
HOW LOW CAN YOU GO?

NET ZERO READY MURBS

Affordable, Replicable and Marketable

netzero readyhome
The ultimate in comfort and efficiency

To support decarbonization targets the industry is exploring electrification and the technology that demonstrates options to remain on existing or smaller electrical panels - **but is it enough**?

What's the best approach for new construction, and what are the **opportunities and limitations**?

How is **electrification impacting deep energy retrofits** and the infrastructure in existing communities?

What technology, programs, and policies will allow the industry to move towards **electrification with right-sized panels**?

NET ZERO READY MURBS

Affordable, Replicable and Marketable

netzero readyhome
The ultimate in comfort and efficiency

How Low Can You Go? Electrification on 100 amps?

Derek Satnik
Vice President
s2eTechnologies

Wil Beardmore
President & Founder
Bluewater Energy

Daman Gill
Advisor, Residential
Technologies
Enbridge

Bertine Stelzer
Program Manager
BC Hydro

Wilma Leung
Senior Manager
BC Housing

SESSION 6

What are the barriers that you feel the industry continues to face with electrification?

68 responses

CANADIAN HOME BUILDERS' ASSOCIATION
netzero home
LEADERSHIPSUMMIT

DEREK SATNIK

VICE PRESIDENT OF TECHNOLOGY, S2E

All-Electric MURB: minute-level data

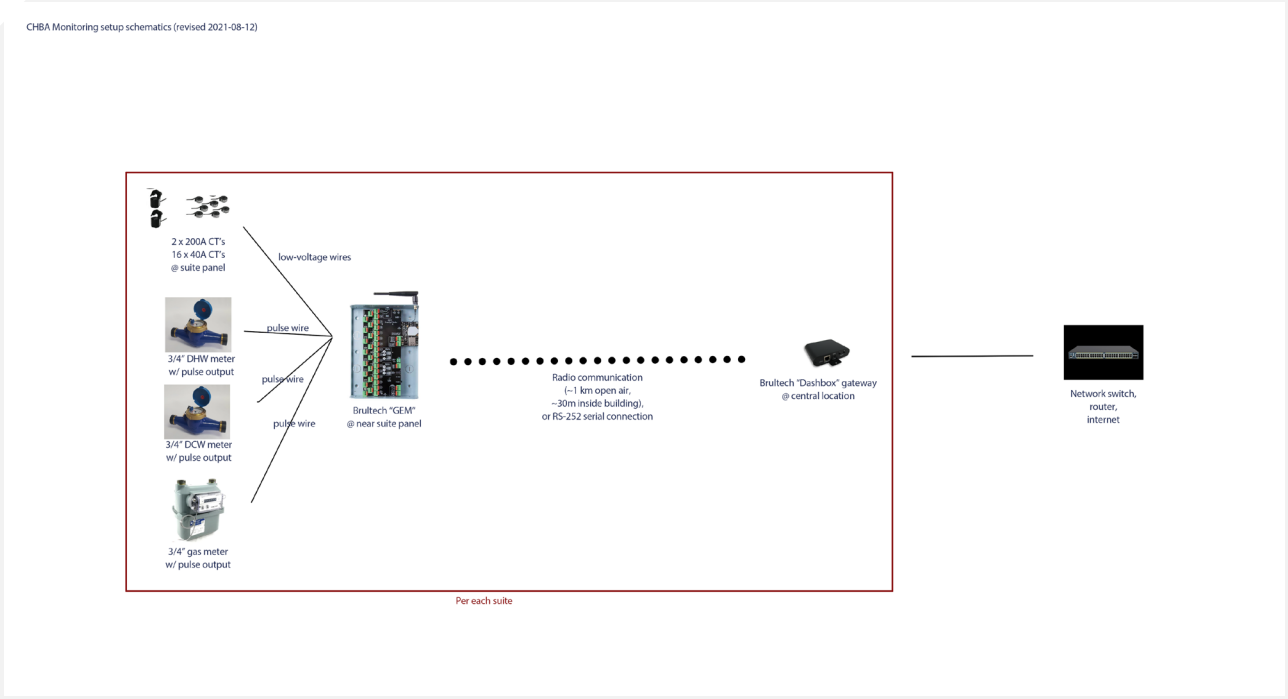
S2E TECHNOLOGIES

Derek Satnik (dsatnik@s2etech.com)

Seungyeon Hong (seungh@s2etech.com)

s2e technologies

All-Electric MURB: minute-level data



Model	24x36 Standard Stacked Units
Floor Area	927 / 1024 SqFt
Front Orientation	South-West
NetZero Ready Spec	

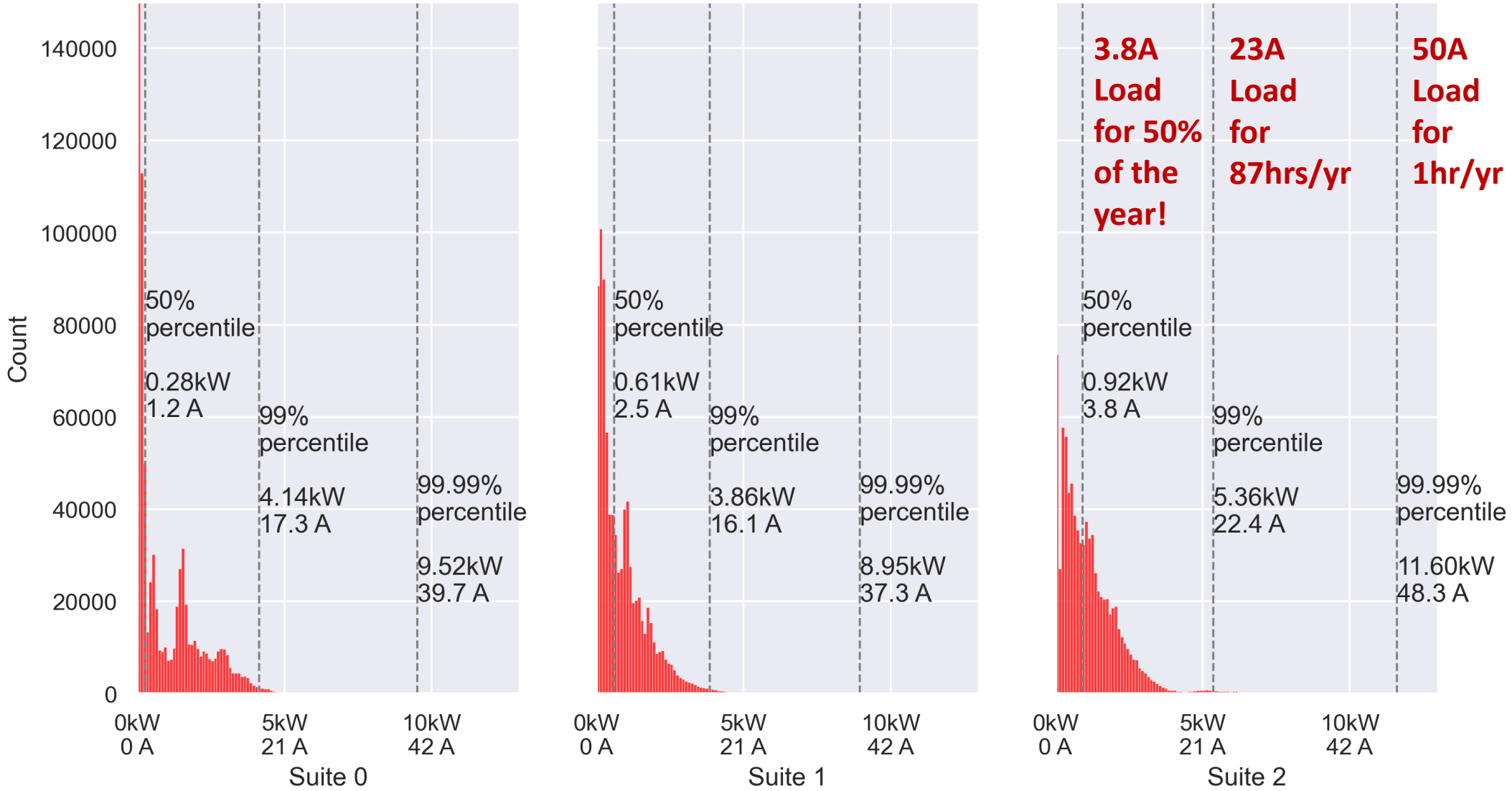
Attic Insulation	2x4 truss @ 24" OC with R60
Roof heel height	7"
Above-grade Exterior Wall	2x6 @ 24" wall w/ 5.5" batt in cavity (R22) + 1" Exterior XPS (R5)
Ground floor garage wall	2x6 @ 24" wall w/ 5.5" batt in cavity (R22) + 1" Exterior XPS (R5)
Slab-on-ground under slab insulation	2" Type-II EPS (R8)
Foundation wall	2-1/2" XPS exterior insulation down to the top of footing
Windows	PVC Frame, Triple Pane, Argon and 2 LowE (All Weather HS3A)
Door	Fiberglass w/ Polyurhtane Core
Partywall between units	Poly on one side of party wall between units
Building Envelop Seal	≤ 2.0 ACH @ 50 Pa
Space Heating & Cooling	Electrical Baseboard + Single-Zone Minisplit ASHP (Fujitsu AUU9RLF /AOU9RLFC or equivalent)
HRV	Venmar AVS X24HRV-ECM, or equivalent
Domestic Hot Water	Hybrid Electric Heat Pump Water Tank (AO Smith ProLine 50 Gal)
Drain Water Heat Recovery	EcoInnovation Technologies Inc. TD372B, or equivalent
Shower heads	Ultra Low Flow (5.7 L/min or less)
Faucets	Ultra Low Flow (3.8 L/min or less)
Appliances	Energy Star, high efficiency (Clothes Washer: 90 kWh/yr; Dish Washer: 240 kWh/yr; Clothes Dryer 531 kWh/yr; Stove: 565 kWh/yr; Refrigerator: 500 kWh/yr)
Lighting	100% LED lamps in all fixtures

UNIVERSITY OF ALBERTA

LANDMARK HOMES

s2e technologies

Histogram: minute-by-minute



-Each plot represents 820,000 datapoints from Nov 2022 to May 2024. Each bin is 100W.

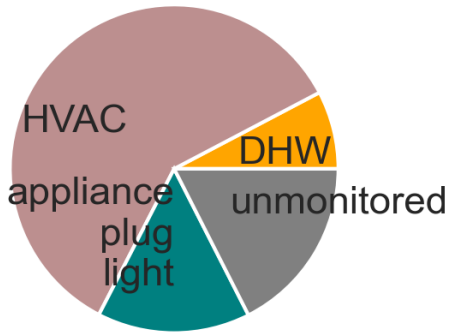
-Sum of the major circuits monitored shown on plots

-Data may have some gaps

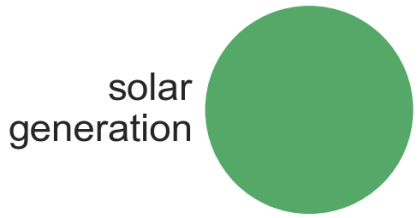
s2e technologies

End Use Breakdown (Net-zero Energy Ready)

