Zero Carbon Step Code Key Facts

This summary aims to provide BCIT faculty with a brief on the BC Energy and Zero Carbon Step Code for the purposes of informing discussions with students and industry. This summary has been prepared to specifically address some unclear information put forth by the BC Coalition for Affordable Dependable Energy (BCCADE).

May 2024

Contents

References:

https://www2.gov.bc.ca/assets/gov/environment/climate-change/action/cleanbc/cleanbc_roadmap_2030.pdf

https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-british-columbia.html#:~:text=Of%20this%20total%2C%2012.2%20MT,B.C.%20comes%20from%20renewable%20sources.

https://www.cdn.fortisbc.com/libraries/docs/default-source/about-us-documents/regulatory-affairs-documents/gas-utility/220509-fei-2022-ltgrp-ff.pdf?sfvrsn=cbf19584_0

https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/electricity-alternative-energy/transportation/renewable-low-carbon-fuels/resource_supply_potential_for_renewable_natural_gas_in_bc_public_version.pdf

https://www.cdn.fortisbc.com/libraries/docs/default-source/news-events/bc-renewable-and-low-carbon-gas-supply-potential-study-2022-03-11.pdf

https://www.bcit.ca/files/facilities/projectservices/pdf/ncip_info_session_package_web.pdf

https://www.zebx.org/zebx-presents-the-b2e-bc-hydro-webinar-is-bc-ready-for-electrification/

1. Does adopting the Zero Carbon Step Code means no more natural gas?

From BCCADE:

Adopting the Zero Carbon Step Code will "mean no more gas stoves, no gas fireplaces and no more gas barbecues"

Simple Comment:

For small residential buildings (Part 9 of the BCBC - single family, townhomes, duplexes, etc.) natural gas for cooking and barbeques is excluded from any emission calculations of Zero Carbon Step Code compliance. Fireplace natural gas use might be included if the other heating system can not satisfy the heating requirements alone.

For larger buildings (Part 3 of the BCBC), the ZCSC applies only to residential, hotels/motels, offices, business and personal services and mercantile occupancies. For these building types, natural gas used for cooking is included in emission calculations., but it is unlikely with these building types that emissions from cooking activities will significantly impact calculated GHG Intensity for ZCSC compliance (GHGI, measured in kg of e-CO2/m2/yr). One exception might be buildings with significant square footage allocated to intensive cooking operations (e.g. full-service hotels – see detailed comments for further discussion).

Expanded Comments:

Further details on why adopting the Zero Carbon Step Code does not exclude use of natural gas for stoves, fireplaces and gas barbecues Expanded comments for this section are included in the Appendix.

- Part 9 Buildings (small commercial buildings and residential homes), page 5
- Part 3 Buildings (larger more complex buildings), page 5

2. Will the Zero Carbon Step Code mean increased energy costs?

From BCCADE:

Adopting the Zero Carbon Step Code will mean increased energy costs to homeowners and businesses.

Simple Comment:

This statement is false. When it comes to space heating, utility costs vary significantly but these variations are most significantly impacted by system efficiency. **In general, utility costs for space heating with a heat pump will be the same or less as heating with natural gas but heating with electric resistance appliances will cost significantly more than heating with natural gas.** It will be uncommon to find new buildings able to achieve the energy performance metrics of the BC Energy Step Code using electric resistance heating due to the comparatively low efficiency of this type of heating appliance.

Expanded Comments:

The energy cost to homeowners and business can be calculated with a simple equation.

Further details on residential rate structure and costs of providing heat with various fuels and system types.

- Energy Costs for Homeowners (Residential utility rates), page 6
- Energy Costs for Businesses (Commercial utility rates), page 6

3. Can't we simply develop more electricity generation?

From BCCADE:

Numerous academic studies from British Columbia have shown how expensive an electrification only approach would be.

One study estimated that the natural gas system in the province provides the equivalent energy of about 20-30 Site C dams.

Simple Comment:

It is correct that BC consumes approximately 100,000 equivalent GWh per year of natural gas and 60,000 GWh/year of hydroelectricity. Site C will produce approximately 5,000 GWh/yr.

A simple but incorrect argument is that it would take 20 site C dams to replace 100,000 GWh of natural gas (100,000 GWh / 5,000 GWh = 20).

