Orion. A (Near) Zero Carbon All-Electric Building in Pemberton BC.

Carbon Performance in BC Local Government New Building Requirements

March, 2022

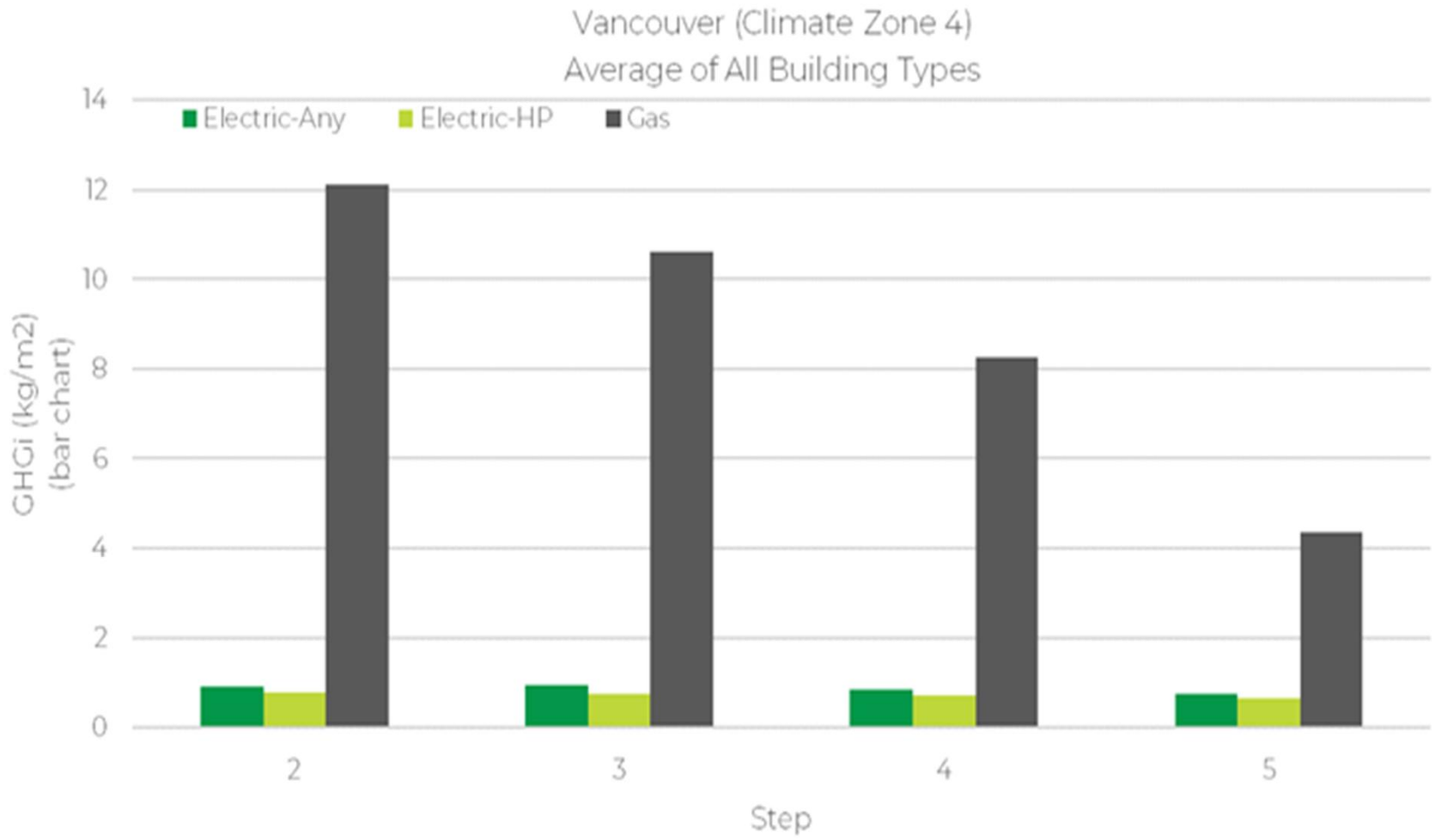
Brendan McEwen, AES Engineering Ltd.

