



Natural Resources  
Canada

Ressources naturelles  
Canada

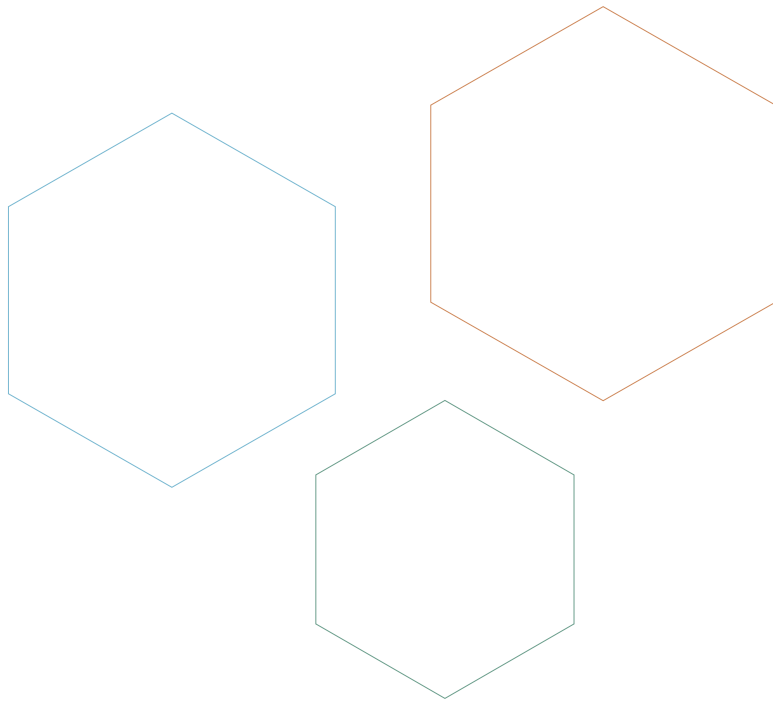
Canada

# MMSD Data Visualization Pilot

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**FINAL REPORT**  
OCTOBER 2023



We would like to extend our sincere appreciation to the entire Metals and Minerals Statistics team for their openness, support, and dedication throughout the course of this project. Your willingness to embrace us as members of your team, provided us with invaluable insights into the mining industry and into the details of how companies invest in this sector. Your patience in answering our million questions did not go unnoticed and significantly enriched our experience. You are the reason for the success of this initiative.

Special thanks to Sarah Heath for entrusting us with the opportunity to foster innovation within the team. We are grateful to Rory Gilsean for his unwavering support and inquisitive approach, which invariably helped us find solutions. We also extend our gratitude to Shane Norup and Sandrine Levasseur for welcoming us into the team and to Dianna Miller for her openness to new ideas during a period of transition.

This report is a testament to the collective efforts and dedication of the entire team, and we are honored to have had the opportunity to collaborate with such an exceptional group.

**Jagoda Walny Nix and Annette Hester**



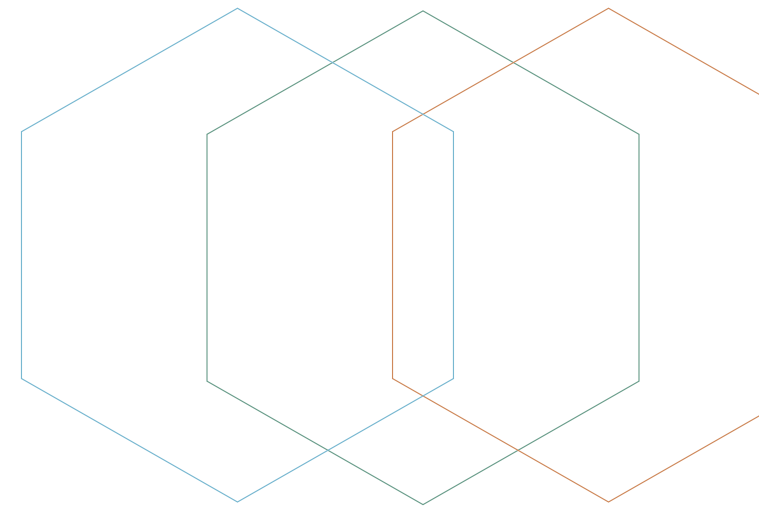
# Executive Summary

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In autumn 2022, the Minerals and Metals Statistics Division (MMSD) embarked on a pilot project with Annette Hester and Jagoda Walny Nix at the helm, aimed at enhancing the accessibility and relevance of mining exploration expenditure data. The initiative was driven by an overarching vision to advance the modernization of MMSD's data landscape and foster a culture of learning within the team. Key objectives encompassed improving data accessibility, identifying primary data audiences, assessing team skill sets, setting an example of modernization, and ensuring sustainable changes. Excellence for a statistics unit was the guiding principle.

The project methodology was based on a design-driven approach, with a detailed design discovery workshop serving as the foundational step. The workshop identified essential insights, including the need for improved data linkages, audience identification and expansion, and a re-evaluation of the data classification system. After analysing the insights from the workshop and considering the pilot timeframe and scope, the team concluded that redesigning the entry page into the Exploration Survey Data to provide context and utilizing it as a “business card” and a conversation starter with diverse audiences would serve as the most effective pilot.

To create these pages the team employed an iterative data visualization design process, integrating expert consultations, feedback loops, and prototype adjustments to refine the design and ensure alignment with stakeholder needs. An integrated coding and static graphic design team was instrumental in translating the design into a functional visualization prototype.



Despite encountering challenges in securing appropriate resources, the team's commitment and agile approach facilitated the successful execution of the design process. Moving forward, the assignment of a project manager to guide the strategic dissemination of the product and ongoing engagement strategies will be crucial for sustaining the project's impact. Post-launch, the focus should shift towards collecting user feedback, establishing a maintenance schedule, and making the visualization code reusable and open source for broader accessibility and collaboration.

The successful implementation of this pilot visualization underscores MMSD's commitment to leveraging data visualization as a catalyst for transformative change. The team's dedication, coupled with strategic planning for the project's long-term success, highlights the potential for continued advancements in the field of minerals and metals statistical data. The pilot has laid a strong foundation for future endeavors, emphasizing the importance of continued engagement, refinement, and commitment to excellence.

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# Introduction

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In the autumn of 2022, the Minerals and Metals Statistics Division (MMSD) enlisted Annette Hester, the CEO of [www.thehester.com](http://www.thehester.com) – an internationally recognized specialist on improving organizational performance and innovation, particularly in the realms of energy, climate, and energy transition – to spearhead a pilot project. The goal was to elevate MMSD’s modernization efforts by significantly improving the accessibility and relevance of the mining exploration expenditure data.

To realize this ambitious goal, Ms. Hester joined forces with Jagoda Walny Nix, a seasoned data visualization design expert from the Canada Energy Regulator. Together, they conceptualized and executed a tailored dynamic data visualization pilot project. The targeted timeline for completing this pilot was set for October 2023, aligning with the conclusion of both Ms. Hester and Ms. Walny Nix’s tenure with MMSD.

This comprehensive report will detail the methodological framework employed as well as provide insights gained throughout the process. The aim is to provide MMSD with the knowledge and direction required to become a trailblazer in the realm of metals and minerals statistical data.

## The core objectives of this initiative were multifaceted:

- 1 Enhance Accessibility and Relevance:**  
Make mining exploration expenditure data easily accessible, comprehensible, and pertinent to a diverse range of stakeholders, both within and beyond the government, even those lacking expertise in the mining sector.
- 2 Audience Identification:**  
Investigate and define the primary audiences for this data, thereby aiding the establishment of a prioritized order of importance.
- 3 Skills Assessment:**  
Identify the strengths and weaknesses in the team’s skill set, facilitating targeted skill development strategies.
- 4 Exemplar of Modernization:**  
Serve as a live demonstration of how to modernize the MMSD data environment while concurrently fostering a culture of “learning by doing” among the staff.
- 5 Sustainability:**  
Ensure that the introduced changes would be sustainable, guaranteeing long-term impact and relevance.



From the outset, this project was founded on the notion that a data visualization design process was the appropriate avenue to reimagine the way MMSD disseminates its data to the public. In an era where information overload is a genuine concern, more data does not always translate to more information. Design thinking emerges as a powerful tool for selecting the most relevant data and presenting it in the most effective manner to achieve a specific goal.

Annette began her tenure at MMSD in November 2022, aware that Jagoda would join the team at the end of February 2023. To ensure a smooth project launch in March, Annette dedicated her initial months to familiarizing herself with mining data and understanding the organization of the Lands and Minerals Sector (LMS) within Natural Resources Canada (NRCan), of which MMSD is a part. This involved mapping out team responsibilities and delving into the policies and international aspects of critical minerals, especially within Canada and other G7 countries.