Suite 0

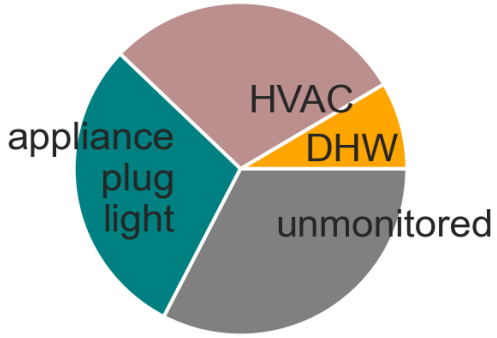


6597 kWh

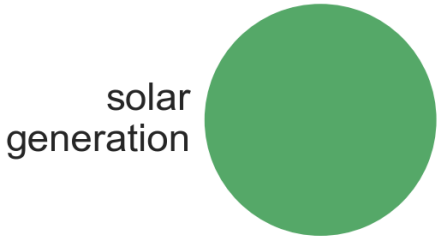


2740 kWh

Suite 1

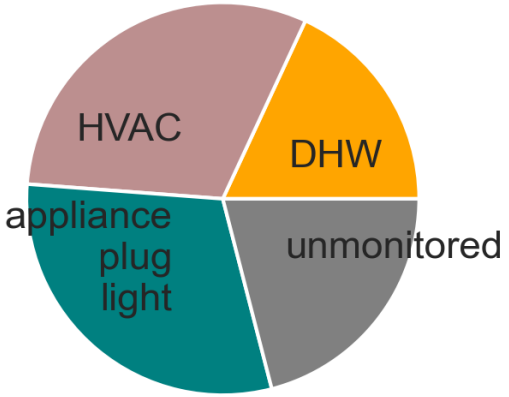


6792 kWh

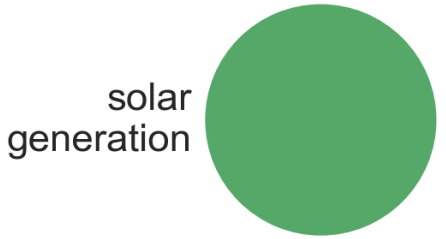


3392 kWh

Suite 2

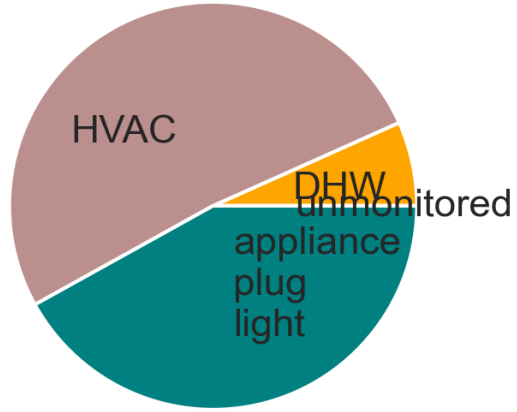


9435 kWh

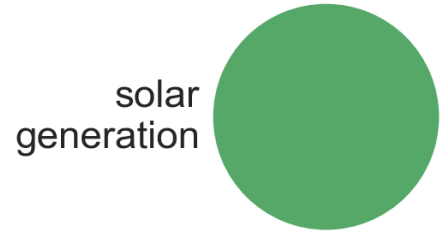


3376 kWh

Modelled



10164 kWh



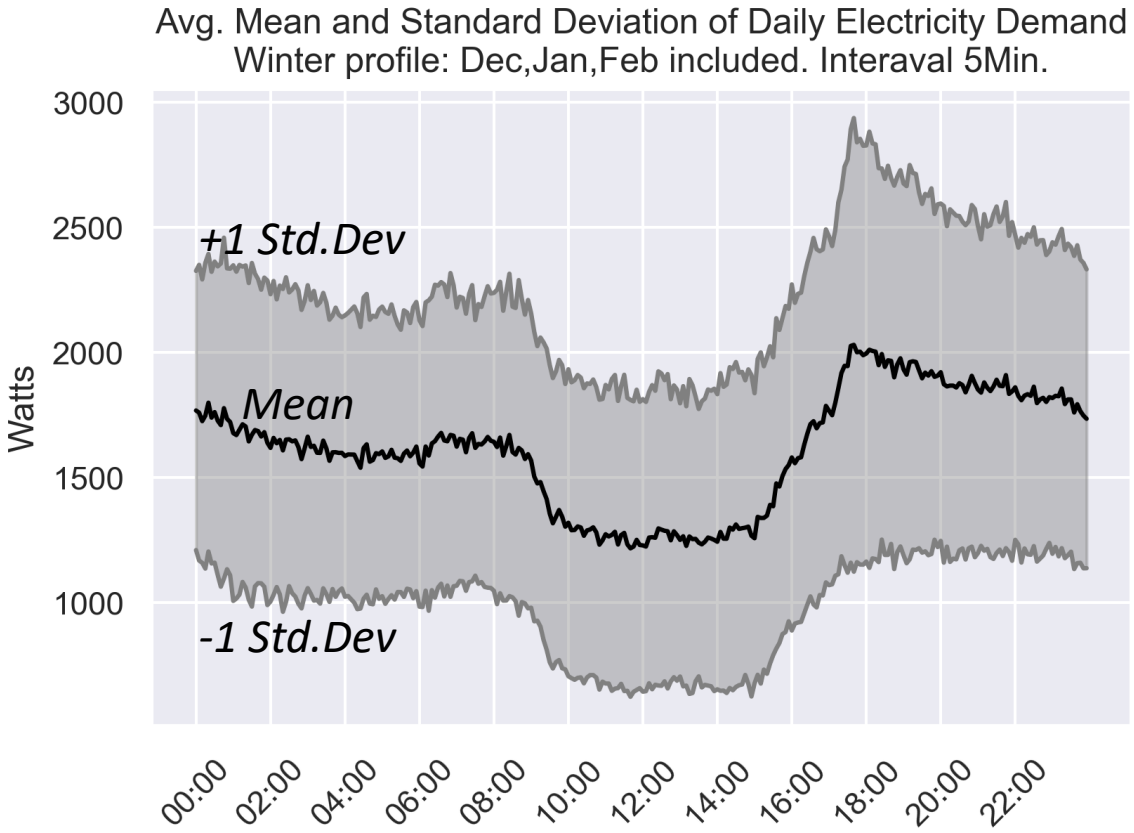
3222 kWh

-Represents 525,600 datapoints from Jan 2023 to Dec 2023.
-Data may have some gaps

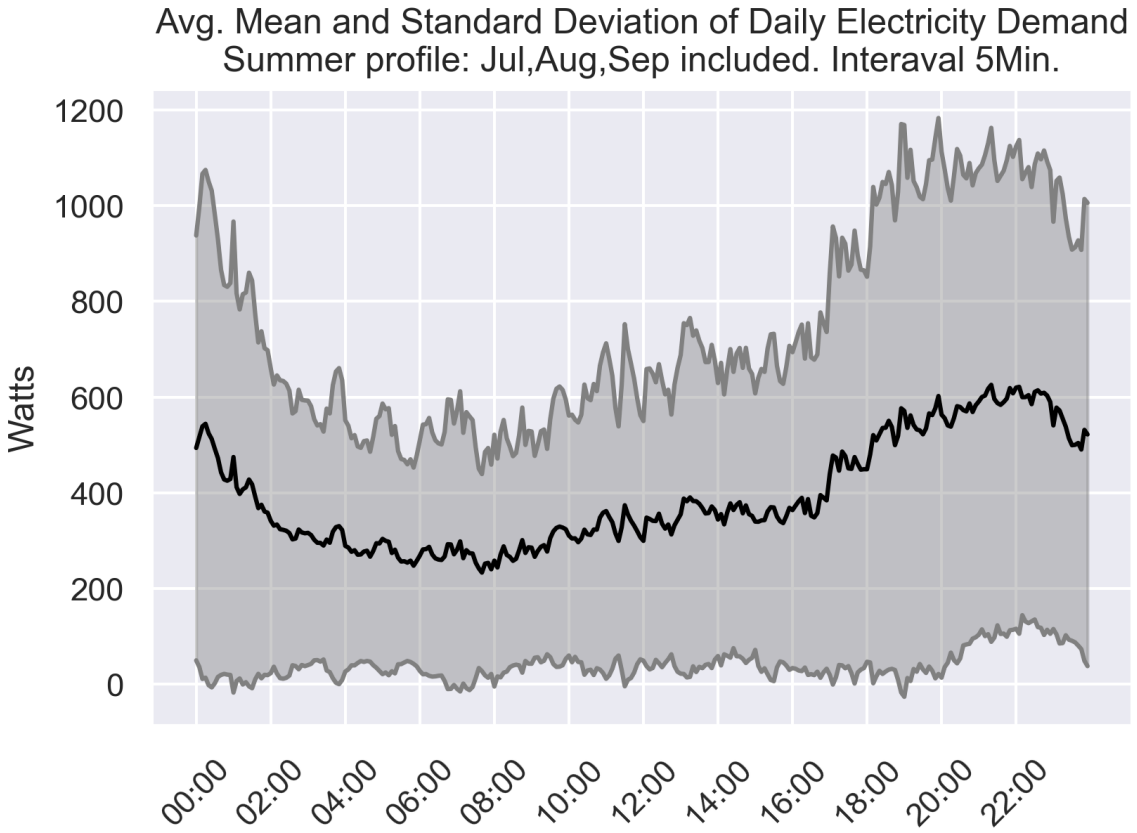
s2e technologies

Daily Load Patterns

WINTER



SUMMER



-Represents 525,600 datapoints from Nov 2022 to May 2024. Resampled at 5-min intervals.
-Sum of the major circuits monitored shown on plots
-Data may have some gaps, especially during solar hours. Updated graphs will be presented in the project report.

s2e technologies

Conclusions

- All electric homes in the MURB case study can run on a 60A utility feed.
- Controls/storage could reduce the service entrance size to 30A with ease.
- Homes twice this size would safely stay below a 100A service size.
- Controls/storage can be used to help turn new communities into grid positive or grid buffering assets: utilities can save money by reducing transformer and infrastructure sizes in favour of adding distributed storage and controls.

CANADIAN HOME BUILDERS' ASSOCIATION
netzero home
LEADERSHIPSUMMIT

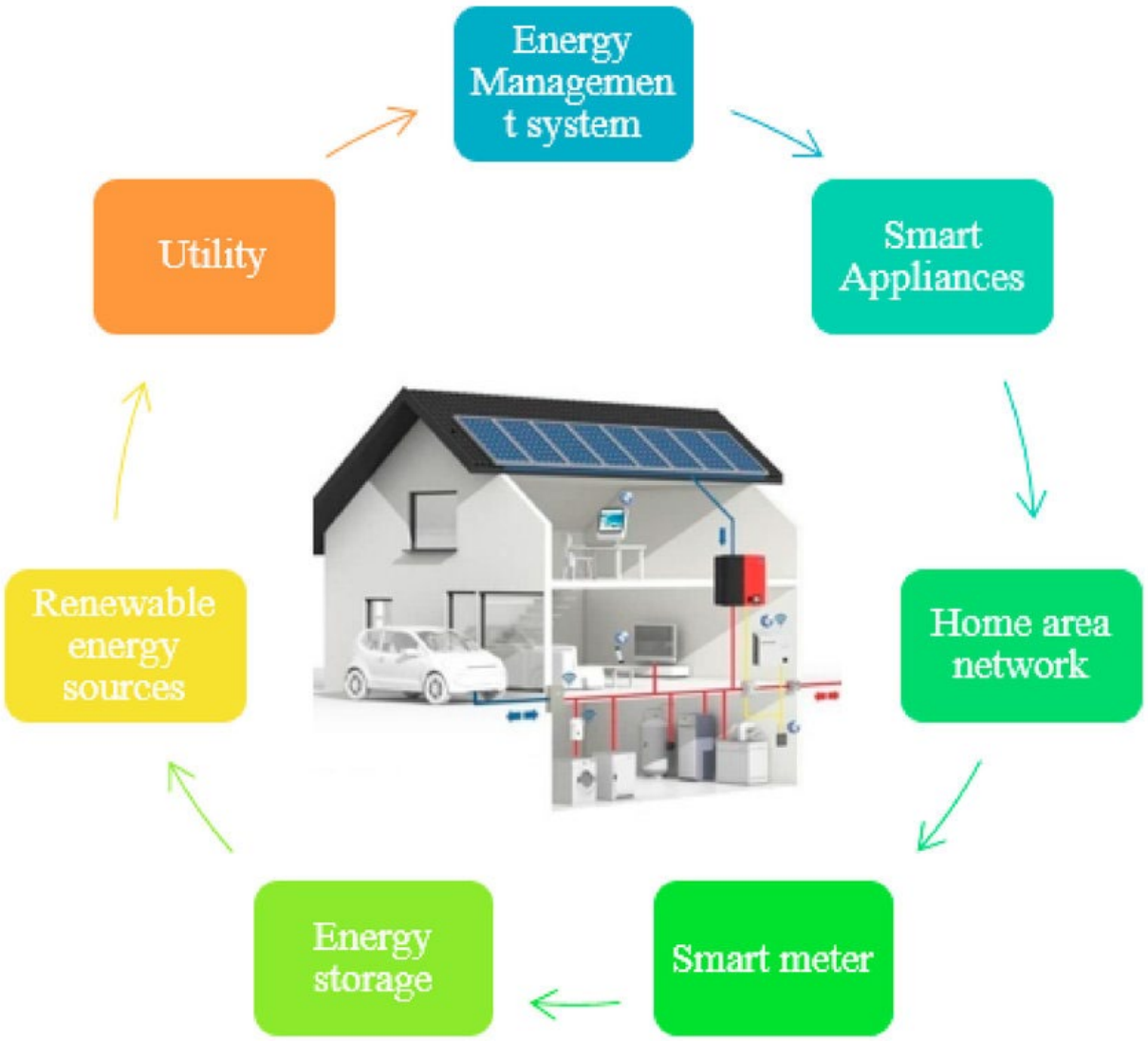
WIL BEARDMORE

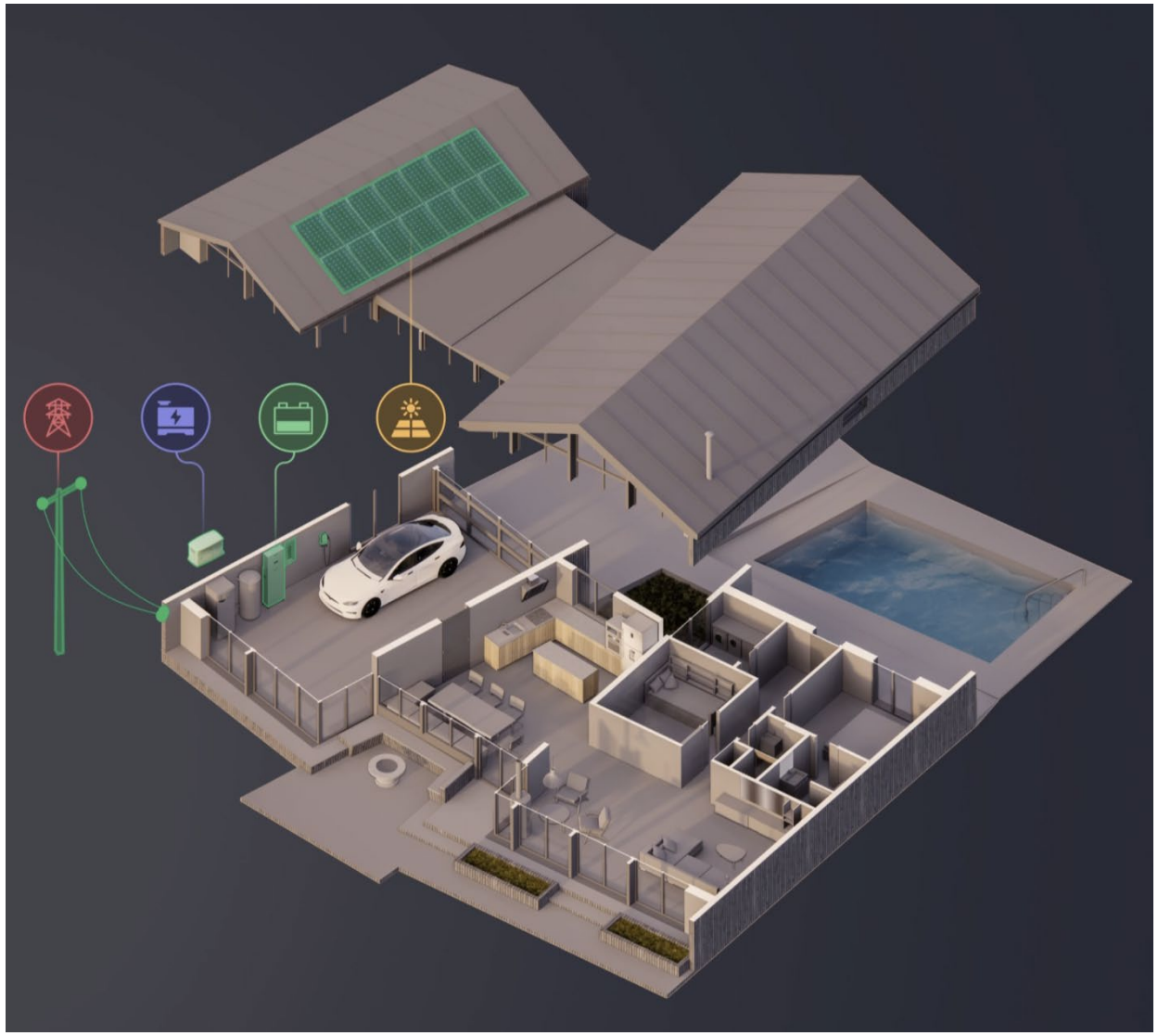
PRESIDENT AND FOUNDER, BLUEWATER ENERGY

Electrification

Battery Energy Storage Systems & Impact on Service/Panel Sizing

The Home Energy Ecosystem





Canadian Electric Code (CEC)

