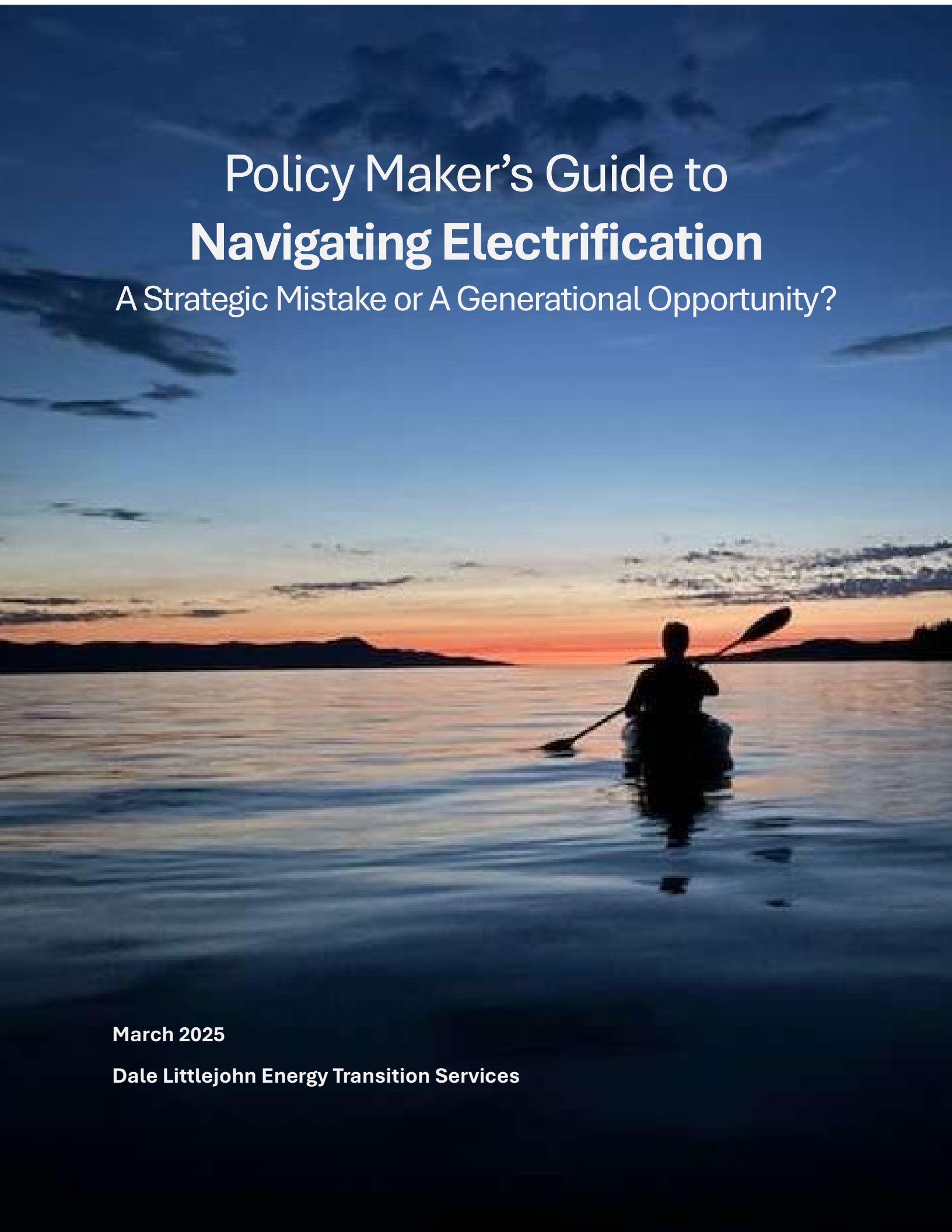


Policy Maker's Guide to **Navigating Electrification**

A Strategic Mistake or A Generational Opportunity?

March 2025

Dale Littlejohn Energy Transition Services

Table of Contents

Purpose of Document 2
Executive Summary....3
Introduction....4
Responsibility to Act on Climate Change 5
Starting Point – Current Energy use in BC 5
How much electricity will be needed in 2050? 6
Energy....6
Capacity 8
How much electricity could we deliver for 2050....8
Energy....8
Capacity 10
Cost 12
Conclusion....14
Key Findings 14
Further Questions for Policymakers & British Columbians....15

Purpose of Document

This report for policy-makers provides intended to provide policy-makers information relevant to management decision making on community-scale electrification. It provides scenarios while exposing assumptions so that policy-makers can create their own scenarios. It is a meal and recipe. It is dense and I have leaned more to analysis than formatting and sound-bites.