In addition to one-on-one conversations with MMSD team members, Annette also reached out to key individuals within LMS, including Andrew Ghattas, Melanie Campbell, Genevieve Marquis, Jim Lauer, and Denis Dupont (at the request of Mark Boyland). Furthermore, discussions with experts like Robert Johnston from Columbia University, Morgan D. Bazilian from the Payne Institute at the Colorado School of Mines, and Michele Michot Foss from the Baker Institute at Rice University offered essential international context for Canadian endeavors, specifically in addressing data-related requirements for policy formulation and conducting insightful research on critical minerals and their impact on energy transition. It is important to note that the Canadian Critical Mineral Strategy was published in December 2022.

# Methodology

We followed an established methodology for data visualization projects, as illustrated in Figure 1. This approach covers the subsequent categories, which will be detailed further in this report.

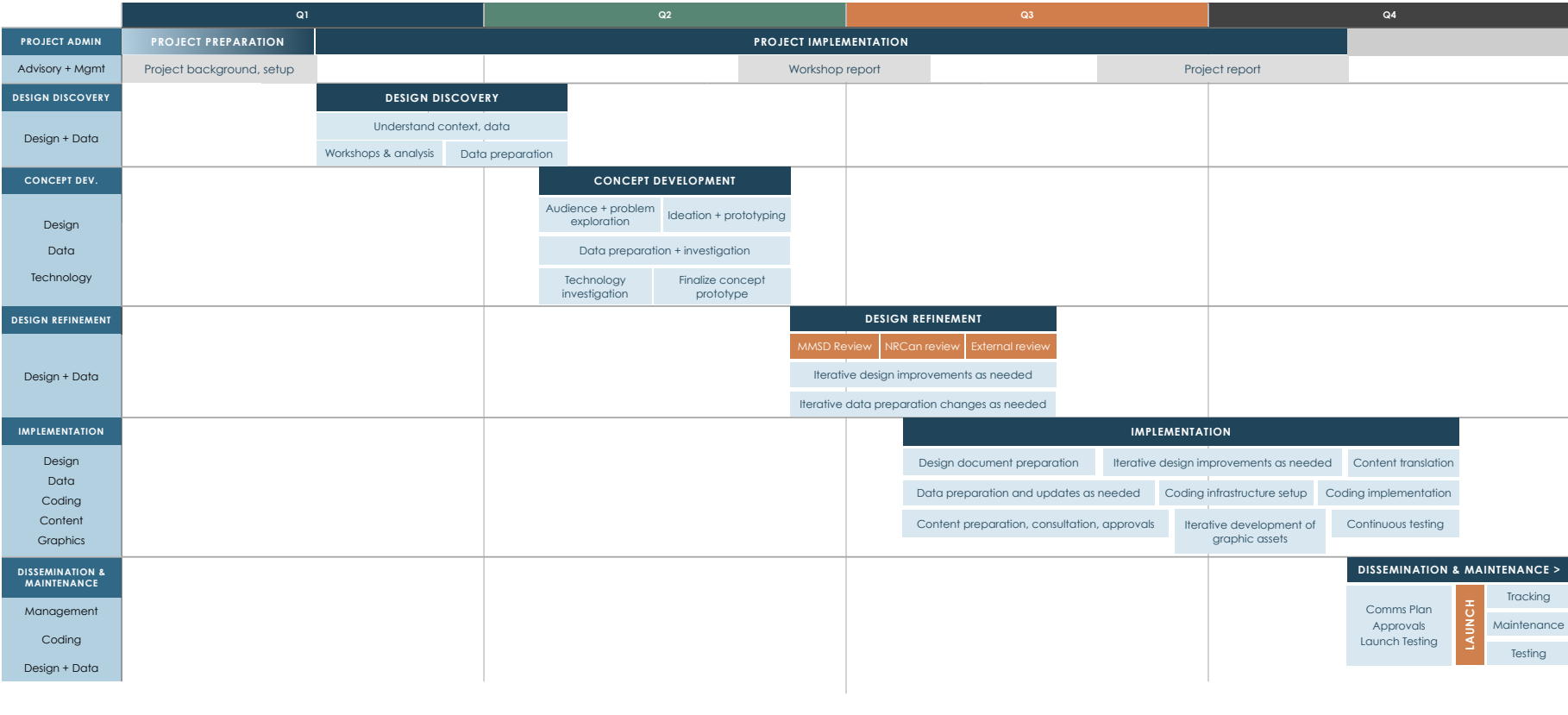


Figure 1. General timeline and roles of the preparation and execution of the pilot project.

- **Design Discovery:** The process of understanding contextual information about the data and discovering and shaping the goals of the project. At this stage, a workshop is often the most efficient path to discovery, as it brings together multiple stakeholders in an open and semi-structured environment to share their perspectives.
- **Data Visualization Concept Development:** This phase explores the available design space to arrive at a concept that responds to the project and audience goals and needs. This involves experimenting with various combinations and presentations of the data to arrive at a workable concept and requires close involvement with data experts.
- **Iterative Testing and Design Refinement:** Once a feasible concept is in place, an iterative process of testing, consultations, and redesign begins. A concept is a tangible, visual artifact, and reactions to it by varied stakeholders inform successive redesigns until the design has sufficiently matured.
- **Implementation:** Once the design is mature, a detailed design document is presented to teams that will bring the concept to life. The design document is a living document that can be further refined in response to challenges and constraints that appear during the building. In this case, the implementation required:
  - **A coding team** to build the interactive visualizations for the MMSD external website.
  - **A graphics team** with data visualization expertise to create infographics, icons, and data visualization-appropriate colour schemes.
  - **A content team** to provide the explanatory text and related translations for the web pages.
  - **Elements of launch planning**, including launch approvals and a communications plan.
- **Dissemination and Maintenance:** A data visualization is a dynamic product. It must be maintained to ensure it responds to data updates and it has room to grow, expand, and change as audience needs become better understood. It also must be actively and strategically disseminated to ensure that it reaches its intended audiences. We outline a number of techniques and recommendations for this process.



# Design Discovery Workshop

Following Jagoda's integration into the team and being briefed on the context, preparations for a design discovery workshop commenced.

The workshop was conducted in person and was exclusively open to NRCan personnel. It was held in Ottawa on March 28 and 29, 2023. A detailed report of the workshop, encompassing objectives, insights, a list of attendees, and the agenda, can be found in Appendix A.

In broad terms, the workshop sought to achieve the following objectives:

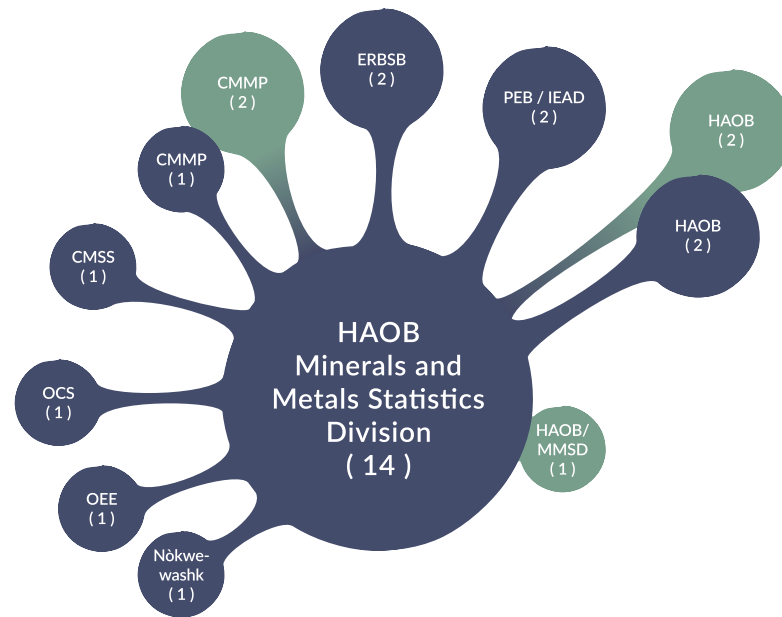
- Enhance the efficiency of the data discovery process by bringing together subject matter experts, data designers, scientists, coders, user experience specialists, and data users. Their task was to assess proposals for data curation and potential narrative approaches for visualizations.
- Explore the interconnections between various facets of the mining industry, including Environmental, Social, and Governance (ESG) factors, the Extractive Sector Transparency Measures Act (ESTMA), Indigenous Knowledge and Relations, and mining exploration expenditures data.
- Gain a collective understanding of what constitutes excellence in statistical data for both the team and NRCan, emphasizing the “what” aspect of the data rather than the “why.”
- Familiarize the team with the data visualization creation process.
- Ensure team buy-in for the pilot project, a critical step in successful change management and integration.

Preparation for the workshop involved the active participation of several MMSD team members who collaborated with Jagoda and Annette to determine and curate the necessary datasets and reached out to other divisions that generously agreed to make presentations at the workshop.

