

Mapping climate initiatives and climate policy in Metro Vancouver

*In partnership with the Society Promoting Environmental Conservation (SPEC)
and the Collaborative for Advanced Landscape Planning (CALP)*

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Abstract

Anthropogenic activities are the leading threat to the current global climate crisis. It is imperative that varied and extensive climate solutions including climate policy, climate mitigation, adaptation, and justice strategies are implemented to minimize further impacts to natural and human systems (IPCC, 2018). Though many policy-makers and initiatives are prioritizing climate action and justice in Metro Vancouver, ease of access to this information and collaboration between initiatives, policy-makers, and the public can and must be strengthened. In 2019, a group of ENVR 400 students from the University of British Columbia (UBC) generated a map in collaboration with the Society Promoting Environmental Conservation (SPEC) and the Collaborative for Advanced Landscape Planning (CALP) to showcase climate mitigation initiatives within the city of Vancouver. This map became one of two Collective Climate Mobilization Maps (CCMMs) created this year; the initiatives CCMM has been populated with additional climate mitigation initiatives, along with climate adaptation and justice initiatives, and the policies CCMM has been populated with climate policies. Both CCMMs now cover all Metro Vancouver municipalities. Research was conducted to generate a list of initiatives, and responses to a Google Form sent to these initiatives supplied the information presented in the initiatives CCMM (descriptions of initiatives, where initiatives are active in, and website and social media links). The CCMMs will improve ease of access to information on local climate initiatives and policy; this can increase both climate knowledge and climate action in Metro Vancouver by connecting climate initiatives and increasing climate dialogue between the public, organizations, and policy makers.

Authors

The research team for this project consists of three 4th year Environmental Sciences (ENSC) undergraduate students at UBC with unique interests and experience pathways who share a common interest in climate change and climate solutions.

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ArcGis, and with coding in Matlab and R. Katie has also taken courses relating to environmental policy and is interested in the idea of spatially representing these policies.

Brendan O'Callahan is majoring in Environmental Sciences with a concentration in Sustainability Science. He has experience with data collection and analysis, constructive collaboration, and effectively communicating science through his courses.

1.0 Introduction

1.1 The Need for Climate Action

Historically, Earth's climate has been in periodic variation in response to changes within natural systems (Fahey et al., 2017). Changes in solar radiance, volcanic eruptions, and the El Niño Southern Oscillation all play a role in natural climate change. However, according to the Intergovernmental Panel on Climate Change (IPCC), the global warming that's been observed since pre-industrial levels has been identified as a result of human activities (IPCC, 2014). Human sources of greenhouse gas (GHG) emissions are largely responsible for the increased frequency and intensity of climate impacts such as severe weather events, ocean acidification, rising sea levels, and ecological extinction threats (IPCC, 2014). The IPCC has indicated an urgency to limit global climate change to no more than 2°C. Although, with the current rates of carbon emissions (50 Gt CO₂ eq/year), we are on track to overshoot that limit in 20 years (IPCC, 2014). Energy consumption is by far the largest source of anthropogenic GHG emissions as it relies on fossil fuels. Thus, the transition away from fossil fuels and into more sustainable sources requires urgent action (Matheson et al., 2011).

1.2 Categories of Climate Solutions

This project has identified three categories of climate solutions: mitigation, adaptation and justice. It is important to note that the fourth assessment report of the IPCC states that none of these actions alone can halt climate change impacts, though can significantly minimize risks when carried out together. Our project will use these categories of climate solutions as a way to differentiate initiatives included on the Collective Climate Mobilization Map (CCMM).

1.2.1 Mitigation

The transition away from a carbon dependent society relies on reducing the rate and magnitude of greenhouse gas emissions as well as enhancing 'sinks' that accumulate and store these gases (such as oceans, forests, and soil) (Semenza et al., 2011). Innovations in renewable energy, green urbanization, zero waste, sustainable food systems, and green transportation have been techniques adopted in urban mitigation (City of Vancouver, 2020). Ultimately, the goal of mitigation is to abstain from significant human interference with the climate system, and stabilize greenhouse gas levels in a time span that allows ecosystems to adapt naturally to climate change (IPCC, 2014).

1.2.2 Adaptation

The impacts of anthropocentric climate change have altered the state of human and natural systems so much so that reducing carbon emissions alone is not enough to avoid further ramifications (Semenza et al., 2011). Climate adaptation refers to action driven from climate impacts (Natural Resources Canada, 2015). Adaptation can be reactive, in which action is in response to climate impacts, or anticipatory, in which action is taken before predicted impacts of climate change are realized (Natural Resources Canada, 2015). In most cases, anticipatory adaptation will result in lower long-term costs and can be more effective than reactive adaptations (Natural Resources Canada, 2015).

1.2.3 Justice

Climate justice action has spearheaded a global movement which shifts climate change discourses to frame global warming as an ethical and political issue (Kluttz & Walker, 2018). The disproportionate social, economic, public health, and environmental impacts of climate change have been widely documented within relevant literature (UN Sustainable Goals, 2019). Many historically marginalized or underserved communities are most vulnerable to climate impacts (McKendry, 2015). The mobilization of climate justice in Metro Vancouver has led to protests, marches, and rallies demanding climate action and the protection of Indigenous sovereignty (Canning, 2018). Hundreds to thousands of people have congregated by port entrances, city street intersections, major roads, institutions, and city halls to amplify the need for climate justice.

1.3 *Filling the Gap*

1.3.1 Advancement of Green Political Action

Rising sea level, warmer temperatures, and extreme weather events have all indicated the undeniable reality that a 'business as usual' regime and a sustainable and just future for all cannot exist in unison. Municipalities across the Metro Vancouver region including Vancouver, Richmond, Burnaby, New Westminster, North Vancouver, West Vancouver and Port Moody have all declared a state of climate emergency. These declarations indicate the recognition that climate action is essential to avoiding the worst impacts of climate change and overwhelming society's capacity to adapt. By electing the IPCC's (2018) 1.5°C global warming limit, many municipalities have built climate emergency response reports and policies, outlining carbon pollution reduction strategies. However, in order to transform outdated systems and build long-term sustainable change, action is required by all.

1.3.2 A United Effort

While personal action is more effective than no action at all, Greiger (2019) states that coordinated collective action is a more significant driver of change. When individuals identify with a collective (e.g., organizations, school clubs, workplaces) with a common goal, they engage in empathic conversations around what they care about, such as the climate crisis. Moreover, individuals tend to look towards their personal social networks for information that confirm their worldviews. Thus, publicly visible behaviours such as advocacy of one's involvement in a climate initiative have the ability to influence others within their community (Greiger, 2019). As a result, these connections create networks to help recruit engagement and action (Kluttz & Walter, 2018). As the urgency for climate action persists, engagement among local and global populations are vital to creating sustainable change.

The work of organizations and community led initiatives play a major role in the ongoing engagement of the public towards climate action. Over the last few decades, the Metro Vancouver region has amassed a plethora of organizations committed to climate change solutions and action. The lack of a singular platform to showcase all climate initiatives, whether organization-, community-, or

municipality-led, can make a Google search seem overwhelming for individuals, organizations, and policymakers. This project aims to increase the accessibility of this information and catalyze social mobilization by offering user-friendly maps allowing users to navigate local climate initiatives and policies across Metro Vancouver.

1.4 Project Partnership

This project is a cap-stone project within the ENVR 400: Community Project in Environmental Science course at UBC. It's completion could not have been fulfilled without the guidance from course instructor, Tara Ivanochko and the collaborative partnership with the Society Promoting Environmental Conservation (SPEC), an organization that aims to empower local communities in the Lower Mainland towards urban sustainability, and the Collaborative for Advanced Landscape Planning (CALP), a research group focussed on innovative solutions that target sustainability issues.

1.5 Project Continuation

This project is in its second year of development, and its continuation this year varies in the project's scope and deliverables. Last year, the ENVR 400 group and SPEC-CALP community partners developed a map with 41 climate mitigation initiatives represented in Vancouver alone. This year, the map contains 58 climate mitigation, adaptation and justice initiatives as well as climate-related policies across Metro Vancouver.

