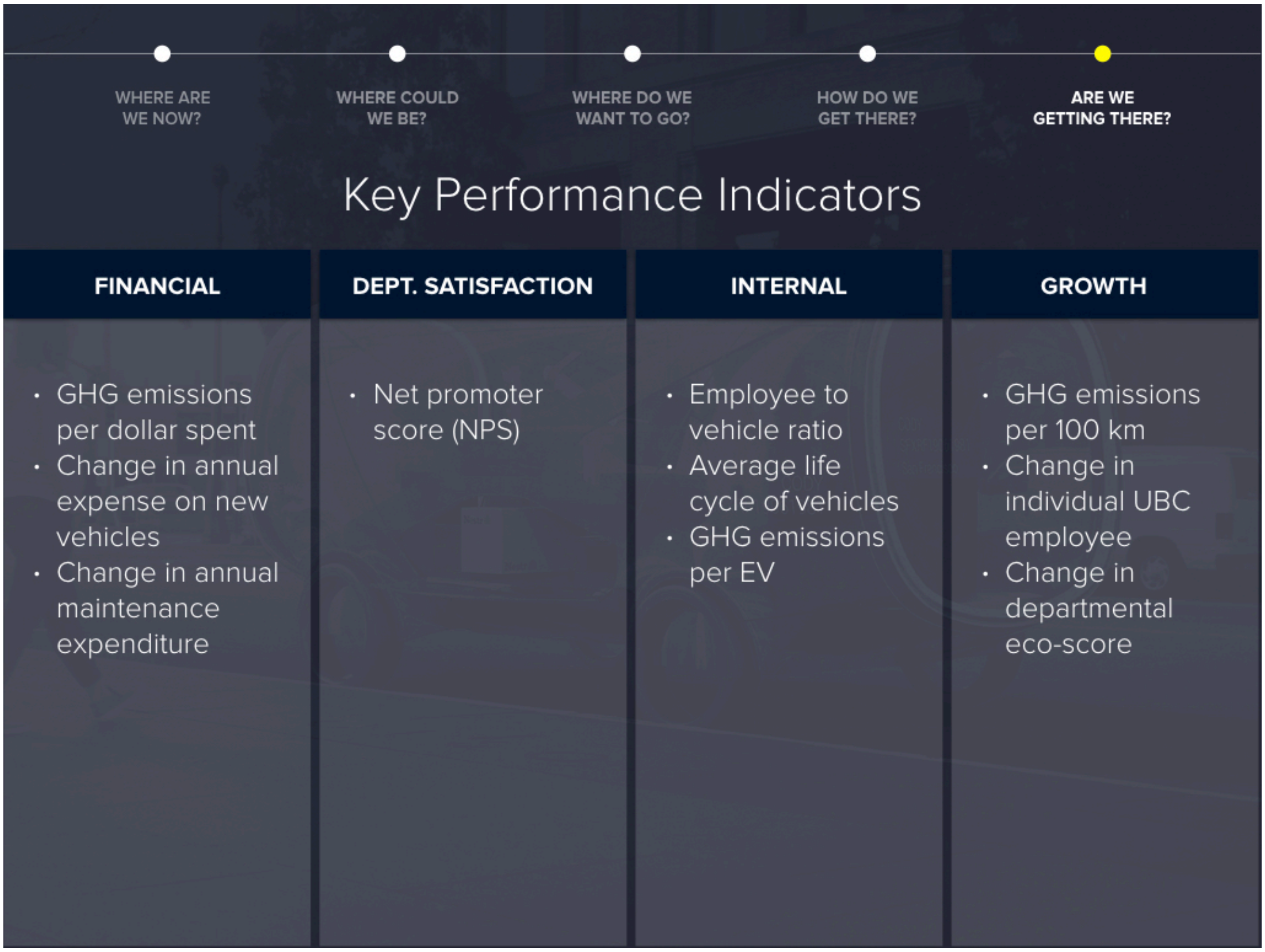
http://www.autoblog.com/2016/03/24/study-autonomous-vehicles-improve-mpg-epa-tests/



Incorporating AVs into the UBC Building Ops fleet is our long-term moonshot strategic recommendation. In our research, we realized that there were far too many uncertainties surrounding when driverless vehicles will enter the market, to how much they will cost to craft a detailed list of tactics and an implementation plan. Instead, we've opted to provide three key strategic contingencies — events which must occur for UBC Building Ops to integrate AVs into their fleet.