Management played a pivotal role in helping the team secure an experienced design workshop facilitator, Alex Eady, in time for the event. Emily Tucker, a research analyst on the MMSD team, led the team's efforts in documenting the numerous discussions that transpired during the workshop.

The materials collected during the gathering are catalogued and available upon request.

## DIVISIONS COMING TOGETHER FOR THE MMSD IDEATION WORKSHOP



- CMMP** Canadian Minerals and Metals Plan
- CMSS** Corporate Management and Services Sector
- ERBSB** Explosives, Regulatory & Business Services Branch
- HAOB** Hazards, Adaptation and Operations Branch
- Nökwewashk** Indigenous sector
- OCS** Office of the Chief Scientist
- OEE** Office of Energy Efficiency
- PEB / IEAD** Policy & Economics Branch / Integrated Economic Analysis Division

- Attendees
- Contributors

# Workshop Insights

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Of particular significance is the fact that this marked the first occasion the MMSD team convened with several potential users of its data to collectively discuss the context and nuances of the exploration survey dataset. Key themes that emerged included foundational excellence, transparency, data consistency, and staying up to date with technology.

The team acknowledged the current challenges associated with the exploration dataset, such as the reporting burden; questioned the utility of the data; and deliberated on whether an evaluation of its alignment with other datasets (provincial) and regulatory processes was warranted. Furthermore, there was an acknowledgment that the way forward necessitates leveraging technology for automated or semi-automated extraction of administrative data, such as stock exchange filings, provincial registry, etc...

Another pivotal insight, crucial for the data visualization pilot, was the realization that the existing audience for the exploration survey data was primarily focused on a select group, the Economic Analysis team, with only a secondary focus on other departments and external organizations. The absence of detailed audience research made it challenging to identify who accessed this data over the years. Nevertheless, given the substantial number of views and downloads, it is likely that experts who understood the data's significance and context were the primary users. **The workshop feedback validated the concept that this information, if made more accessible, would be valuable to other teams within NRCan and the government at large.**

**The issue of data confidentiality and the inconsistency between what is accessible in provincial datasets versus the federal system was also a topic of discussion. Addressing this challenge was deemed essential to ensure data openness in the future.**

**A notable deficiency identified was the absence of location data and unique mine identifiers. Without a linking element that connects the exploration survey data to other datasets, robust trend analysis and data integration become improbable.** During the workshop, it became evident that while individuals could recognize the relevance of ESG and Indigenous Knowledge to the mining industry, they faced challenges connecting it to the sample dataset, even conceptually.

On a positive note, the workshop underscored the significance of and openness to creating room for learning and experimentation. **Looking ahead, management should reassess the demands on the team's time to enable these initiatives. A continuous re-evaluation of what constitutes excellence, taking into account current methods and legislation, is crucial to maintain the team's cutting-edge position and its role as NRCan's data steward.**

# Data Visualization Design

## Concept

Coming out of the workshop it was clear that ambitious aspirations were not possible with the current dataset. While the division aimed to improve its publication approach, achieving this implied a fundamental shift in the data collection process. In essence, modernization would need to transcend the ongoing transition from paper-based to digital, to also encompass a revision of the data collected. The utilization of the distinct three phases - exploration, deposit appraisal, and mine development complex - in the current survey serves as a case in point. Despite these phases not following a strict sequence or demonstrating distinct separation, the current data made it impossible to finesse a different structure.

The notion of expanding the current audience to include other teams within LMS/ NRCan through collaborative efforts was considered. However, the intricacies involved in this collaboration would have significantly extended the timeline, making it unfeasible given the impending October deadline.

Confronting this reality, we acknowledged that our scope was limited to reflecting the existing data. So, if our capacity only allowed us to change the data presentation, the question arose: how could we elevate it to the next level?

We concluded that redesigning the entry page into the Exploration Survey Data to provide context and utilizing it as a “business card” and a conversation starter with diverse audiences would serve as the most effective pilot approach. **The hope was that a “business card” would allow the team to see the gaps and, through input from new users, generate new ideas for the future.** This design would also confine the information to “Summary Statistics” (aka descriptive statistics), providing the MMSD team with a benchmark for excellence in a statistics unit.

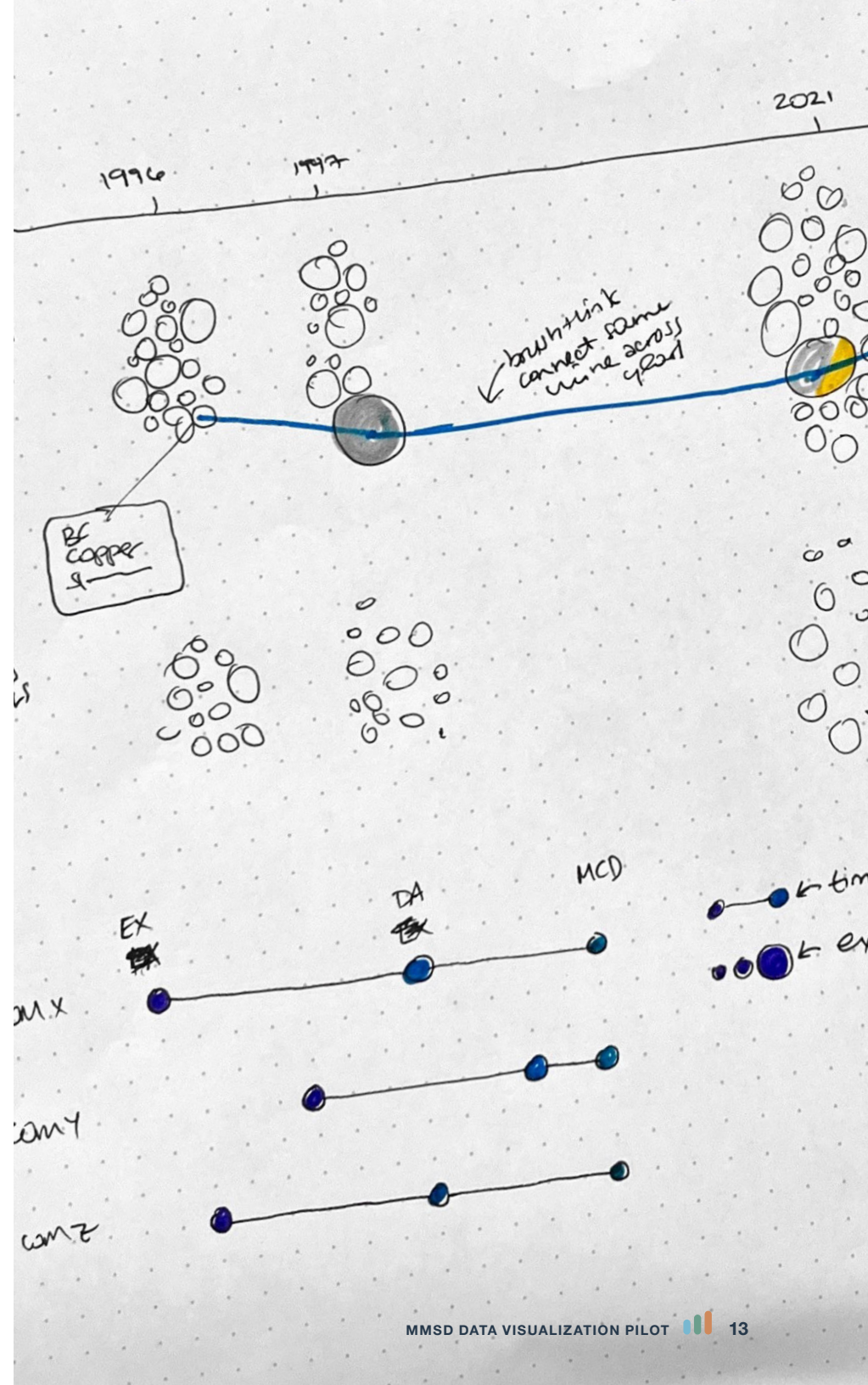
## Data & Technology

An agile design team was assembled, with Jagoda and Emily collaborating closely on the design of the entry page while seeking input from Donald Wright, an MMSD analyst with extensive mining industry experience, and the survey specialists on the details of the data. The process was to explore the data, experiment with possible visuals, and consult with internal experts on the meaning of the data and what would be useful to show

At this time, it was important to decide on the technological approach to implementing the visualization, as different approaches vary in terms of their design possibilities and constraints.