2.0 Objectives

The CCMMs are intended to enhance awareness of climate solutions and mobilize collective climate action. It's accessibility and functionality has the potential to profoundly impact the reach and influence of climate initiatives in Vancouver. The addition of relevant climate policies into a streamlined online environment that is user-friendly will allow for further accessibility of information to empower citizens to engage and hold policy-makers to higher standards. The overarching goal of the new CCMM additions is to promote communication and action concerning the climate crisis among all stakeholders. The sub-objectives of this project are as follows:

- To increase the scope of the data presented on the CCMMs by adding climate policies, climate adaptation initiatives, climate justice initiatives, and more climate mitigation initiatives;
- To widen the spatial scope of the CCMMs to include initiatives and policies within all Metro Vancouver municipalities;
- To conduct effective outreach in order to get the CCMMs into as many hands as possible;
- To make the CCMMs more self-sufficient so that data input into the database can be automatically processed into the map.

3.0 Methods

3.1 Policy Collection

Policies and sustainability/climate action plans within Metro Vancouver were gathered for each municipality through their individual official governance websites (See Appendix A). For simplicity and consistency of the information presented on the policies CCMM, the main focus of climate related policies and action plans included: carbon emission reduction targets/goals, a breakdown of climate related policies and action plans and relevant resources pertaining to climate and sustainability within each municipality.

3.2 Initiative Collection

As a continuation of last year's collection of climate mitigation initiatives, this year's efforts were to widen the scope of climate initiatives included on the initiatives CCMM. Therefore, climate adaptation and justice initiatives within Metro Vancouver were collected in addition to climate mitigation initiatives (See Appendix B). Using the previous year's database, we compiled additional initiatives by inputting keywords and phrases such as 'climate activism', 'climate justice', and 'environmental initiatives' into online search engines. Additionally, resources such as The Canadian Directory of Environmental Groups which offers information on environmental organizations across Canada were consulted. Each organization under the regional category of 'British Columbia' was reviewed for relevant projects, initiatives, or branches of the organization that are active in Metro Vancouver. In order to expand the map's breadth of initiatives to include those

not easily located using keywords, resources such as the Greenest City Grant winners, environmental donation websites, and volunteering websites were also employed.

Through discussions with SPEC-CALP, and maintaining the project's continuity from last year, a guiding framework was created to outline the project's discernment of what constitutes an 'initiative'.

Guiding Framework For Defining Climate Initiatives:

The climate initiatives included in the initiatives CCMM satisfy all of the following requirements:

1. Be located in Metro Vancouver
2. Be active within the last year
3. Be organized by a non-profit, charity, NGO, government organization, or community group (at least 2 people)
4. Work to do one of the following:
 - a. Climate mitigation: actively reduce and increase awareness on and engagement in the reduction of greenhouse gas (GHG) emissions
 - b. Climate adaptation: action driven in response to or anticipation of climate change impacts
 - c. Climate justice: action targeting climate change from an intersectional perspective (i.e. ethically, politically)

3.2 Google Form

In order to gather information from initiatives to be presented on the initiatives CCMM, a Google Form was created to ensure the initiative's self-determination of their representation on the CCMM (See Appendix C). Thus, the goal of the form was to acquire the following:

1. Initiative & participatory organization(s) name(s)
2. Initiative description
3. The initiative's climate solution categorization (mitigation, adaptation, and/or justice)
4. Location(s) of initiative
5. Webpage & social media links/handles
6. Target audience

7. Year founded

To ensure a mutual understanding of the project's use of words such as 'mitigation', 'adaptation' and 'justice', definitions were included in the Google Form as well as a description of the CCMMs project.

In order to create a thorough Google Form, a pilot form was sent out to ten climate initiatives to gather feedback in regards to question-related concerns, the need for increased clarity, or identifying gaps. Out of the 10 initiatives the pilot form was sent out to, 2 initiatives responded with concerns regarding not having a physical address to input into the form. Thus, to accommodate their feedback the Finalized Google Form allowed initiatives to select which municipalities they are active in and up to 5 neighbourhoods if applicable.

The Finalized Google Form was sent out to all initiatives in the database as well as SPEC-CALP contacts that were not included in the database. To incentivize initiatives to respond in a timely accordance with the project's timeline, a closing date for responses was included, followed by a reminder email after a week of the form being sent out. In total, 31 responses were received for initiatives active in 11 municipalities within Metro Vancouver.

3.3 Outreach Strategy

The goal of our outreach strategy is to distribute and publicize the map throughout a variety of relevant groups/organizations across dominant media platforms. By creating publish-ready content for Instagram, Facebook, Twitter and events for organizations, community members, news outlets and initiatives to use for advertising, we hope to have the CCMMs in the hands of many (See Appendix B). In addition to our initiative database, an additional database of organizations was created as a starting point for SPEC-CALP to reach out to to help promote the CCMMs (See Appendix G).

For news outlets in particular, we've written three separate op-eds to be submitted to the Ubysey, The Georgia Strait and Narcity alike (See Appendix E). For future SPEC-CALP project presentations/conferences/meetings, a poster was created to communicate the project's importance, objectives, as well as promote the CCMMs (See Appendix F).

3.4 Mapping

Following the collection of climate initiatives and policies, we created two online maps using ArcGis online to display the information in an easily digestible yet comprehensive manner. Both the climate policies and climate initiatives are represented on a municipal scale, meaning they were grouped and displayed on the map based on what municipality they are active in. In doing this, we were able to accommodate the climate initiatives that do not operate in a single location or identify with any location at all. We determined that mapping the exact location of each climate initiative would exclude many potential initiatives and could cause excessive crowding on the CCMMs. Therefore, instead of using an exact address to allocate points on the CCMMs, we grouped initiatives by municipality or municipalities where they're active. Thus, users select a municipality and receive a list of the climate initiatives active there.

Since both climate initiatives and policies are grouped by which municipality they are present in, the basemap used for each CCMM is a world navigation map centered on the Metro Vancouver region. This allows autonomy for viewers to scale their spatial view (streets, neighbourhoods and municipalities) using the zoom tool on the map. To further help users view municipalities more clearly, an additional layer was created. The layer contains the municipal boundaries which were manually drawn onto the CCMMs using map notes. The municipal boundaries layer was added to both the policies and initiatives CCMM.

3.4.1 Climate Policies Mapping

The climate policies CCMM consists of the basemap, the municipal boundaries layer, and a municipal area layer where a 'pop-up' will appear when a polygon is selected. The climate policies added to the municipal area layer. The final policy map is referred to as **Figure 1**.

