



INTERNATIONAL ENERGY FORUM - 2024

Innovations and Energy Transitions/Futures
May 14, 2024

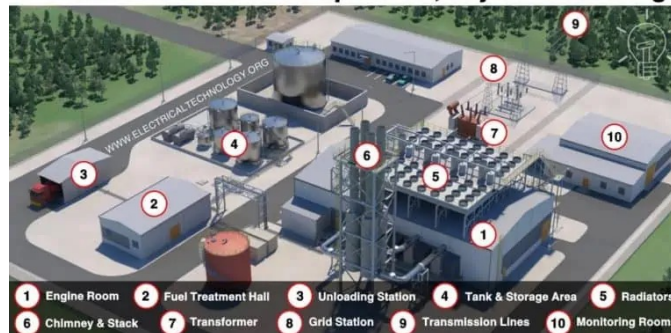
Brief History of Electrical Energy Production in North America



- *Today, I'll take you on a short Journey through the Past, the Present and a vision of how energy might look like 50 years from now:*



Diesel Power Plant - Components, Layout & Working



First, Let's time travel to New York at the turn of the Century

Horse vs. Automobile

BEFORE you discard your horse and buy an auto it is well to think of the cost.
Figure how much you spend for harness and then think of what new tires amount to.
Figure up what it takes to feed Dobbin in a year and then think of gasoline, repairs and storage charges.
Dobbin is worth what you paid for him two years ago, where's the man with an auto that can say the same?
Come in and get a new harness instead of a new car and remember that Dobbin will take you through snow and mud as well as on good roads and that his carburetor is never out of order.

Ed. Klein
732 Massachusetts Street



- Horses dropped about 10 kg manure per day, in New York, that was about 350 MT per year for the city.
- People at the time were concerned that cities would be buried in Manure...
- Cars were a significant energy and transportation disrupter, which resolved the manure problem, and..
- Electricity came to North America...



Today, Climate change is impacting the planet!



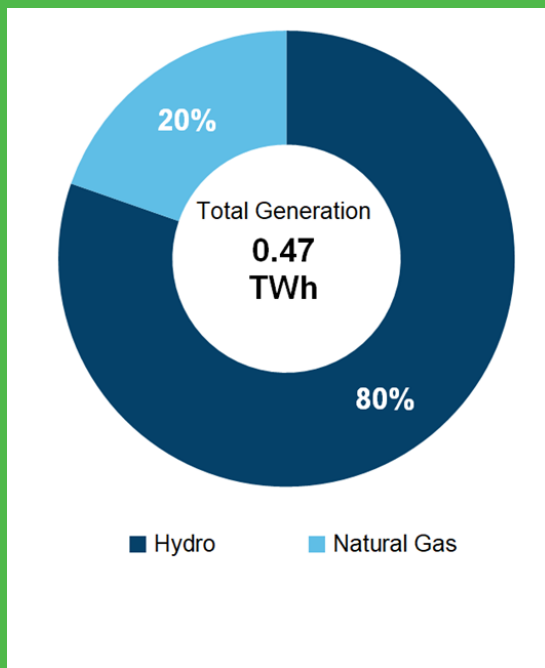
- Automobiles with internal combustion engines have replaced horses, In 2018, Internal combustion engines in New York produced approximately 44 MMT of CO₂,
- There are few households who do not rely on electricity.
- Electricity has become one of the most important Innovations of our time, there are few households who do not rely on electricity.
- Fossil fueled generation is used on many power systems, but use is declining.
- Electrification is also increasing, there is now a federal mandate in Canada to electrify vehicles.
- Electricity is large part of climate change problem, and the potential solution.

Today, Climate change is impacting the planet!