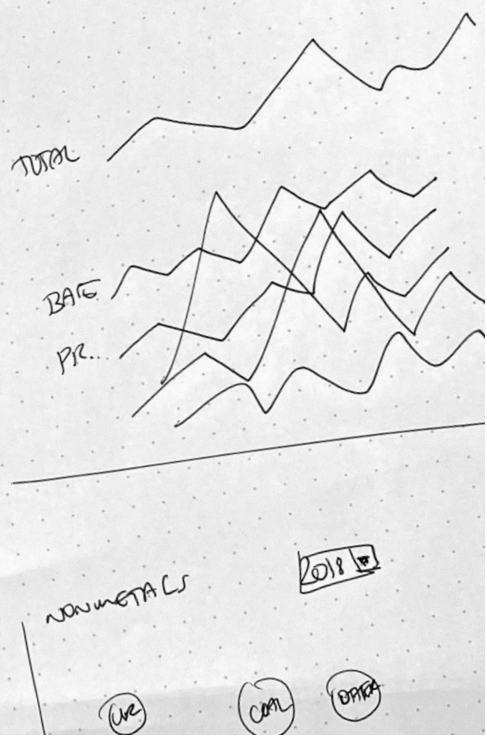
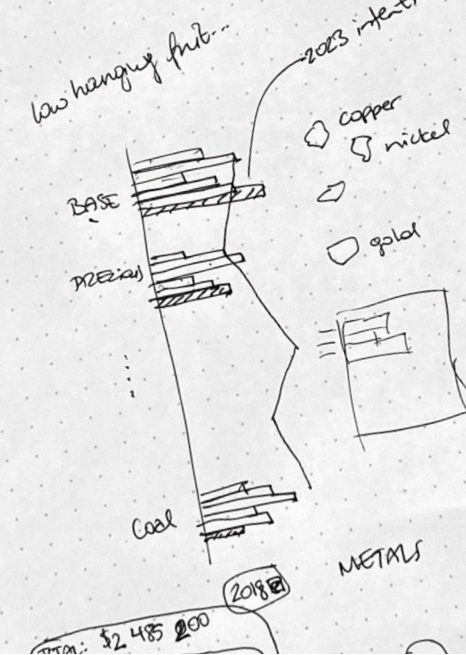
**The expressive power of a visualization technology can determine the types of possible visualizations, their interactivity, their ability to blend in with Canada.ca design standards, and their support for accessibility standards.**

While the design team worked on developing a prototype, Annette, in consultation with Jagoda, began establishing a precedent for the utilization of diverse visualization technologies on the Government of Canada webpages. The document can be found in Appendix B.

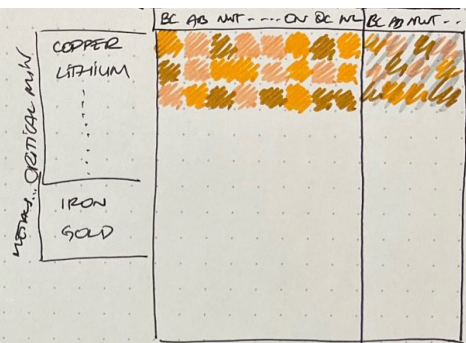
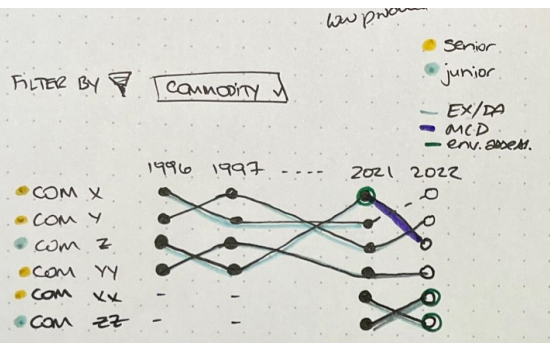


- Base
- Precious
- Other
- Iron
- Uranium
- Nonmetals
- Diamond
- Coal
- Critical Minerals??

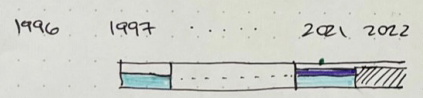
2018 (prelim) - 2023 (intentional)



important? relative amt? year?



- \* better for uncertain numbers
- \* shows which commodity provinces are heating up
- \* collapse plot to view just years
- \* can further split into jr/sr



joint style  
 ← relative or absolute?  
 ← maybe not enough space?



mine sites / BC	name	loc	Exp 2021	2022
~				
~				
~				
~				
~				
~				
~				
~				

goal: show history - which have stagnated, which have fizzled out

This initiative was crucial because despite NRCan's extensive use of PowerBI, the department lacked an external publishing license for this tool. Paradoxically, this limitation proved advantageous since PowerBI, while suitable for certain applications, was not the ideal tool for the dynamic custom visualizations the team envisioned. D3 emerged as a superior option for this purpose. As a well-established JavaScript library, D3 is well-suited for crafting visualizations for general audiences, allowing for enhanced accessibility and customized styling. Fortunately, numerous examples of D3 visualizations were already present on the Canada.ca pages, providing MMSD with a robust case for its implementation in the pilot.

Early data visualization sketches during the concept development stage.

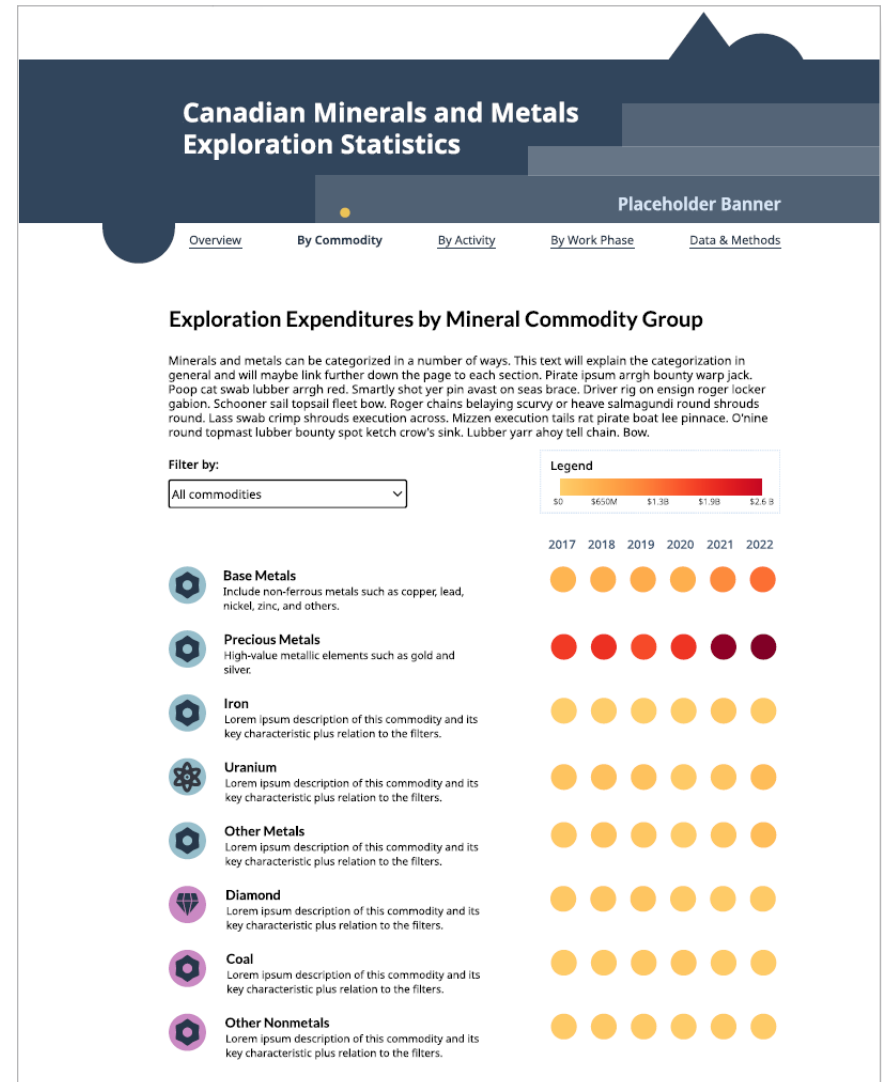
## Design Prototype

Once the prototype was done, rigorous testing started within LMS, and then with interested government partners, including provincial governments and industry organizations. The feedback was meticulously documented, and the prototype underwent multiple revisions.

Initial internal consultations at MMSD proved invaluable in terms of bringing about clarity and precision.

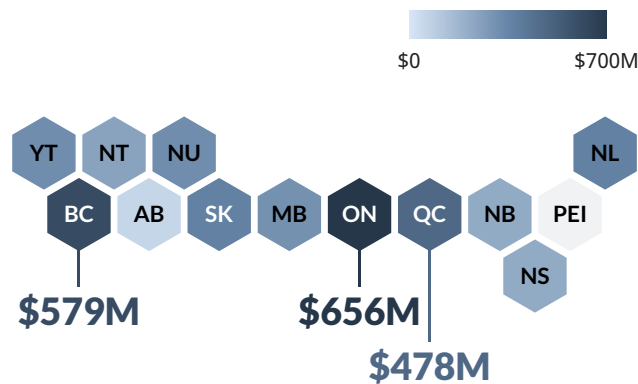
Notably, the existence of a prototype facilitates the identification of gaps in understanding between the design team and subject matter experts, shifting discussions from theoretical to practical realms.