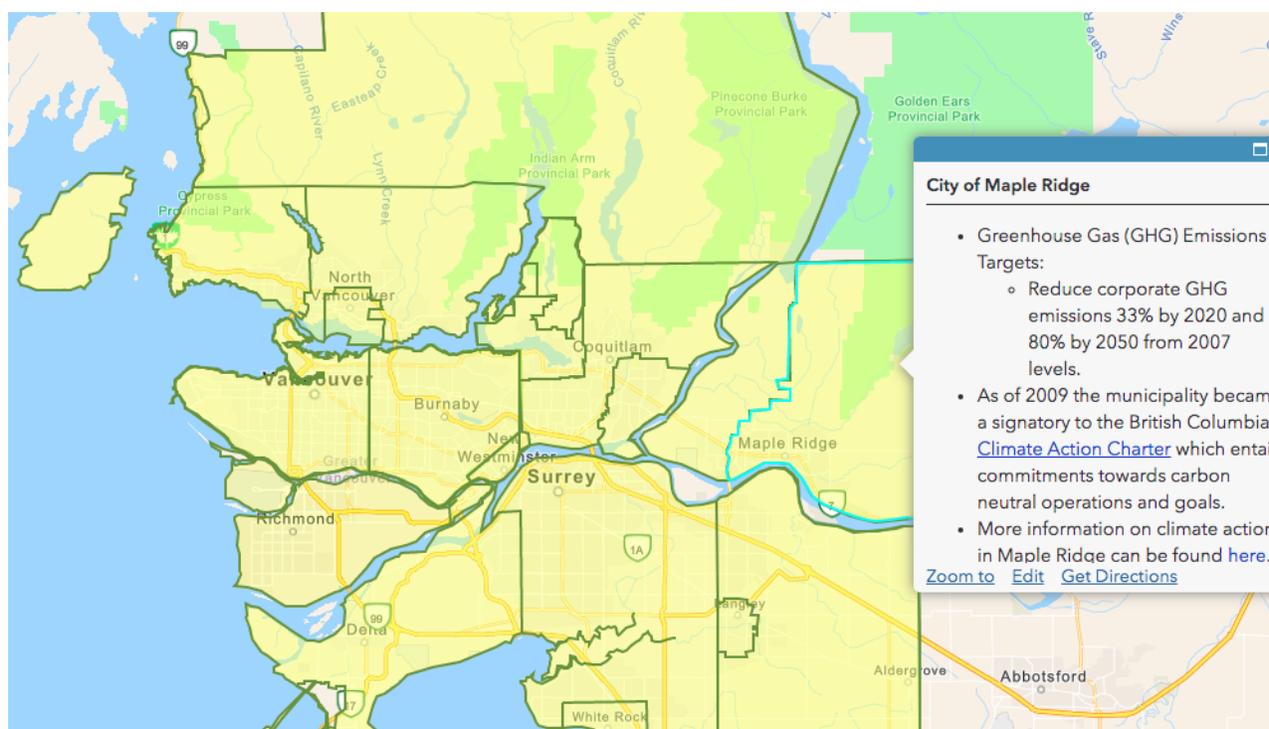


Figure 1: This CCMM is designed to display the climate policies implemented around Metro Vancouver. The user will see a map with the municipal areas shaded with a transparent pink layer. When the municipal area is selected, the user will see a 'pop-up' with a list of all the municipality's climate policies.

3.4.2 Climate Initiatives Mapping

The climate initiatives CCMM consists of the basemap, municipal boundaries layer, and a layer with the climate initiatives' information derived from an uploaded CSV file renamed as 'climate initiative response'. The 'climate initiative response' layer appears as a singular numbered point in the center of each municipality. The number on the point represents the number of climate initiatives in the respective municipality. Selecting the point will provide information on the initiatives such as the organization name, description, category and link to the organization's main webpage obtained from the Finalized Google Form. The final initiative CCMM is referred to as **Figure 2**.

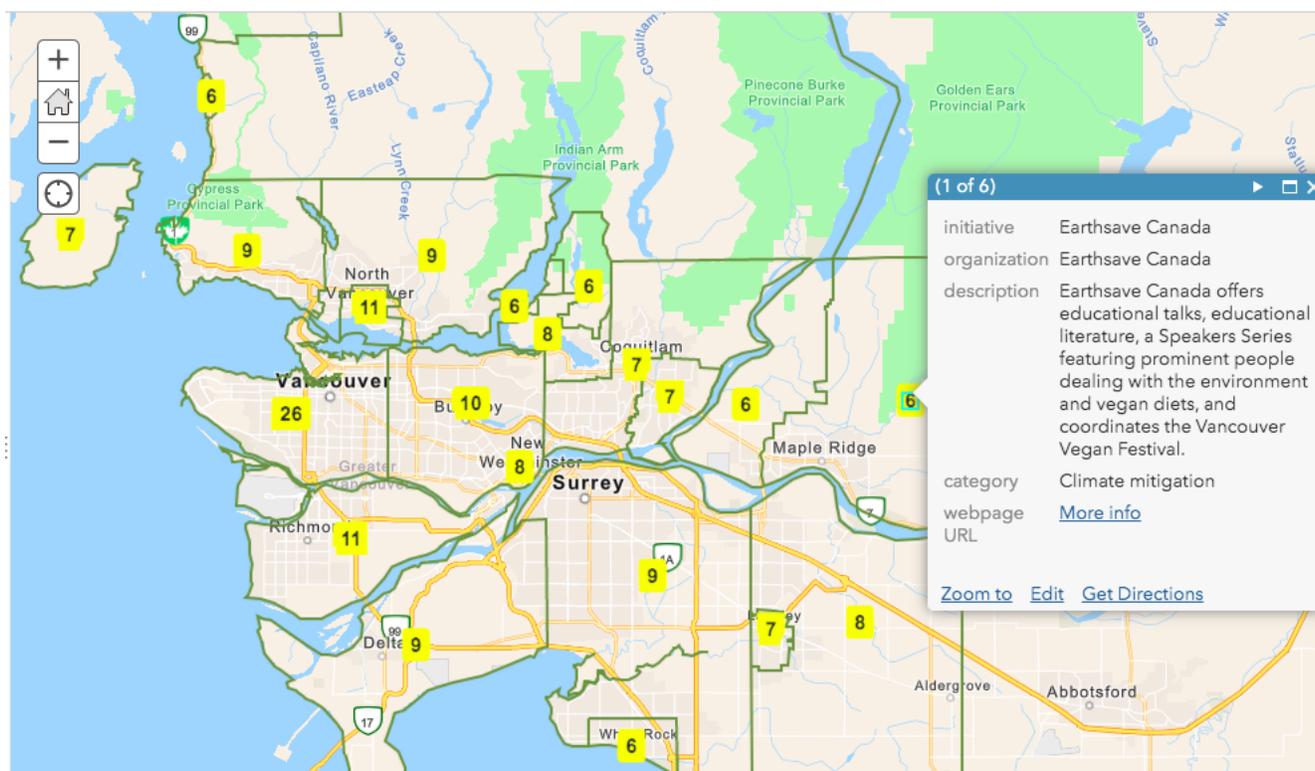


Figure 2: This CCMM focuses on displaying the climate initiatives found in each municipality. The lines on the map represent the municipality boundaries, the points with the numbers on them represent the number of initiatives in the municipality. Users can navigate through climate initiatives on the point by selecting the triangle located on the top right of the 'pop-up'.

3.5 Automated Google Form

The Finalized Google Form was redesigned to allow for the construction of an automated database. In doing this, responses will be processed into uploadable data when a new response is added to the Google Form. This enables future volunteers or students working on this project to send out the automated version of the Google Form to climate initiatives which they could then upload the linked Google Sheet to ArcGIS Online with minimal editing of the responses required. The *Automated* Google Form varies from the *Finalized* Google Form as it utilizes a checkbox style answer opposed to a short response style answer to acquire the location(s) of climate initiatives. Due to the nature of processing initiatives' responses onto a Google Sheet, the Automated Google Form has limited character (350 character limit) and storage capacity. This poses restrictions on the number of questions that could be asked, as well as the word count available for an initiative's description. The automated Google Form can be found in Appendix C.

3.6 *Climate Initiative Database*

The process of converting the information obtained from the automated Google Form into data points on the CCMM involved creating a Google Sheet which automatically processes responses into location coordinates that the map is then able to plot. Location coordinates are allocated to initiatives who select municipalities applicable to them via a location specific question on the form. The coordinate points representing each municipality were chosen based on visual aesthetic and overall consistency. With the use of complex Google Sheet equations and formatting, the initiative name, organization name, description, category of climate solution, and webpage URL are organized in rows on a Google Sheet tab named 'processed data'. This sheet would be automatically updated with each new response on the form and can be readily uploaded manually to ArcGIS Online via a CSV file.

4.0 Discussion

4.1 *Main challenges & limitations of mapping strategy*

One of the original objectives of the project was to create a map that informed the public of climate initiatives in their neighbourhood. The initial plan was to create a map with specific points indicating where the climate initiatives are located by using their addresses. However, responses from the pilot Google Form expressed concern regarding using addresses due to some initiatives unable to identify a singular address or have multiple locations that would cause crowding on the map. To address these challenges, the CCMM was redesigned to spatially represent initiatives by the municipality(ies) they are active in. The redesign included a single numerical point on each municipality which successfully mitigates potential crowdedness, and accommodates representation of initiatives that are not location-specific by representing them in all municipalities.