Calculated load for services and feeders

8-200 Single dwellings (see Appendix B)

1) The calculated load for the service or feeder supplying a single dwelling shall be based on the greater of Item a) or b):

a)

i) a basic load of 5000 W for the first 90 m² of living area (see Rule 8-110); plus

ii) an additional 1000 W for each 90 m² or portion thereof in excess of 90 m²; plus

iii) any electric space-heating loads provided for with demand factors as permitted in Section 62 plus any air-conditioning loads with a demand factor of 100%, subject to Rule 8-106 3); plus

iv) any electric range load provided for as follows: 6000 W for a single range plus 40% of any amount by which the rating of the range exceeds 12 kW; plus

v) any electric tankless water heaters or electric water heaters for steamers, swimming pools, hot tubs, or spas with a demand factor of 100%; plus

vi) except as permitted by Rule 8-106 11), any electric vehicle supply equipment loads with a demand factor of 100%; plus

vii) any loads provided for that have a rating in excess of 1500 W, in addition to those outlined in Items i) to vi), at

A) 25% of the rating of each load, if an electric range has been provided for; or

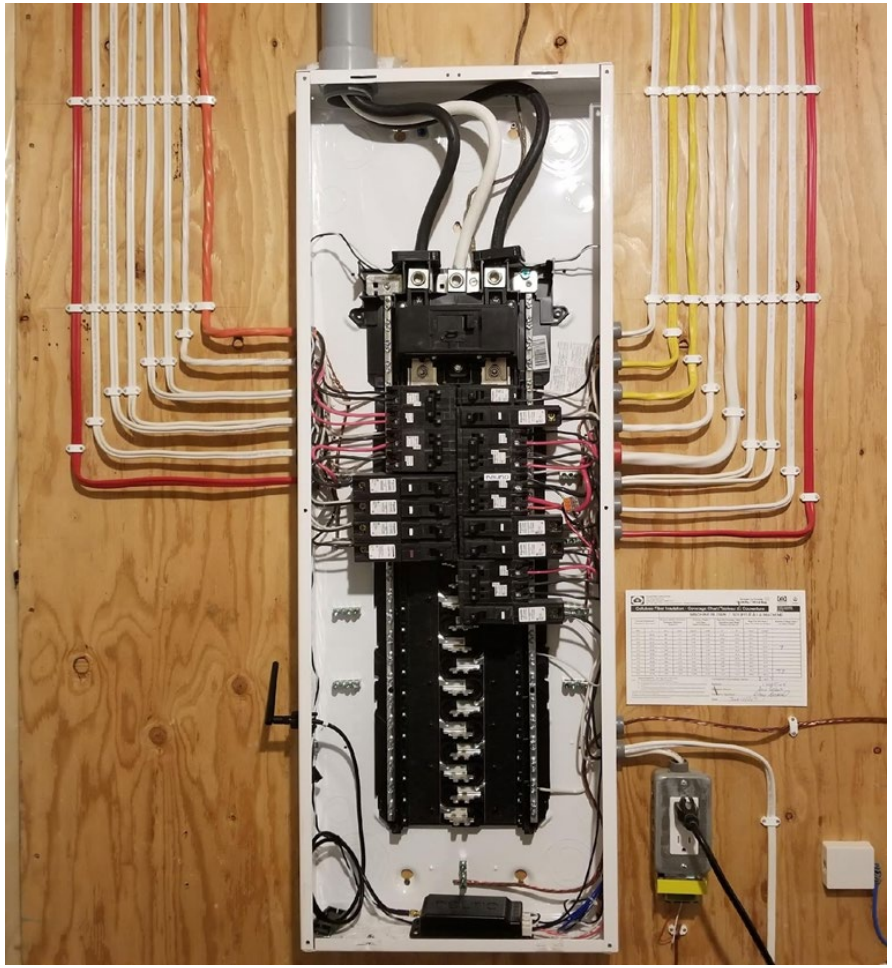
B) 100% of the combined load up to 6000 W, plus 25% of the combined load that exceeds 6000 W, if an electric range has not been provided for; or

b)

i) 24 000 W where the floor area, exclusive of the basement floor area, is 80 m² or more; or

ii) 14 400 W where the floor area, exclusive of the basement floor area, is less than 80 m².

Electrical Panel



Generation Backfeed Limitations

100A Panel = 25A = 6kW
Largest PV/Bty Inverter = 3.8kW

200A Panel = 50A = 12kW
Largest PV/Bty Inverter = 9.6kW

***Generation Limit does not apply when feeding the Main Breaker Directly from Generation Source Output

Canadian Electric Code (CEC)

Δ **64-112 Interactive point of connection** (see Appendix B)

4) Where equipment or conductors located on the premises are supplied simultaneously by a primary power source and one or more interactive inverters, and where equipment connected as permitted by Subrule 3) is capable of supplying multiple branch circuits or feeders, or both, provisions for interconnection between the primary power supply source and the interactive inverter(s) shall comply with the following conditions:

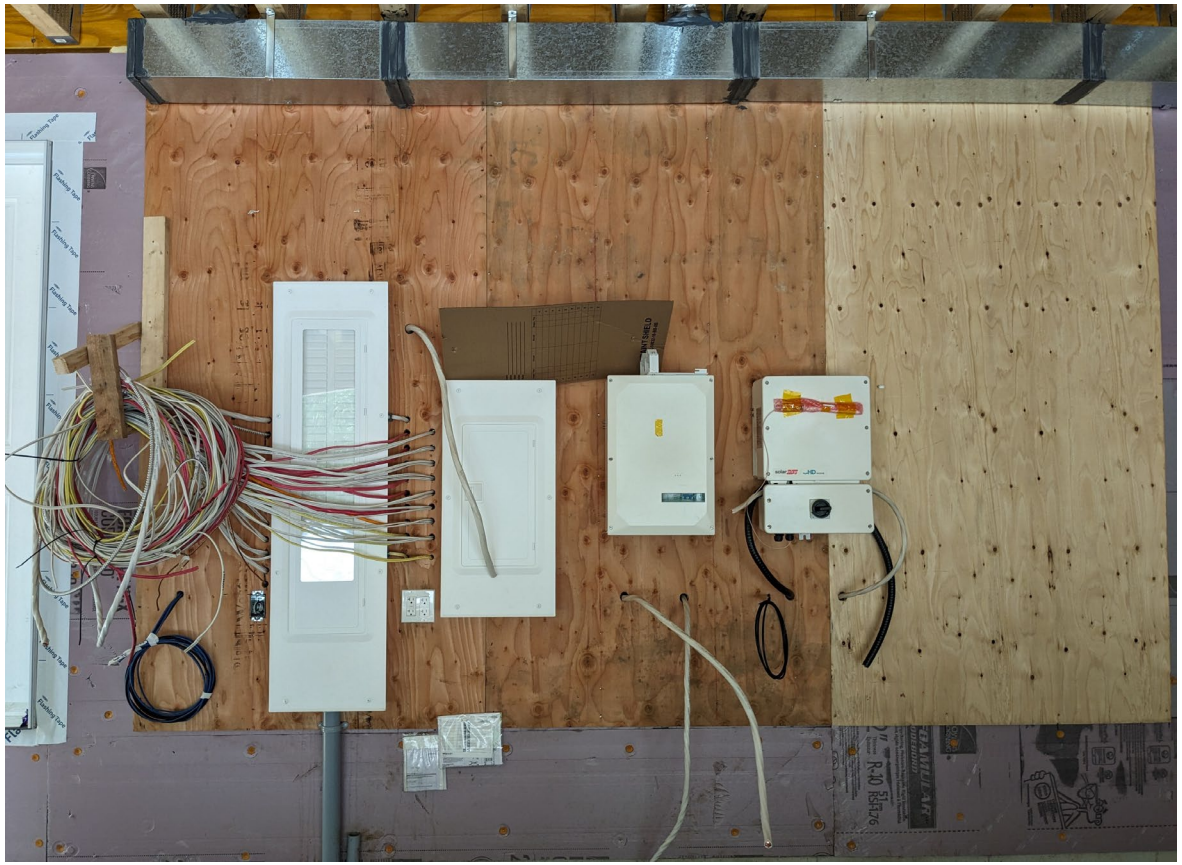
f) notwithstanding Section 14, for a dwelling unit, the sum of the ampere ratings of the overcurrent devices supplying power to equipment or conductors shall be permitted to exceed the equipment or conductor ratings to a maximum of 125%;

Batteries

Note CEC Rule 64-1100 for Locating BESS in Homes

Other Equipment

Design Pre-Planning and Rough-ins are Essential



CEC

Δ

Installation of energy storage systems at residential occupancies

64-1100 Location and separation requirements (see Appendices B and G)

1) Except as required by Subrule 2), energy storage systems installed at a dwelling unit or building of residential occupancy shall be suitable for residential use, and be located
   a) in an attached garage;
   b) in or on an associated detached garage, or other freestanding structure;
   c) on the exterior surface of the building;
   d) in a dedicated room or utility room having a door equipped with a self-closing device and enclosed with a minimum construction of
      i) ceilings and walls finished with gypsum board; and
      ii) floors finished with lumber sheathing; or
   e) in other locations where permitted.

Energy Management Systems (EMS)

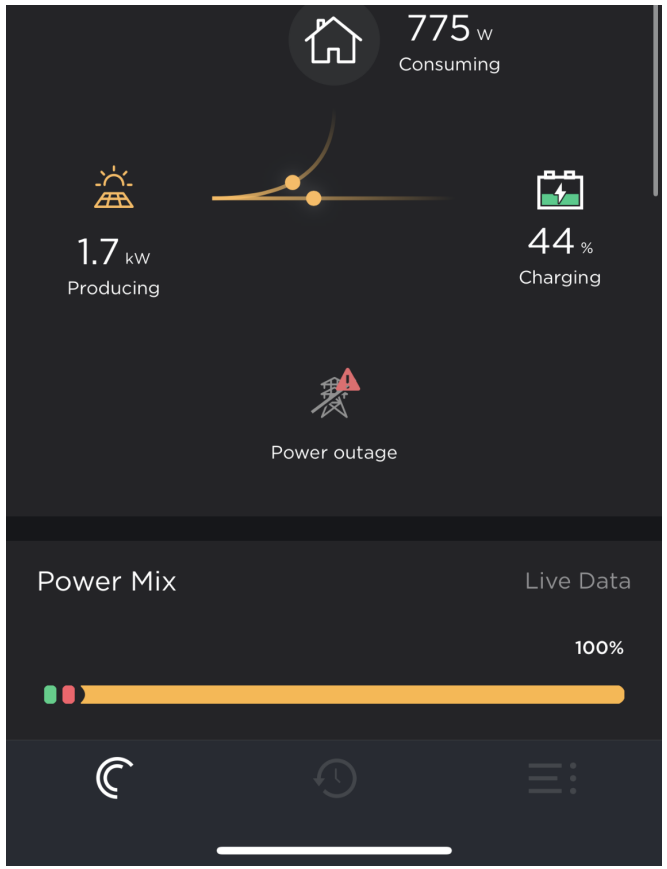
- A system consisting of any of the following: a monitor, communications equipment, a controller, a timer, or other device that monitors and/or controls an electrical load or power production or storage source

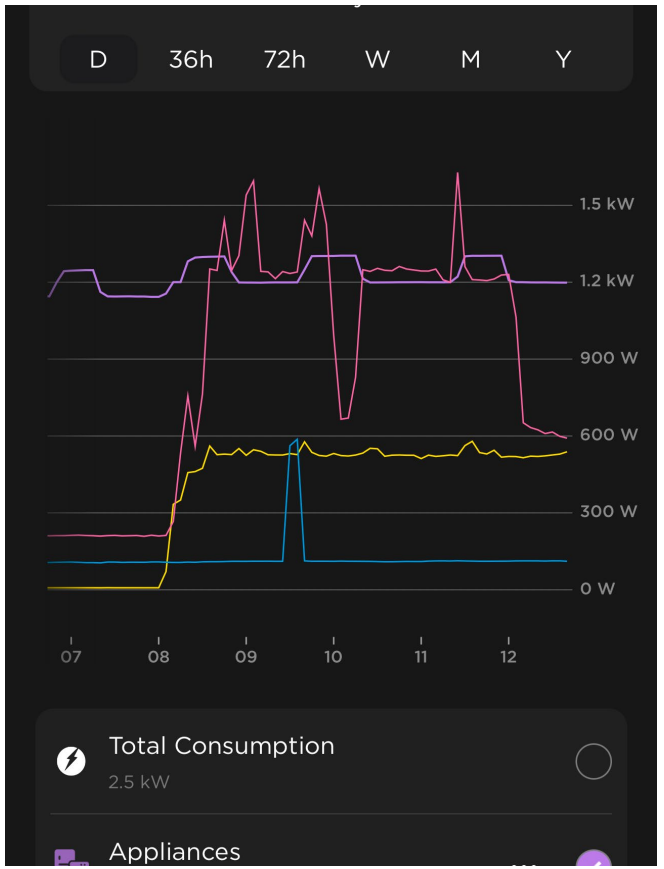
EMS

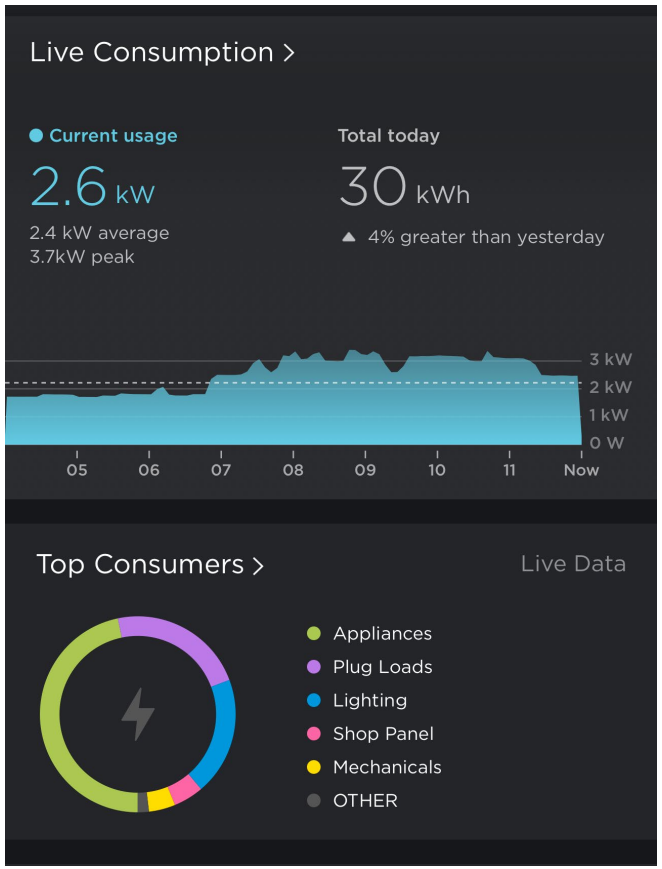
Not Yet Permissible as means to limit Service Sizing in Canada

Controls UI

How is the system programmed and controlled - Critical







EVMS3

Electric vehicle energy management systems

8-500 Electric vehicle energy management systems

1) Electric vehicle energy management systems shall be permitted to monitor electrical loads and to control electric vehicle supply equipment loads.
2) An electric vehicle energy management system shall not cause the load of a branch circuit, feeder, or service to exceed the requirements of Rule 8-104 5) or 6).
3) An electric vehicle energy management system shall be permitted to control electrical power by remote means.