Policy-makers need to make decisions today that will have impacts for generations. While how much electricity BC had recently, has currently or will shortly have in 2030 are interesting, from a policy perspective, the larger question is once the full impacts of electrification hit the grid, will we have enough? This report does not attempt to precisely predict the exact amount of electricity needed and available. It takes the approach of over-estimating requirements and costs to provide policy-makers with an upper bound of possibility.

Executive Summary

One of the questions I hear from policy-makers at the local government level in BC is '**Does BC have enough electricity if we electrify buildings and transportation'**? The answer needs a 2050 perspective rather than a 2023 or 2030 perspective. **Looking out to 2050, the answer is 'yes'.** There is also a role for public dialogue with a change of this magnitude.

BC will likely need **30% to 100% more electricity in 2050** than it does today if an insightful approach is taken to implementing electrification. This approach would include swapping baseboard heating for heat pumps, avoiding green hydrogen, crpyto data centers, and nuclear generation.

BC has the renewable, largely onshore wind, resources to meet the annual energy demand. BC also has the resources to meet the peak capacity demand through the new generation brought onstream, massively distributed storage at load with EV's and solar/battery systems, distribution network utility scale batteries and demand response.

The **cost could be 0.8% to 1.5% above inflation for the next 25 years**, resulting in an electricity cost in 25 years similar to Ontario's today and significantly lower than Alberta and the US. The electric and natural gas systems are becoming more inter-dependant and any significant change to one will impact the other. One example of this is that there could be even greater costs that I have not yet seen calculated to decommission parts of the natural gas grid.

This report does not make recommendations to policymakers. It provides **two scenarios (a meal) and details the assumptions behind them (the recipe)** for policymakers to cook up their own understanding.

Questions worthy of a public dialogue on the future of energy in BC include:

1. Is there continued will for mitigation actions?
2. Is increasing onshore wind socially acceptable?
3. Is the cost (0.8% to 1.5% above inflation for 25 years) acceptable?
4. What do we want the future of the natural gas grid to look like?

Introduction

Policy-makers at the provincial and local government levels have decisions to make on electrification as a pathway to reducing carbon emissions. The question of 'Does BC have enough electricity' is central to these decisions. This question also has 3 different answers depending on the timeframe or perspective you take.

1. **Current perspective**: If you are concerned about running out of electricity this year or in the next couple of years, you would be interested in BC Hydro importing about 25% of the electricity it needed in fiscal 2023 during an exceptional drought. Generally, the answer is that we need more to avoid having to depend on neighboring jurisdictions in droughts. It does take a while to bring new generation online so we'll be a bit tight for a few years.
2. **Short term**: if you are concerned about if there will be electricity to supply a new industrial facility like a mine or perhaps a high density new development that will take several years to get in place, you are probably looking at the 2030-ish timeframe. We don't expect to see a large increase in energy needed to support more heat pumps and electric vehicles by 2030 because heating systems and vehicles turn over slowly. With recent green-lighting of mining projects in response to US tariffs, it is likely that new industrial demand will be greater than new residential / commercial demand. The answer is that with the recent call for power, there should be enough generation. Transmission would also be a question for a mine as would the distribution system for a new development.
3. **Strategic**: If you are a policy-maker nervous about electrifying buildings and transportation at the same time, you need to look out to 2050 when the impacts of the decisions taken today fully work their way through the system. **This is the focus of this report**.

Recent reports by Energy Futures Institute and Reality Check - Clean Energy Canada provide useful information, particularly on the current and short term perspectives. BC Hydro's 2025 Integrated Resource Plan, which may not emerge until 2026 with approval possibly as late as 2027, will provide more precise calculations on demand and supply options out to 2050, but likely will stop short of projecting rate impacts that far into the future.

Before we go to 2050, a couple of definitions and a couple of warnings are provided below.

Definitions:

- I will use '***energy***' to refer to the total amount of electricity produced over a year
- I will use '***capacity***' for the total amount of electricity that can be sent through the wires at any given time which is useful for discussing the peak electricity use and how to address it

Warnings

- Warning 1! There will be **math** in this report, though I will try to make palatable to people who have an allergic reaction to Excel.
- Warning 2! The analysis will look out 25 years and be oriented to being **directionally right rather than precisely wrong**.

Responsibility to Act on Climate Change

Climate change is real and caused in large part by humans through the combustion of fossil fuels. The impacts will have an unprecedented cost in terms of human suffering, planetary life systems, and the economy. No matter what BC does, we won't solve the global climate crisis on our own and even if all of humanity stopped fossil fuel use, there would still be locked in impacts over the next seven generations or more. Climate change won't be solved by negotiations but by actors seeing examples of a better way and racing toward it to secure the benefits. BC has the ability (financial, human, technological, energy sources), and one could say therefore the responsibility, to take a lead in the race to decarbonization in a way that will inspire others to join the race.