The Finalized Google Form sent out to climate initiatives did not use checkbox styled questions to acquire an initiative's location. Instead, initiatives were required to provide short-answer styled responses describing their location(s). Certain responses caused challenges as it was unclear which municipality the climate initiative is active in. For example, some initiatives indicated that they are active in North Vancouver or in Langley, but it is unclear whether they were referring to the City of North Vancouver or District of

North Vancouver/the City of Langley or Township of Langley. The ambiguous answers were treated by assigning the initiatives to all the locations that we deemed appropriate (i.e. both City and Township/District). However, changes made for the Automated Google Form mitigates this challenge by having initiatives check relevant municipality boxes to fulfill location requirements.

Through the development of the CCMMs, we experienced a tradeoff between using an automatically updating database and creating visually appealing maps for users. Being able to manually configure the 'pop-up' that appears when users select a point on the CCMMs would employ a greater degree of control regarding what could be included on the 'pop-up'. Manual configuration of the 'pop-up' would enable a longer initiative description as well as pictures to make it more visually appealing. The functionality of the automatic updating database requires descriptions to be approximately 350 characters maximum due to the word capacity within a single bin in Google Sheets. Future volunteers or students working on the project would need to monitor the character limit on the descriptions portion of the sheet. A set character limit or instructions to limit initiative descriptions to a character limit can be included in the Google Form.

4.2 Future recommendations

To further improve the project, another map that displays the exact locations at which climate initiatives are located is recommended to allow users to determine the most convenient climate initiatives to engage with. For another map to be constructed, another Google Form and a database that stores the responses would need to be made since ArcGIS Online cannot plot both coordinate and address points from the same CSV file. The Google Forms for each CCMM could be included in the email sent to organizations during the initiative-collecting phase and organizations could choose to fill out either or both surveys based on how they would like to be spatially represented. An automatically updating database for the Google Form is possible since ArcGIS can convert addresses into data points. An indication that an initiative is looking for volunteers can also be included in initiative 'pop-ups' on the CCMM to help map users that are looking to volunteer.

In addition, improvements to the initiatives CCMM should focus on the initiatives' presentation and user experience. As more initiatives are added to the CCMM, the numbered points will become larger, and users will have to navigate through each initiative in a municipality individually. This will become tedious and time consuming for

users. Therefore, configuring a way to present the initiative's on a larger scale (allowing users to view more than one initiative at a time) will be most ideal. For instance, creating a table to supplement the current 'pop-ups' so that users can also navigate by scrolling through multiple columns of initiatives. Initiatives can also be organized alphabetically through the CSV connected to the CCMM to allow greater ease for users to find particular initiatives/organizations they may be seeking.

Updating the CCMMs in the future will be a challenge, as new climate policies and initiatives will inevitably emerge and old ones will no longer be relevant. Future volunteers and students will therefore need to monitor current policies and update the CCMM accordingly. A possible project idea would be to archive the old climate policies on the CCMM so that users can see the progression and evolution of climate policies over time. Information on climate policies in each municipality is currently rather minimalistic, so including more links or descriptions on the 'pop-ups' on the map could also be included to make the policy CCMM more comprehensive. A similar approach could be used for climate initiatives that are no longer active, such as climate marches, so that CCMM users can see the history of short and long-term initiatives in Metro Vancouver. To address the 'expiration date' of climate initiatives, a question can be included in the survey that asks for the anticipated date when the climate initiative ends, if this is applicable, therefore requiring less investigative work for future volunteers and students.

This project has focused largely on the climate policy and initiative CCMM. As a result, the website in which they are housed should be focused on in the future. This can include embellishing the StoryMap to include information on the project, the goal of the maps, and how to navigate it would be productive in making it more informative, user-friendly and visually appealing. Additionally, we recommend providing a land acknowledgement on this website to call attention to the stolen land on which the work of each initiative operates on. Although it may not be necessary to overlay or include another map of traditional Indigenous territories around Metro Vancouver, it could be beneficial to include a link to the Native Land website.

5.0 Conclusion

As the consequences of anthropogenic climate change continue to increase in severity and frequency from extreme weather events, rising sea levels and temperatures, to mass

extinctions, it is clear that a just transition away from 'business as usual' is non-negotiable. While many municipalities in Metro Vancouver have declared a climate emergency, increased efforts from NGOs, grassroots organizations, community initiatives and civil society continue to advocate for more progressive climate change agendas. These efforts include the emergence of climate mitigation, adaptation and justice initiatives hoping to catalyze collective mobilization towards climate solutions.

The development of the CCMMs, outreach strategy, and automation has contributed to the expansion of the project's scope, accessibility, and longevity. By offering a single location to access climate policies and initiatives, the project aims to support collective action. The online platform on which the CCMMs are located allows for ease of public access to climate initiatives and policies not only in Vancouver, but within all of Metro Vancouver. The project successfully represents thirty climate mitigation, adaptation and justice initiatives from across Metro Vancouver.

The CCMMs continued expansion can be optimized through the implementation of the outreach strategy, which aims to reach the public through relevant venues such as climate focussed organizations. Additionally, the automated Google Form connected to the initiatives CCMM allows initiatives to be represented on the map with little organizational input from our partners. Thus, the project's publication coupled with the outreach strategy will further promote and amplify the map's influence among organizations, climate activists, policy makers, and interested individuals as a resource and tool for collective action, engagement, collaboration, and education.

6.0 References

Canning, P. C. (2018). I could turn you to stone: Indigenous blockades in an age of climate change. *International Indigenous Policy Journal*, 9(3).

City of Vancouver. (2019). *Climate Emergency Response*. Retrieved from: <https://council.vancouver.ca/20190424/documents/cfsc1.pdf>

Cook, J., Oreskes, N., Doran, P. T., Anderegg, W. R. L., Verheggen, B., Maibach, E. W., et al. (2016). Consensus on consensus: A synthesis of consensus estimates on human-caused global warming. *Environmental Research Letters*, 11, 1–7.

- Fahey, D.W., Doherty, S.J., Hibbard, K.A., Romanou, A., & Taylor, P.C. (2017). Physical drivers of climate change. In: *Climate Science Special Report: Fourth National Climate Assessment, Volume I* [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 73-113.
- Geiger, N., Swim, J.K., & Leland, G. (2019) Spread the Green Word: A Social Community Perspective Into Environmentally Sustainable Behavior. *Environment and Behavior*, 51 (5), 561-589.
- Natural Resources Canada (2015). *Chapter 1: An Introduction to Climate Change Adaptation*. Retrieved from:
<https://www.nrcan.gc.ca/changements-climatiques/impacts-adaptation/chapter-1-introduction-climate-change-adaptation/10081>
- IPCC, 2014: Summary for Policymakers. In: *Climate Change 2014: Mitigation of Climate Change*. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- IPCC, 2018: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. Retrieved from
https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_Low_Res.pdf
- Kluttz, J., & Walter, P. (2018). Conceptualizing Learning in the Climate Justice Movement. *Adult Education Quarterly*, 68(2), 91-107.
- Mathiesen, B. V., Lund, H., & Karlsson, K. (2011). 100% Renewable energy systems, climate mitigation and economic growth. *Applied Energy*, 88(2), 488-501.

doi:10.1016/j.apenergy.2010.03.001

McKendry, C. (2016) Cities and the challenge of multiscalar climate justice: climate governance and social equity in Chicago, Birmingham, and Vancouver, *Local Environment*, 21:11, 1354-1371.

Semenza, J.C., Ploubidis, G.B. & George, L.A. (2011) Climate change and climate variability: personal motivation for adaptation and mitigation. *Environ Health* 10, 46.