CANADIAN HOME BUILDERS' ASSOCIATION
netzero home
LEADERSHIPSUMMIT

DAMAN GILL

ADVISOR RESIDENTIAL TECHNOLOGIES, ENBRIDGE

Benefits of Hybrid Heating in Ontario

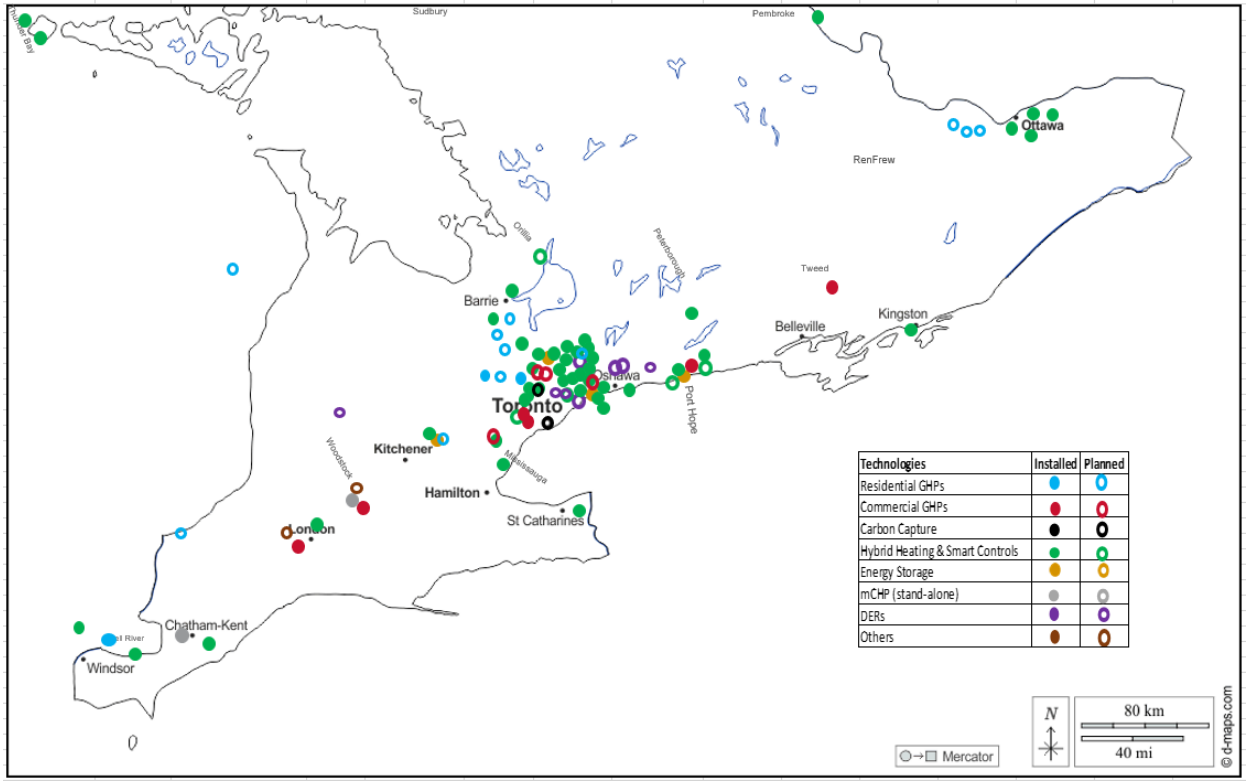
Daman Gill
Technology Development
Enbridge Gas

June 12, 2024

ENBRIDGE
Life Takes Energy

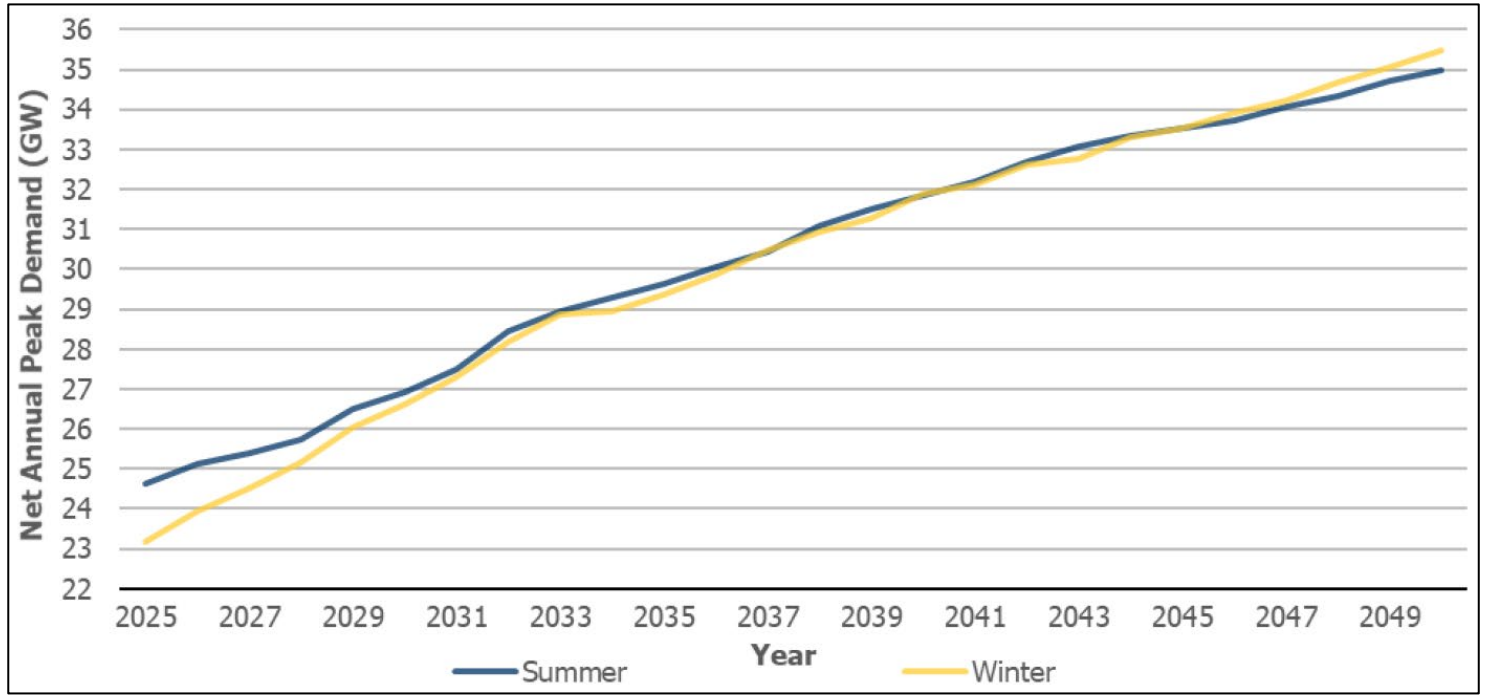
Enbridge Gas Technology Development Team

2024 TD Team Pilots – Installed and Planned



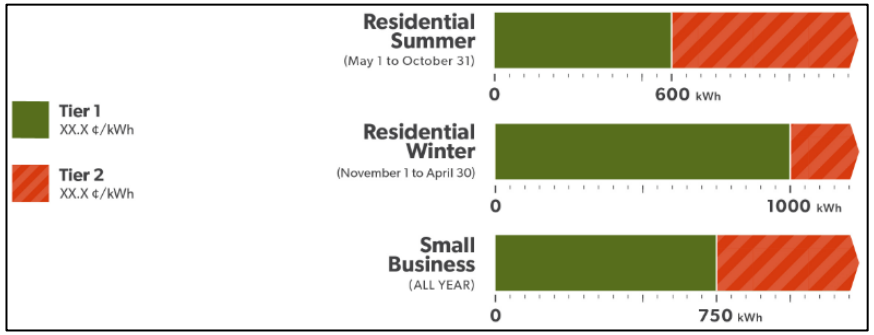
Ontario IESO Projects Increased Electricity Demand in Ontario

IESO Peak Demand Forecast (Source IESO March 2024 APO)

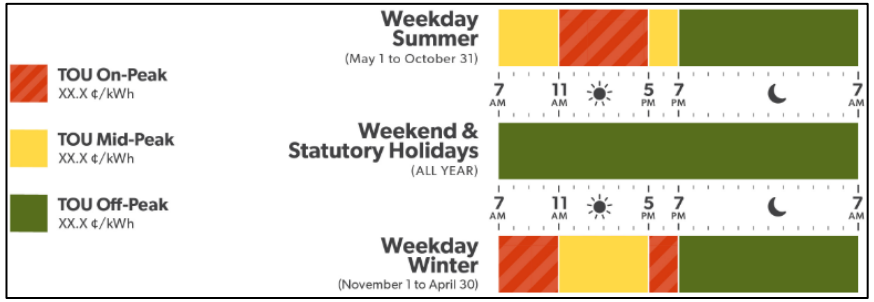


Enbridge has served energy demand in excess of **90 GW** during winter peak

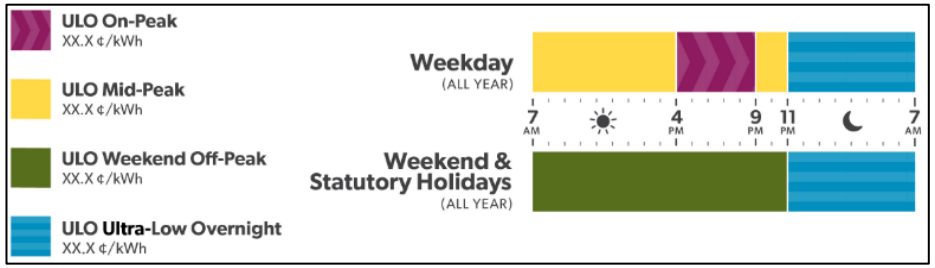
Ontario Tiered Electricity Pricing



Ontario Time-of-Use (TOU) Pricing

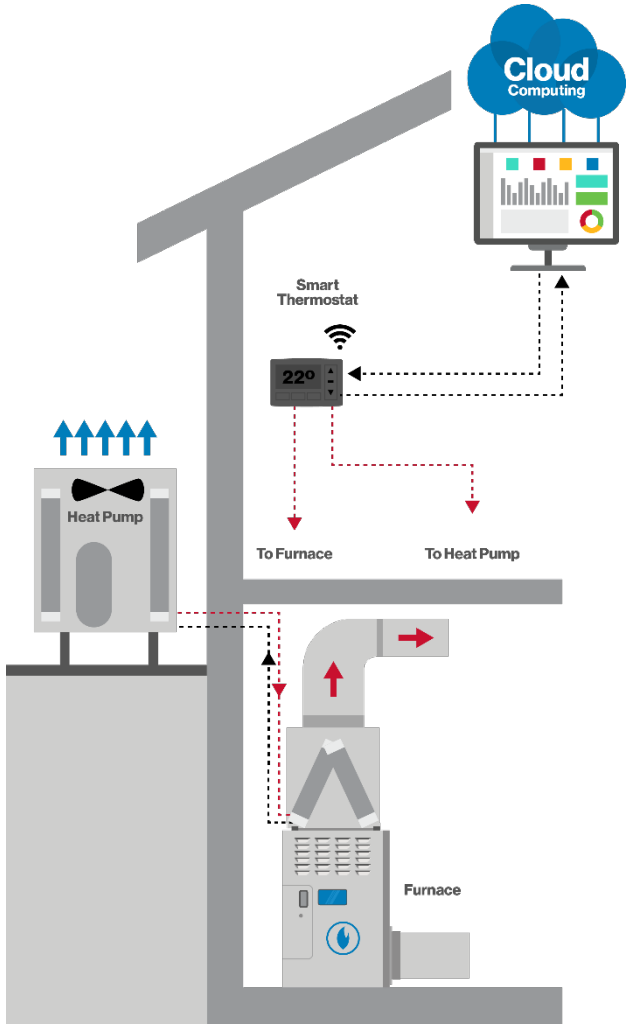


Ontario Ultra-Low Overnight (ULO) Pricing

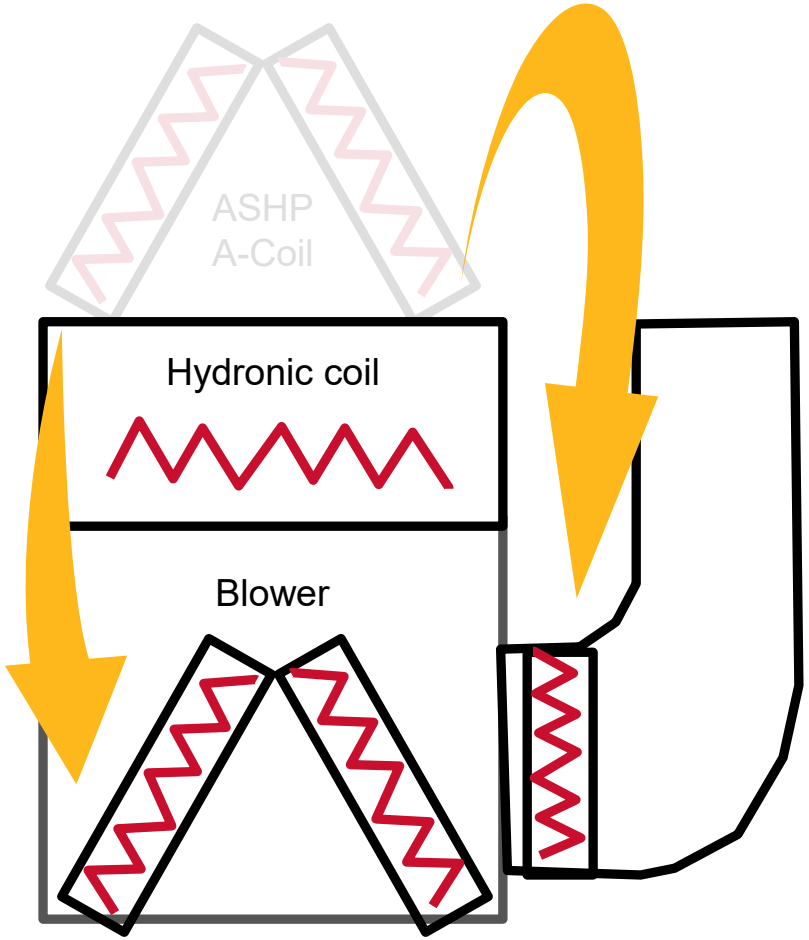


Current Work

Hybrid Heating and Smart Controls



Simultaneous Hybrid Heating



Clean Home Heating Initiative

- Launched Fall 2022 and ended Spring 2024
- ~1,500 installations achieved
- Training of 80+ contractors in all 8 communities
  - Sales, technical, and smart controls training provided. This included sizing and selection
- Customer focused marketing to support heat pump awareness and understanding

Lessons Learned:

- Various installation considerations for retrofit applications
- Contractor education on technical topics must continue
- Customer education must continue

"I thank the Government of Ontario for introducing this innovative program, which will not only help homeowners save money on their energy bills, but also help significantly reduce their emissions. It's a win-win for the wallet and the environment."