Excerpt from an early prototype of the commodities heat map



The following represent the focal points addressed during the iterative evolution of the design prototype:

- Different opinions surfaced regarding the most important categories to feature on the front page, influenced by each person’s viewpoint and area of expertise. In the end, we chose to highlight the broadest categories relevant to Canada. The design begins with a comprehensive overview on the initial page and gradually focuses into more specific details across the following four pages. The last page maintains the information available on the current MMSD exploration data page to ensure a seamless experience for current users and those accustomed to extracting data from tables.



Final design of the hex tile map showing the latest year's expenditures per province.

An early version of the front page consolidated data from all three phases and used different commodity groupings in the line chart.

## Canadian Minerals and Metals Exploration Statistics

Placeholder Banner

[Overview](#) | [By Commodity](#) | [By Activity](#) | [By Work Phase](#) | [Data & Methods](#)

**placeholder image**

**Mining is an important industry for Canada.** It supplies raw materials for everyday goods, infrastructure, and renewable energy projects like batteries, solar panels, and wind turbines.

**About this data.** Mineral exploration investment indicates industry health. Natural Resources Canada collects annual data from mining companies on exploration expenditures. Use the provided links to access data on commodity-specific spending, various exploration activities, and the three exploration phases. Data downloads are also available.

**placeholder image**

**Intended**

**\$7.2B** 2023

Companies estimate they will spend \$7.2B this year, down 2% from 2022.

**Total**

**\$7.4B** 2022

Spent on exploring for minerals, appraising deposits, and developing mines in Canada last year.

**Total exploration & development expenditures in Canada by commodity group**

Last update: June 27, 2023. Values are nominal.

[Data Table, Text Description, and Notes](#)

**Where is the money spent?** Quebec, Ontario, and British Columbia are the top mining regions of Canada. In 2022, their combined spending on exploring for minerals, appraising deposits, and developing mines was 2/3 of Canada's total.

[Data Table, Text Description, and Notes](#)

**What are companies searching for?**

Precious metals (mainly gold) are the most sought-after commodities in Canada, accounting for 58% of the spending in 2022.

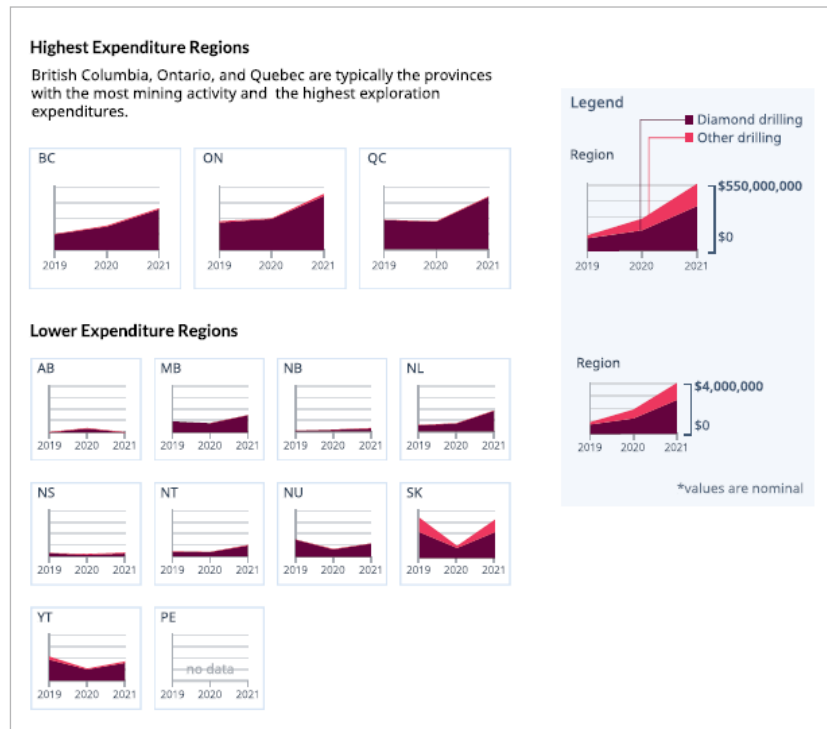
Precious metals	Base Metals	Non-metals
		Uranium
		Other metals
		Co. Iron Ore

[Data Table, Text Description, and Notes](#)

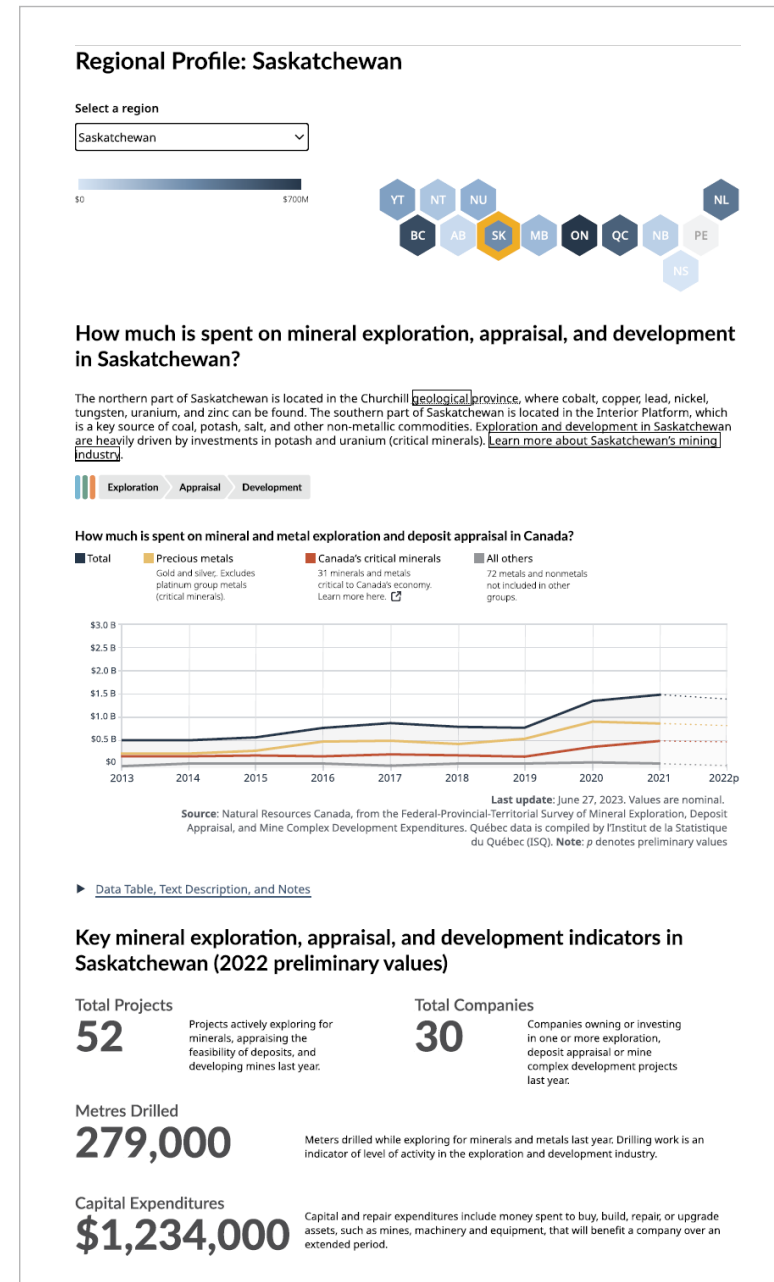
[Explore commodity data >](#)



- Our initial attempt at displaying activity expenditures by province revealed that while regional data was intriguing, the specific data we initially chose did not resonate with users. Consequently, we simplified the activity visualization and introduced a **regional profiles section that possesses the potential for expansion to cater to future requirements from MMSD data audiences.**
- Consultations with diverse NRCAN and external stakeholders provided valuable insights into the most interesting indicators associated with the regional profiles, such as capital expenditures and meters drilled.



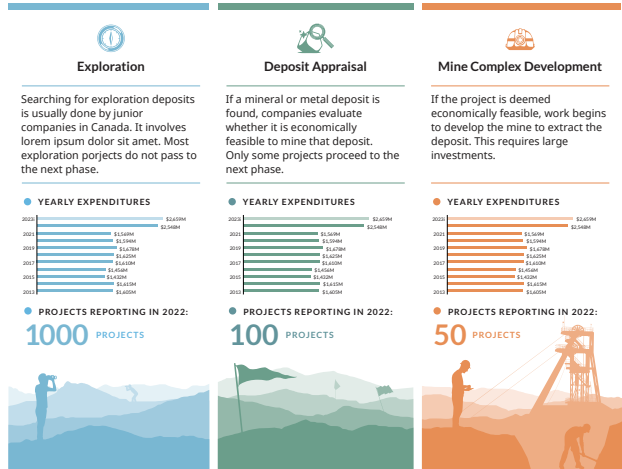
Early prototypes included regional comparisons of detailed activity expenditure data.