Outline

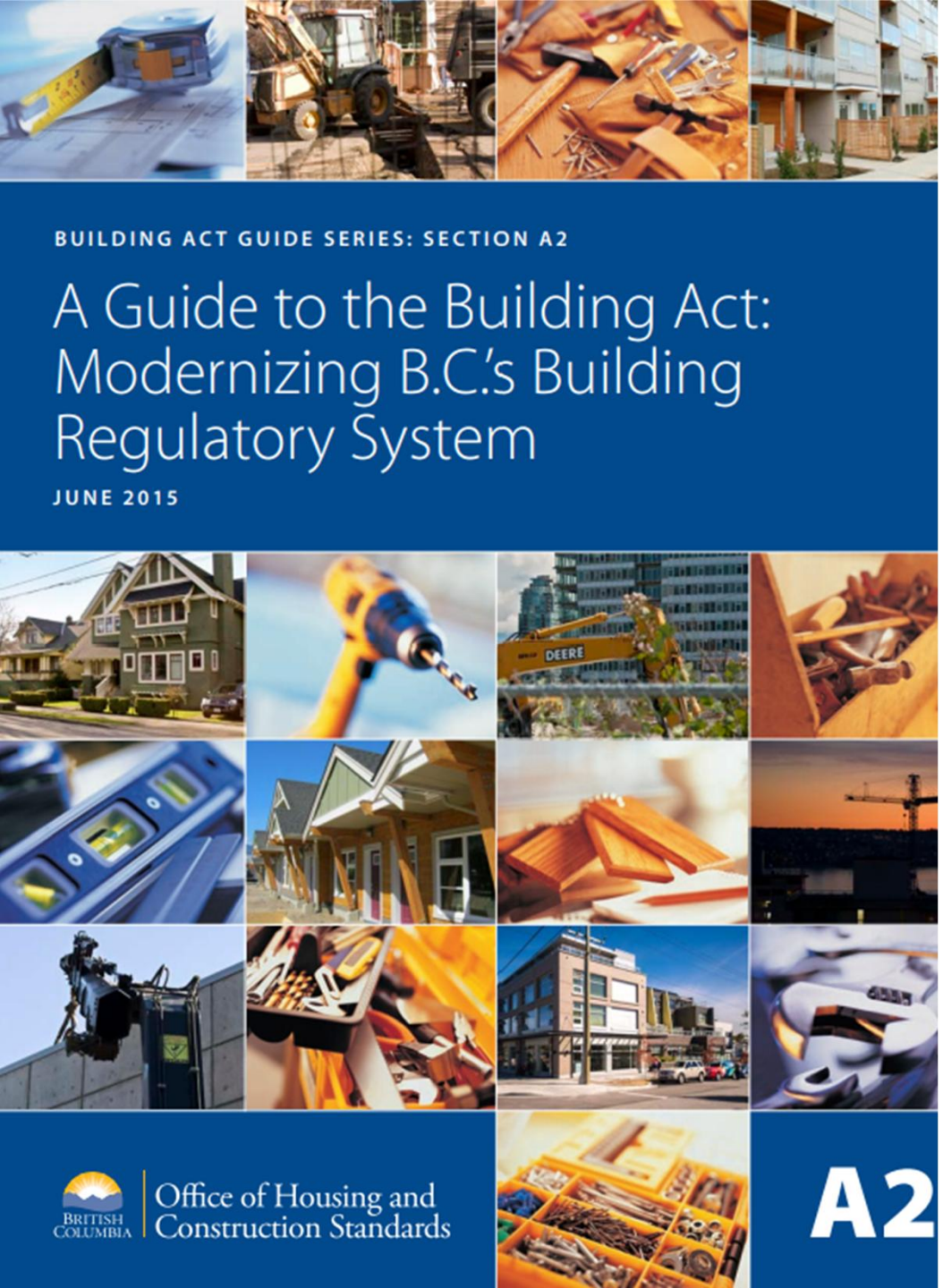
- Overview of BC Local Government Carbon Performance Requirements
- Summarize Proposed Provincial “Opt-in” Carbon Performance Requirement
- Potential Paths for BC Local Governments

Electric building systems are very low carbon on BC's clean electrical grid

Part 9 Buildings – New Construction



Source: BC Energy Step Code Metrics Research. Updated 2020 by Remi Charron.



To Date, BC Local Governments Could Not Directly Require GHG performance

Local governments are limited by the BC Building Act from making technical building requirements

... but they can provide options...

Local Government	Requirements LCES Option			Effective Date
Part 9 Buildings (Smaller buildings, less than 4 storeys & 600m² in footprint) Step 5 is highest Step; Step 3 is anticipated apprx. performance of 2022 baseline BC Building Code				
D. of West Vancouver	Step 5	OR	Step 3	Mar 2021
City of Vancouver	~Step 5	OR	~Step 4	Jan 2022
City of North Vancouver	Step 5	OR	Step 3	Jul 2021
District of North Vancouver	Step 5	OR	Step 3	Jul 2021
City of Richmond	Step 3	OR	Step 2	In Effect
City of Richmond (proposed)	Step 4	OR	Step 3	Jan 2022
City of Victoria (proposed)	Step 4	OR	Step 3	Jan 2022

Part 3 Buildings – Residential (Larger buildings, 4+ storeys or 600m² footprint) Step 4 is highest Step; Step 2 is anticipated apprx. performance of 2022 baseline BC Building Code				
D. of West Vancouver	Step 4	OR	Step 2	Mar 2021
City of Vancouver – 7 + stories	~Step 3	OR	~Step 2	In effect
City of Vancouver – < 7 stories	~Step 4	OR	~Step 3	In effect
City of Richmond – 7 + stories	Step 3	OR	Step 2	In effect
City of Surrey	Step 3	OR	Step 2	In effect
City of Port Moody	Step 3 Step 4	OR OR	Step 2 Step 3	In effect 2021
City of Burnaby	Step 3	OR	Step 2	In effect
City of New West	Step 3	OR	Step 2	forthcoming
D. of North Vancouver	Step 4	OR	Step 3	2021
City of Victoria (proposed)	Step 3	OR	Step 2	Jan 2022
Part 3 Buildings – Office & Retail Step 3 is highest Step; Step 2 is anticipated apprx. performance of 2022 baseline BC Building Code				
City of Burnaby	Step 3	OR	Step 2	In effect
D. of North Vancouver	Step 3	OR	Step 2	Jul 2021

CleanBC Roadmap to 2030 – Buildings Commitments

- Carbon performance in the BC Building Code
  - Local government “opt-in” requirements in 2022
  - Phase in provincial requirements over time (2024, 2027, 2030)
  - Transition to zero-carbon new buildings Province-wide by 2030.

- Highest efficiency standards for new space and water heating equipment
  - After 2030, all new space and water heating equipment sold and installed in B.C. will be at least 100% efficient [e.g. Heat pumps or electric resistance. Gas combustion not allowed.]

Opt-in Carbon Performance Reg

Source: BC Building & Safety Standards Branch

Metrics

- Anticipated that Province will introduce an "opt-in" carbon performance regulation using a "greenhouse gas intensity" (GHGI) metric
  - GHGI is a modeled value
  - Measured in $kgCO_2e/m^2/year$
- Potential levels:
  - Measure GHG emissions only
  - Medium carbon (GHGI set to decarbonize domestic hot water *or* heat)
  - Low carbon: (Decarbonize domestic hot water *and* heat)
  - Zero-carbon: *all* systems use low-carbon fuels

Hot Water Heat Pumps with Ultra-Low GWP Refrigerants
A Low Carbon Building Technology

Province's Proposed Part 3 targets

Occupancy	GHGI Targets ($kgCO_2e/m^2/year$)		
	Medium	Low	Zero Carbon Ready
MURB	7 (or 6-8?)	3 (or 4?)	2 (or 1.5?)
Office	5	3	1.5
Retail	6	3	2 (or 1.5?)
Hotel	9	4	2 (or 1.5?)