Almost half the votes in the last provincial election went to a party whose platform committed to stopping most effective climate actions in BC. Polling indicates that perhaps there is still voter preference for climate action Polling Backgrounder - BC Election and Climate Change. We exceeded 1.5c above pre-industrial levels in 2024 according to Copernicus: 2024 is the first year to exceed 1.5°C above pre-industrial level | Copernicus. Some may want to just focus on adaptation and emergency management.

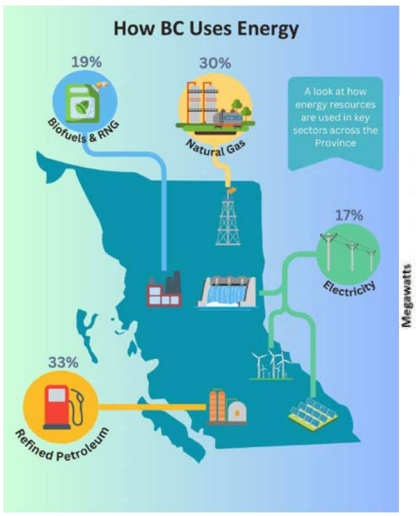
Question: Is it still the collective will of British Columbians to do our part on climate mitigation?

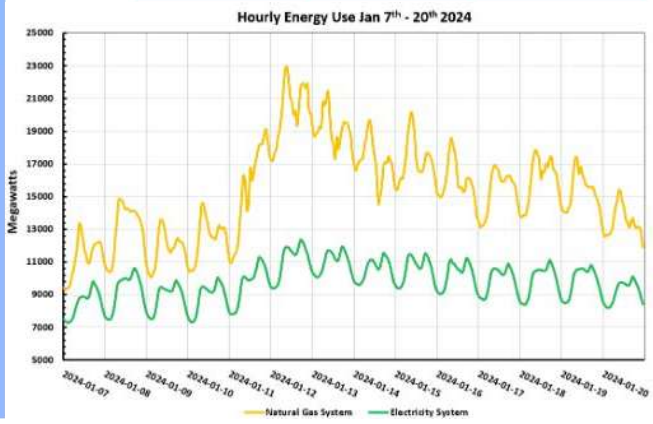
Starting Point – Current Energy use in BC

According to the Province of BC's '***StrongerBC for everyone, Backgrounder: BC's Energy System***'(backgrounder_-_bcs_energy_system.pdf) from 2024, electricity provides about 17% of the total energy used in BC (graphic below) split across residential and commercial buildings (57%) and industrial (43%) (table at side).

Energy Type	Overall Use (PJ)	Breakdown by Sector
Refined Petroleum	394 PJ (33%)	• 74% Transportation • 24% Industrial • 2% Buildings
Natural Gas	366 PJ (30%)	• 60% Industrial • 40% Buildings
Biofuels and Decarbonized Gas	229 PJ (19%)	• 81% Industrial • 13% Transportation • 6% Buildings
Electricity	208 PJ (17%)	• 57% Buildings • 43% Industrial
Other	8 PJ (1%)	• 100% Industrial

The same provincial document includes a table (chart at side) depicting the peak use which helps determine how much capacity is needed.





The BC Hydro quick facts 2022 states "*In 2021, B.C. generated 71.7 terawatt-hours (TWh) of electricity*". Yes, this translates to about 258 PJ though it is likely a different year than the 2024 provincial document referenced above which in turn references Canada's Energy Future 2023: Energy Supply and Demand Projections to 2050 - electricity-generation-2023 - Open Government Portal. 200-260PJ is directionally correct and most numbers within that range will be precisely wrong. For the purposes of our macro analysis, lets go with directionally correct for now. The same BC Hydro report states "*B.C.'s estimated capacity is 18,514 megawatts (MW)*".

Keep in mind the difference between energy (total over the year) and capacity (max amount that can be delivered at any time)

How much electricity will be needed in 2050?

Energy

The short answer is **between 35% and 100% more than today** depending on if we electrify industry and how efficient we assume heat pumps are in the south coast.

The slightly longer answer involves a bit of math. The table below provides a summary of the (rounded) numbers used for estimating energy needs in 2050.

Energy	2024 use in PJ (approx.)	Efficient Electrification Conversion Factor	2024 use if electrified	2050 (24% pop growth)
Petrol	394	27%	106	132
Natural Gas	384	30%	115	143
Electricity	223	60%	134	166
Total	999		356	**440**

Electrifying BC would require about 100% more electricity than we currently have **(this is intentionally a bit high)**. However, BC's population is expected to grow by 20% in the next 25 years, so assuming that all energy uses increase at the same 20% (again an over estimate particularly for buildings given Step Code), we would need **441 PJ** in 2050 (about **122 TWh**) …almost doubling the amount of electricity generated in BC while more than halving the total energy required even with increasing population by a quarter. This is in line with other analysis including what is quoted on page 18 of '**Powering BC**': "*The Canadian Climate Institute, for example, estimates that BC will need to add 1.3-2.6 times more generation and 1.8-2.9 times more capacity by 2050*."