United Nations. (2019). Sustainable Development Goals. Retrieved from <https://www.un.org/sustainabledevelopment/blog/2019/05/climate-justice/>

7.0 Appendix

- A. [Metro Vancouver Climate Policies & Action Plans by Municipality](#)
- B. [Spreadsheet of initiatives](#)
- C. [Google Form](#)
- D. [Social Media Outreach](#)
- E. [Op-ed/blog for Outreach](#)
- F. [Poster for Outreach](#)
 - This poster can also be edited using the following link:
https://www.canva.com/design/DAEbHrohDUg/share/preview?token=jgkMmdjy5_w6awNp19LUyQ&role=EDITOR&utm_content=DAEbHrohDUg&utm_campaign=designshare&utm_medium=link&utm_source=sharebutton.
- G. [Outreach organizations](#)
- H. ArcGIS online story maps: <https://arcg.is/10qH8j>
- I. Mapping Instructions
 1. Updating Climate Policies CCMM
 2. Updating Climate Initiatives CCMM
 3. Recreating the Climate Policies CCMM
 4. Recreating the Climate Initiatives CCMM
 5. Recreating the automated Google Sheet

1. Updating Climate Policies CCMM

1.1 Once logged into ArcGis Online, go to the group for this project and select the 'Climate policies by municipality map'. The group page should look like this:

The screenshot displays the ArcGIS Online group page for 'SPEC', owned by katherine02clarke_UBC. The page layout includes:

- Group Header:** 'SPEC' logo and 'owned by katherine02clarke_UBC'.
- Description:** A section titled 'Description' with an 'Edit' icon and a link to 'Add an in-depth description of the group.'
- Recently added content:** A section titled 'Recently added content' with a 'View all group content' link. It features three map items:
 - Climate policies by municip...:** Created: Jan 30, 2021; Updated: Apr 1, 2021; View Count: 529.
 - Mapping Climate initiatives ...:** Created: Feb 21, 2021; Updated: Apr 6, 2021; View Count: 298.
 - Climate Initiatives and Polici...:** Created: Feb 1, 2021; Updated: Apr 16, 2021; View Count: 162.
- Navigation:** A vertical sidebar on the right contains icons for home, search, and other navigation functions.

NOTE: You would need an ArcGIS organizational account to be able to edit content from this project. If you have a UBC organizational account, go to My Organization Groups and

scroll down to find the group created for this project.

P

Project Group - KAB

Owner: ziqiangh_UBC

Created: Nov 26, 2020 Last updated: Nov 26, 2020 Viewable by: Organization

✎ Shared Update

C

SCARP Hazards Lab

Owner: ryan.reynolds_UBC

Created: Feb 13, 2018 Last updated: Feb 13, 2018 Viewable by: Organization

The coastal hazards lab group at SCARP

S

SPEC & CALP Mapping Climate Initiatives and Climate Policies

Owner: katherine02clarke_UBC

Created: Apr 10, 2021 Last updated: Apr 10, 2021 Viewable by: Everyone (public)

A collaborative project between the two organizations the SPEC (Society Promoting Environmental Conservation) and CALP (Collaborative for Advanced Landscape Planning).

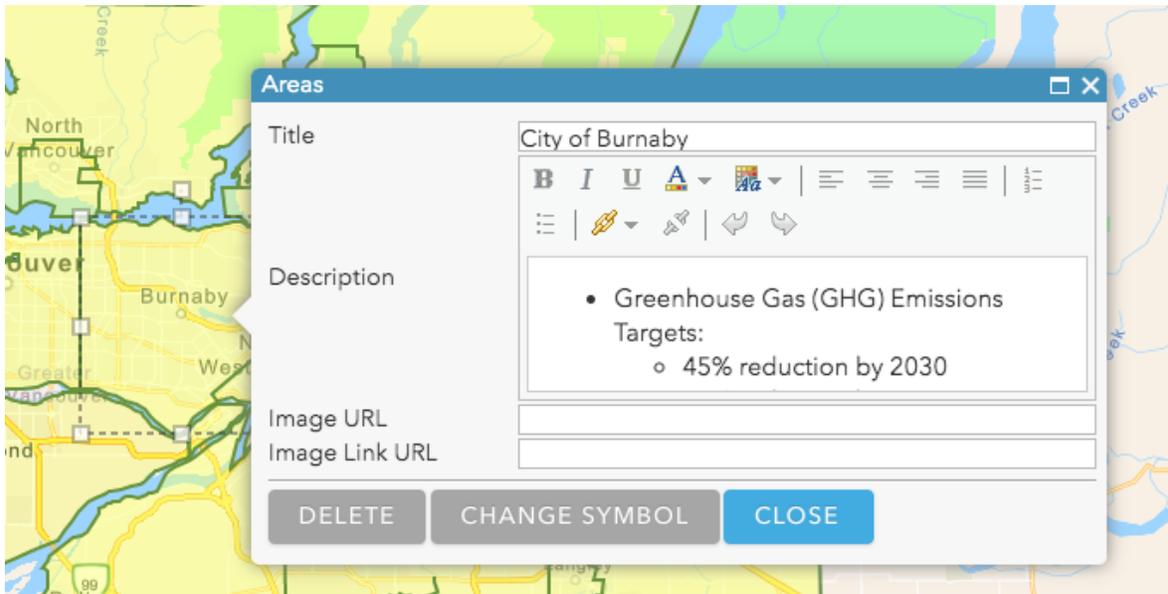
Click on SPEC & CALP Mapping Climate Initiatives and Climate Policies and add yourself to the group.

If you have an account from a different organization you'd need , you'd need the right privileges to join external groups and an invite to join a group created for this project. Refer to this bog page:

<https://www.esri.com/arcgis-blog/products/arcgis-online/sharing-collaboration/sharing-and-collaboration-across-arcgis-online-organizations/>

1.2 Select a municipality to view a 'Pop up' ('Pop up' is an ArcGIS term for a text box that appears when you click on a map notes feature) that contains the climate policies/action plans. The hyperlinks within each municipality's 'Pop up' direct viewers to the appropriate web page of the municipality's official website that outlines the climate policy/action plan. Survey the website for each municipality to find new/updated climate policies/action plans implemented and add them to the directory for each municipality.

1.3 Identify the policies/action plans that are no longer relevant and remove them from all the 'Pop ups'. Do this by clicking edit on the pop up and change the description.