Province's Proposed Part 9 performance targets

Path 1: GHG "base allowance"

Targets

Ideal for small houses

	GHG Base Allowance
	kg CO2e per unit
Medium	1200
Low	500
Zero Carbon Ready	300

Path 2: GHGI & GHG Cap – Both apply

	Building GHG Intensity	GHG Maximum Cap
	kgCO2e/m2/yr	kg CO2e per unit
Medium	6	2400
Low	2.5	1000
Zero Carbon Ready	1.5	500

Ideal for medium-sized houses

Limits emissions of the largest houses

- Hybrid GHG/GHGI approach
  - Each dwelling unit gets a minimum carbon allowance
  - If the dwelling unit exceeds the allowance, it must meet either a GHG or GHGI, whichever emits *the least total GHG*
  - All paths available regardless of home size or AHJ
- Why?
  - Gives small homes a chance; doesn't let large homes off the hook
    - Small homes greatly exceeded 6/3/1 GHGI targets yet have lower total GHG emissions than larger homes
    - Large homes still need to be thoughtfully decarbonized

Proposed Part 9 prescriptive path

Path 3: Prescriptive

Targets

	Action
Medium	Decarbonize space heat
Low	Decarbonize both heat & hot water
Zero Carbon Ready	Fully decarbonized building

- Why?
  - Simpler
  - Compatible with any future prescriptive Part 9 path in BCBC
  - Compatible with communities that have not adopted Step Code (which is performance based)
  - It works for the Fort Nelson electricity grid

Potential Provincial Timeline for BC-Wide Requirements

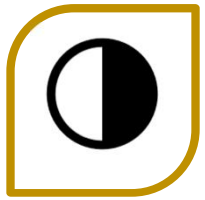
2022

Measure GHGs

Energy modelling already includes GHG analysis

2024

Medium



2027

Low

2030

Zero-carbon

Potential Local Government Pathways

- 2023 / ‘24
  - Require “Low Carbon” (or Zero-Carbon Performance)
    - If needed, implement an interim “Low Carbon Energy System Option”, if Province is slow to implement opt-in carbon performance requirement:
      - e.g. Step 5, OR Step 3 (or BCBC) & Low Carbon Energy System
  - <u>Either way, decarbonization will predominantly require electric mechanical systems (e.g. heat pumps)</u>
- Future years (e.g. 2026)
  - Increase Step Code (energy efficiency)
  - Zero Carbon Performance (if started at low carbon)

Thank you!

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Additional Slides

Considerations for Renewable Natural Gas

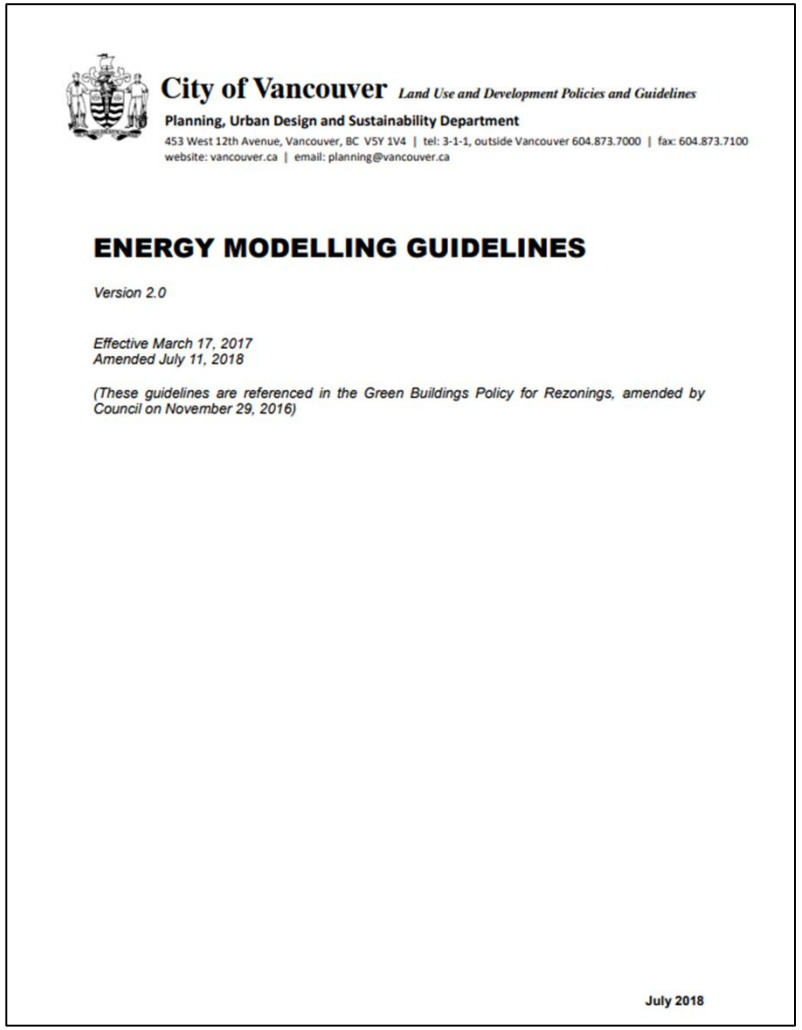
Challenges with relying on RNG in new construction to achieve climate objectives

What is RNG?