- Kevin Ashe
Mayor, City of Pickering

CANADIAN HOME BUILDERS' ASSOCIATION
netzero home
LEADERSHIPSUMMIT

BERTINE STELZER

PROGRAM MANAGER, NEW CONSTRUCTION MARKET TRANSFORMATION, BC HYDRO

Power Pathways: Building B.C.’s energy future

Bertine Stelzer, New Construction Market Transformation

June 12, 2024

BC Hydro
Power smart

Codes and Standards

ENERGY STEPCODE
BUILDING BEYOND THE STANDARD

ZERO CARBON STEPCODE

Zero Emissions Vehicle Act

Timeline for Energy Efficiency Regulatory Requirements in the BC Building Code

Here's what the province's CleanBC plan will mean for new-construction requirements.

	PART 9 BUILDINGS	PART 3 BUILDINGS	NET-ZERO ENERGY-READY UP TO:
2032	STEP 5	STEP 4	80%
2027*	STEP 4	STEP 3	40%
2022*	STEP 3	STEP 2	20%

*NEW TARGET DEADLINES

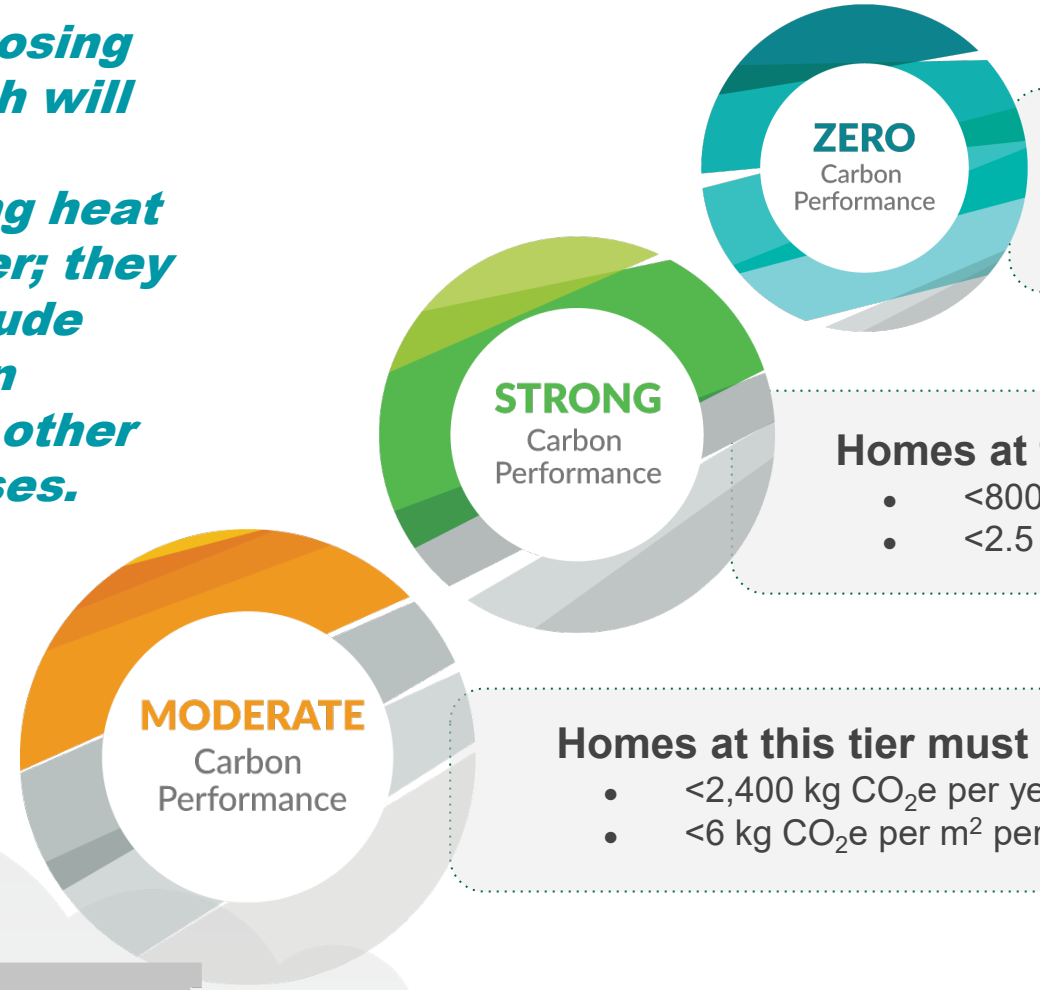
Energy-efficiency improvement above 2018 BC Building Code requirements

ENERGY STEPCODE
BUILDING BEYOND THE STANDARD

BC Hydro
Power smart

Part 9 Buildings: The performance path for Zero Carbon Step Code compliance

Builders choosing this approach will focus on decarbonizing heat and hot water; they can still include fossil fuels in cooking and other minor end uses.



Homes at this tier must emit:

- <500 kg CO_2e per year *and*
- <1.5 kg CO_2e per m^2 per year GHG intensity

Homes at this tier must emit:

- <800 kg CO_2e per year *and*
- <2.5 kg CO_2e per m^2 per year GHG intensity

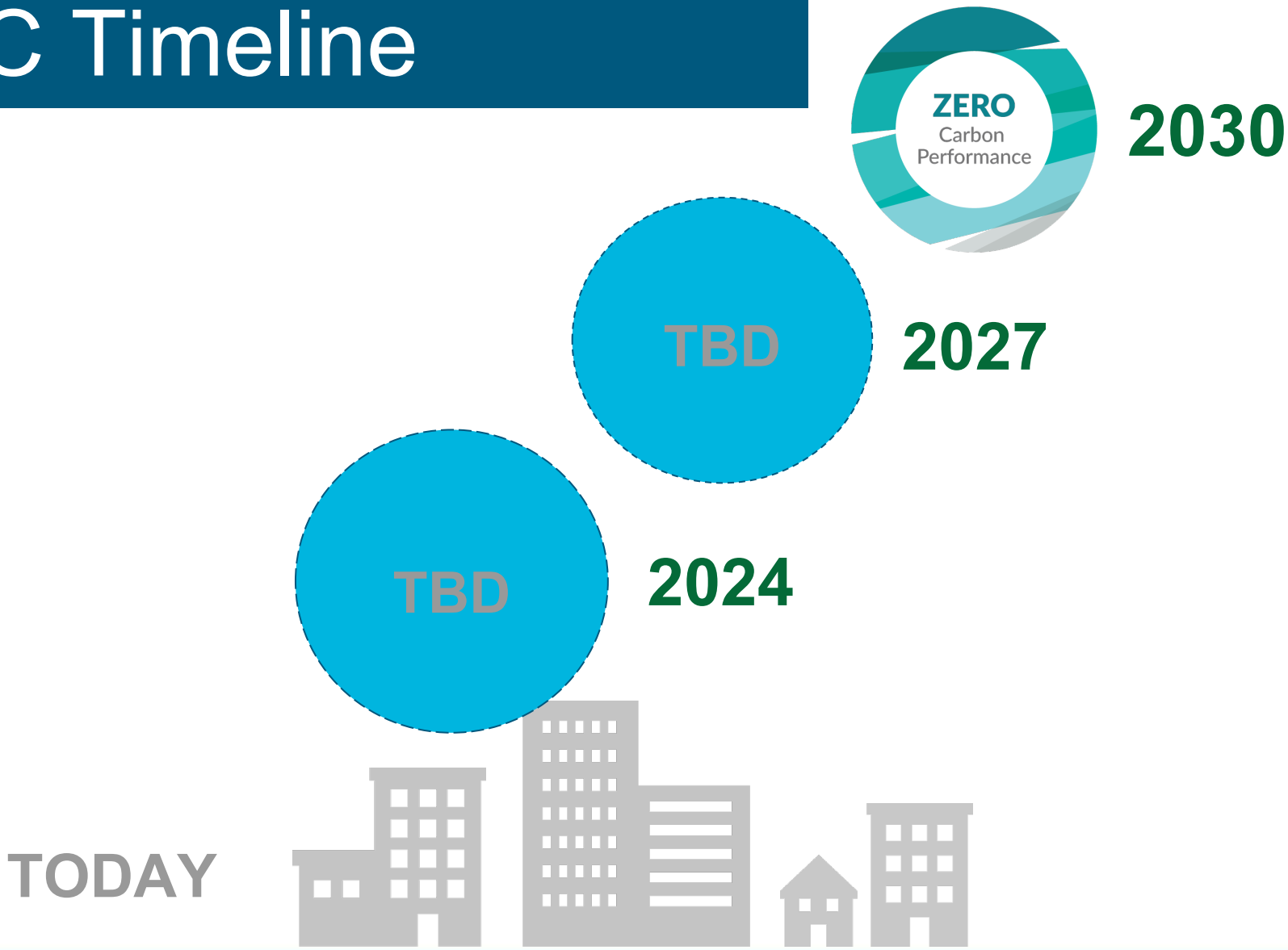
Homes at this tier must emit:

- <2,400 kg CO_2e per year *and*
- <6 kg CO_2e per m^2 per year GHG intensity

Note: Calculations only consider emissions produced by heating, cooling, ventilation, and domestic hot water equipment. Builders need not include emissions from auxiliary end uses (e.g., cooktops or clothes dryers) nor backup heating sources (e.g., wood stoves or decorative gas fireplaces) that are not designed to cover the home's entire heating load. They may include this equipment at any tier.