Site C is expected to produce 5.1 TWh annually. In comparison, the projects selected for the 2024 BC Hydro Call for Power are expected to produce about 5 TWh annually.

This analysis does not add the Site C generation or the LNG compression load. Given the limited resources available for analysis, a simplifying assumption that both would cancel each other out was made.

This also assumes that BC does not do things that make little economic or energy sense such as green hydrogen which would increase the load while producing an over-priced product that would struggle finding an economic market without industrial electricity rate subsidization.

If only residential and commercial are electrified and the electricity efficiency factor is 40% reflecting better heat pump performance where 80% of the BC population is, the total PJ needed for 2050 is only 300 – a 35% increase from today.

Notes on Calculations

You can skip this part if that's enough math for you.

- Starting points for energy use:
  - Refined Petroleum: Full amount quoted in 'Powering BC', sourced from Government of Canada. **Over-estimates electrification given jet fuel will likely displace the majority of jet fuel rather than electrification** (except for very short-haul flights). Also over-estimates given the energy mix for heavy duty vehicles is still unclear.
  - Natural gas: Used Canada's Energy Future 2023: Energy Supply and Demand Projections to 2050 - electricity-generation-2023 - Open Government Portal 2022 amount for natural gas plus 1% for renewable gas and environmental attributes of non BC projects. Note that industrial use accounts for 60% of natural gas use in BC with commercial and residential each accounting for 20%. It is highly unlikely that a lot of industrial gas use would be electrified. It is more likely that there would be self-generation through locally available resources. So the total number used significantly over-estimates the natural gas use that would be electrified.
  - Electricity: used the 2022 total end use number from Canada's Energy Future 2023: Energy Supply and Demand Projections to 2050 - electricity-generation-2023 - Open Government Portal, noting that BC Hydro's 'total generation' for 2021 likely included exports.
- Efficient electrification conversion factors
  - Refined Petroleum: Internal combustion engines are about 30% efficient meaning 30% of the energy moves the car forward and 90% is lost, mostly as waste heat. Electric vehicles are about 90% efficient meaning that 90% of the energy that goes into the vehicle is spent on moving it forward. So an EV on average will require 90% of 30% of the energy of an internal combustion vehicle. Hence a factor of 27%.
  - Natural Gas: Assumption that heat pumps perform on average over the course of the next 25 years at a coefficient of performance of 3 (300% efficient) and that gas equipment is 90% efficient. Note that the south coast (Vancouver island, Sunshine Coast, Metro Vancouver, and Fraser Valley) comprise 73% of BC's population and share a moderate climate. With 300% efficiency, you only need 33% as much energy as a 100% efficient system. Subtracting 10% of that (3%) because only 90% of the gas energy is useful, we get 30%. We do not calculate the impact of **step code** for new buildings or **building envelope** improvements for existing buildings.
  - Electricity: 60% was chosen to be conservative, recognizing that replacing electric furnaces, baseboards, boilers, and hot water heaters with heat pumps would save two thirds of the electricity assuming a CoP of 3 over the next 25 years but electricity

is used for things other than heating such as lighting, laundry, etc. Again no allowance for improved building envelopes was made.

- BC population growth
  - BC Population Estimates & Projections were used for 2023 and 2046

Capacity

How much electricity needs to be available to meet the needs of peak demand which occurs on the coldest day of the year?

Some of the numbers we need to make sense of:

- 18,514 MW - BC Hydro's quick facts report quotes about 18,514 MW of capacity.
- 21,600 MW – FortisBC sponsored Guidehouse report estimate of 2050 capacity requirements in the 'electrification' pathway (page 16).
- 12,000 MW approx. – 2024 peak electricity demand from Powering BC
- 23,000 MW approx. – 2024 peak natural gas demand from Powering BC
- 43,507 MW – midpoint of Canadian Climate Institute estimate for 2050 capacity
- 37,028 MW – growing capacity at the same rate as energy in the most over-estimating scenario

So BC Hydro has more capacity than the recent peak demand requires and the gas system delivers about twice as much peak as the electricity system on the coldest day of the year.

For the purposes of testing if BC would likely be able to add sufficient capacity, we'll estimate the requirement to be 37,028 MW which grows capacity at the same scale as energy in the over-estimating base scenario. The challenge is to get an additional 18,500MW of capacity.