BC's plan to cut carbon emissions in buildings includes more than just electrification of buildings. BC's plans include improving energy efficiency, using renewable and regular natural gas, conservation, adding renewable energy, and more. BC is not electrifying everything, BC Hydro will not have to build 20 site C to replace BC's natural gas consumption.

Expanded Comment:

BC's energy mix includes hydroelectricity, natural gas, renewable gas, petroleum, and biomass. When we switch to new technologies for the same services, like switching from gas to electric heating with heat pumps, it's not a direct swap in energy use (i.e. it is not a one for one replacement). For example:

- An 85% efficient heating system gives you less heat for every unit of energy (you get 0.85 units of heat energy for every unit of raw energy purchased) . In this case, to get 1 unit of heat, you need to buy and consume 1.2 units of energy.
- An electric baseboard heater gives you the same amount of heat as the energy you put in (you get 1 unit of heat energy for each unit of raw energy purchased). In this case, to get 1 unit of heat, you need to buy and consume 1 unit of energy.
- An electric air-source heat pump can give you 2 to 5 times more heat than the energy it uses (200% to 500% efficiency). In this case, to get 1 unit of heat energy, you need to buy and consume 0.2 to 0.5 unit of electrical energy.

So, using electricity for heating (with a heat pump) needs less energy than gas. This is one example why BC hydro does not need to build a 20 site C to replace natural gas.

Also, even if electricity costs more per unit of energy, heating with a heat pump can be cheaper (see previous table). The same goes for switching from a 20 to 30% efficient combustion engine to an electric drive in a car. Gains in efficiency from fuel and technology switching must be part of the accounting and planning exercise. Ultimately, transitioning to a low carbon economy will be done mostly by switching to more energy efficient technologies.

4. Doesn't BC have an excess supply of hydroelectric power with Site C?

From BCCADE:

Not for long.

BC Hydro recently announced a new call for power, acknowledging that its system will soon need new sources of generation even with Site C.

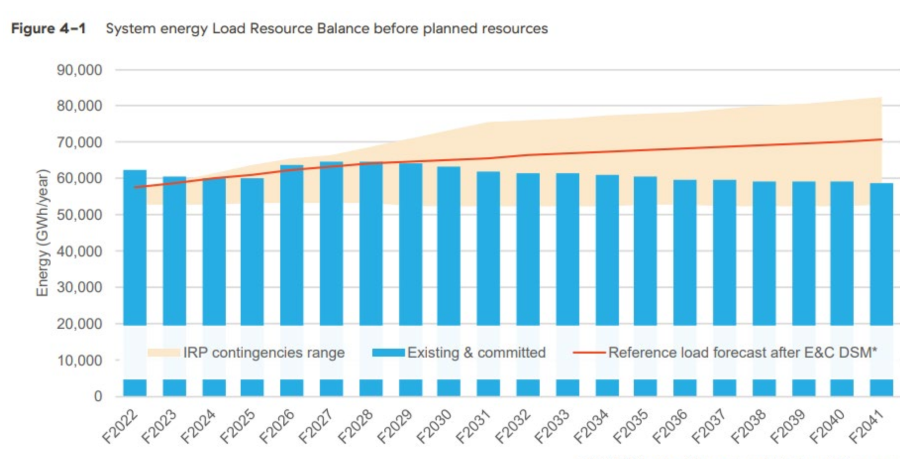
Simple Comment:

BC is getting ready for more electricity needs in the future, and they've been planning for it. This type of planning for growth has always been part of how utilities, including BC Hydro, do business.

Expanded Comment:

Future demand and supply of electricity:

BC Hydro and the Province of BC have a history of planning ahead for how much electricity we will need. In the 2021 Integrated Resource Plan (updated in 2023), BC Hydro lays out how much electricity we can generate (blue bars, see graph below) and how much we'll likely need (red line, see graph below). They're expecting a 5,000 GWh/yr rise of the blue bars in 2026 when all the site C dam generators come online.



Predicting demand for electricity isn't easy, but BC Hydro's plan estimates we might need an extra **5,000 GWh/yr by 2030** (see red line within graph above, could be up to 10,000 GWh by 2030, see beige area of the graph) and **10,000 GWh per year by 2041** (again, see red line within graph above, could be up to 20,000 GWh by 2041, see beige area of the graph).