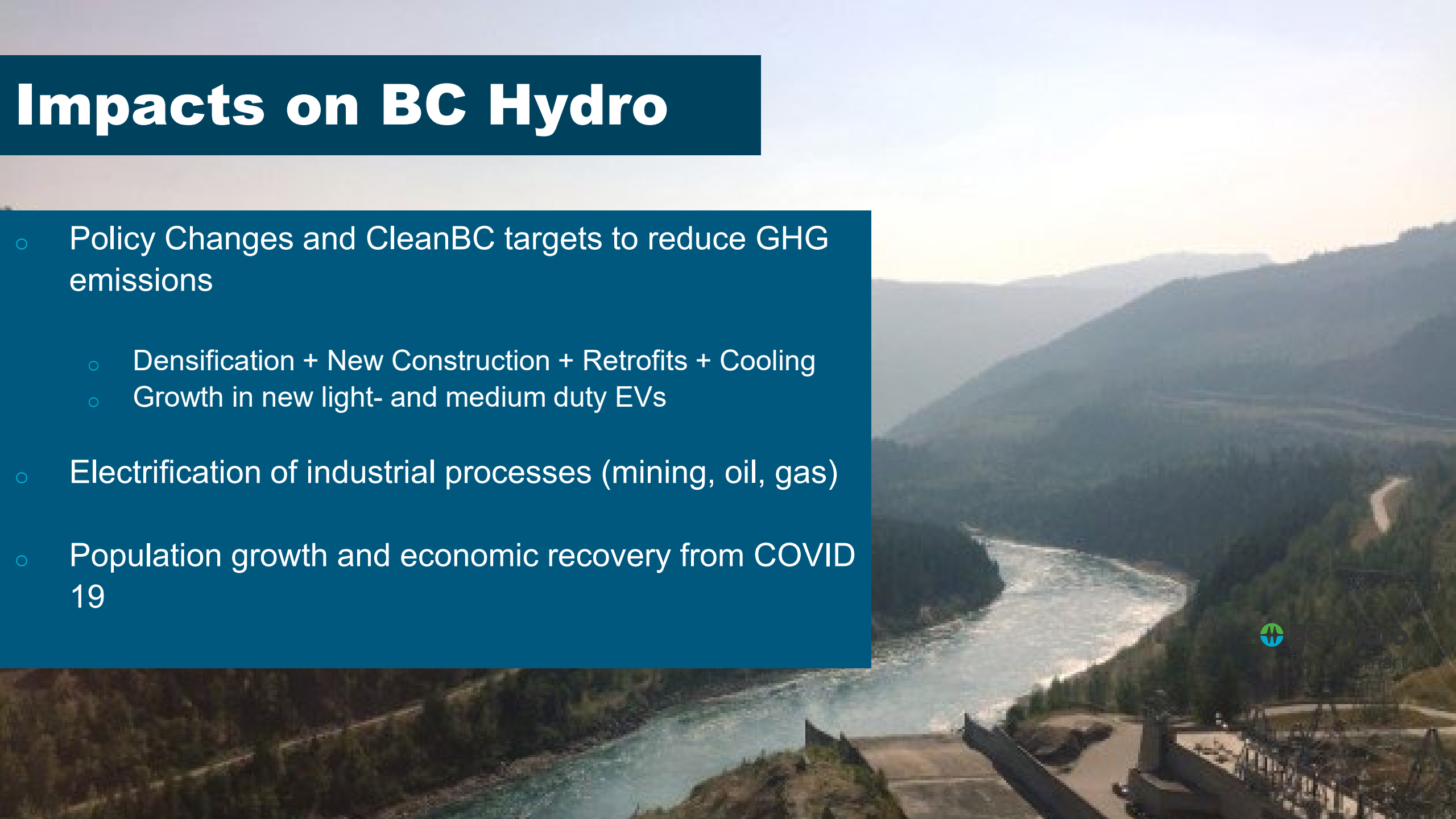
BC Hydro
Power smart

ZCSC Timeline



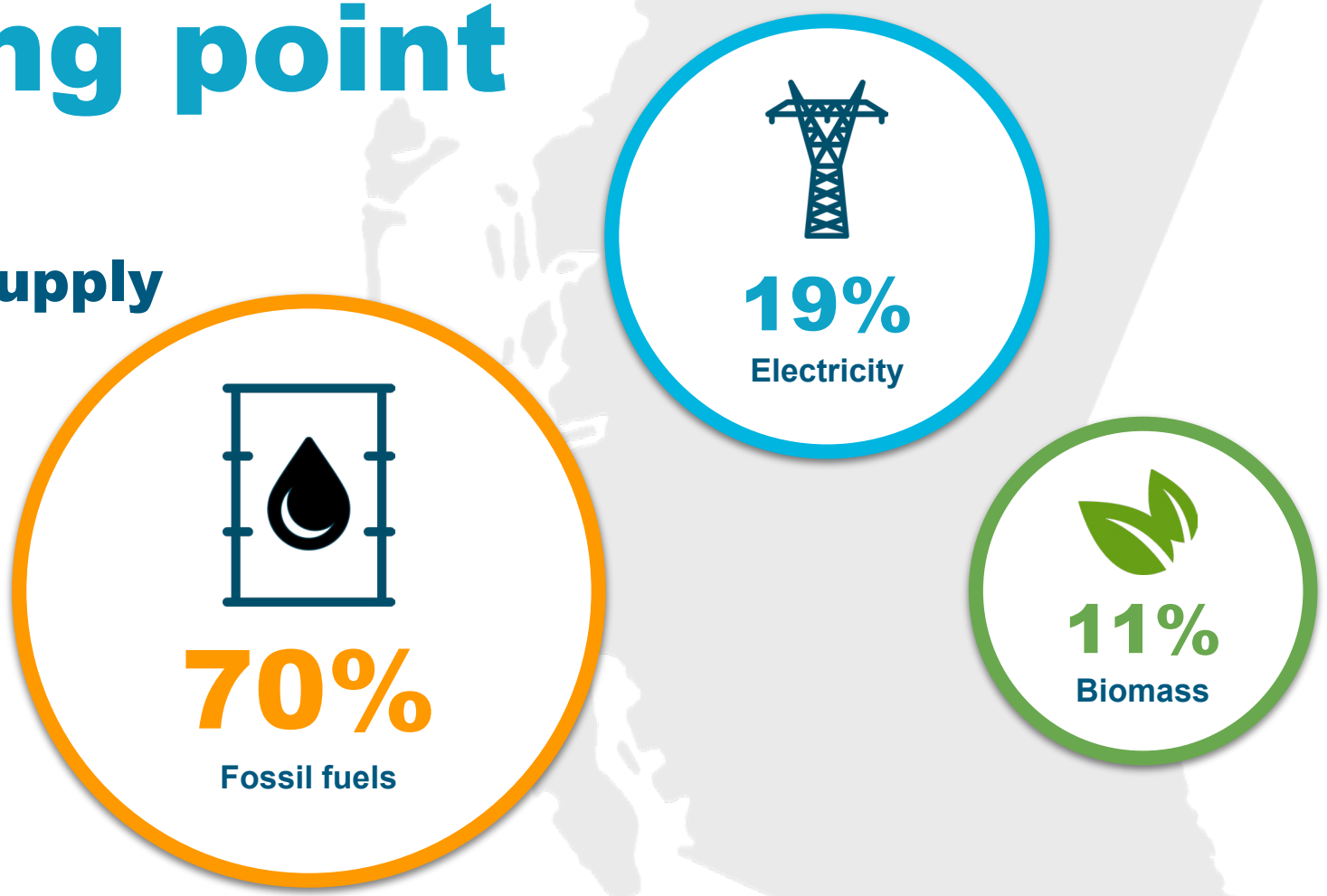
Impacts on BC Hydro

- Policy Changes and CleanBC targets to reduce GHG emissions
  - Densification + New Construction + Retrofits + Cooling
  - Growth in new light- and medium duty EVs
- Electrification of industrial processes (mining, oil, gas)
- Population growth and economic recovery from COVID 19

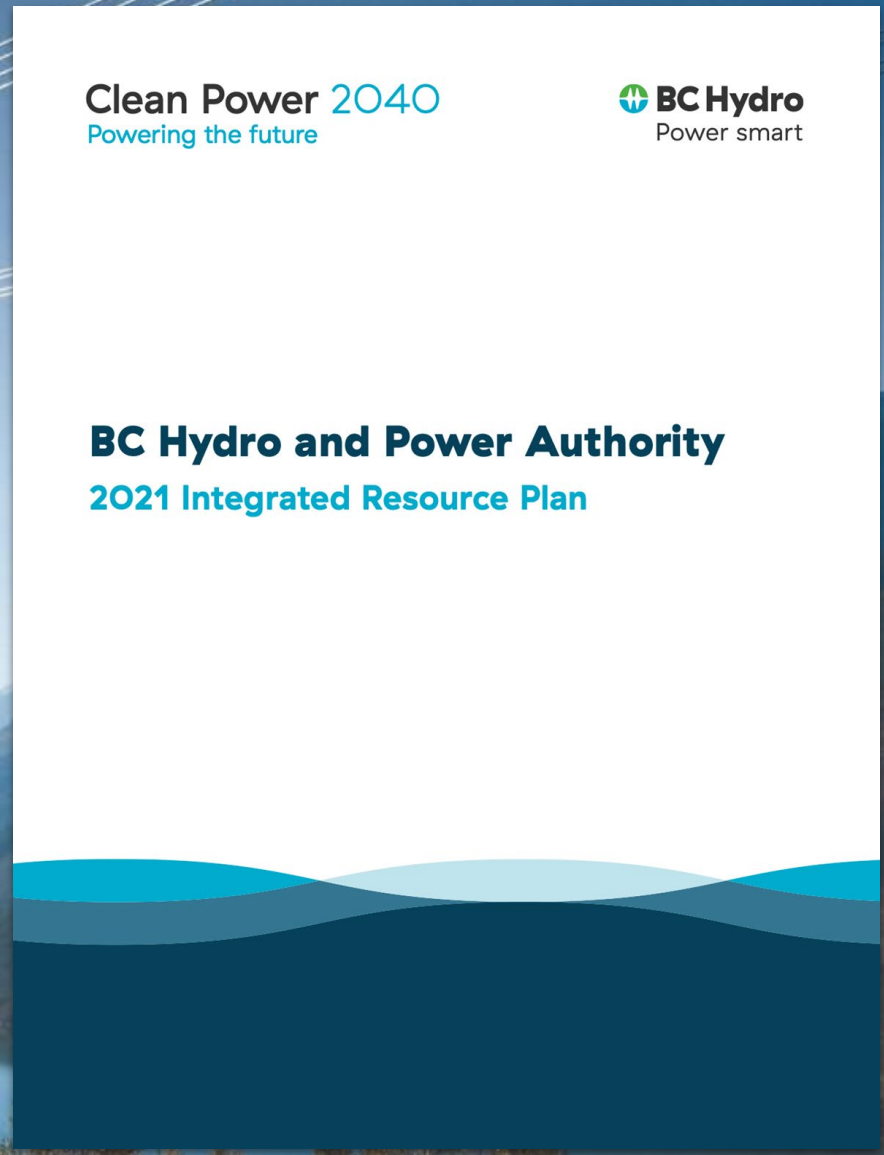


BC's starting point

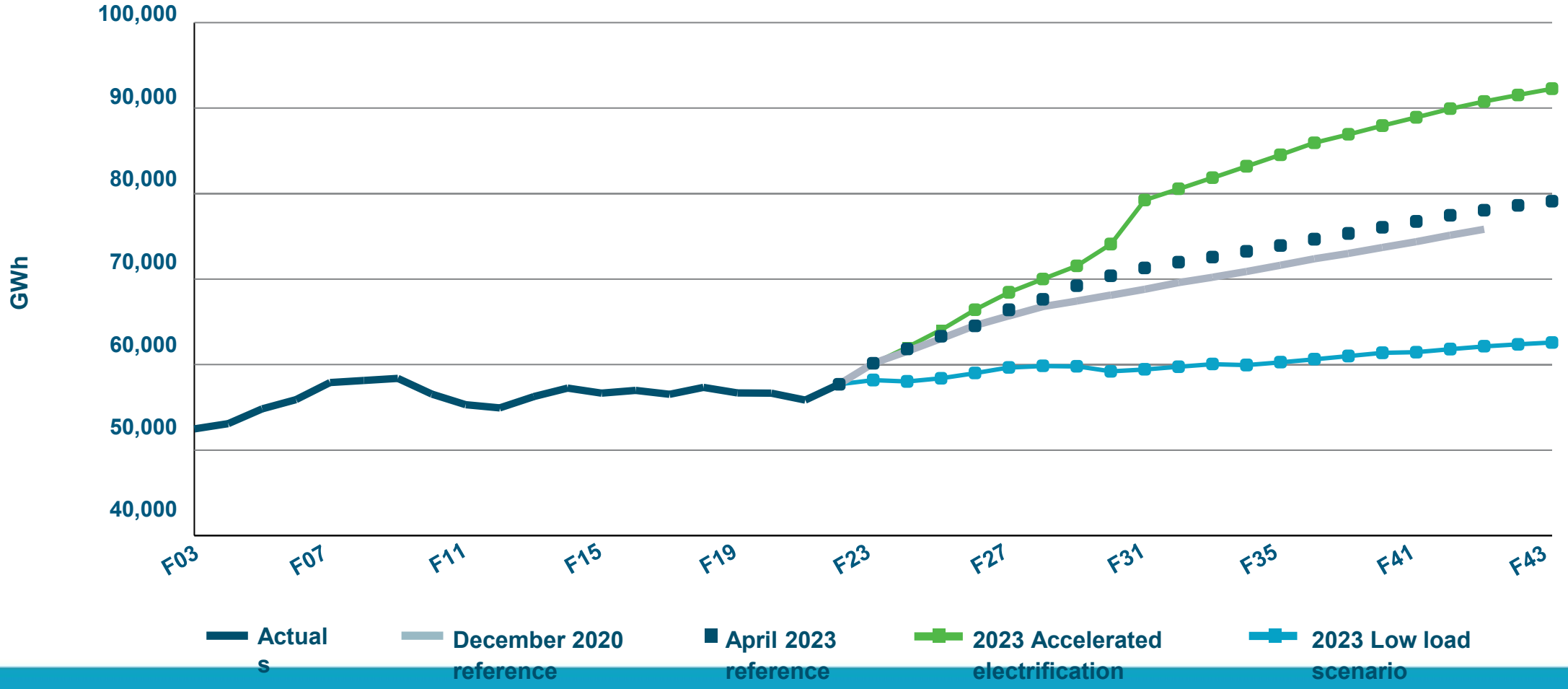
Fossil fuels currently supply most of our province's energy needs



Planning for the Future



Flexible planning



Bringing on generation:
Site C

BC Hydro
Power smart

Bringing on generation:
Call for Power

BC Hydro
Power smart

Connecting communities:

BC Hydro's $36 billion capital plan

Sustainment

$21 BILLION

Electrification and GHG reduction

$10 BILLION

Reinforcement

$5 BILLION

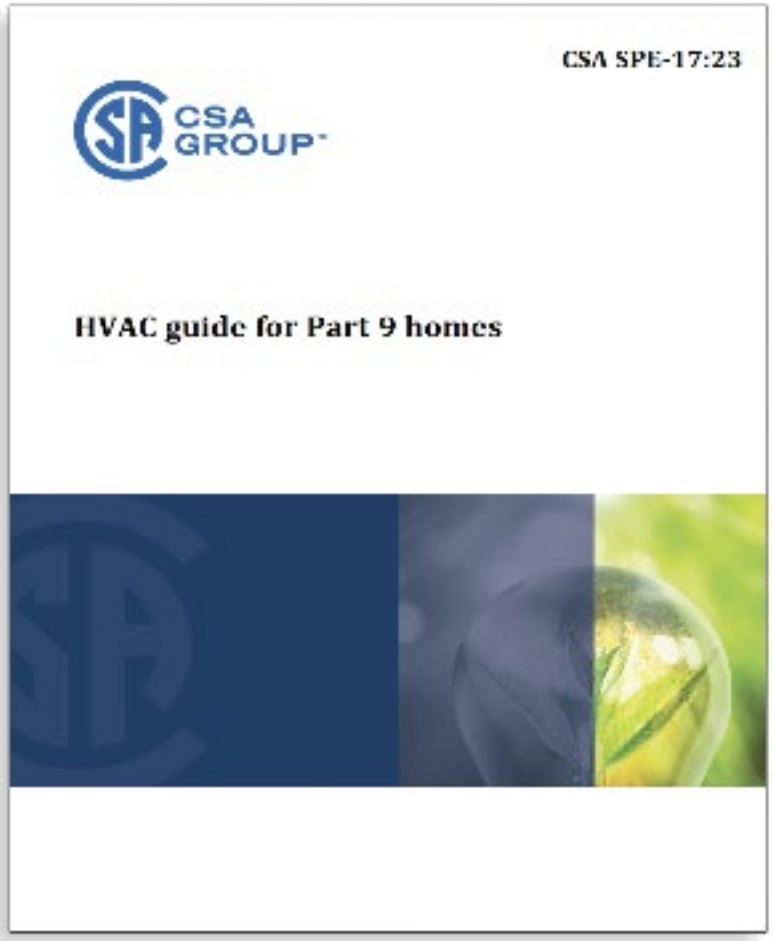
Energy Efficiency is key

- Continue to encourage energy efficiency
- Annual savings = 5,400 gigawatt hours
  - Equivalent of powering 540,000 homes per year

Managing Panel Sizing

- Rates, incentives, connection policies
- Design solutions (SPE17:23)
- Technology solutions

