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Democratizing Open Energy Data for Public Discourse using Visualization

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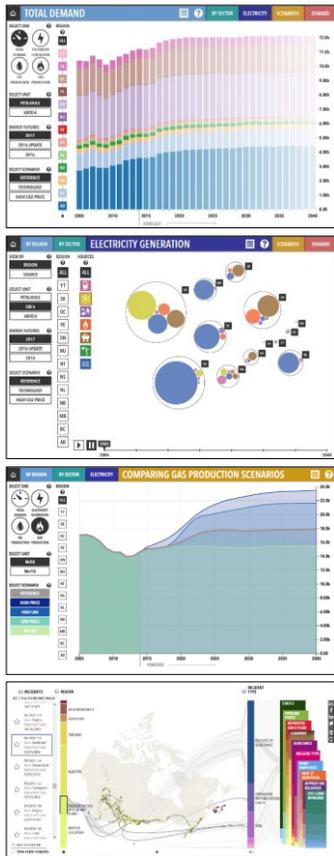


Figure 1. Visualizations of Canada's National Energy Board Data: *Energy Futures* (top three images) and *Pipeline Incidents* (bottom image).

Abstract

For this demo, we will show two interactive visualizations: *Energy Futures* and *Pipeline Incidents*. We designed and developed these visualizations as part of an open data initiative that aims to create interactive data visualizations to help make Canada's energy data publicly accessible, transparent, and understandable. This work was conducted in collaboration with the National Energy Board of Canada (NEB) and a visualization software development company, VizworX.

Author Keywords

Open data, data visualization, citizen engagement, information visualization, data democratization.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction

Both individuals [1] and researchers [2] are increasingly conscious of the potential environmental and social impacts of energy production. Moreover, as citizens in our modern society, we are increasingly aware that vast amounts of data exist about our world. Effective use of this data has the potential to lead to a more informed society and an increasingly data-driven public discourse around topics like energy use. However, the data that is currently made available to the public is

Energy Futures Data

The energy futures data has projections for **total energy demand** of electricity, natural gas, petroleum products, coal, and renewable fuels. This does not include demand for energy used to generate electricity. There are also projections for **electricity generation by source** (oil products, nuclear, biomass and biofuels, natural gas, coal, solar/wind/geothermal, and hydro), crude **oil production**, and **natural gas production**. The data is divided into **regions** — 13 Canadian provinces and territories — and **sectors** (residential, commercial, industrial, and transportation). Each Energy Futures report provides several projections based on select **scenarios**. For example, the 2017 report includes three scenarios: a baseline, a high carbon price scenario, and a technology scenario in which Canada has greater adoption of emerging production and consumption energy technologies.

1.1); Energy demand by sector; Electricity generation by region and source (Fig. 1.2); Comparison of scenarios (Fig. 1.3); and relative change in demand shares by region (Fig. 2). These visualizations employ a mix of familiar and novel visual representations.

Through lab studies [3] and web analytics, we observed that visitors are particularly drawn to the Electricity generation visualization (Fig. 1, second from top), which uses an animated bubble chart. We also introduce a novel visualization called a *rose chart* (Fig. 2) to show projected changes in energy demand share. Each rose represents a single province or territory. It is sliced into separate coloured pieces per energy source. and a single slice represents relative changes between two years selected on a timeline. A key insight from this visualization is that while Canadians' use of green energy is expected to increase in the future, its relative share of the total demand is somewhat stable. This highlights the challenges ahead for reducing Canadian dependence on fossil fuels.

Pipeline Incidents Visualization

Every day, the Canadian network of underground pipelines transports millions of litres of oil and gas. At certain times unintended events (or *incidents*) occur. While some incidents are minor, others involve explosions, injury, or adverse effects on the environment.

