

Introduction

This report is segmented into two principal sectors: **Electricity Generation** and **Fossil Resources**. The Electricity Generation sector encompasses all energy types utilized for electricity production, including **hydro, nuclear, solar, and wind power**. Meanwhile, the Fossil Resources sector focuses on **coal, crude oil, and natural gas**. Each sector is further dissected into three detailed visual reports: Sector Sentiment, Nationwide Statistics Dashboard, and Province Statistics Dashboard.

- **Sector Sentiment Dashboard:** This dashboard offers an in-depth analysis of **sentiment scores** across various companies and sectors. It provides **comprehensive summaries**, identifies **trends**, and outlines the overall sector sentiment.
- **Nationwide Statistics Dashboard:** This dashboard presents data on the production and consumption of different forms of energy across Canada, offering a macro-level view of the country's energy landscape.
- **Province Statistics Dashboard:** Like the nationwide dashboard, this version offers a granular view of energy data, breaking down statistics by province or region within Canada.
- **Web Application:** Allows users to conveniently view **different Power BI dashboards**, and integrates various **AI features**, enabling easy **searches** for specific industry information **online**, or **answering** specific **questions about news** stored locally. It also incorporates **multimodal AI**, capable of understanding both **text** and **image** information simultaneously.

Data and Methods

Sector Sentiment Dashboard

- **Data Source:** Approximately 60,000 news articles were collected from over 400 companies, spanning from 2008 to 2016. These articles were then analyzed to generate summaries, keywords, and sentiment scores using advanced AI tools.
- **AI Models/Tools Employed:** A combination of AI tools including pygooglenews, nltk, selenium, KeyBERT, FinancialBERT-Sentiment-Analysis, bart-large-cnn, facebook/bart-base, gpt-3.5-1106, and gpt-4 were utilized to analyze the data comprehensively.

Note: Experimented with llama2 model-7B; it matches GPT-3.5 outcomes but exceeds my graphics card's memory limit. The llama2-70B model requires even more memory. With better hardware, using llama2 could bypass GPT-API costs.

Nationwide and Province Statistics Dashboards

- **Data Source:** All data for these dashboards were sourced directly from Canada Statistics, covering various energy types such as Coke coal, Crude oil, Natural gas, and Electricity.
Coke coal: <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2510004501>
Crude oil: <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2510006301>
Natural gas: <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2510005501>
Electricity: <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2510001501>
- **AI Models/Tools Employed:** The dashboards were developed using Power BI, incorporating techniques such as M, DAX, and ARCGIS, along with SARIMA for predictive modeling.

Web Development Tools

- **Tools Employed:** The web platform supporting this report was created using Power BI, FastAPI, and React18, alongside AI and machine learning libraries such as OpenAI API, nltk, sk-learn, and bert-base. This combination of technologies ensures a dynamic and interactive user experience, allowing for real-time data exploration and analysis.

Reports

Fossil Energy

- **Coal & Coke**

In **Ontario**, **coal** is exclusively used, with over **90%** dedicated to **metal production**. Notably, coke reserves are robust, ensuring a supply for 3 to 4 years without the need for production or imports. And all the coal is imported, while the coke is either imported or made from imported coal.

- **Crude Oil and Natural Gas**

For crude oil and natural gas, production and use are correlated. Crude oil sees higher production and consumption levels compared to natural gas. A significant portion of these resources, particularly crude oil, is **exported** to the **USA**.

The **crude oil** sector is marked by **steady growth**, with **oil sands extraction**, including both in-situ and mined crude bitumen, accounting for over **half** of all **production**. This trend is expected to continue. Over **60%** of **crude oil** is exported to the **USA** via **pipelines**, and **conventional crude oil** dominates **refinery inputs**, contributing up to **90%**.

The **natural gas** sector experiences annual variations in production and consumption, yet it follows an overall upward trajectory. Contrary to crude oil, a substantial portion of natural gas, **42%**, is consumed domestically for various **industry uses**, closely mirroring the **export** rate of **41%**.