Design, Installation, Verification

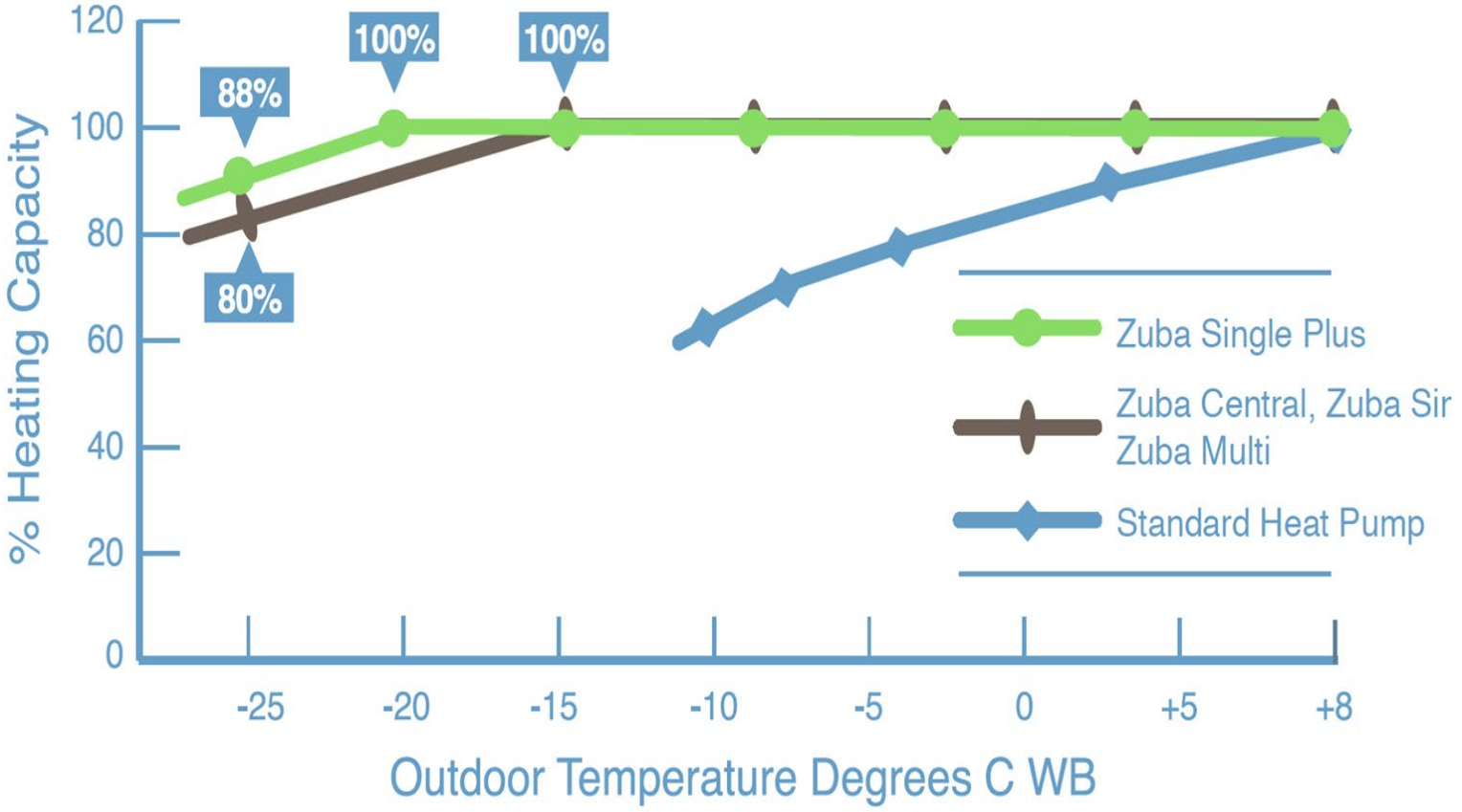


- Canadian Standards Association Publication
- Published 2023 (Capacity Building)
- Specifically for Residential (non-commercial)
- HVAC Specific - Best Practices!

BC Hydro
Power smart

BC Hydro
Power smart

Careful Heat Pump Selection



Temperature operating range can be extended with cold climate heat pumps

Supplementary electric heat may not be needed – depending on climate zone

BC Hydro
Power smart

BC Hydro
Power smart

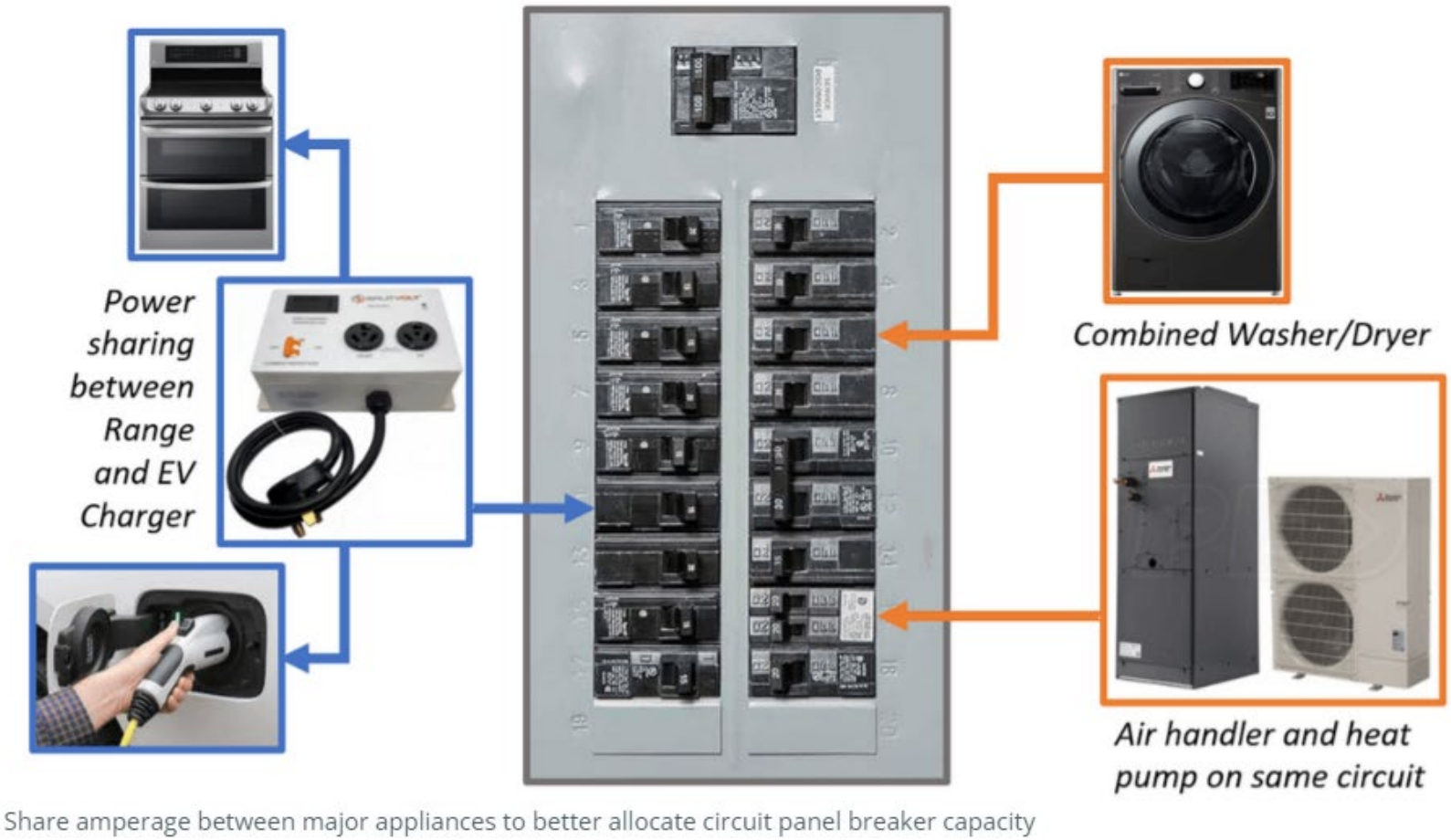
A few thoughtful selections can save you thousands of dollars and months of waiting for service upsizing.

Rules 8-106 2) 3):

requires only the larger of the two loads to be considered

Rule 8-106 11:

EV charger load can be neglected



Share amperage between major appliances to better allocate circuit panel breaker capacity

Technical Safety BC Bulletin:

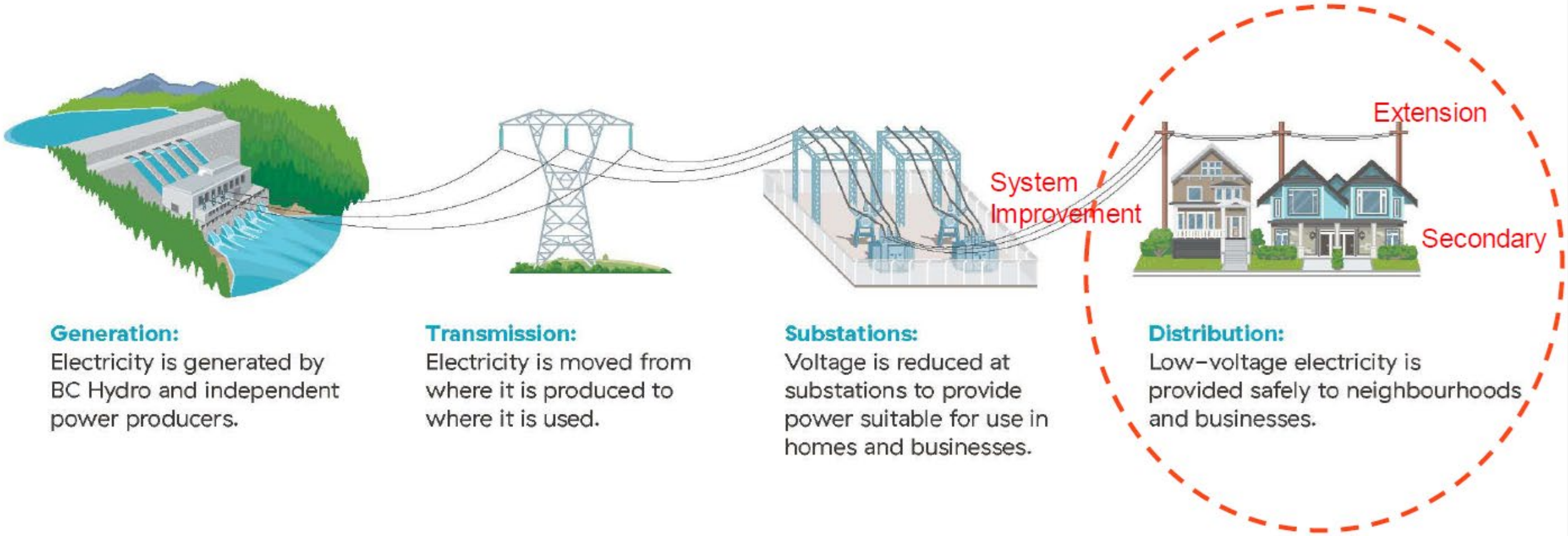
Historical load can be used to calculate and justify lower panel sizing

Source: redwoodenergy.net/watt-diet-calculator

BC Hydro Power smart

BC Hydro Power System Capacity

Available capacity depends on location, load, and timeline.



Generation:
Electricity is generated by BC Hydro and independent power producers.

Transmission:
Electricity is moved from where it is produced to where it is used.

Substations:
Voltage is reduced at substations to provide power suitable for use in homes and businesses.

Distribution:
Low-voltage electricity is provided safely to neighbourhoods and businesses.

BC Hydro
Power smart

CANADIAN HOME BUILDERS' ASSOCIATION
netzero home
LEADERSHIPSUMMIT

WILMA LEUNG
SENIOR MANAGER, TECHNICAL RESEARCH & EDUCATION, BC HOUSING

Net Zero Leadership Summit 2024

Session 6 - HOW LOW CAN YOU GO. Electrification on 100 amps?

June 12, 2024

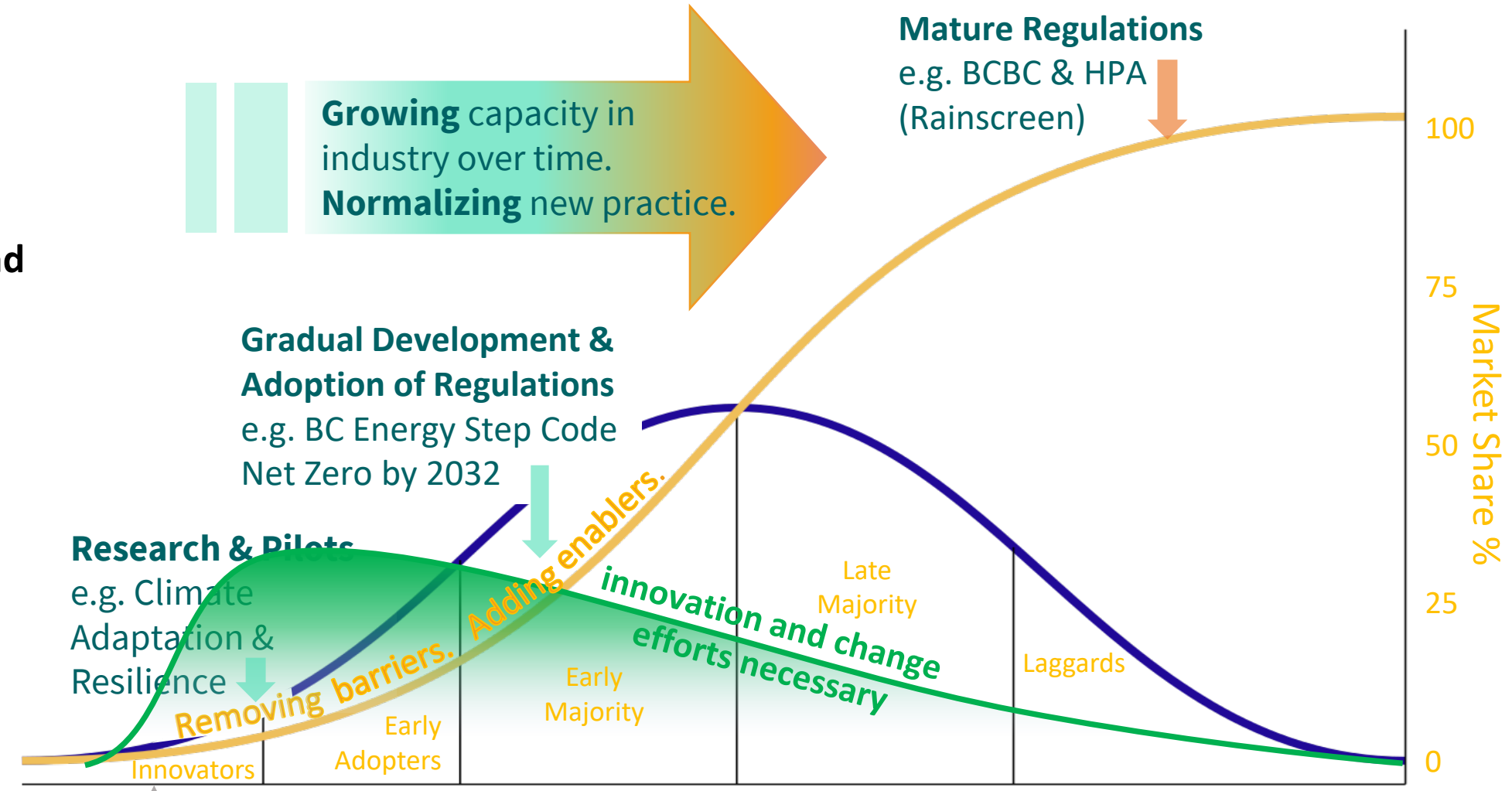
Wilma Leung
Senior Manager, Technical Research & Education
BC Housing Research Centre

BC HOUSING
RESEARCH CENTRE

MBAR
MOBILIZING
BUILDING ADAPTATION
AND RESILIENCE

NZE: Transforming Industry Practice

CHBA's Net Zero Home and MURB programs have been leading industry in **honing our craft on developing and using passive measures**, making it much more feasible to address emerging needs e.g. meeting cooling demands and protecting thermal safety in a most sustainable and affordable manner.