Our Pipeline Incidents visualization (Fig. 1 (bottom) and 3) shows data about incidents from 2008 onwards (see sidebar on next page). This unique design combines two visualization techniques — parallel coordinates [4] and parallel sets [5] — to simultaneously display information about individual incidents in the context of aggregate relationships. Here, parallel sets show the

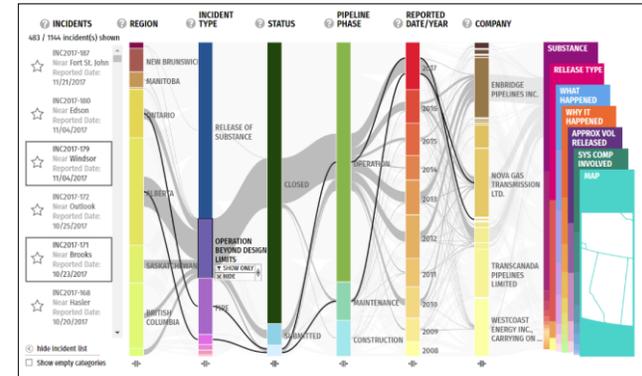


Figure 3. The Pipeline Incidents visualization, here showing 3 dimensions: incident type, what happened, and an estimated reason for the incident.

aggregate relationships between dimensions, while parallel coordinates show specific details about individual incidents through interaction. By overlaying parallel coordinates on parallel sets, the visualization provides detail in context, allowing people to follow a specific incident, while keeping an overview of general trends.

In the interest of openness and to reach a wide audience, we designed this visualization around simple views that are easy to read and learn. While the data is quite complex, the visualization uses a consistent representation pattern that a viewer only needs to learn once, and can be introduced using simple, annotated views (Fig. 3). We also designed the visualization to be easily shareable. Every state of the visualization has a unique URL, making it possible to share and refer to specific views and incidents in online conversations.

Pipeline incidents are of great interest to many members of the public, including people who live and work near pipelines as well as people with environmental and

Incidents Data

The incidents data describes approximately 1100 incidents (as of January 22nd, 2018) which occurred on or around pipelines and facilities regulated by the NEB since 2008. Our Pipeline Incidents visualization (Fig. 3) shows the causes, locations, status, company names, dates and other features associated with each incident using a unique parallel visualization containing up to 13 stacked columns. Viewers can explore the entire collection by adding, removing, or rearranging columns; reordering categories; filtering; and following the connections between related dimensions.

Visualizations

Both visualizations in this demo are available for the general public online.

Energy Futures:
ilab.cpsc.ucalgary.ca/energyvis/energy-futures

Pipeline Incidents:
ilab.cpsc.ucalgary.ca/energyvis/pipeline-incidents

safety concerns about the energy sector. By providing this data in an interactive format, the incidents visualization provides access to information that was previously *available* but largely *invisible* to the public. In doing so, it promotes a more inclusive discourse about pipeline incidents to a wider range of citizens.

Conclusion

These two visualizations, as well as the broader research and design effort that produced them, represent an initial foray into the rich and important space of *data democratization*. Building on these initial visualizations, our ongoing research continues to examine how visual and accessible tools can empower citizens and enable greater confidence in public institutions. While our initial results are promising, critical questions remain: *How can public institutions more efficiently create and deploy visualizations to increase the accessibility of a wider range of data? How can more social visualization tools encourage public engagement and support more robust discourse? How can public visualizations contextualize and teach viewers about data, while remaining objective and supporting multiple interpretations?*

In Canada, as in much of the world, the energy sector represents one of the most promising and important areas for public discourse. Energy continues to drive Canada's economy. Oil and gas pipelines cross public as well as privately owned land, while trains carrying energy products cross through towns and cities, where 82% of Canadians reside. As a result, the range of stakeholders who may benefit from access to this kind of data is vast, and the potential impact of democratizing tools is profound.

Our Energy Futures and Pipeline Incidents visualizations showcase how visual tools can help increase the

accessibility of public data. As such, our demo will emphasize the challenges associated with designing for public data, as well as the unique designs and insights drawn from our initial engagements. Moreover, it hints at the potential benefits of open data visualization for a much wider range of public institutions and domains.

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