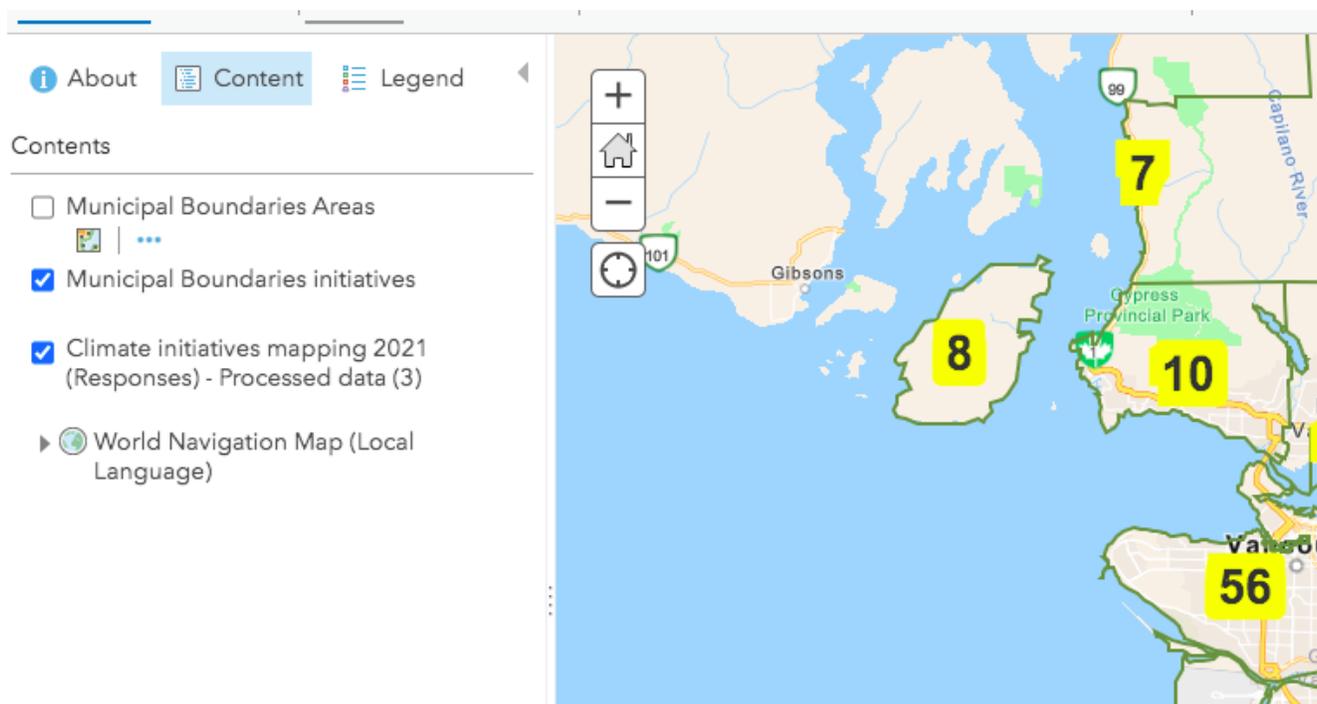


1.4 Save the map

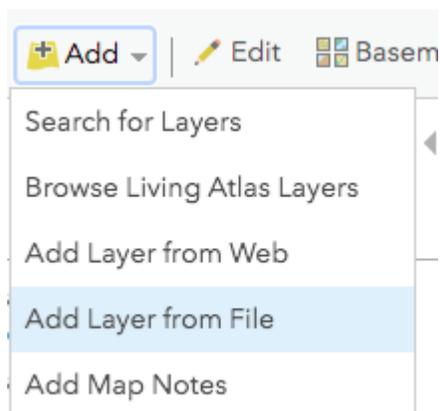
2. Updating Climate Initiatives CCMM:

2.1 Go to the [automated Google Form](#)'s responses. Download the 'Processed Data' tab as a CSV file.

2.2 Once logged into ArcGIS Online, locate the climate initiatives map. Untick the climate initiatives response layer (or in the case of this figure, the 'Climate initiatives mapping 2021 (Responses)- Processed data (3)' so that the old data is no longer visible.

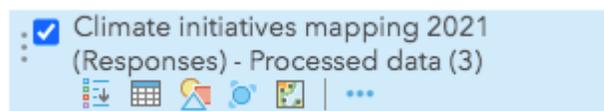


Upload the new data to ArcGIS (Go to Add -> Add Layer from File -> import file).



2.3 Once the points are added onto the map, select 'more options' located under the layer, then configure 'pop-up'. Select configure attributes and de-select the boxes 'Object ID', 'latitude', 'longitude', and 'count'.

More options is the triple dot symbol as shown:



Configure attributes:

Configure Attributes

Check the fields you want to display and edit. Select a field to change its alias, order it, and format it.

<input type="checkbox"/> Display	<input type="checkbox"/> Edit	Field Name	Field Alias	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	{Description}	Description	↑
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	{Webpage_URL}	Webpage URL	↓
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	{Organization}	Organization	
<input type="checkbox"/>	<input checked="" type="checkbox"/>	{Latitude}	Latitude	
<input type="checkbox"/>	<input checked="" type="checkbox"/>	{Longitude}	Longitude	
<input type="checkbox"/>	<input checked="" type="checkbox"/>	{count}	count	

2.4 Under 'More options', select 'Manage labels' and select 'count' located next to the text box. Add a halo to emphasize the number.

This is what the 'Manage labels' page should look like:

Label Features

Climate initiatives mapping 2021
(Responses) - Processed data (3)

Label Features

Text: count

Font: Arial

28 **B** / U ■

Halo 9 ■

Alignment:

Visible Range:

World Room

OK CANCEL

2.5 Save the map.

3. Recreate the Climate Policies CCMM:

3.1 Log into ArcGIS then go to my maps. Scroll to the Metro Vancouver area, then choose a visually appealing yet relevant basemap from the ArcGIS Living Atlas. For this particular map, a world navigation map was used.

Home ▾ My Map

Details Add Basemap Analysis Save Share Print Directions

← Search for 5,085 layers

- Search for Layers
- Browse Living Atlas Layers
- Add Layer from Web
- Add Layer from File
- Add Map Notes

Terrain
by Esri
Updated: 3/24/21

World Navigation Map

Tile Layer by Esri
Updated: April 8, 2021

Authoritative Living Atlas

This (v2) vector tile layer provides a detailed basemap for the world featuring a custom navigation map style.