In response to feedback on the earlier prototypes, the final design shows regional profiles instead.

### Three Work Phases of Mining Exploration and Development

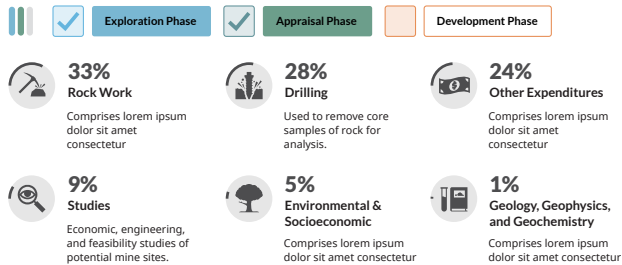
Mineral exploration and development encompasses the steps needed to establish a working, producing mine. Statistics for producing mines are available on NRCan's [Mineral Production Statistics](#) page.



Last update: June 27, 2023. Values are nominal. Source: Natural Resources Canada, from the federal-provincial territorial Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.

[Data Table, Text Description, and Notes](#)

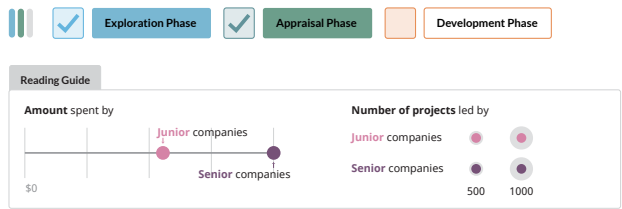
What activities is the money spent on in each phase?



Last update: June 27, 2023. Values are nominal. Source: Natural Resources Canada, from the federal-provincial territorial Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.

[Data Table, Text Description, and Notes](#)

Who invests when? Junior or senior companies?



- The classification of the data into three distinct exploration phases, a recurring topic raised by both internal and external stakeholders, emerged as a point of contention. While the data itself remains definitive, the process defies linear classification, resembling more of a “life cycle” than distinct phases. Survey experts are trained in the classification of this data. A sizeable percentage of the data audience, however, are not. Potentially, this misalignment, leads to misinterpretations or a lack of understanding of the data and its relation to other data sources. **This contentious issue calls for further research, as the purpose and beneficiaries of this typology remain unclear beyond the notion of tradition.**
- Discussions on critical minerals and their various groupings drew diverse opinions. Prior to this pilot, MMSD had not published data tables featuring any critical minerals groupings or corresponding annotations. Addressing this gap necessitated determining the most significant combination (list) for inclusion, as NRCan publishes several critical minerals lists for different purposes.

The final design incorporates a visual language for the three phases upon which the exploration data is based and provides visitors the option to combine data from the phases of their choosing.

- The idea of showing “battery-critical” minerals stemmed from early external consultations, highlighting the importance of seeking external perspectives to complement NRCan-centric viewpoints. External contributors, operating from different perspectives, possess extensive industry knowledge and data insights, enriching the discussion with a fresh frame of reference.

After three months of design, consultations, and management approvals, the team concluded by mid-July that the design had reached its optimal maturity for coding and timely delivery. Many good ideas did not make it to the final design, and other ideas were discarded after analysis as they were unsuitable for different reasons. Promising ideas were documented into a “parking lot” that can be used when time comes for updated versions.

The subsequent step involved the handover of the annotated design document to both the coding and static graphic design teams.

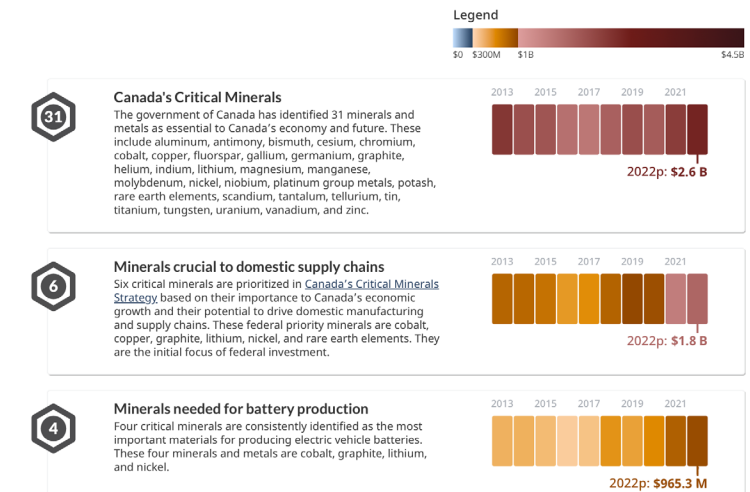
## Commodities Sought in Canadian Mineral Exploration and Development

Commodities are minerals and metals that companies search for and extract as raw materials so they can ultimately be used in a variety of products. This page provides information about spending on the exploration and development of projects seeking various commodities throughout Canada. There are three visualizations on this page: expenditures by general commodity groups, expenditures by key critical mineral groups, and a ranking of the top 10 commodities sought over time.

VIEW All Commodities Critical Minerals Commodity Ranking

Exploration Phase
Appraisal Phase
Development Phase

### How much is spent on exploration and appraisal of key commodity groups in Canada?



Last update: June 27, 2023. Values are nominal. Source: Natural Resources Canada, from the Federal-Provincial-Territorial Survey of Mineral Exploration, Deposit Appraisal, and Mine Complex Development Expenditures. Québec data is compiled by l'Institut de la Statistique du Québec (ISQ).

The final design displays data for different groupings of critical minerals. It is designed with room to respond to changes and updates to relevant critical minerals lists.

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## The Coding Team and Process

Our methodology requires an integrated coding, design, and data team. Design plays a central role in ensuring all aspects of the project are integrated and consistent with the problem being solved and with previous design decisions. Design is more than aesthetics and involves a series of investigations, choices, and adherence to principles. Once implementation has begun, designers make decisions about changes to the design when technology and data constraints appear. Data experts provide and verify accurate data in the appropriate format. Coders build the final product, ensuring that it adheres to the design, works well and accurately, and is compliant with accessibility and other governmental standards. The implementation process is iterative; all team members work together to respond to challenges as they appear.

MMSD was fortunate to possess some IT/coding talent. However, none were familiar with D3 or the integration of complex interactive visualizations into a web environment. Despite identifying this gap early on, securing resources with the requisite expertise from other government teams proved challenging. Compounding the issue was the financial disparity between the maximum daily rate allowed by the government for this expertise, which fell significantly below the remuneration commanded in the private sector, where demand for these skills is exceptionally high.

It took creativity from management and the pilot leads to secure the necessary resources to form a coding team, allow them time to experiment. They secured an expert consultant

in interactive data storytelling, Eugene Chen of IdeaOwl, to collaborate with the coders, **facilitating a learn-by-doing and observational approach**. The goal was to ensure accurate and refined implementation of the design document, allowing the team to grasp best practices, sustain the visualization, and progress to developing additional visuals for MMSD.

While the new coding team faced several challenges while learning to **use agile methodologies**, they eventually found their stride, although this took some time. Consequently, the original publishing date got postponed from October to probably the end of November. Despite these obstacles, they embraced new ideas and tried out different technologies to improve translation, accessibility, and the creation of visualization code that could be reused by MMSD or other government departments. As of now, this work is still ongoing. It is important to keep an eye on the timelines and the project's scope to make sure the pilot is finished and published by the end of November.

The challenges encountered while integrating the coding team provided valuable insights to management, revealing weaknesses in the overall pilot project design. Particularly, **the absence of a project manager from the MMSD meant that there was no dedicated resource to oversee that the progress of various project components was occurring in a timely manner**. Annette handled most of these responsibilities and was able to finesse the challenges, however, having an internal resource trained for this role is essential for future projects. Additionally, **a project charter with clearly defined objectives, timelines, and other relevant details would have enhanced the overall management of the project**.

# Static Graphic Design

Another important facet of our methodology involves the **inclusion of a graphic design team specializing in the static aspects of the design, particularly those requiring infographics**. We opted to collaborate with Tétro Design from Winnipeg, known for their extensive experience in this field, especially within the parameters set by the Canada.ca framework.

Their involvement began in late July, when they received a version of the annotated prototype and held multiple meetings with the design team to comprehend the overall aesthetics and grasp the challenges ahead. Key directions to the team included:

- Creating infographics to illustrate the three exploration phases,
- Establishing a visual hierarchy of commands,
- Devising a color scheme for the entire page with necessary variations, and
- Crafting a coherent set of icons.

Tetro dedicated a few weeks to research all the LMS pages related to metals and minerals, ensuring consistency between the new proposed look and the existing scheme used by NRCan. They adhered to the department's suggested color scheme whenever possible. **The design underwent iterative refinements, with input from internal and external stakeholders**. We believe including many MMSD team members in this process helped them realize the importance of details. However, most of the design decisions were made by a small group, always receiving final approval from management.