UBC holds many valuable corporate and research partnerships with technology companies who are currently testing driverless vehicle technology. For example, Microsoft suggested UBC as a potential innovation hub in Vancouver during the Vancouver Emerging Cascadia Innovation Conference in September of 2016. UBC Building Ops can potentially leverage such a partnership to help Microsoft, whose partnered with Volvo to test autonomous vehicle technology, bring their own driverless car initiatives to UBC campus.

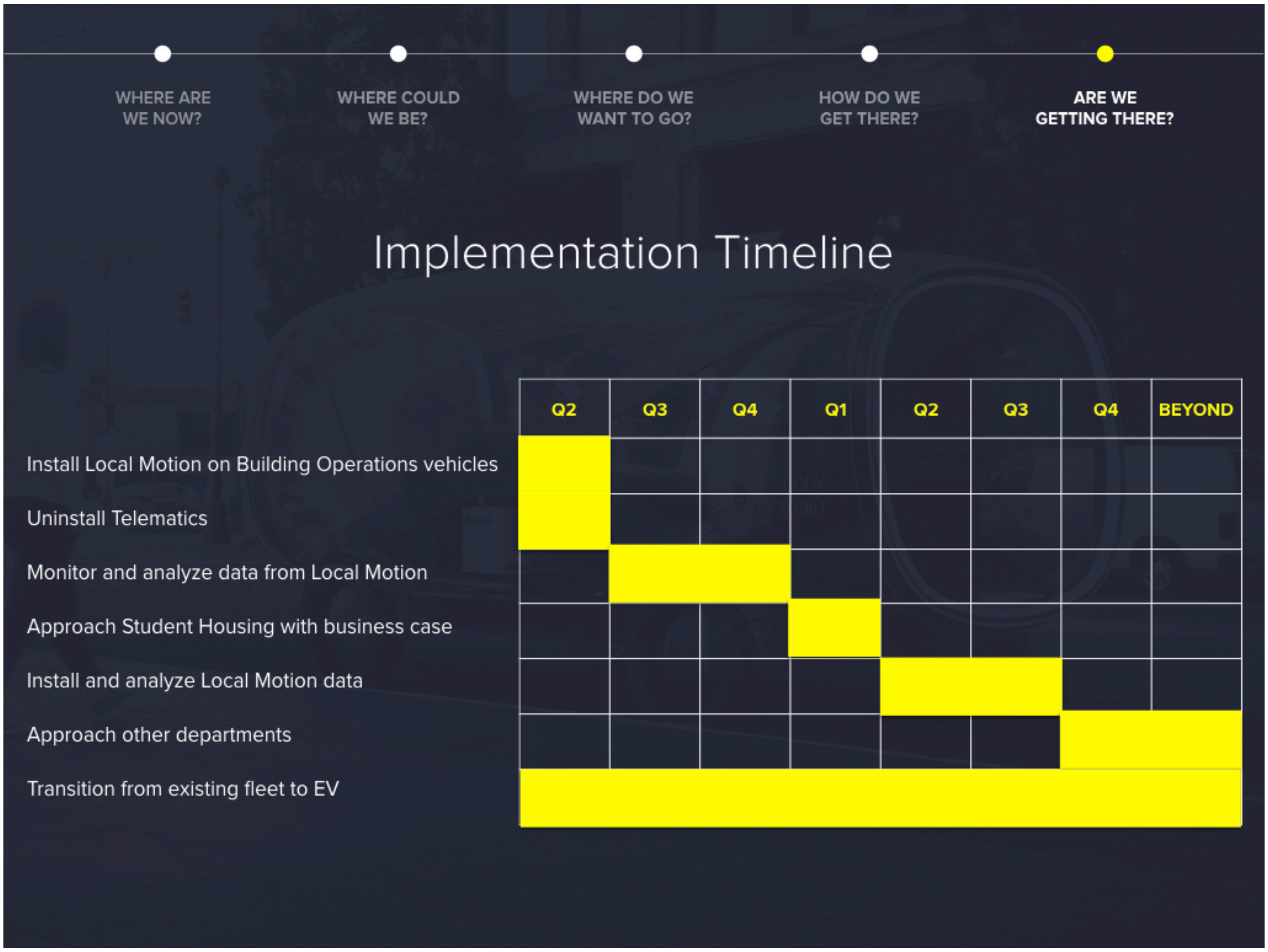
We identified many organizations who could potentially become coalition supporters on and off campus. Groups like the UBC Engineering Physics Student Association, and the BC Innovation Council have much to gain from autonomous vehicle technology being brought to UBC campus. By identifying and enlisting these organizations as supporters of a UBC AV fleet initiative, Building Ops stands a much better chance of funding and implementing a driverless vehicle fleet.
The final contingency would be the actual entrance of autonomous vehicles into the commercial market place. So far, the Ford Motor Company projected these vehicles could enter into widespread production as early as 2021.