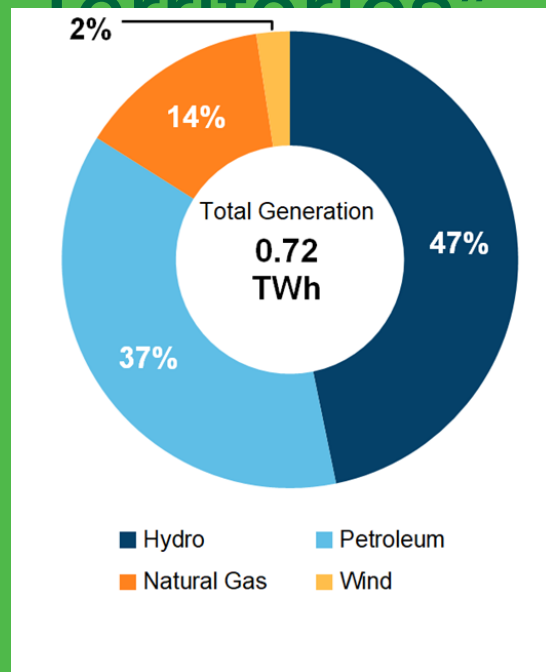
- So, what are some of the industry trends we are seeing in Canada:
 - **Technologies** - Clean generation technologies at larger and smaller scales are commercially available or nearly commercially available.
 - **Legislation** - Governments are legislating Climate Targets.
 - **Legislation** - Indigenous Rights are legislated in a growing number of jurisdictions.
 - **Engagement & Accommodation** - Indigenous Rights Holders are taking an active role in infrastructure projects.
- Let's look closer at the Arctic Territories:

Electrical Service “Yukon”



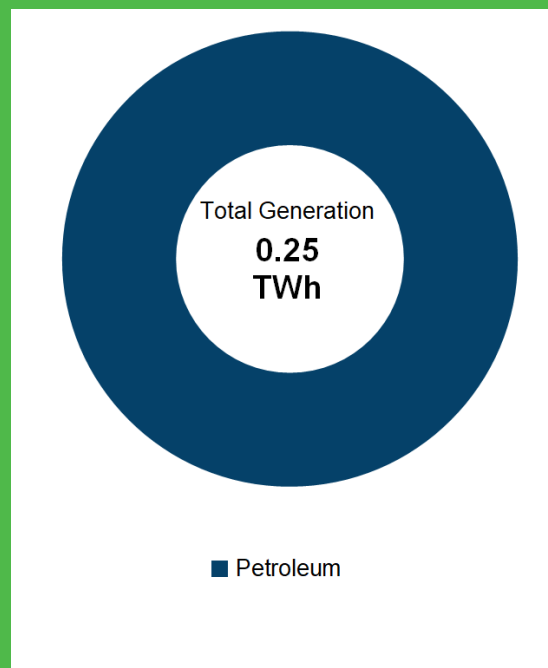
- In 2019, Yukon generated about 0.47 terawatt-hours (TWh) of electricity, approximately 0.07% of total Canadian generation.
- Estimated generating capacity of 136 megawatts (MW).
- Served by two utilities, Yukon Electric Corporation (YEC), which is a publicly owned utility and ATCO Electric, a privately owned utility.
- Regulated based on “Cost of Service”.
- In 2019, hydroelectricity accounted for 80% of total generation. Territory has four hydro plants with a total capacity of nearly 95 MW.
- Hydrocarbon based generation is required for peak demand. Yukon used to rely primarily on diesel, but the lower cost of liquefied natural gas. (LNG) in recent years has made investments in LNG facilities more economical.
- A 0.9 MW solar array with battery is currently operational in the fly-in community of Old Crow. (Partnership between ATCO Electric & local Indigenous community)
- New solar projects have been proposed, including a 2.9 MW solar farm for the off-grid community of Watson Lake and a 1.0 MW project near Whitehorse.

Electrical Service “Northwest Territories”



- In 2019, NWT generated about 0.72 terawatt-hours (TWh) of electricity, which is approximately 0.1% of total Canadian production..
- Estimated generating capacity of 217 megawatts (MW).
- Served by two utilities, Northwest Territories Power Corporation (NTPC), which is a publicly owned utility and ATCO Electric, a privately owned utility.
- Regulated based on “Cost of Service”.
- In 2019, 46.8% of NWT’s electricity came from hydroelectricity and 37.2% came from petroleum.
- Solar generated less than 1% of electrical energy in 2019, over several community scale solar projects, a growing trend of partnership with local Indigenous communities.
- Eight communities use hydroelectricity serviced by two isolated grids. The remaining 25 communities rely on diesel or LNG fired power plants for base load electricity.
- Inuvik grid includes a diesel and a natural gas plant with LNG imported from Alberta and British Columbia (B.C.) by truck and a 4.0 MW wind generator with battery storage.
- The Government of the NWT is working on the Taltson Hydroelectric Expansion Project. Project could create significant new capacity for planned mining projects.