Plan to meet future demand of electricity:

To meet the projected 2030 electricity demand, BC Hydro:

i. issued in April 2024 a call for proposals to add 3,000 GWh/year of clean or renewable energy by as early as 2028. As a comparison, Alberta recently added 4,500 GWh/year of wind power, showing what's possible,
ii. is also planning to add 700 GWh/year to existing facilities in the short term, and;
iii. is planning to boost customers' energy efficiency to free up 1,700 GWh/year.

In total, this is enough to cover the predicted 5,000 GWh/yr gap (3,000 + 700 + 1,700 = 5,400 GWh/yr).

How could BC Hydro meet the projected 2041 electricity demand?

In BC, if a quarter of homes got 10 kW of solar panels, or half got 5 kW, we could add around **5,000 GWh/year** of clean electricity to our energy mix. **This could cover the next 5,000 GWh/yr, getting us to a total of an additional 10,000 GWh (5,000 from previous paragraph + 5,000 from solar) of electricity flowing in the BC Hydro grid, for example.**

What about system peak capacity for high demand periods?

BC Hydro's Integrated Resource Plan also looks at increasing capacity in the system for peak demand, both at the utility and neighborhood levels.

Approximate Numbers at a Glance	GWh/yr
New electricity generation needed by 2041	10,000 (between 0 to 20,000)
New electricity generation needed by 2030	5,000 (between 0 and 10,000)
April 2024 call for new power	3,000
New power to be secured by improving existing facilities	700
Electricity made available to other clients via energy efficiency – by 2030	1,700
Wind-based electricity added to the grid in Alberta in the last year	4,500
Potential for on-site electricity production with roof mounted solar panels	5,000

5. What about electric distribution capacity in our neighborhoods?

From BCCADE:

We're already seeing the cost of electrification only approaches on distribution infrastructure.

A lack of electric distribution capacity has resulted in a number of stunning problems throughout British Columbia including:

a) *Some new housing projects have been told they are not able to access the electricity system because there isn't enough distribution capacity in their area;*

b) *A local hospital was forced to run on emergency backup generators because there wasn't enough distribution capacity in the area; and*

c) *Some local governments are learning that new neighbourhoods might not have access to the electricity grid for many years, again as a result of insufficient distribution capacity.*

Simple Comment:

BC Hydro and local utilities have multiple solutions and approaches that can be put forward to deal with capacity issues, these solutions exist today, and can be planed for.

Expanded Comment:

There are many ways to deal with electrical grid capacity. For example:

- Switching from electric baseboards to heat pumps reduces the demand for power, freeing up capacity in neighborhoods for things like charging electric vehicles.
- Using renewable energy like rooftop solar panels means we don't need as much electricity from BC Hydro's grid.
- BC Hydro and its partners are working on physically upgrading local distribution capacity. For example, BCIT has been improving things in the North end of the Burnaby campus.
- In colder parts of BC, using dual fuel heat pumps might help with electrical grid capacity. While cold-climate heat pumps can work well in very cold weather (delivering sufficient heat at temperatures lower than -25C), it might make sense to use dual fuel heat pumps which switch to natural gas (conventional or renewable) on the coldest days, to save BC Hydro capacity at peak. For example, Quebec utilities (Hydro Quebec and Energir, natural gas utility) are collaborating on balancing fully electric with dual fuel heat pump systems to address potential electrical grid peak capacity issues.

6. What is RNG?

From BCCADE:

Renewable natural gas is a low-carbon energy that puts waste to work, helping reduce greenhouse gas (GHG) emissions.

RNG is developed by capturing and naturally occurring biogas from local farms, landfills and other sources of decaying organic material.

Simple Comment:

This statement is correct but must be quantified. Renewable natural gas helps with the carbon emissions reduction, but it's only a small part of the climate crisis solution.

Expanded Comment:

In the near term, renewable natural gas can provide about 1,200 to 1,700 GWh/year of energy. With current technology and feedstock available in BC, we could potentially ramp up to 3,400 GWh/year in the long term. But even that wouldn't be enough to heat all BC houses or replace the nearly 100,000 GWh/year of conventional natural gas energy we use today. So, while renewable natural gas is helpful, it's still just a small piece of the bigger energy puzzle.

Consumption of conventional natural gas will have to be reduced by a series of solutions, including renewable natural gas, electrification, energy efficiency, and more.

Note: The CleanBC plan aims for 15% of natural gas in BC pipelines to be renewable.