It is crucial to have key performance indicators (KPIs) in place to track the success and effectiveness of the recommendations. We have divided the KPIs into 4 segments: financial performance, departmental satisfaction, internal processes and growth. The financial KPIs are change in GHG / dollar spent, annual expense on new vehicles and change in annual maintenance expenditure. These KPIs would help understand if the change from current fleet to EVs will lead to a reduction in GHG emission. It will also help understand if the efficiency of vehicles has improved across all departments as a lower expenditure on new vehicles would suggest better usage.

To assess departmental satisfaction, the most valuable KPI to look into is Net Promoter Score (NPS). Net Promoter Score is a survey that helps understand customer satisfaction levels and probability of referrals. The survey would be distributed to UBC departments on a semi-annual basis and would ask whether they would recommend another UBC department to partner with Building Operations to reduce their GHG emissions. If the score is 9 or 10, then they would count as a Promoter. 0-6 would be considered as Detractors as the scale suggests they are currently unhappy with the service and lastly 7 or 8 are considered as Passives and do not have a score. Eventually, the total number of Promoters are subtracted by the total number of Detractors and the number is divided by total respondents. A positive number reflects that the departments are satisfied with Building Operations and vice versa. This is important as Building Operations have been unable to incentivize other UBC departments to work in coalition with them. However, with the implementation of the recommendations discussed earlier, we believe that the NPS will go higher as there will be higher satisfaction amongst departments.

The internal processes will be assessed by employee / vehicle, average life cycle of vehicles and GHG emissions / EV. These metrics will help analyze the level of impact that implementing EV and AV has on UBC's GHG emissions and whether the impact could be increased. Last, the learning and growth KPIs will be GHG emissions / 100km, change in individual UBC employee and departmental eco-score. These scores would help understand whether the changes made are having a sustained impact. A betterment in these KPIs suggest that involvement with Building Operations has been successful for UBC departments and GHG emissions across UBC are reducing at an impressive rate.



The implementation plan has been constructed to effectively achieve the change management recommendation. Our team has not created an implementation plan for converting

The implementation timeline above provides a framework for effectively executing the recommendations. The first step is to contact Local Motion for the 200 vehicles that Building Operations currently manages. Contacting Local Motion, finalizing the contract and installing devices in the vehicles will be completed by end of June (3 months). During the same period, Telematics should be uninstalled from the vehicles, as Local Motion is a superior device and is an upgrade from Telematics. For the following 6 months, Building Operations would collect and analyze the data to create a strong business case to present to the UBC departments. This will include understanding the KPIs listed earlier and showing how they have been able to surpass the industry wide standards due to their best practices.