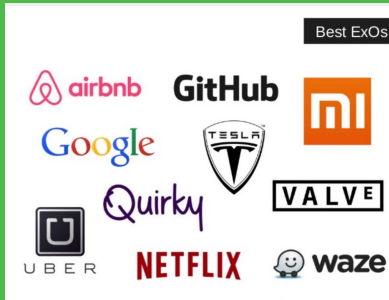
Electrical Service “Nunavut”



- In 2019, Nunavut generated around 0.25 terawatt-hours (TWh) of electricity, about 0.05% of total Canadian production.
- Nunavut has an estimated generating capacity of 54 megawatts (MW).
- Served by a single utility Qulliq Energy Corporation (QEC), a publicly owned utility.
- Regulated based on “Cost of Service”.
- In 2019, 100% of Nunavut’s electricity came from came from petroleum.
- QEC operates 25 diesel plants in 25 remote communities.
- QEC has submitted a plan to the territorial government to replace older diesel generators with more efficient models, including the ability to integrate renewable sources at many sites.
- In August 2019, the Canadian government, QEC, and the Mayor of Kugluktuk announced joint funding for Nunavut’s first hybrid solar/diesel power plant, project includes a 500 kilowatt (kW) solar system.
- Construction of the plant was delayed due to COVID-19, the facility was completed this past winter.

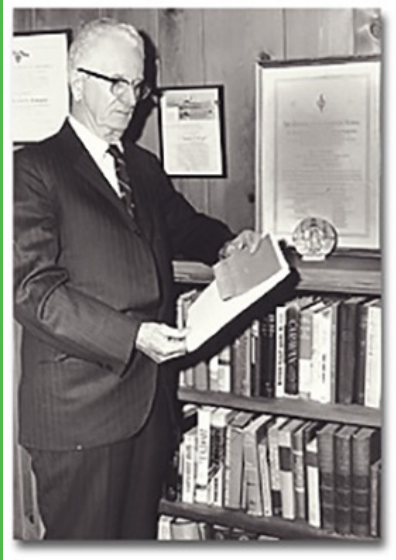
“The pace of change has never been this fast, yet it will never be this slow again”

Justin Trudeau

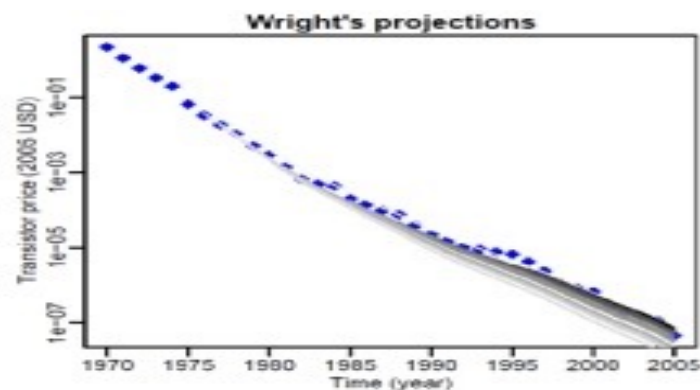


- Innovation is the key to our collective future,
- Some recent examples of innovation are;
 - *Netflix has transformed the world for Movie watchers.*
 - *Cell phones have gone from a convenience to a necessity in a very short time.*
 - *COVID-19 vaccines showed how the world can cooperate for collective good.*
- How does this impact energy?
 - *Community owned solar systems are now common in remote communities.*
 - *Windmills & batteries in Inuvik, have significantly reduced diesel consumption.*
 - *Microgrid systems are starting to emerge. Lutsel k'e is one example.*

How will innovation affect the future of energy for remote communities?