Description

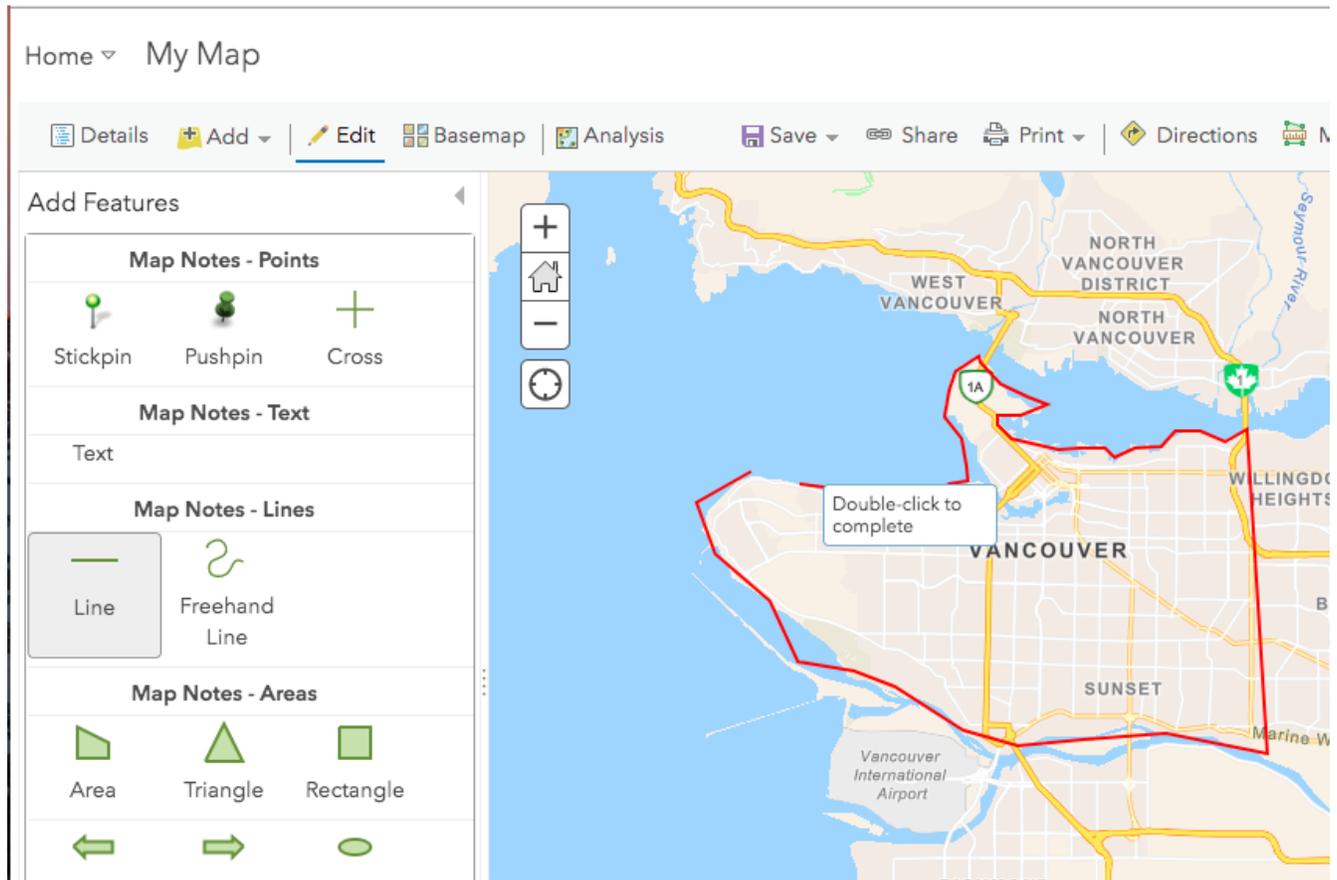
Add to Map

Use as Basemap

The image shows a screenshot of the ArcGIS Online interface. At the top, there are navigation tabs: 'Home', 'My Map', 'Details', 'Add', 'Basemap', 'Analysis', 'Save', 'Share', 'Print', and 'Directions'. The 'Add' menu is open, showing options: 'Search for Layers', 'Browse Living Atlas Layers', 'Add Layer from Web', 'Add Layer from File', and 'Add Map Notes'. Below the menu, a search bar shows 'Search for 5,085 layers'. A search result for 'Terrain' by Esri is visible, updated on 3/24/21. To the right, a map of the United States and surrounding seas (Bering Sea, Beaufort Sea, Gulf of Alaska) is shown with navigation controls (zoom in, home, zoom out, refresh). Below the main map, a detailed view of a search result for 'World Navigation Map' is shown. It includes a thumbnail of a street map, the title 'World Navigation Map', the creator 'Tile Layer by Esri', and the update date 'April 8, 2021'. It also features 'Authoritative' and 'Living Atlas' badges. A description states: 'This (v2) vector tile layer provides a detailed basemap for the world featuring a custom navigation map style.' At the bottom, there are two buttons: 'Add to Map' and 'Use as Basemap'.

3.2 Use Google Maps to figure out the boundaries of the municipalities in Metro Vancouver. By defining certain streets, neighbourhoods, rivers municipal boundaries cross in, use lines under map notes to draw in the municipal boundaries onto the map itself. Make a copy of that layer and rename it as municipal boundaries initiatives and

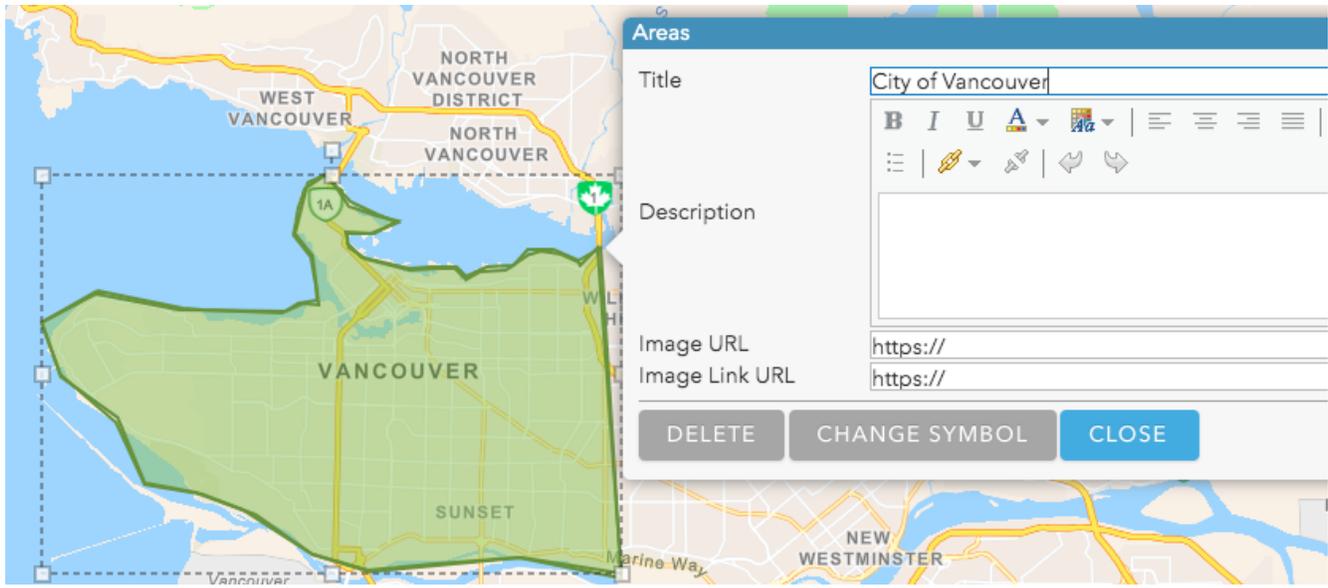
save it to 'Your contents'. Only use the municipal boundaries layer in the climate policies map since it will change if you edit it on a different map.



(Creating the municipal boundaries)

3.3 Create another map notes layer but use areas instead. Using the municipal boundaries layer as a guideline, create polygon areas that are the same shape and size as the municipalities. Selecting those areas, a blank text box should pop up. To make the map more visually appealing, you can change colors and adjust the transparency of the

lines and areas of the polygons.



(Creating the Municipal boundary layer)

3.4 In those empty text boxes, type in a brief description of the climate policies found in the municipality and copy and paste in governmental links that lead to the webpage where these policies can be found. With that, the climate policies map is complete. Save the map.

4. Recreating the Climate Initiatives CCMM

4.1 Follow the steps of step one from the 'Recreating the climate policies map' instructions.

4.2 Upload the Municipal boundaries initiative layer from my content made in the climate policies section to the map.

4.3 Download the 'Processed Data' tab from the Google Sheet and then upload it to ArcGIS (Go to Add -> Add Layer from File -> import file)

4.4 Once the points are added, select 'more options' located under the layer then configure 'pop-up'. Select 'configure attributes' and de-select the boxes 'latitude', 'longitude', and 'count'.

4.5 Under 'options', select on 'manage labels' and select 'count' located next to the text box. Add a halo to make the emphasis the number.

4.6 Save the map and add to story maps.

5. Recreating the automatically updating database

There are three tabs used on Google Sheets:

Form Response 1 sheet (where the data will first enter):

A	B	C	D
Timestamp	1. Organization name(s)	2. Initiative name (may be	4. Webpage URL
3/18/2021 13:11:23	Climate Convergence Me	Climate Convergence Me	http://www.climateconver
3/18/2021 14:01:59	FarmFolk	Climate Solutions Progra	https://www.farmfolkcityfc
3/18/2021 14:04:08	City Farmer Society	Vancouver Compost Den	http://www.cityfarmer.info
3/18/2021 15:26:11	Stepup4earth Society	Stepup4earth Society	https://stepup4earth.org/
3/18/2021 15:27:33	City of Surrey, Real Estat	Urban Heat Ready	https://www.surrey.ca/enc
3/18/2021 15:29:17	British Columbia Sustaina	British Columbia Sustaina	https://www.bcsea.org

E	F	G
6. Description of initiative	7. Which of the following	Which of the following m
Grassroots coalition educ	Climate justice	City of Burnaby, City of N
Our agricultural lands hol	Climate mitigation	Village of Anmore, Villag
We provide solutions to t	Climate adaptation	Village of Anmore, Villag
Stepup4earth organizes a	Climate mitigation	City of North Vancouver,
The Goal is to understand	Climate adaptation, Clima	City of Surrey

H	I	J	K
Municipalities list	Municipalities String	Municipalities no space	Organization
City of Burnaby	CityofBurnaby	CityofBurnaby, Cityof	Climate Convergence
City of New Westminster	CityofNewWestminster	VillageofAnmore, Villageo	Climate Convergence Me
City of Vancouver	CityofVancouver	VillageofAnmore, Villageo	Climate Convergence Me
Village of Anmore	VillageofAnmore	CityofNorthVancouver, Dis	FarmFolk
Village of Belcarra	VillageofBelcarra	CityofSurrey	FarmFolk