Towards the end, following a demonstration of the prototype to the Prospectors & Developers Association of Canada (PDAC) management team, we recognized the need to modify one of the infographics. Considering their feedback, we adjusted the prototype accordingly and presented the final version to the entire MMSD team. They zeroed in on the same infographic and made significant contributions to the final design.

The issue was that the original depiction of mine development showed it in a way that made little sense to experts. It was a lay person's idea of a mine. Specialists pointed out that the modern mine complex is much different. **Once again, the team learned by doing.**



# Other Comments

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We focused on the main components of our methodology, however, there are many other elements for a successful launch of a data visualization pilot. We chose not to detail them because they were mostly led by MMSD, hence, we are confident that the team is aware of these steps and their importance. For the record:

- Although Jagoda drafted the first content elements for the visualization, Emily Tucker was responsible for both drafting, seeking input, and approvals for the final content. Since Emily is away on vacation, Joshua and Shane have taken over the final step of content development, the translation request process.
- Management coordinated the internal consultation and approvals from LMS web and communications teams.
- The IT/Coders are taking care of preparing and loading the visualizations on the servers and will take care of security approvals.
- Management will also be at the helm to ensure all necessary approvals are received prior to launch.

# Dissemination

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Strategic dissemination of the product is key to ensuring the right audiences are made aware of the product at the right time, and to allowing the product to be thoroughly tested and approved before being made available to wider audiences.

The process we adhere to includes a staged rollout that serves as a user experience check while ensuring that every team member is well-versed in the visualization.

Initially, the final coded prototype is **made accessible to MMSD for a limited period. This allows for multiple checks** to ensure data accuracy, functional links, content, adherence to the data and process, and language parity between the French and English versions. Subsequently, **a series of open houses is conducted, beginning with a presentation to the Director General (DG) and a select group from LMS. At this point management can decide on the best course for presentations to the ADM and DM levels.**

Effective sessions are promoted through posters and other promotional materials, with multiple screens and presenters facilitating small group discussions. Adjustments can be made based on feedback before the public launch.

The public launch should involve **a preview for a select mailing list**, including individuals who contributed during the pilot's development, along with the MMSD mailing list. **It is recommended to thank them, emphasizing their impact on the final product. Finally, social media posts with engaging questions are the most effective to attract new users.**

# After the Launch

Despite the considerable efforts invested thus far, **the success of the new visualizations hinges on the actions taken from this point forward.** As a reminder, the aim of the new visualizations was to serve as a business card and to engage with new audiences. Publishing and initiating an initial social media campaign are crucial steps, but they alone are not sufficient. Plans should be devised for an **ongoing engagement strategy, which could involve presentations at various conferences and events, such as PDAC, outreach displays or events at the Museum of Science and Technology, and a minerals and metals exploration data day at different libraries. Dialogues with university business schools focusing on the mining sector should also be considered.**

**A system for collecting and organizing user and team feedback must be established** to ensure it contributes to the “parking lot” document associated with this project. **A maintenance schedule should be created,** encompassing data updates, a review of collected items, and prioritization for implementation. Moreover, **web analytics should move beyond tracking clicks to more sophisticated analysis,** capturing the success or failure of the original objectives. Questions such as the average time spent on the page, the ratio of new to returning users, and the correlation between page usage and table downloads need answers. Once a substantial amount of data on the use of the new pages has been collected, engaging with a user experience expert can assist MMSD in producing more effective versions.

Meanwhile, **the coder/IT team can formulate a strategy to make the visualization code reusable and open source,** ensuring that the visualization components benefit others in the government beyond MMSD. **The project manager remains responsible for coordinating all of these activities.**



# In the End

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The design-driven approach adopted by MMSD, led by Annette Hester and Jagoda Walny Nix, sets a precedent for how designing data visualization can be leveraged to drive transformative change within government agencies. The commitment of the project team, supported by management and key stakeholders, have paved the way for a more transparent and accessible information landscape within the mining sector.

In being open to this design process, the MMSD team has demonstrated its willingness to engage with new audiences, examine its data collection and usability practices, and propose new ideas to elevate their work to higher standards. The visualization design process is a catalyst; the rest lies in the hands of the team.

Moving forward, strategic dissemination of the visualizations and the establishment of an ongoing engagement strategy are vital to ensuring the long-term success of the project. A strong team structure, including a project manager, who can oversee the drafting of a maintenance schedule, user feedback collection system, and advanced web analytics are crucial for the evolution and improvement of the data visualization platform.

This is particularly important as the team sets its sights on visualizing more of its data. Care must be taken to ensure that multiple products have a cohesive feel to outside visitors, and that an understanding of the audience and what data serves its needs is the foundation for future efforts. Furthermore, commitment to make the visualization code open source and reusable will foster collaboration and innovation beyond the boundaries of MMSD while benefiting future MMSD projects.

Ultimately, excellence in design is felt, not seen. If the key audiences for MMSD's data know about the data, know where to find it, can understand it, and can use it without frustration, confusion, or overly specialized knowledge - and dare we say with some delight - then the project has met its goal. This pilot visualization has opened doors; the team now has an opportunity to keep building on it.

# Appendix A

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## Ideation Workshop Report

April 18, 2023

Authors: Jagoda Walny Nix and Annette Hester

### Event

The workshop took place in Ottawa, March 28 and 29, 2023. Jagoda Walny Nix and Alex Eady facilitated. Annette Hester could not attend due to a Covid diagnosis.

### Summary

The workshop achieved its main objectives: (1) It shortened the data discovery process, including the connection between the survey and production data and other aspects of mineral extraction and production (2) It exposed the team to the data visualization creation process. (3) And it brought the team together to think about their future work.

We now have a strong direction for the curated datasets and a plan for which visualizations will be included in a pilot project.

The workshop's agenda can be found in Appendix B. The first day was dedicated to big picture discussions such as defining "excellence" for a Stats Division in 2023 and how the existing Minerals and Metal Survey data intersects with three proxies for Environmental, Social, and Governance (ESG) Criteria: Environmental Assessment Impact; Indigenous Agreements Data and Materials; and ESTMA data. Day two revisited the concept of excellence and focused on data-specific exercises.

### Insights

Most relevant for our pilot, our primary insight is that focusing on internal audiences is a key pathway towards fostering excellence of the statistics team and is of importance in refining and streamlining the data the Division collects and provides. Originally, we planned to focus our visualizations on investors, NGOs, and students, producing a visualization to substitute the data currently published on the website, as well as other visualizations to be shared with the public. Given the interest from different groups in NRCan, the current state of the data, the modernization program, and the team's workload, shifting focus to connect with interested NRCan teams serves multiple objectives.

- Using the insights into the internal audiences allows us to create an internal-facing visualization with more details and including confidential data. In addition to communicating data internally, this visualization can be used as an internal engagement tool and a reflection of the work the Division does.
- In the meantime, we plan to conduct a small study into confidentiality of provincial data. We know that most provinces' licenses carry a confidentiality clause that lasts, on average, three years. That means that we might, inadvertently, have been keeping public data confidential. If this proves to be the case, the team would be able to issue a public release of the internal-facing visualization (minus the last three years). Hence, the pilot would generate a pipeline of visualizations that can be released in distinct intervals, keeping the site "fresh."

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- It remains important to create an external-facing visualization of existing data as it is currently. This is a first step to connecting with external and internal audiences. As we expect that the work with internal audiences will take time and will ultimately change what data is released publicly, we propose reserving deeper engagement with target external audiences for a later date.

Another insight came from the discussion of the importance of location data and of unique identifiers for mines in the dataset. Unique identifiers are critical to understanding long term trends even as other metadata such as mine ownership or mine names change, and they are essential for connecting disparate datasets from other teams. Location is a potential candidate for a unique identifier as mine locations stay constant over time. It is also a particularly valuable piece of information for analysts of all kinds given how essential geography is to understanding mining. Another potential candidate for a unique identifier that is worth exploring is information coming from National Instrument 43-101, which all companies are required to file. In addition, having the Stats team add location would provide an incentive for other teams to do the same. If our time and staff resources permit, we will be testing what would be necessary to add this information to the current data. At a minimum, we will start on a schedule for this work.

A third insight was the realization that the team is eager to broaden their horizons, have a closer connection to data users, and understand the value and use of this data. To achieve these goals, it will be imperative to create “empty” space for learning, thinking, outreach, and experimentation. This necessitates that the demands on the

team’s time from typical data collection activities decrease. This will be one of management’s biggest challenges – yet one that needs to be addressed. Without space to think and experiment, implementation of even a small modernization agenda will be impossible. To make this space, the choice of whether to accept a lower response rate or add more staff also present its own challenges. Adding staff to solve immediate bottlenecks overrides the primacy of hiring for future skills. Given the time and effort required for hiring new staff, the sustainability of any modernization effort will be predicated on having the right team.