How much electricity could we deliver for 2050

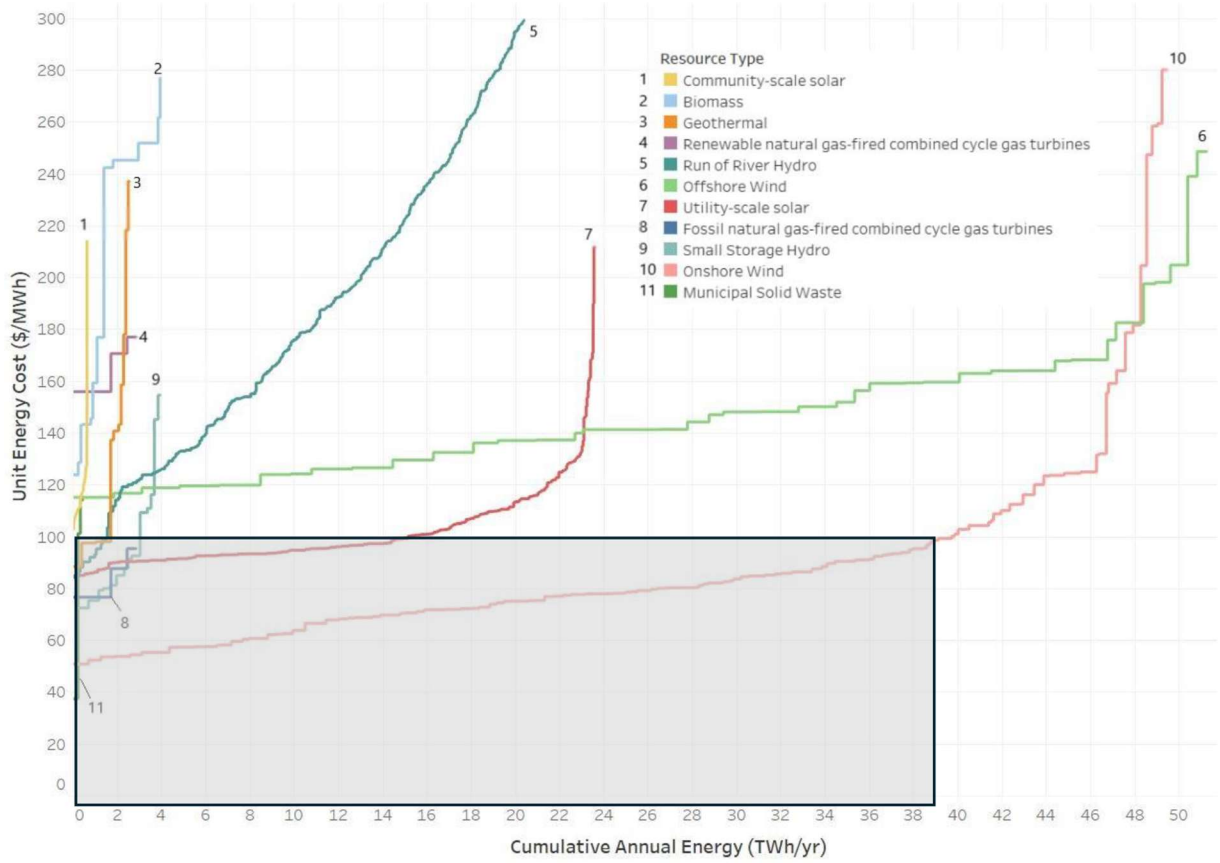
Now we turn our attention from how much we need to what could be delivered.

Energy

The 60 additional TWh needed over the next 25 years represents the same amount of energy as about **12 Site C's** OR **12 calls for power similar to 2024 over 25 years**...about one every two or three years. This also translates to roughly **tripling the Independent Power Production in BC**.

Okay, so that sounds like A LOT of new electricity. Are there sources of renewable electricity in BC that could meet that demand? Yes. **There is about 61 TWh energy available to be developed at $100/MWh**.

RODAT rou-resource-options-database-2021-irp-appendix-j-20211221-v01.pdf the graph below (Figure J2 on page 10) provides a slightly dated overview of expected costs and amount of energy for various generation options. This isn't perfect and is being updated with the results from the most recent call for power. It also doesn't perfectly predict which resources will be bid into specific calls for power. It is, however, the best estimate available of overall supply options and prices in BC.