L	M	N	O	P
Initiative	Webpage URL	Description	Category	number
Climate Convergence	http://www.climateco	Grassroots coalition	Climate justice	30
Climate Convergence Me	http://www.climateconver	Grassroots coalition educ	Climate justice	
Climate Convergence Me	http://www.climateconver	Grassroots coalition educ	Climate justice	
Climate Solutions Progra	https://www.farmfolkcityfc	Our agricultural lands hol	Climate mitigation	
Climate Solutions Progra	https://www.farmfolkcityfc	Our agricultural lands hol	Climate mitigation	

Coordinates (A library of values):

Municipality	latitude	Municipality	longitude
CityofVancouver	49.2487	CityofVancouver	-123.15411
CityofBurnaby	49.2562	CityofBurnaby	-122.9686
DistrictofNorth	49.3554	DistrictofNorth	-123.007558
DistrictofWest	49.3591	DistrictofWest	-123.19921
VillageofBelcarra	49.3211	VillageofBelcarra	-122.92254

Processed data (the sheet that would be uploaded to ArcGIS online map):

A	B	C	D	E
Initiative	Category	Description	Webpage URL	Organization
Climate Converg	Climate justice	Grassroots coaliti	http://www.clima	Climate Converg
Climate Converg	Climate justice	Grassroots coaliti	http://www.clima	Climate Converg
Climate Converg	Climate justice	Grassroots coaliti	http://www.clima	Climate Converg
Climate Solution	Climate mitigatio	Our agricultural l	https://www.farm	FarmFolk
Climate Solution	Climate mitigatio	Our agricultural l	https://www.farm	FarmFolk

F	G	H
latitude	longitude	count
49.2562	-122.9686	10
49.212495	-122.917683	8
49.2487	-123.15411	26
49.3346	-122.8456	6
49.3211	-122.92254	6

5.1 Find coordinates that would be appropriate to represent each municipality. Created four columns as following on a tab called 'Coordinates':

Municipality	latitude	Municipality	longitude
CityofVancouver	49.2487	CityofVancouver	-123.15411
CityofBurnaby	49.2562	CityofBurnaby	-122.9686
DistrictofNorth	49.3554	DistrictofNorth	-123.007558
DistrictofWest	49.3591	DistrictofWest	-123.19921
VillageofBelcarra	49.3211	VillageofBelcarra	-122.92254
CityofPortMoody	49.302274	CityofPortMoody	-122.8886
VillageofAnmore	49.3346	VillageofAnmore	-122.8456

It is important to have no spaces in the municipality since we

will use the Vlookup function. The writing in the municipality column would need to match the 'Municipalities String' column on the Form Responses 1 sheet.

5.2 Each survey response would answer the question 'which municipalities are you active in?' and that unprocessed response would appear like this:

City of Burnaby, City of New Westminster, City of Vancouver

On the tab where the data will initially be imputed (Form Responses 1) write on the next empty column 'Municipalities List'. Here, you will extract the multiple answers from a single text box to make a list of municipalities so it'll look like this instead:

Municipalities list
 City of Burnaby
 City of New Westminster
 City of Vancouver

Using the formula `=TRANSPOSE(SPLIT(JOIN(",",G2:G),","))` on column H2 will achieve this.

5.3 After the municipalities list is made, all the spaces need to be removed. On the next column labelled 'Municipals String', the formula `=ARRAYFORMULA(IFS(ROW(A:A)=1,"Municipalities no space",G:G="",",",TRUE, SUBSTITUTE(G:G," ","")))` was added on the bin I1 to achieve this. The writing inside the bins in column I will be the same as the writing inside the bins on the coordinates page.

Municipalities String
CityofBurnaby
CityofNewWestminster
CityofVancouver

Municipality	latitude	Municipality	longitude
CityofVancouver	49.2487	CityofVancouver	-123.15411
CityofBurnaby	49.2562	CityofBurnaby	-122.9686
DistrictofNor	49.3554	DistrictofNor	-123.007558

Column I from Form
Responses 1 sheet

Coordinates sheet

5.4 In the 'Processed Data' tab, add the following formula to F1.

`=ARRAYFORMULA(IFS(ROW(F:F)=1,"latitude",D:D="",",",TRUE, VLOOKUP('Form Responses 1'!I:I,Coordinates!A:B,2,0)))`

Then add the following formula to G1.

`=ARRAYFORMULA(IFS(ROW(F:F)=1,"longitude",D:D="",",",TRUE, VLOOKUP('Form Responses 1'!I:I,Coordinates!D:E,2,0)))`

This would give you the data points that ArcGis can plot on the map.

5.5 This section is to ensure that the 'pop-up' provides information that matches with the data points. Go back to the Form responses 1 tab for the following steps. Next is to create the column 'Municipalities no Space' on column J where inside the bins look like this:

City of Burnaby, City of New Westminster, City of Vancouver

To achieve this, add = ARRAYFORMULA(IFS(ROW(A:A)=1,"Municipalities no space",G:G="", "",TRUE, SUBSTITUTE(G:G," ",""))) to J1.

5.6 For the next couple formulas to work, create a column P and in P2, add:

=COUNTA(B2:B)

5.7 To make the long list of metadata that matches with the list of coordinates use this formula in K2

=TRANPOSE(SPLIT(JOIN("",ARRAYFORMULA(REPT(offset(B2,, \$P\$2)&"/",len(offset(J2,, \$P\$2))-len(SUBSTITUTE(offset(J2,, \$P\$2)," ","")+1))),"/"))

K
Organization
Climate Convergence
Climate Convergence Me
Climate Convergence Me
FarmFolk

This would give you the list of organizations. If a survey responder said the climate initiative was found in all 21 municipalities (or all of B.C/Worldwide), then the organization name will be written 21 times.

For initiative list use in L2:

=TRANPOSE(SPLIT(JOIN("",ARRAYFORMULA(REPT(offset(C2,, \$P\$2)&"/",len(offset(J2,, \$P\$2))-len(SUBSTITUTE(offset(J2,, \$P\$2)," ","")+1))),"/"))

For Webpage URL list use in M2:

=TRANPOSE(SPLIT(JOIN("",ARRAYFORMULA(REPT(offset(D2,, \$P\$2)&"/",len(offset(J2,, \$P\$2))-len(SUBSTITUTE(offset(J2,, \$P\$2)," ","")+1))),"/"))

For Initiative description list use in N2:

```
=TRANSPOSE(SPLIT(JOIN("",ARRAYFORMULA(REPT(offset(E2,,,$P$2)&"/",len(offset(J2,,,$P$2))-len(SUBSTITUTE(offset(J2,,,$P$2),"","")+1))),"/"))
```

For Initiative category use in O2:

```
=TRANSPOSE(SPLIT(JOIN("",ARRAYFORMULA(REPT(offset(F2,,,$P$2)&"/",len(offset(J2,,,$P$2))-len(SUBSTITUTE(offset(J2,,,$P$2),"","")+1))),"/"))
```

5.8

Next to make the data presentable and easily uploaded as a csv file for ArcGIS. On the 'Processed Data' tab, add the following formulas:

In A1: =ArrayFormula('Form Responses 1'!L1:L)

B1: =ArrayFormula('Form Responses 1'!O1:O)

C1: =ArrayFormula('Form Responses 1'!N1:N)

D1: =ArrayFormula('Form Responses 1'!M1:M)

E1: =ArrayFormula('Form Responses 1'!K1:K)

F1: =ARRAYFORMULA(IFS(ROW(F:F)=1,"latitude",D:D="",TRUE, VLOOKUP('Form Responses 1'!I:I,Coordinates!A:B,2,0)))

G1: =ARRAYFORMULA(IFS(ROW(F:F)=1,"longitude",D:D="",TRUE, VLOOKUP('Form Responses 1'!I:I,Coordinates!D:E,2,0)))

H2: =ARRAYFORMULA(COUNTIF('Form Responses 1'!I2:I,'Form Responses 1'!I2:I))