At the start of 2018, Building Operations will approach Student Housing with their business case. We suggest that they approach Student Housing first because their values align with Building Operations'. Presenting the business case and getting the approval through the boards will take 3 months. Post-approval, Building Operations will contact Local Motion to install their devices into the Student Housing fleet. Also, since Building Operations will be the primary body that will manage these fleets, the data shall be collected and analyzed by Building Operations to improve efficiency for Student Housing's fleet. This will allow for Building Operations to further build their business case as the data collected for the next 6 months will allow them to show the improvement achieved by collaborating with Building Operations. This business case could then be presented to the other UBC departments to incentivize them to follow Student Housing.

While the above change management steps are being implemented, there will also be steps taken to transition from the existing vehicles to electric vehicles. As this is a significant change, it is difficult to predict the exact time it will take to fully transition, but it is expected to go beyond the two-year timeline. The transition will allow for UBC to achieve lower GHG emissions and this transition will also be implemented on any UBC department that wishes to collaborate with Building Operations.

Risks and Mitigation

1. Local Motion’s technology isn’t suitable towards UBC Building Ops’ needs or falls short in an unforeseen way.

Run a pilot project using Local Motion’s product on a few vehicles. Gather feedback from UBC employees.

2. Disinterest from Student Housing and Hospitality Services in collaborating with Building Ops.

Engage in discussions early on with other UBC departments as alternatives (i.e. Parking & Access Control, Food Services)

LIST OF APPENDICES

APPENDIX A: SWOT ANALYSIS & ERRC GRID

STRENGTHS

- ARI's partnership with BOps - leveraging its telematics and Garage Management System
- Achieved Canada's first and 1 of 2 E3 Platinum fleet certification (Richmond being second)
- Since 2007, UBC Building Operations has made significant reductions in the GHG emissions from UBC's fleet

WEAKNESSES

- BOps Fleet represents around 2% of UBC's overall emissions and therefore does not get as much attention - harder to create persuasive business case
- Lack of collaboration between departments regarding communication, utilization and management of these vehicles

OPPORTUNITIES

- Leverage data from ARI's services to figure out the emission rates for other department's vehicles
- data to leverage individual data
- Adopt other technologies that are being utilized by google and other industry leaders in GHG reductions
- New electric cars and alternative options that have more efficient, better maintained vehicles

THREATS

- Other opposing parties who would rather fund more effective business cases
- Departments that aren't willing to adopt the systems in place by BOps to communally lower emissions
- Budget decrease if insufficient

ELIMINATE

- Under-utilization of vehicles
- Siloed communication

RAISE

- Cooperation between departments (communication, ops)
- Vehicle fuel efficiency

REDUCE

- Reduce GHG emissions below industry standard
- Lack of communication between departments
- Reduce UBC'S existing fleet size
-

CREATE

- Infrastructure that supports adoption of new technology and alternative energy
- Integrate Local Motion's keyless web-based fleet management system.
- A smorgasbord of solutions for all users in differents departments to take advantage of

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These analysis tools clarified the strengths and weaknesses of building ops, as well as the opportunities available for building ops to leverage. The details of each analysis allowed us to assess the situation and apply the best strategy while mitigating the risks.

APPENDIX B: LOCAL MOTION COST DETAILS

SERVICE	COST
HARDWARE INSTALLATION (PER VEHICLE)	150
RFID BADGE (PER VEHICLE)	5
DOOR ACTUATOR INSTALLATION (FOR OLDER MODELS)	250
ON-SITE TRAINING	0

NUMBER OF CARS	MONTHLY FEE
20-30	150
31-300	5
301-750	250
750+	0

Tiered pricing drops all vehicles down to the new tiered price when the vehicle volume reaches a tiered level.

For example, if Local Motion currently manages 30 customer vehicles, and that customer decides to add one additional vehicle to a total of 31 vehicles, all of the vehicles, including the first 30, would be billed at $75.