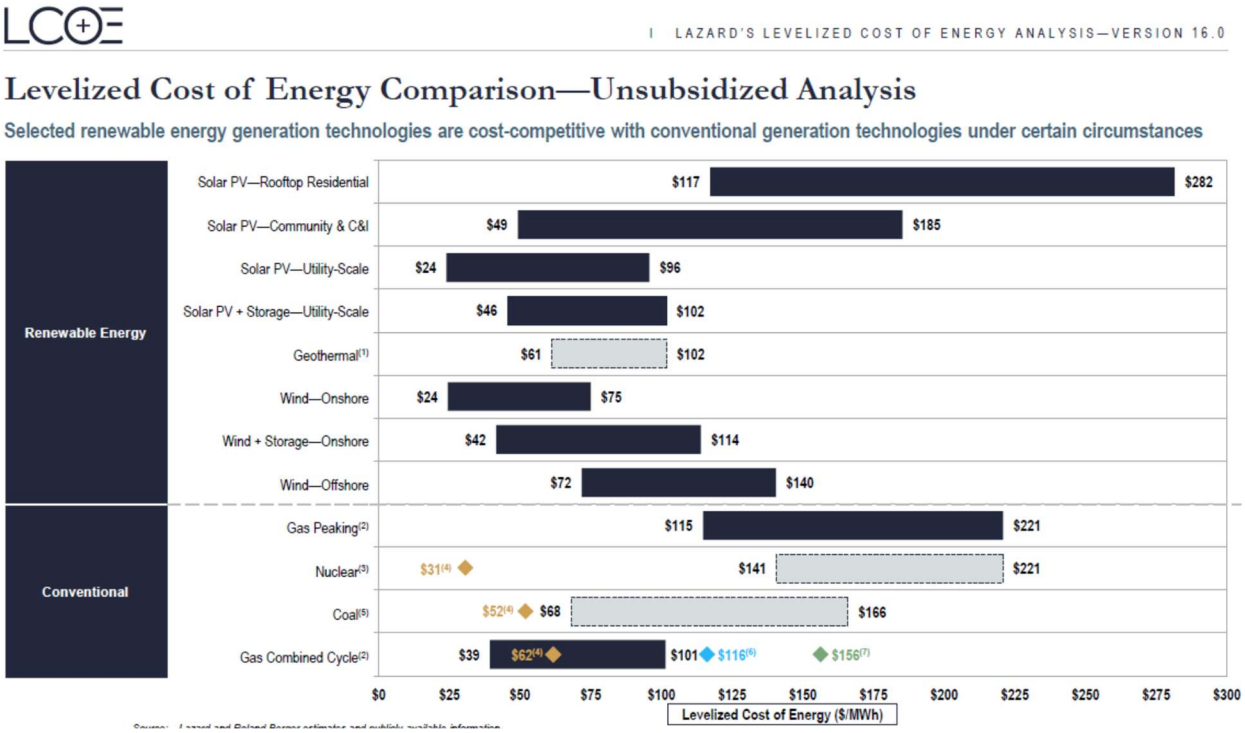


The table below approximates where the Cumulative Annual Energy intersects with the $100/MWh line for each of the resources appearing under the line.

Resource	MWh available at or below $100/MWh
Onshore wind	39
Utility scale solar	15
Offshore wind	0
Run of River	2
Small storage hydro	3
Geothermal	2
Community scale solar	0
TOTAL	**61**

Note that this is a version of the RODAT that BC Hydro published before the results of the last (2024) call for power and the general expectation is that the cost for both wind and solar will be adjusted downward based on information from the call for power.

The Lazards US-based energy analysis yields similar results in USD of course. The first chart in the report (lazards-lcoeplus-april-2023.pdf) is replicated below. Note that nuclear is significantly higher than onshore wind and utility scale solar.



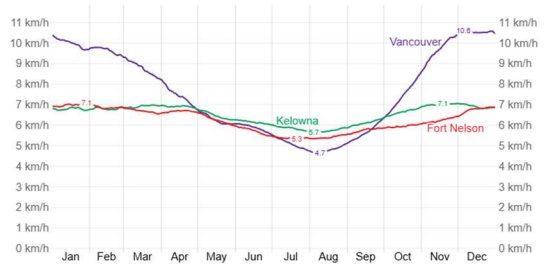
Nuclear is not included in the RODAT. From Ontario's experience, nuclear is over $95/TWh Regulated Price Plan Price Report (October 22, 2021). Note that this is based on plants built years ago and I would expect that new generation (like Site C compared to heritage dams) would be more expensive and have material risk of significant cost over-runs. **Nuclear is not impossible in earthquake prone BC, but it doesn't seem to make economic sense when we have an abundance of renewable resources at lower cost (and the cost of wind and solar continue to decrease).**

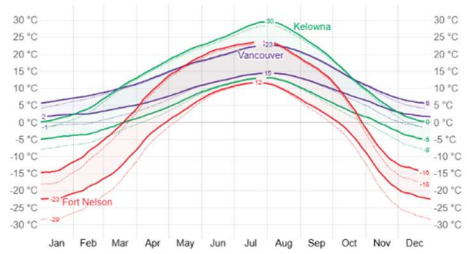
Capacity

But what about capacity for 'intermittent' resources like wind? Could we get the 18,500 MW of capacity needed in the over-estimating base scenario? **Yes, 16,000 MW seems achievable between 13,500MW from wind and 16,500MW from V2X plus the additional generation resources not counted in the wind number, solar and stationary batteries, utility scale batteries in the distribution network and demand response, there seems to be ample ability to meet the capacity needs of the over-estimating base scenario.**

The 39 TWh of wind can be expected to add about 13,500 MW of capacity using the actual capacity for installed wind in BC (Wind Electricity in BC — Business Council of British Columbia). To deliver all that extra capacity at once would require significant transmission grid upgrades.