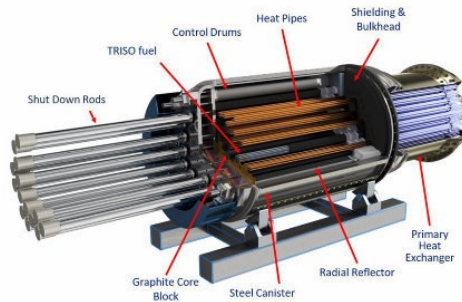
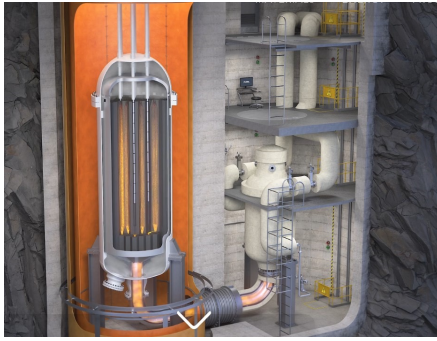


- Theodore Paul Wright, also known as T. P. Wright, was a U.S. aeronautical engineer and educator.
- Wright played a key role in expanding U.S. aircraft production, especially in developing essential statistical tools that provided accurate information on industrial capacity and measured worker efficiency.
- Wright's law predicts each time production is doubled, costs & production time will drop by about 20%.
- What does this mean for the future of energy?
- How will this impact remote communities?
- Let's explore how this could affect the potential future state...



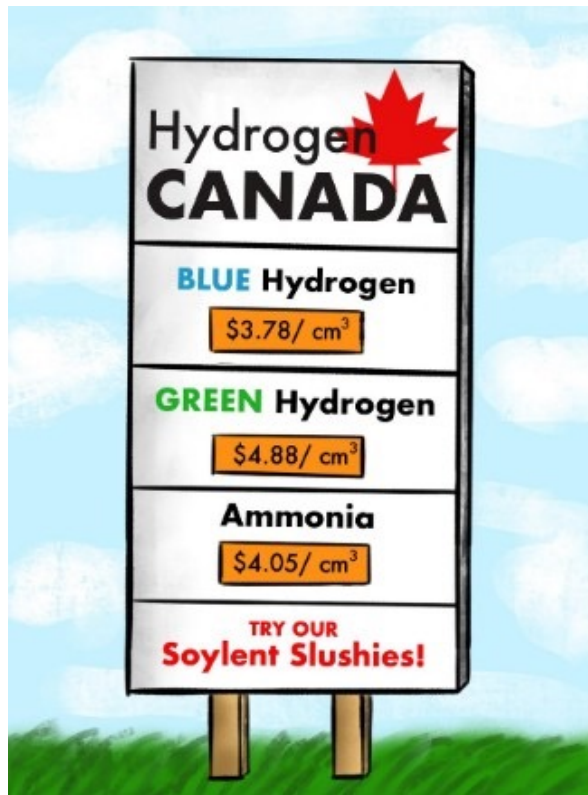


Let's time travel 50 years into the future - How has Wright's law affected future energy production?



- Clean energy generation technologies have wide acceptance due to innovations that have made Clean Energy more economical than fossil fuel energy,
- Nuclear and Hydro have replaced fossil fuels for base electricity due to their economics and emission profiles..
- Hydrogen, Ammonia,, batteries and other storage technologies have increased the utility of Clean Energy for non grid connected applications.
- Geo-Thermal, Tidal, Wind and Solar are contributing to base load energy production due the development of economic energy storage solutions.
- Hydrogen and Ammonia are produced by clean energy power generation facilities for use in some non-grid connected applications.
 - *Hybrid Cars could be one example*
- The world has achieved “Net Zero”.

Let's time travel 50 years into the future - How has Wright's law affected energy production & use in remote communities?



- Many remote communities have implemented microgrids with multiple energy sources.
- Nuclear, Hydro, Wind and Solar are producing an abundance of energy for remote communities for local use and for export.
- Micro-Modular Nuclear plants and larger Hydro plants in **some** remote communities are producing Hydrogen and/or Ammonia, for export to their neighboring communities.
- Diesel plants no longer power communities, diesel has been by Hydrogen fuel cells and other Clean Energy sources.
- And...

Let's time travel 50 years into the future - How will the environment change in remote communities?



- Let's review how the world looks, sounds and smells for remote communities
- What do we hear?
 - *Quiet – the noisy diesel plants that Elders remember have been retired.*
- What do we smell?
 - *The air is fresh and clean as the creator meant it to be because non desirable plant emissions have been eliminated.*
- What do we see?
 - *There will still be power generation sites, but a new focus on the environment will be reflected in these facilities.*
- Thank you for listening



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