- Bio-methane
  - Manure
  - Energy crops
  - Farm/forestry residues
  - Etc.
- Landfill gas
- Synthetic methane (i.e. Power to methane)
- Blending zero carbon hydrogen into gas pipelines (up to a certain percentage)

CoV Energy Modeling Guidelines

- "Where renewable energy is purchased directly from utilities or renewable energy providers, and guarantees of long-term supply are provided to the satisfaction of the AHJ… an emissions factor of zero may be used."
  - However, appropriate mechanisms to guarantee of long-term supply have not yet been used
  - Challenges with enforcing such mechanisms



City of Vancouver *Land Use and Development Policies and Guidelines*

Planning, Urban Design and Sustainability Department

453 West 12th Avenue, Vancouver, BC V5Y 1V4 | tel: 3-1-1, outside Vancouver 604.873.7000 | fax: 604.873.7100
website: vancouver.ca | email: planning@vancouver.ca

ENERGY MODELLING GUIDELINES

Version 2.0

Effective March 17, 2017
Amended July 11, 2018

(These guidelines are referenced in the Green Buildings Policy for Rezonings, amended by Council on November 29, 2016)

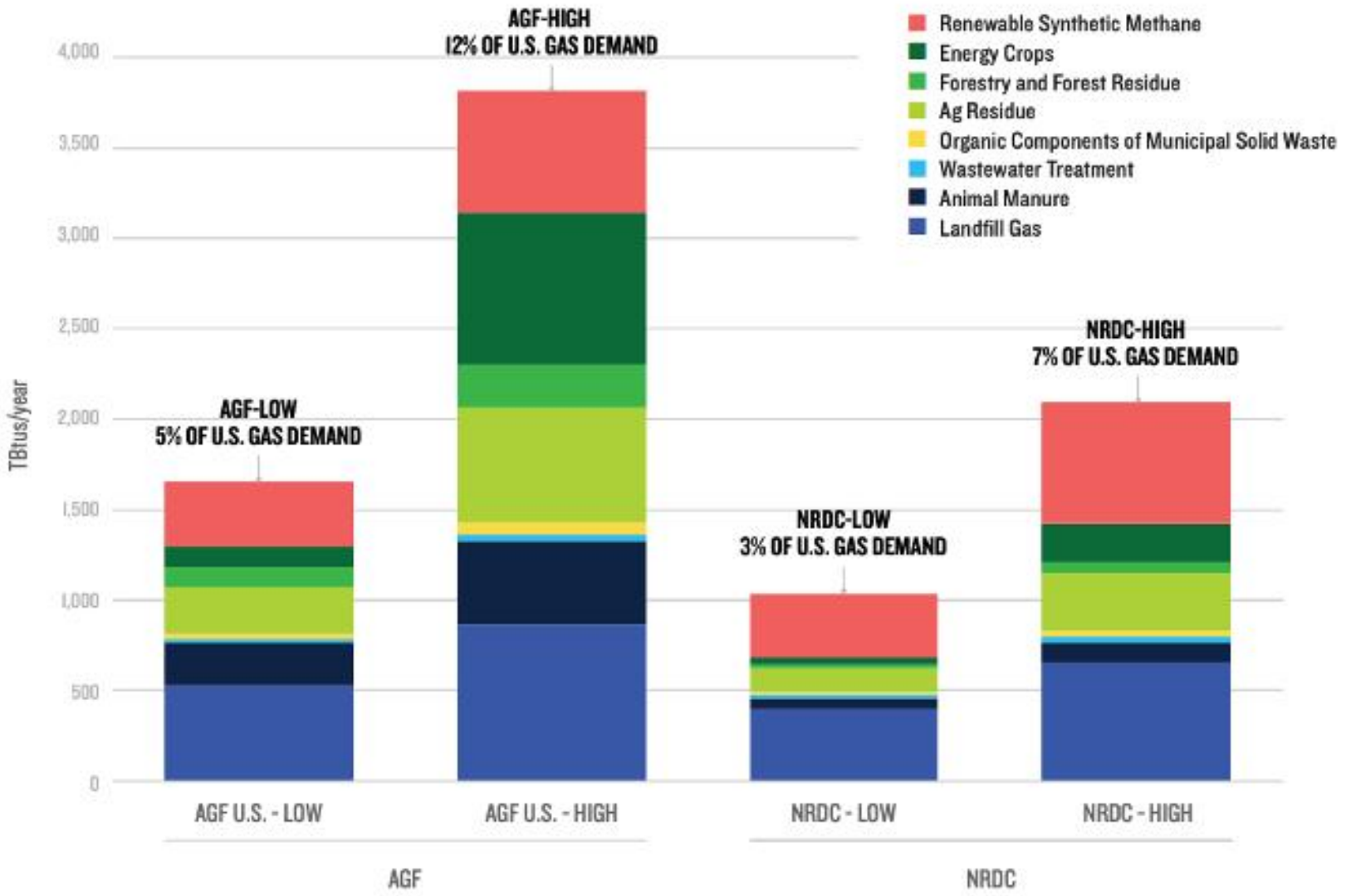
July 2018

https://vancouver.ca/files/cov/guidelines-energy-modelling.pdf

Technically feasible supplies of RNG in North America are estimated to be limited

FIGURE 5: AMERICAN GAS FOUNDATION AND NRDC HIGH AND LOW ESTIMATES OF BIOGAS AND SYNTHETIC GAS POTENTIAL*

(TBtus per year by 2040, and as percentage of 2019 U.S. gas demand)