But will the wind blow when it is cold?





The above charts from British Columbia Climate, Weather By Month, Average Temperature (Canada) - Weather Spark show that the coldest months are also the most windy with wind likely producing more rather than less when it is most needed.

However, we are in the early stages of deploying massively distributed storage at load. These batteries just happen to have their own wheels and are called electric vehicles. While not all of the current EV's on BC roads are bi-directional charging ready, most newer ones like the F150 Lightening are. We can expect future EV's to be bidirectional given current trends, California's new law California Governor Signs EV Bidirectional Charging Bill into Law | American Public Power Association and NEMA's new standard New NEMA Standard Defines Parameters for Transferring Power from EVs to the Grid.

The assumptions around the math are in the table below.

Topic	Metric	unit	Notes
passenger vehicles in bc 2023	2,704,113	Policies in force (vehicles)	Quick Statistics - Policies in force | Tableau Public
population growth to 2050	24%	Percent	
passenger vehicles in 2050	3,353,100	vehicles	assuming ldv growth with population
50% participation	1,676,550	vehicles	assuming reasonable tarrif and participation
output	10	kw	For 240V bi-directional charging
total output	16,765,500	kw	
total output mw	16,765	mw	
battery size	100	kwh	Assumption of average battery size in 2050, likely **under-estimated** as current average of available vehicles is 71 KWh Useable battery capacity of full electric vehicles cheatsheet - EV Database
50% of battery	50	kwh	Assuming a draw down of 50% of battery so as to not inconvenience the driver (this would still leave the ability to travel 150-200km)
hours at 10kw	5	hrs	

The EV capacity is short term but would cover at least 5 hours at full output or 10 hours at 50% output with the above conservative assumptions. The EV capacity is a double-benefit because the vehicles instead of charging and adding to the peak are feeding energy back into the system when it needs it the most.

So, between the 13,500MW from wind and the 16,765 from just passenger vehicles not including the nearly 1 million commercial vehicles registered in BC currently, it seems likely we can get the 18,500MW of capacity needed in the over-estimating base scenario.

In addition to these resources, there are others that will materially contribute to meeting the (likely over-estimated for the purpose of this analysis) capacity needs such as:

- BC Hydro is currently incenting rooftop solar and battery installations which have the potential to add capacity similar to EV's over time depending on adoption.
- Utility scale batteries in the distribution grid will likely also play a role to provide additional capacity in constrained areas.
- This is also before demand response where the utility turns down appliances or heating in homes to time-shift energy use from the 'peaks' to the 'valleys' of electricity use

Cost

Even if we over-estimate electrification needs, we seem to have options for both energy and capacity, but at what cost? **The cost of generation could increase by roughly 22% to 47% over 25 years** depending on the scenario (22% being electrifying buildings and transportation but not industry with reasonable performance of heat pumps particularly on the south coast).

The table below provides an overview of the increase we could expect for generation cost. Of course, transmission and distribution systems will need to be strengthened though not doubled if done wisely. In the over-estimating base scenario, we can expect the cost of generating electricity in BC to rise by **47% above inflation or about 1.5% above inflation every year**.

Generation Cost	Generation GWh	% generation	Cost/MWh
Heritage Assets	49,000	75%	$33
IPP	16,330	25%	$100
total & avg	**65,330**		**$50**
New IPP for 2050	56,670		
2050 total IPP	73,000	60%	
2050 total heritage	49,000	40%	
total 2050	**115,000**		**$73.09**
Increased cost above inflation			$23.34
Percentage change above inflation			47%

Increasing bills (a bit different than generation cost, because it includes transmission, distribution, debt costs, deferral accounts and a host of other things) by 47% would put **BC electricity costs on par with Ontario and still significantly lower than Alberta**.

The $100 cost for IPP power is likely a material over-estimate given the $75/MWh cost in the 2024 call for power, the RODAT cost curve, and trajectory of solar and wind costs over the last decade.