- **Provinces**

Provincial insights reveal that Ontario is the sole consumer of coal or coke. **Alberta** is the powerhouse of the **crude oil** sector, contributing over **90%** of the **supply** and **consumption**, primarily destined for the **USA**. In the **natural gas** market, **Alberta** provides about two-thirds of the supply, with **British Columbia** contributing the remaining third. Alberta's consumption slightly surpasses that of other provinces, reflecting its central role in Canada's energy landscape.

Electricity

- **Clean**

Electricity production has been on the rise in recent years, driven not only by utility companies but also by industrial producers. A standout leader in **clean energy**, Canada harnesses **hydroelectric** power extensively, with over **half** of its electricity generated by **hydro turbines**. In provinces like **Quebec** and **British Columbia**, hydroelectric power is particularly dominant, contributing to more than **95%** and **85%** of their electricity respectively. Other clean energy sources, such as nuclear, solar, wind turbines, and biomass, also play significant roles. Notably, **nuclear power**, primarily used in **Eastern Canada** and especially **Ontario**, accounts for over **50%** of the region's electricity. **Wind** energy is **rapidly expanding**, now producing **half** as much electricity as **nuclear power**. **Solar** energy is also on the **rise**, though it currently provides only a tenth of the electricity

generated by wind turbines. **Biomass**, a newer energy source, has seen **fluctuating** production levels but slightly exceeds solar power in output. **Tidal turbines**, once considered promising, have been completely **phased out**.

- **Unclean**

On the other hand, **Alberta** has relied heavily on **unclean** energy sources, with about **90%** of its electricity coming from such sources in recent years. However, Alberta is actively transitioning its energy mix. Since **2016**, the province has started employing **combustion turbines**, which **burn gas** to generate electricity. This includes both **renewable** and **non-renewable gas**, though specific details are not provided in statistical tables. While burning gas does emit **greenhouse gases**, the emissions are significantly **lower** than those from traditional **fossil fuels**. Moreover, clean energy sources, particularly **wind** energy, are experiencing **rapid growth**.

- **Other Provinces**

Other provinces generate considerably **less electricity** compared to the ones mentioned earlier. The energy sources **vary** significantly **across these regions**. For detailed information, please refer to the **Power BI dashboard**.

Conclusion

- **Fossil Fuels:** In Ontario, **coal** and **coke** are primarily used for **metal production**, accounting for over **90%** of their use, with all coal **imported**. Coke reserves are sufficient to last 3 to 4 years without new production or imports. **Crude oil** and **natural gas** production and consumption are closely **linked**, with crude oil production and usage exceeding that of natural gas. Over **half** of the crude oil is **exported** to the **USA** through **pipelines**, while a significant portion of **natural gas**, 42%, is consumed domestically for various **industrial uses**.

Provincially, Ontario is the sole consumer of coal or coke. **Alberta** dominates the **crude oil** sector, providing over **90%** of supply and consumption, mainly for export to the USA. In the **natural gas** market, **Alberta** supplies about two-thirds, with **British Columbia** contributing the rest. Alberta's consumption slightly exceeds other provinces, highlighting its central role in Canada's energy sector.

- **Electricity:** Electricity production is **increasingly clean**, led by **hydroelectric power** which generates over **half** of Canada's electricity. **Quebec** and **British Columbia** significantly rely on hydro power, contributing more than **95%** and **85%** of their electricity, respectively. Other clean sources like **nuclear**, **solar**, **wind** turbines, and **biomass** also play important roles, with **nuclear power** being a major source in **Eastern Canada**, particularly **Ontario**. **Wind** energy is **rapidly growing**, now producing half as much electricity as nuclear power. **Solar** and **biomass** energies are emerging, with biomass slightly outperforming solar in output. **Alberta** has historically depended on **unclean** energy but is transitioning towards **gas combustion turbines** and **increasing wind energy** usage. Electricity generation varies across other provinces with diverse energy sources.