Finally, the discussion of excellence generated a host of interesting ideas. Themes of note include:

- **Foundational excellence:** For the Division to be seen as an authoritative data source, it must start with a strong data foundation. This theme revealed the pressure felt of producing complete and accurate data with a very high response rate. It is not clear where this pressure comes from. Nonetheless, it is felt. At the same time, it was suggested that data perfection is neither essential nor even possible and that there is a tolerable level of uncertainty in any dataset; it is more important to have strong, documented, repeatable processes backed by storage, resources, management approval, and support to produce the optimal data to meet audience needs.
- **Transparency and connection with audiences:** An excellent Statistics Division is aware of its audiences, their needs, and how well it is meeting those needs. It has a level of pride in its work that is validated by a clarity of purpose and the knowledge that audience

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needs are met. Additionally, true transparency requires a level of openness about the data that allows for a dialogue with audiences.

- Data consistency and comparison: The Division is uniquely placed to be a “one stop shop” for comparable mining data from across Canada. To do so it must be willing to collect and normalize data from multiple sources and to cooperate with provinces and territories to obtain that data.
- Keeping up with technology: Technology and talent is reaching a point where it is possible to increase the relevance and usefulness of data by layering multiple datasets together. An excellent Statistics Division will readily enable this kind of layering.

We think it will be a valuable exercise to continually examine what is excellence for a Stats team in 2023. While we are aware that legislation underpins the current survey and data publication, it might be more productive to examine the intent of the legislation. This way we can apply state-of-the-art methods to achieve these goals. This continuous questioning will serve to maintain the team at the vanguard and allow it to become NRCan’s de facto data steward.

# Minerals & Metals Statistics Division Ideation Workshop Agenda

**March 28 - 29, 2023**

Location: Camsell Hall, 580 Booth Street, Ottawa ON

Workshop Leads: Annette Hester, Jagoda Walny Nix, Alex Eady

<b>March 28</b>	<b>ACTIVITY</b>
8:50 – 9:00	Doors open, get nametags.
9:00 – 9:30	Introduction Opening remarks: Rory Gilsean, Shane Norup, Sarah Heath Workshop introduction: Annette Hester
9:30 – 10:15	Exercise: Envisioning Excellence What makes an excellent statistics division?
10:15 – 10:30	Break
10:30 – 12:00	Exercise & Discussion: Mining Data Framework (10:30) Part I: Data introductions (5 min each) <ul style="list-style-type: none"> <li>• Exploration data (Sandrine Levasseur)</li> <li>• What is ESG? (Jacob Ediza)</li> <li>• ESTMA (James Lauer)</li> <li>• Indigenous Agreements Map &amp; Material (TBD)</li> <li>• Environmental Assessments (TBD)</li> </ul> (11:00) Part II: Brainstorming / Discussion
12:00 – 1:30	Lunch (on your own; group lunches encouraged!)
1:30 – 3:00	Exercise: Telling the Stories of Mining in Canada The narratives about mining that we can communicate with data, context, expertise, and visual tools.
3:00 – 3:15	Break
3:15 – 4:00	Discussion & Day Summary

4:00 – 6:00	Break
6:00	Social Activity (optional; details TBD)

<b>March 29</b>	<b>ACTIVITY</b>
9:00 – 9:15	Introduction & Warm up
9:15 – 10:15	Exercise: Data Audiences Who needs/wants to hear about mining statistics? + Review of excellence
10:15 – 10:30	Break
10:30 – 12:00	Exercise: Sketching BC Data Focused exercise in suggesting stories and visual representations of a small, manageable subset of BC Data. Build on discussions from Day 1.
12:00 – 1:30	Lunch (on your own; group lunches encouraged!)
1:30 – 3:00	Exercise: Clarifying Data Context & Coverage Giving our audiences the data that they need. How data meets or does not meet audience needs.
3:00 – 3:15	Break
3:15 – 3:55	Discussion & Workshop Summary
3:55 – 4:00	Wrap up

Participants' list is available on request.

# Appendix B

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## Use of different technologies on Canada.ca A Precedent Study

### Background

The Minerals and Metals Statistics Division (MMSD) is designing and implementing a pilot project to create custom dynamic data visualizations of the mining exploration expenditure data. The intention is to make the data available, understandable, and appealing to interested parties, including those not experts in mining.

The bulk of the project work is planned to be delivered by the end of August 2023. Additional adjustments may be made in Fall 2023.

### Objective

The goal is to create a state-of-the-art data visualization. This requires the use of a variety of data visualization technologies. The specific case(s) will depend on the final choice of data, intended audience, and integration with static infographic portions that add visual context to the information provided.

To ensure MMSD is compliant with the current Canada.ca standards, we scanned the government site to single out innovative uses of data visualization technologies. Note that there is a clear distinction between use of visualizations for story telling (akin to data journalism) and visualizations that provide access to data sets. We are concentrating

on the latter, as the MMSD is a statistics division. Nonetheless, there are occasions that statistics-like organizations focus on storytelling to explain data/information.

For a general view of data visualization, please visit [Data Visualization: a primer on Open Canada.ca](#)

### Case Studies

#### Statistics Canada

##### JavaScript: D3.js and React.js libraries

[Canada's population clock \(real-time model\) \(statcan.gc.ca\)](#) – this tool uses React

[Canadian International Merchandise Trade Web Application \(statcan.gc.ca\)](#) – this is a front-end piece to an exceptionally large (trillions of data points) data set.

#### Power BI

[Labour Force Survey in brief: Interactive app \(statcan.gc.ca\)](#)

[New Motor Vehicle Registrations Data Visualization Tool \(statcan.gc.ca\)](#)

#### RShiny

[Personal Inflation Calculator \(statcan.gc.ca\)](#)

[Provisional deaths and excess mortality in Canada dashboard \(statcan.gc.ca\)](#)

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## Public Health Agency of Canada

### Health Infobase – 3 cases

1. Complex – the following is a sample of applications that are coded in React, PostgreSQL, and d3.js:
  - a. <https://health-infobase.canada.ca/substance-related-harms/opioids-stimulants>
  - b. <https://health-infobase.canada.ca/pass>
2. Simple – applications that run off.csv files, often connected to Google Sheets (to speed up the update process). These applications are simple html and custom d3.js. Given the code is modular, you may notice recurring elements across products (the map code, for instance):
  - a. <https://health-infobase.canada.ca/covid-19/current-situation.html>
  - b. <https://health-infobase.canada.ca/covid-19/wastewater/>
  - c. <https://health-infobase.canada.ca/drug-analysis-service/analyzed-drug-report.html>
  - d. <https://health-infobase.canada.ca/covid-19/vaccination-coverage/>
  - e. <https://health-infobase.canada.ca/mpox/>
3. Flat – Little interactivity, no connection to a DB or an online data source, one-off reports, and blogs:
  - a. <https://health-infobase.canada.ca/breastfeeding/>
  - b. <https://health-infobase.canada.ca/covid-19/post-covid-condition/spring-2023-report.html>
  - c. <https://health-infobase.canada.ca/carss/blog.html>

In some cases, the visuals reside on the Health Infobase server but are coded in such a way that [embedding directly on Canada.ca via iframe is seamless](#). In other cases, the data transformation and auto PDF creation is made available so the Communications team can create [dynamic data tables](#).

A more comprehensive list of products can be found via the Health Infobase homepage.

For more information about the Health Infobase, its process, and visuals, please see the Health Infobase Design Manual.

## Canada Energy Regulator

JavaScript (including the use of React.js, Nivo, and D3.js libraries)

- [Explore Canada's Energy Future](#)
- [Incidents at CER-regulated pipelines and facilities](#)
- [Imports & Exports of Energy Products to and from Canada](#)
- [Conditions on CER-regulated energy projects](#)
- [BERDI](#)

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## Tableau

The CER (Canada Energy Regulatory) uses Tableau to publish its weekly Market Snapshots. Older snapshots use embedded views from Tableau Public; newer snapshots embed views from a CER Tableau server using data sources hosted by the CER. Tableau is also used throughout the [CER Pipeline Profiles](#) product.

- [Full list of Market Snapshots](#)
- Example: [REC – Market Snapshot: Geothermal Power is stable and low carbon, but what is its potential in Canada? \(cer-rec.gc.ca\)](#)
- Example: CER – [Market Snapshot: Canada’s oil exports started to recover from COVID-19 in June and July 2020 \(cer-rec.gc.ca\)](#)

## Others

Note that the use of ESRI in mapping is ubiquitous in Canada.ca. Other mapping technologies include HRDEM Mosaic Web Map Service (WMS). Another mapping technology is leaflet.js, however, we could not find it in Canada.ca. Tableau, PowerBI, and D3 have basic mapping capabilities. Last, PCO (Privy Council Office) uses Tableau for its internal communications with Ministers and the Cabinet.