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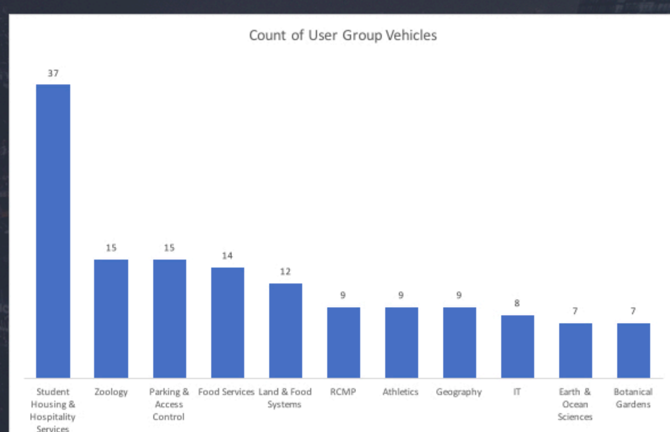
APPENDIX C: EXTERNAL DEPARTMENTS
Breakdown of User Group Vehicles

B OPS USER GROUPS	COUNT
Student Housing & Hospitality Service	37
Zoology	15
Parking & Access Control	15
Food Services	14
Land & Food System	12
RCMP	9
Athletics	9
Geography	9
IT	8
Earth & Ocean Sciences	7
Botanical Gardens	7



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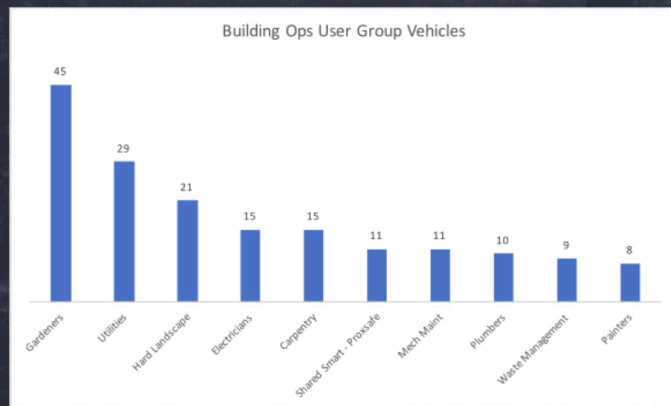
*Forestry excluded because utilization involves driving off campus. Our scope only involves vehicles operating within the UBC campus.

APPENDIX D: BUILDING OPERATIONS
Breakdown of User Group Vehicles

B OPS USER GROUPS	COUNT
Gardeners	45
Utilities	29
Hard Landscape	21
Electricians	15
Carpentry	15
Shared Smart - Proxsafe	11
Mech Maintenance	11
Plumbers	10
Waste Management	9
Painters	8



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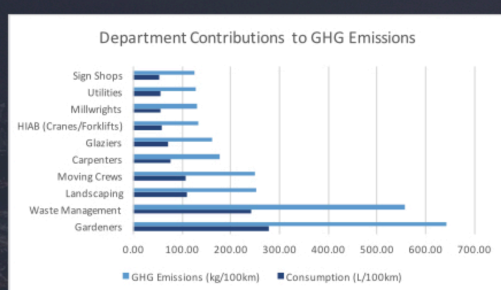
APPENDIX E: CO2 EMISSIONS PER BUILDING OPERATIONS DEPARTMENT



DEPARTMENT	CONSUMPTION (L/100KM)	GHG EMISSIONS (KG/100KM)
GADENERS	279.27	642.33
WASTE MANAGEMENT	242.45	557.64
LANDSCAPING	109.17	251.10
MOVING CREWS	108.08	248.58
CARPENTERS	77.14	177.42
GLAZIERS	70.48	162.1
HIAB (CRANES/FORKLIFTS)	57.80	132.95
MILLWRIGHTS	56.24	129.36
UTILITIES	55.26	127.1
SIGN SHOPS	54.26	124.81