If we make a generous assumption that transmission and distribution systems costs will increase at a similar rate, we are left with the question: ***Are British Columbian willing to have electricity rates increase of up to 0.8% - 1.5% above inflation every year to electrify the economy, achieve energy independence and address climate change?***

References for cost table

Source	Topic
PowerPoint Presentation	IPP total generation
Microsoft Word - Heritage LGIC Rpt-Recommendations.doc	Heritage asset total generation
BC Gov News	Heritage asset and IPP costs

The true cost of electrification may have more to do with the stranded assets of the natural gas distribution grid than with the cost of generating electricity. This analysis, as far as I can determine, has not yet been completed.

Conclusion

Key Findings

One of the questions I hear from policy-makers at the local government level in BC is '**Does BC have enough electricity if we electrify buildings and transportation'**?. The answer needs a 2050 perspective rather than a 2023 or 2030 perspective. **Looking out to 2050, I have found that the answer is 'yes'.** There is also a role for public dialogue with a change of this magnitude.

BC will likely need 30% to 100% more electricity in 2050 than it does today if an insightful approach is taken to implementing electrification. This approach would include swapping baseboard heating for heat pumps, avoiding green hydrogen, crpyto data centers, and nuclear generation.

BC has the renewable, largely onshore wind, resources to meet the annual energy demand. BC also has the resources to meet the peak capacity demand through the new generation brought onstream, massively distributed storage at load with EV's and solar/battery systems, distribution network utility scale batteries and demand response.

The cost could be 0.8% to 1.5% above inflation for the next 25 years, resulting in an electricity cost in 25 years similar to Ontario's today and significantly lower than Alberta and the US. The electric and natural gas systems are becoming more inter-dependant and any significant change to one will impact the other. One example of this is that there could be even greater costs that I have not yet seen calculated to decommission parts of the natural gas grid.

This report does not make recommendations to policymakers. It provides two scenarios (a meal) and details the assumptions behind them (the recipe) for policymakers to cook up their own understanding.

Questions worthy of a public dialogue on the future of energy in BC include:

5. Is there continued will for mitigation actions?
6. Is increasing onshore wind socially acceptable?
7. Is the cost (0.8% to 1.5% above inflation for 25 years) acceptable?
8. What do we want the future of the natural gas grid to look like?

Further Questions for Policymakers & British Columbians

Ultimately British Columbians will decide if electrification is a strategic mistake or a generational opportunity. Further questions that are fundamental to getting to the answer and are worthy of public dialogue include:

1. **Is there still a will to do our part to address climate change?** Almost half of ballots cast in the last provincial election going to a party whose platform committed to stopping most effective climate actions in BC however polling indicates that perhaps there is still voter preference for climate action Polling Backgrounder - BC Election and Climate Change. We exceeded 1.5c above pre-industrial levels in 2024 according to Copernicus: 2024 is the first year to exceed 1.5°C above pre-industrial level | Copernicus. Do British Columbians and the communities they live in want to continue addressing climate mitigation while also addressing adaptation or just focus on adaptation and emergency management?
2. **Is tripling the independent power production (primarily onshore wind) socially acceptable?** There will be a need for a lot more energy. BC has the resources to deliver but are people willing to accept wind farms? Recent changes to calls for power requiring some level of Indigenous ownership or participation may help with this.
3. **How much is too much?** We don't know the full cost of electrification because we haven't completed BC-specific analysis yet of the impact of electrification on the natural gas grid including stranded assets and a controlled wind-down of segments of the natural gas grid. What we do expect is that electricity cost could rise 0.8% to 1.5% above inflation for two and half decades. Income-tested rebates on electricity could add modestly to the cost while avoiding energy poverty.
4. **What is the value of the natural gas distribution grid in BC?** What are the costs of decommissioning all or part of the natural gas distribution grid and who pays for it? What value does it provide for future flexibility? What do we collectively want the future of natural gas distribution in BC to look like? These are material questions that are worthy of a public dialogue. There are also other related questions about the gas grid that bear further research and discussion.
    a. Would making the gas grid fully renewable be easier and less costly? The amount of Renewable Natural Gas that can be produced in BC is the system equivalent to a cow fart in the wind. There are options to generate 'blue hydrogen' with carbon capture and sequestration though this is expensive and most sequestration projects have not met expectations. 'Turquoise hydrogen' using pyrolysis may be possible and economic but technologically it is early days. A shift to using primarily hydrogen would involve some intricate planning as hydrogen has different thermal properties from natural gas. Wood waste could be used though there is long term risk regarding ongoing operations of mills producing the waste product as well as increased competition for the resource for synthetic crude and sustainable aviation fuel not to mention cost and technical challenges. Buying environmental attributes of Renewable Natural Gas projects in the US or across Canada (yes, this does sound like offsets) could allow BC to show a 'net' zero accounting for natural gas while continuing to burn fossil gas locally.