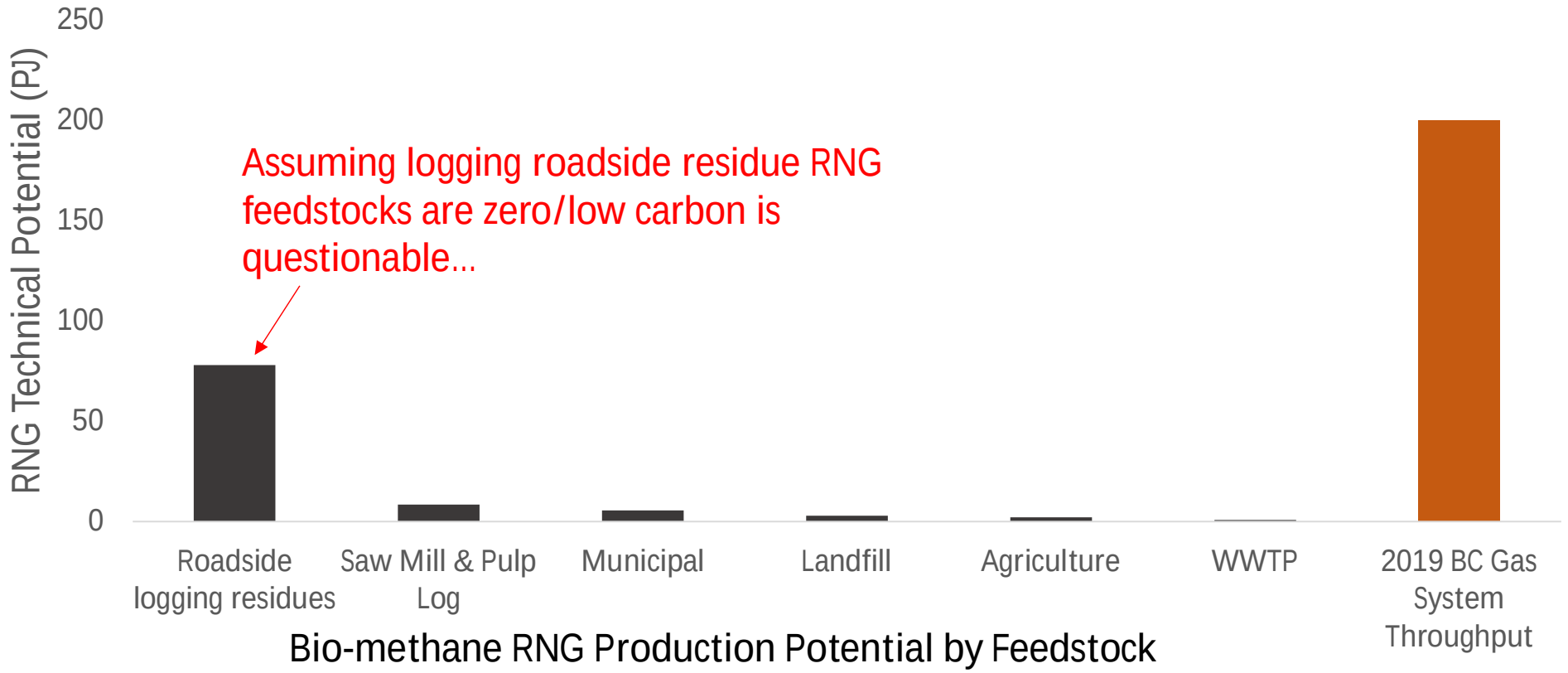


* NRDC estimates are based on the AGF results, adjusted for our biogas resource policy recommendations given in Figure 2. We use the AGF high and low estimates for synthetic methane produced with renewable electricity.

Source: NRDC: https://www.nrdc.org/resources/pipe-dream-or-climate-solution

BC Technically Feasible Supplies Bio-Methane

- Hallbar Consulting (2017) estimated potential RNG feedstocks in BC viable in long-term at up to $28/GJ* (with technology advancement)



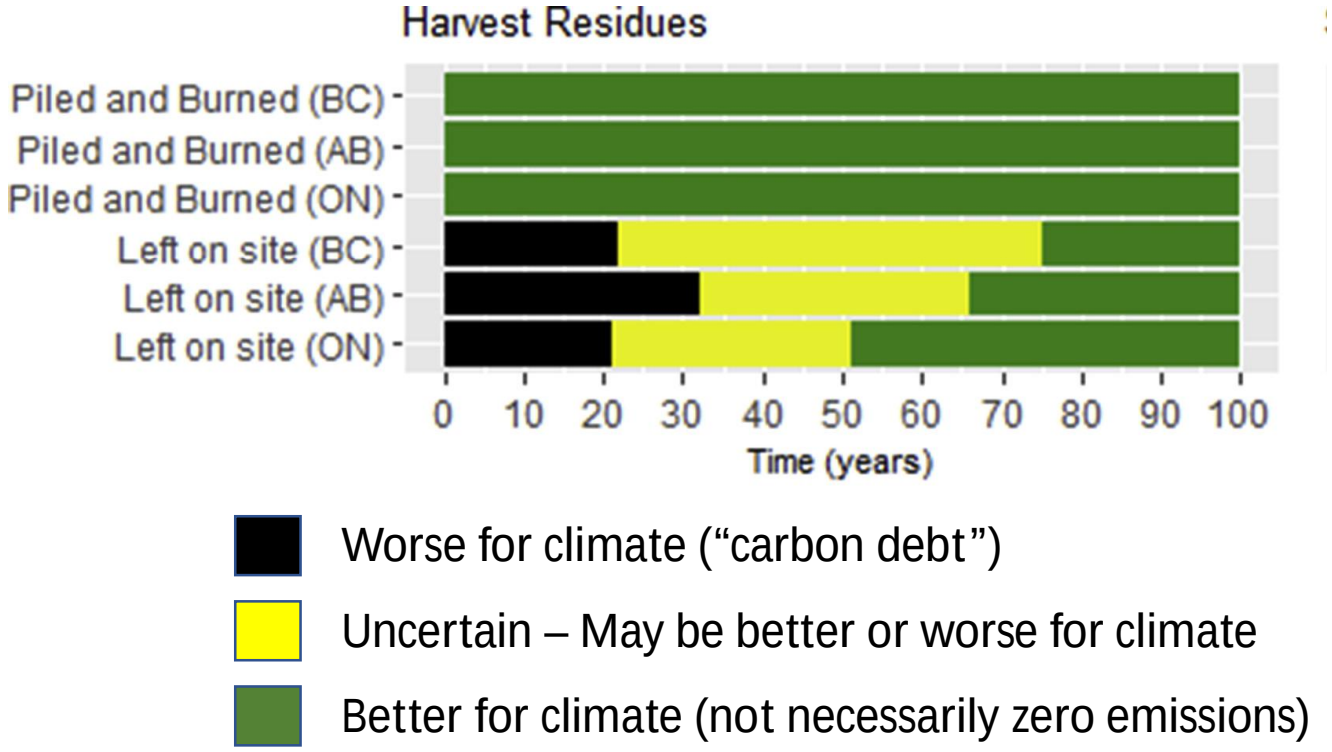
* For comparison, FortisBC cost of gas in Lower Mainland currently $2.84/GJ

Data from: Hallbar Consulting, *Resource Supply Potential for Renewable Natural Gas in B.C.* Prepared for Province of British Columbia, FortisBC Inc., and Pacific Northern Gas Ltd. 2017.