ASSUMPTION: 1 L GASOLINE = 2.3 KG CO2

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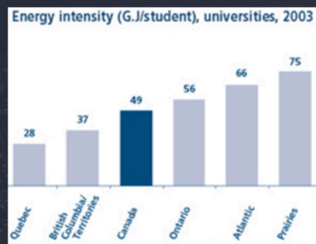
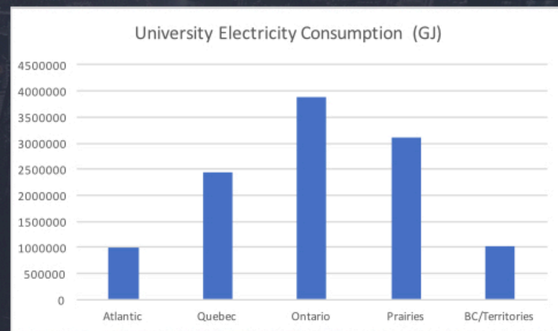
Source: http://www.nrcan.gc.ca/energy/efficiency/transportation/cars-light-trucks/buying/16770

APPENDIX F: UNIVERSITY ENERGY STATISTICS BY PROVINCE



REGION	UNIVERSITY ELECTRICITY CONSUMPTION (GJ)
Atlantic	1011100
Quebec	2452002
Ontario	3881060
Prairies	3103865
BC/territories	1025850



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*GJ = gigajoules

Source: Survey for Consumption of Energy Survey for Universities, Colleges and Hospitals, 2003

APPENDIX G: Appendix: UBC CAP - Public Consultation Report

Question 2(b) – UBC-Owned Vehicles

What comments do you have regarding the proposed actions to further reduce GHG emissions?

Theme	#	Outcome
General support for actions identified around reducing GHG emissions and UBC-owned vehicles	10	Support is welcome and appreciated.
Support for using more electric vehicles	9	Pursuing more electric vehicles is included within the CAP 2020 detailed actions.
Concern that GHG emissions related to UBC-owned vehicles have a minor impact on UBC's overall emissions	3	This point is acknowledged in the CAP 2020 Plan.
Suggestion to increase the number of electric charging stations on campus	2	Reviewing charging station infrastructure is included within the CAP 2020 detailed actions.
Support for using more hybrid vehicles	2	Pursuing more alternative/high efficiency vehicles is included within the CAP 2020 detailed actions.
Support for using appropriately sized vehicles for maintenance work	2	Support for right sized vehicles is included in the detailed CAP 2020 actions.

Note:
The table reflects the comments most frequently heard from the 46 questionnaire respondents. Comments received 2 or more times are represented, along with how the feedback has been addressed in the submission being provided to the UBC Board of Governors for approval.