Approximate Numbers at a Glance	GWh/yr	%
Potential near term availability of RNG	1,200 to 1,700	1.2% - 1.7%
Potential long term availability of RNG	3,400	3.4%
Total natural gas consumption in BC	100,000	100%
CleanBC objective, portion of natural gas mix in BC to be from RNG	?	15%

APPENDIX – Additional details

Will the Zero Carbon Step Code mean no more natural gas?

Part 9 Buildings (small commercial buildings and residential homes)

This statement is false. Zero Carbon Step Code compliance in Part 9 buildings is possible with gas stoves, gas fireplaces and gas barbecues. This is largely because in Part 9 buildings, energy and emissions from gas stoves, fireplaces (that are not the required to meet the heating loads at design conditions), and gas barbecues are excluded from all calculations for compliance with Zero Carbon Step Code.

BCBC: Section 9.37. Greenhouse Gas Emissions

However, there are two major compliance pathways for Part 9 buildings:

1. Performance Code Compliance Pathway

   Section 9.36.5.4 Calculation Methods specify that the only energy from systems that is included in calculations are:
   a) space heating,
   b) ventilation,
   c) service water heating, and
   d) space cooling (where installed)

   NOTE – We have already seen Energy Step Code 3, Part 9 homes in the Kootenays[1], using natural gas backup heating able to meet EL-4 of the Zero Carbon Step Code because the natural gas usage occurs for such a limited portion of the year it has limited impact on the overall GHGI when using the performance compliance pathway.

2. Prescriptive Code Compliance Pathway

   The prescriptive pathway to comply with EL-4 (most stringent GHG Emission Level) requires "energy sources supplying all building systems including equipment and appliances" to have emission factors that are not possible from natural gas energy utilities in BC but "redundant or backup equipment for the systems and equipment is excluded". In the case of Part 9 buildings, redundant or backup equipment includes decorative gas fireplaces or heaters that are not needed to provide the heating load of the building at design conditions.

   Fireplaces or backup natural gas heating equipment are included when they are required to meet the primary energy requirements at design conditions (e.g. fireplaces or gas furnaces providing space heating when heat pumps have not been designed to satisfy the full heating load of the building).

   The definition of 'appliances' as described under Part 9 energy sources for (Table 9.37.1.1) of the BCBC refers to appliances used for space heating, cooling, and service hot water production. This **excludes combustion equipment like non-essential fireplaces, cooktops, or clothes dryers. Outdoor heating appliances (patio heater, BBQ, etc.) are also excluded.**

[1] Reference provided by ZEBLC PTS instructors reviewing ESC Compliance Forms for projects in this region.

Part 3 Buildings (larger more complex buildings)

First, keep in mind that the Zero Carbon Step Code applies only to buildings with the following occupancies:

- Residential, hotels/motels, offices, business and personal services and mercantile occupancies.

This statement is false. The Zero Carbon Step Code will not "mean no more gas stoves, no gas fireplaces and no more gas barbecues", but it depends on what type of building occupancy. The following provides some perspective on building types that are of concern when it comes to gas cooking appliances, fireplaces, barbecues:

- RESTAURANTS ARE EXCLUDED: The ZCSC does not apply to Part 3 buildings that are restaurants (Group A, Div. 2 Occupancies under the BCBC).
- COOKING AND FIREPLACES IN RESIDENTIAL or OFFICE BUILDINGS ARE INCLUDED: Most Part 3 buildings using natural gas for cooking or decorative fireplaces will see this as a small percentage of the total energy end use, meaning it will have low impact on the ZCSC GHG Intensity (GHGI, measured in kg of e-CO2/m2/yr) calculation (e.g. office building with small cafes or fireplaces in multi-unit residential buildings). Modeling guidelines stipulate how use of these appliances is calculated and determine what overall impact this limited energy use will have on the GHGI.
- COOKING IN FULL-SERVICE HOTELS: For some hotel types, intensive cooking can lead to higher impacts on GHGI. For example, Pacific Northwest National Laboratory (PNNL) case study for **1968** full-service hotel[1] shows:
  - Commercial kitchen cooking appliances measured natural gas consumption representing 7% of overall energy intensity (20.5 e-kWh/m2/yr).
  - With the BCBC emissions factors, cooking only with natural gas in this full-service hotel could result in a GHGI of 3.7 kg of e-CO2/m2/yr).
    - This number would exceed GHGI maximum of 2.0 e-CO2/m2/yr for ZCSC EL-4, but still be lower than the GHGI maximum of 4.0 e-CO2/m2/yr for ZCSC EL-3 for hotels and motels occupancies.
  - Full-service hotels occupancies known for high natural gas use in commercial kitchens could have some concern achieving the top step of the ZCSC with 100% natural gas cooking appliances. Note that today, many electric cooking appliances are preferred (e.g. pizza ovens, deep fryers, griddles, steam tables, combi ovens, induction ranges) and this would decrease the GHGI of a commercial kitchen in a full-service hotel.