Climate Impacts of Residue Wood Feedstocks for RNG

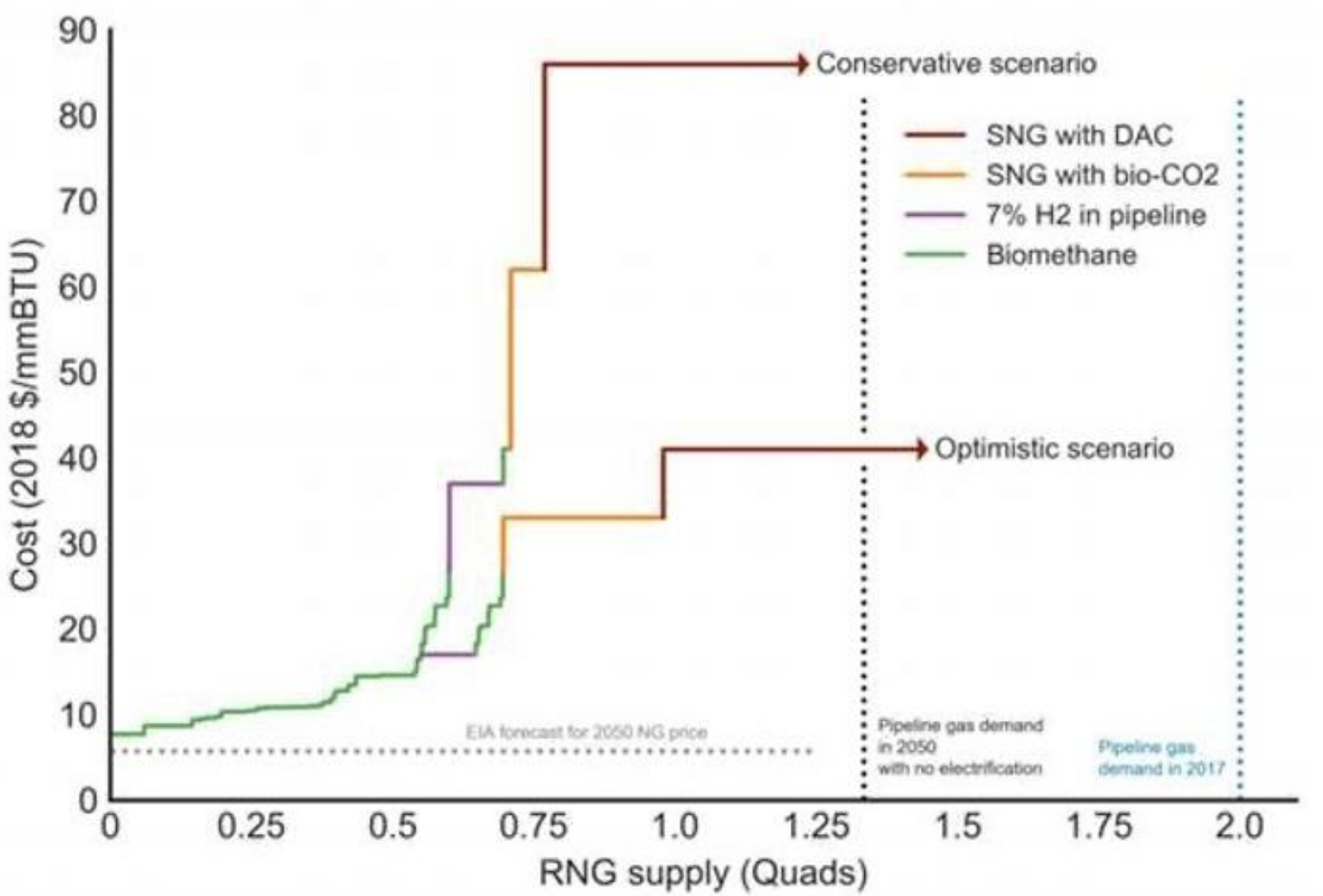
Climate impacts depends on:

- what would otherwise happen to residues, e.g.
  - Fully burned
  - Left on site
  - Stored carbon (e.g. engineered wood; etc.)
- Regrowth time (rotation)



Source: Rut Serra; Iman Niknia; David Pare; Brian Titus; Bruno Gagnon; Jerome Laganiere (all of Canadian Forest Service), "From conventional to renewable natural gas: can we expect GHG savings in the near term?,“ *Biomass and Bioenergy*, vol. 131, 2019.