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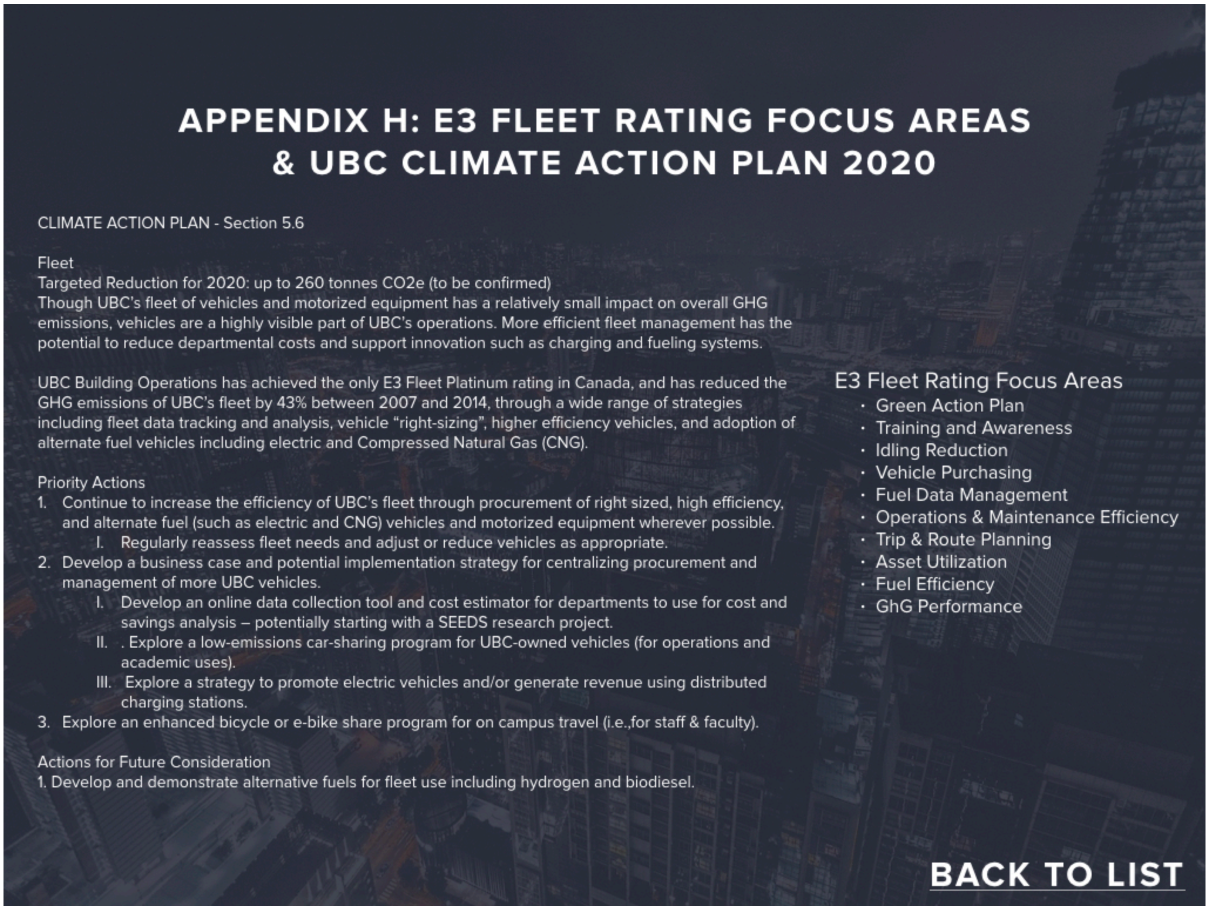

E3 Fleet Rating Focus Areas

- Green Action Plan — Creating an action plan and business strategy for improving fuel efficiency, reducing greenhouse gas emissions and reducing overall environmental impact of equipment and operations. The plan should also demonstrate the organization's commitment to corporate social responsibility and create awareness and acceptance in all levels of the organization.
- Training and Awareness — Training drivers and staff in fuel-efficient driving techniques, training dispatchers and managers in fuel-efficient management practices and creating a culture of fuel efficiency, cost management and environmental care.
- Idling Reduction — Eliminating unnecessary and wasteful idling of vehicles and equipment.
- Vehicle Purchasing — Purchasing the most energy-efficient vehicles and equipment for the intended use in a fleet.
- Fuel Data Management — Maintaining efficient and accurate fuel records and determining the true costs of fleet operations as related to fuel consumption.
- Operations & Maintenance — Optimizing the fuel efficiency of vehicles and equipment in a fleet, reducing down time caused by equipment failures or breakdowns and increasing awareness of how maintenance practices affect fuel efficiency.
- Trip & Route Planning — Lowering costs by maximizing the efficiency of trips and using the most direct or efficient routes.
- Asset Utilization — Matching the size of the fleet to the level of need, and taking action to identify and replace, retire or redeploy inefficient or under-used equipment and vehicles.
- Fuel Efficiency — Ensuring management programs, policies, activities and technologies improve fleet fuel efficiency.
- Greenhouse Gas Performance — Ensuring management programs, policies, activities and fuel and technology choices help reduce a fleet's GHG emissions on an ongoing basis. Fleets are also encouraged to partially or fully offset GHG emissions.

APPENDIX I: STEPS FOR CHANGE MANAGEMENT

- Create urgency
- Form a coalition
- Create a vision for change
- Communicate the vision
- Empower action
- Create quick wins
- Build on the change
- Make it stick

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