BCBC- Section 10.3. Greenhouse Gas Emissions

Performance Code Compliance Pathway - 10.2.3.4. Energy Modelling requires inclusion in overall building energy (TEUI) and GHG emissions (GHGI) the following:

a) process loads including swimming pool heating, patio heaters, commercial kitchen cooking appliances, exterior fireplaces – with usage aligned with design and expected occupant use.

b) interior fireplaces – with usage aligned with design and expected occupant use.
All calculations will adhere to the referenced CoV Energy Modelling Guidelines.

Will the Zero Carbon Step Code mean increased energy costs?

Energy Costs for Homeowners (Residential utility rates)

The table below shows the utility costs from delivering a kWh of heating energy to a home at residential utility rates (BC Hydro and Fortis BC, April 1, 2024). The table shows that the heating with electric resistance baseboards will cost more than heating with natural gas furnace, but that a high efficiency heat pump will cost less than heating with natural gas, given the high system efficiency.

RESIDENTIAL UTILITY RATES:

Heating System Type	Efficiency %	C.O.P.	Residential Utility Rate (including carbon taxes)		Cost of Energy Delivered $/e-kWh
electric resistance	100%	1.0	$0.1408	/kWh (step 2 rate)	$0.14
			$0.1097	/kWh (step 1 rate)	$0.11
heat pump	250%	2.5	$0.1408	/kWh (step 2 rate)	$0.06
			$0.1097	/kWh (step 1)	$0.04
heat pump	350%	3.5	$0.1408	/kWh (step 2)	$0.04
			$0.1097	/kWh (step 1)	$0.03
natural gas furnace	95%	0.95	$0.0454	/e-kWh ($9.177 for delivery, storage, commodity and $3.431 carbon tax - April 1 2024)	$0.05
natural gas furnace	70%	0.70	$0.0454	/e-kWh ($9.177 for delivery, storage, commodity and $3.431 carbon tax - April 1 2024)	$0.065

Energy Costs for Businesses (Commercial utility rates)

The table below shows the utility costs from delivering a kWh of heating energy to a business at the commercial utility rates (BC Hydro and Fortis BC, April 1, 2024). The table shows that the heating with electric resistance will cost more than heating with natural gas, but that a high efficiency heat pump will cost less than heating with natural gas, given the high system efficiency.

COMMERCIAL UTILITY RATES:

Heating System Type	Efficiency %	C.O.P.	Residential Utility Rate (including carbon taxes)		Cost of Energy Delivered $/e-kWh
electric resistance	100%	1.0	$0.1352	/kWh (Sm. Gen. Service)	$0.14
			$0.1044	/kWh (Md. Gen. Service, consumption charge only, assume no impact on peak demand charge)	$0.10
heat pump	250%	2.5	$0.1352	/kWh (Sm. Gen. Service)	$0.05
			$0.1044	/kWh (Md. Gen. Service, consumption charge only, assume no impact on peak demand charge)	$0.04
heat pump	350%	3.5	$0.1352	/kWh (Sm. Gen. Service)	$0.04
			$0.1044	/kWh (Md. Gen. Service, consumption charge only, assume no impact on peak demand charge)	$0.03
natural gas air handlers	95%	0.95	$0.0396	/e-kWh GJ (Sm. Com.l $7.538 for delivery, storage, commodity and $3.431 carbon tax - April 1 2024)	$0.04
Natural gas hydronic boiler	95%	0.95	$0.0396	/e-kWh GJ (Sm. Com.l $7.538 for delivery, storage, commodity and $3.431 carbon tax - April 1 2024)	$0.04
natural gas air handlers	70%	0.70	$0.0396	/e-kWh GJ (Sm. Com.l $7.538 for delivery, storage, commodity and $3.431 carbon tax - April 1 2024)	$0.06
Natural gas hydronic boiler	70%	0.70	$0.0396	/e-kWh GJ (Sm. Com.l $7.538 for delivery, storage, commodity and $3.431 carbon tax - April 1 2024)	$0.06