RNG cost & availability – California example



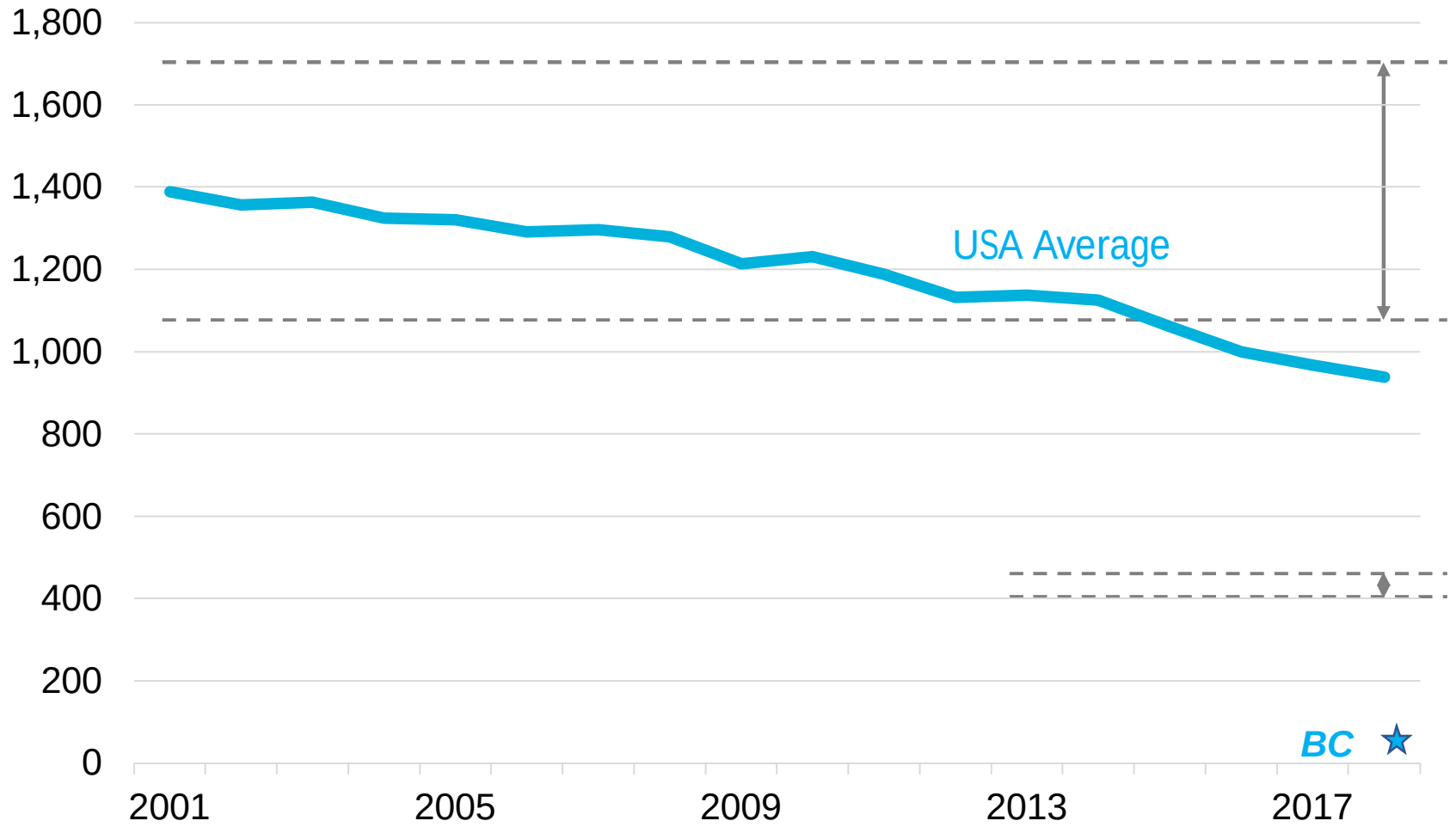
Source: E3. 2019. For California Energy Commission. https://ww2.energy.ca.gov/2019publications/CEC-500-2019-055/index.html

Carbon Intensity of Electricity

Which is Better for the Climate - Electric vs. Gas Heating?

Depends on electric grid GHG intensity

Carbon intensity of electric system
lbs/MWh, 2001–2017



Break-even range
lbs/MWh

1,650 lbs/MWh
Mild climate

The use of electric heat pumps produces less carbon emissions than gas appliances.

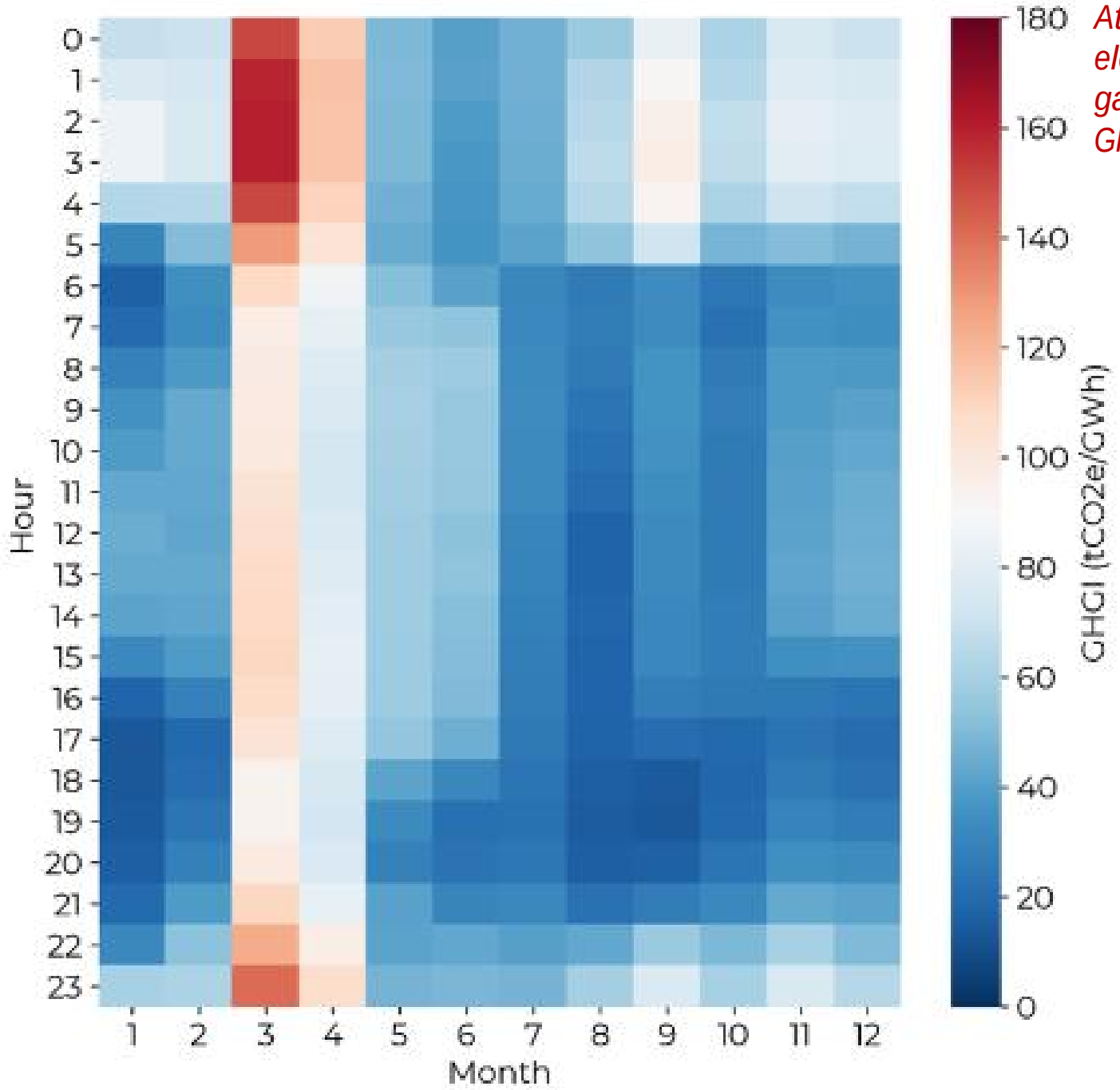
1,050 lbs/MWh
Cold climate

Inefficient electric appliances (e.g., resistance heat) produce less carbon emissions than gas ~400 lbs/MWh–450 lbs/MWh.

Note: "Mild" climate modeled as single-family home in Oakland, CA; "Cold" climate modeled as multifamily residential building in Boston, MA.
Sources: emissionsindex.org, RMI analysis

GHG Intensity of BC Grid at Each Hour of the Year

2019 data

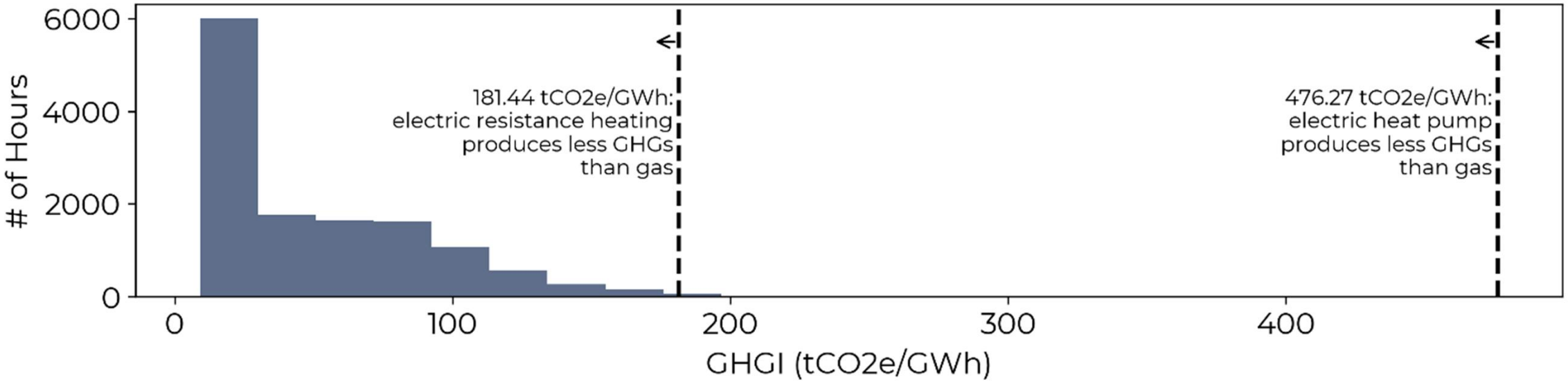


At ~180 tCO2e/GWh electric resistance & gas equipment same GHG intensity

Source: AES Engineering. 2020.

GHG Intensity of BC Grid at Each Hour of the Year

2019 data



Source: AES Engineering. 2020.

Some Implications of “Low Carbon Energy System” Definition

	All-electric	GHGI
Precedents	• ~50 California cities • Seattle (commercial & large multifamily) • City of Vancouver Part 9 Prescriptive requirements (SH & DHW)	• Most BC local governments LCES Options in Energy Step Code requirements.
Impact on gas equipment	• Precludes installation of gas equipment • Exceptions can be made for certain end uses (e.g. commercial kitchens)	• As GHGI lowers, energy end uses (e.g. SH, DHW, cooking, etc.) increasingly electrify • Gas equipment can be used as backup
Reversion to polluting gas equipment, e.g. 1) future conversion 2) excessive reliance on “back up” systems	• Best avoids these outcomes	• Risk of conversion • Risk of reliance on “back up” gas equipment (however, City of Vancouver requires if you install gas, treated as main source)
Applicability of RNG NOTE: Supplies of sustainable, legitimately low carbon sources of RNG are limited.	• Can not use RNG to comply	• Theoretically possible - Modeling Guidelines stipulate: “Where renewable energy is purchased directly from utilities or renewable energy providers, and guarantees of long-term supply are provided to the satisfaction of the AHJ… an emissions factor of zero may be used”.

About Greenhouse Gas Intensity (GHGI)

- Measured in units of kg $CO_2e/m^2/yr$.
- Derived from the energy models used to document compliance with the Energy Step Code (as described in City of Vancouver *Energy Modeling Guidelines* reference by Energy Step Code).
- Reported as an output on Step Code compliance tools:
  - Part 3 Energy Design Report
  - BC Energy Compliance Report - Performance Path for Part 9 Buildings
- Province is currently studying potential threshold levels (i.e. “steps”) for GHGI requirements

GHGI Level	Implications for Residential Developments – Climate Zones 4
Measure	All systems may be gas
6 kg $CO_2e/m^2/yr$	Space heating tends to be predominantly electric; DHW may remain gas.
3 kg $CO_2e/m^2/yr$	Space heating & DHW tend to be electric (back-up gas systems for peak capacity possible); gas fireplaces and cookstoves possible.
1.5 kg $CO_2e/m^2/yr$	(Nearly) all building systems electric.

Note: Multiple means of meeting a particular GHGI performance level exist, and these implications are intended only as a general guide for policy-makers to understand likely implications of GHGI metrics.