MBAR started as a research initiative with funding from NRCan and others, and is being redefined as an Innovation Program

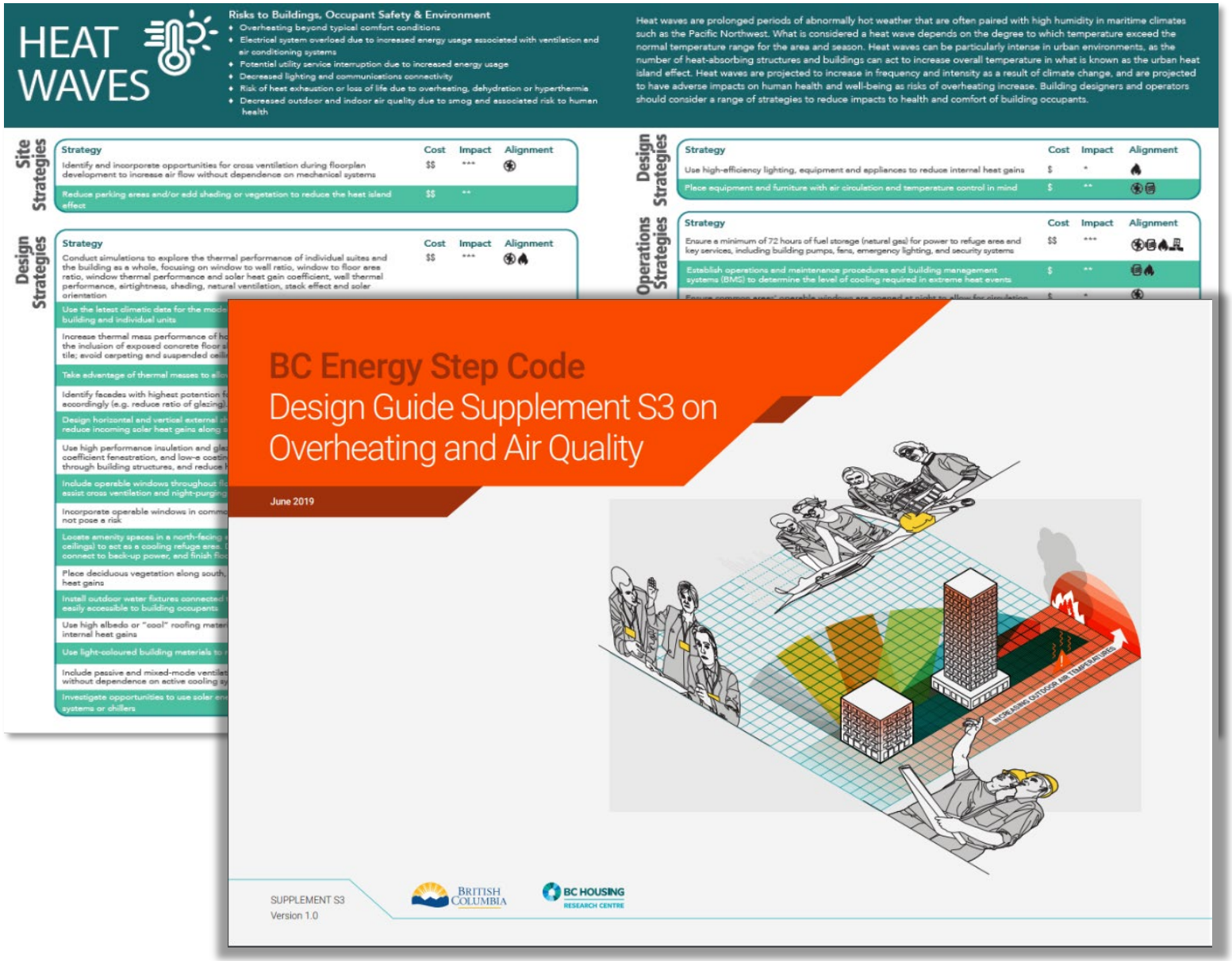
Mobilizing Building Adaptation and Resilience (MBAR) has been a multi-year, multi-stakeholder knowledge and capacity building project funded by BC Housing, the Province of BC, NRCan, BC Hydro, City of Vancouver, and the Lower Mainland Health Organizations, with participation and contribution from over 30 organizations, including national, provincial, and local agencies; and industry partners.

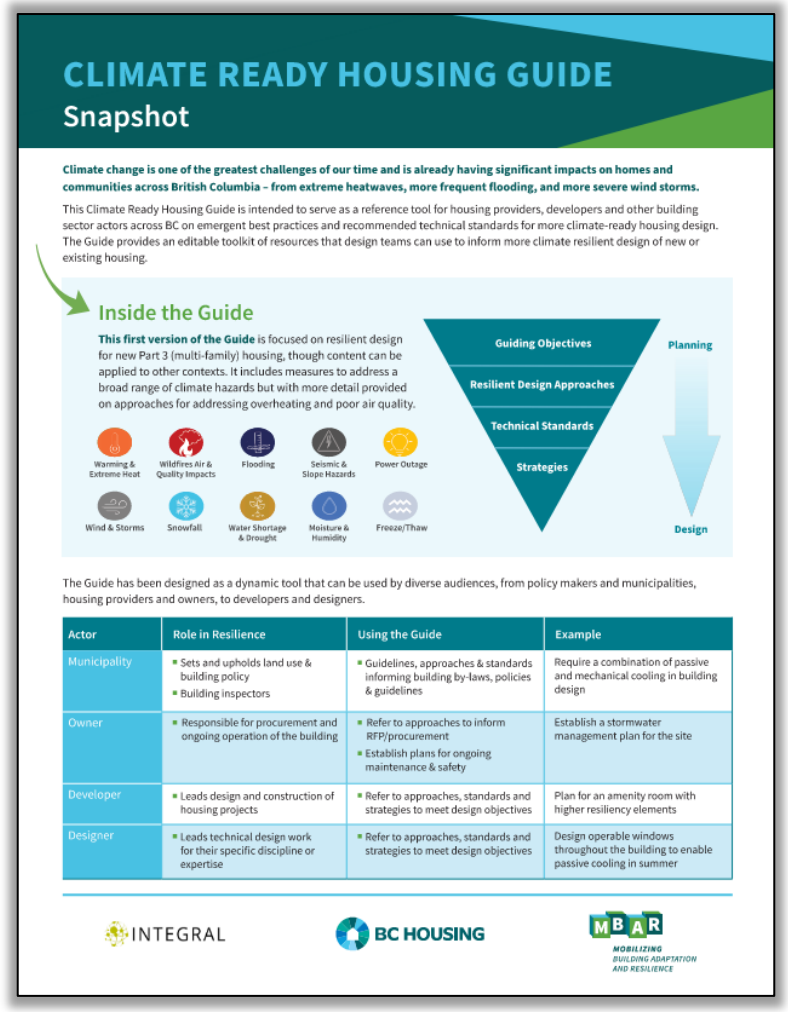
BRITISH COLUMBIA

BC HOUSING RESEARCH CENTRE

MBAR MOBILIZING BUILDING ADAPTATION AND RESILIENCE

Resources on Overheating





BC HOUSING RESEARCH CENTRE

MBAR
MOBILIZING
BUILDING ADAPTATION
AND RESILIENCE

Resources on Overheating

Number 19

BUILDER INSIGHT

BC HOUSING RESEARCH CENTRE

Builder Insight is a series of bulletins and companion videos designed to provide practical information on new technologies, research results, good building practices and emerging technical issues in residential construction to Licensed Residential Builders and others in the industry.
This bulletin was prepared by Focal Engineering with support from Integral.

Modelling the Future Climate in Passively Cooled Buildings

Overview

The Province of British Columbia w
next several decades. Temperature
by 2050, and the province is already
frequent and severe heat waves an
events pose serious risks to British
being, and financial investments of
can play a key role in enhancing ou
designers must increasingly consid

This Builder Insight provides an ov
resilience by considering the risk of
Code for applicable projects. It incl
potential for passively cooled buildings to overheat under future climate scenarios.

This document is intended for readers with an understanding of energy modelling who are new to this type of analysis, with the goal of establishing a procedure that can be consistently used across the building industry.

Contents

Overview 1
Future Weather Files 2
Overheating Analysis 4
Reporting 7
Methodology Summary 9
Additional Resources 9
Acronyms 10
Definitions 10

BRITISH COLUMBIA
www.gov.bc.ca

Information Bulletin

Building and Safety Standards Branch
PO Box 9844 Stn Prov Govt
Victoria BC V8W 9T2
Email: building.safety@gov.bc.ca
Website: www.gov.bc.ca/buildingcodes

No. B24-08
April 19, 2024

Protection from Overheating in Dwelling Units

This bulletin provides information about new provisions in the British Columbia Building Code (Building Code) 2024 related to minimizing the risks to health and safety due to overheating in dwelling units. These new Building Code 2024 requirements apply to projects for which a building permit is applied for on or after March 8, 2024. These changes apply to new dwelling units in all large (Part 3) and smaller (Part 9) residential occupancies.

Background

Recent extreme heat events in the summer of 2021 in British Columbia had devastating impacts, attributing to 619 deaths. Similar weather episodes are projected to become hotter, longer, and more frequent as B.C.'s climate changes.

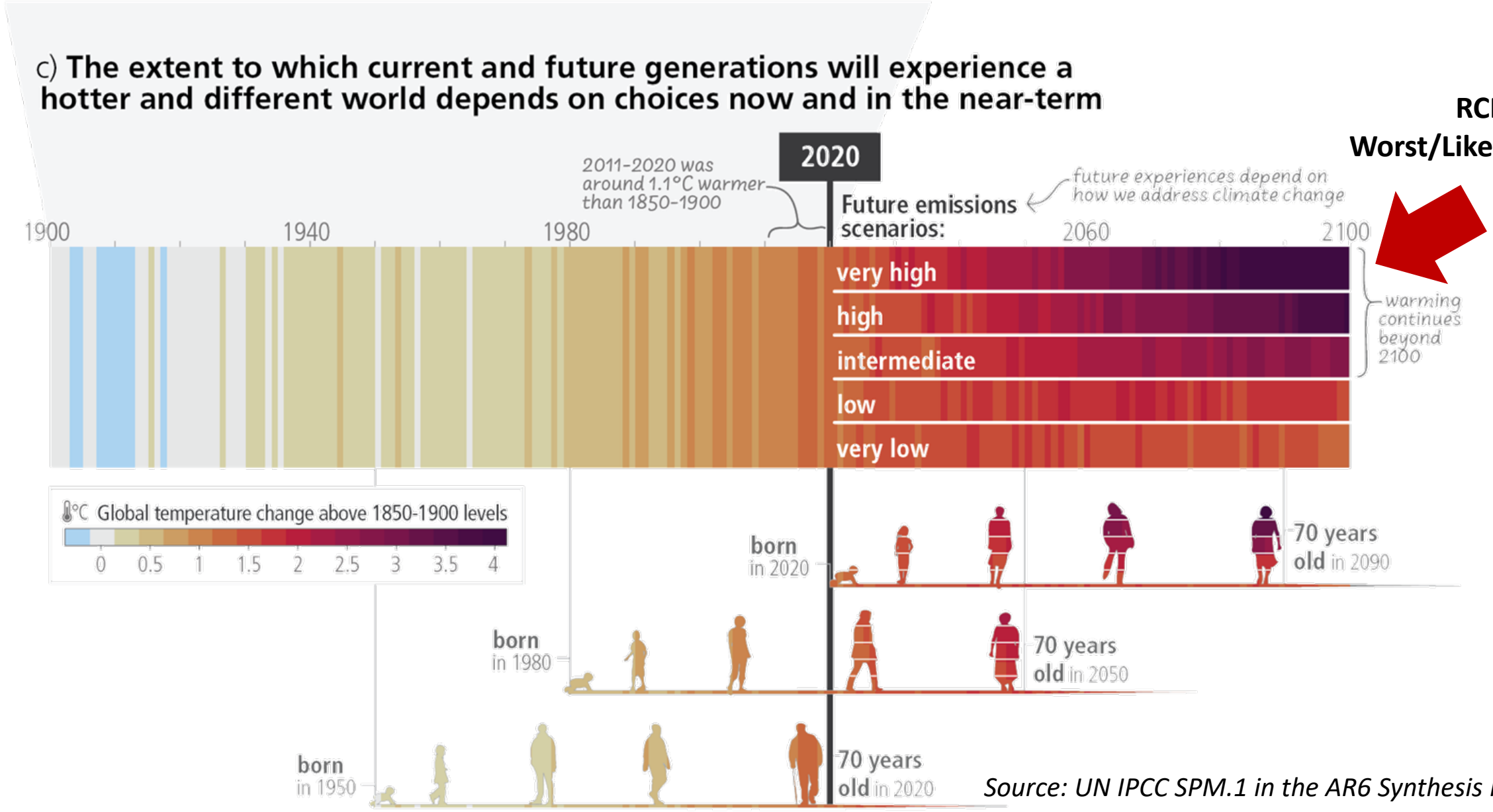
In the Report to the Chief Coroner of British Columbia, titled "Extreme Heat and Human Mortality: A Review of Heat-Related Deaths in B.C. in Summer 2021" a recommendation was made to "...ensure that the 2024 release of the BC Building Code incorporates both passive and active cooling requirements in new housing construction...".

BRITISH COLUMBIA

BC HOUSING RESEARCH CENTRE

MBAR MOBILIZING BUILDING ADAPTATION AND RESILIENCE

Risks: Find Yourself On the Graph



RCP 8.5
Worst/Likeliest

Source: UN IPCC SPM.1 in the AR6 Synthesis Report

Risks & Strategies for Housing

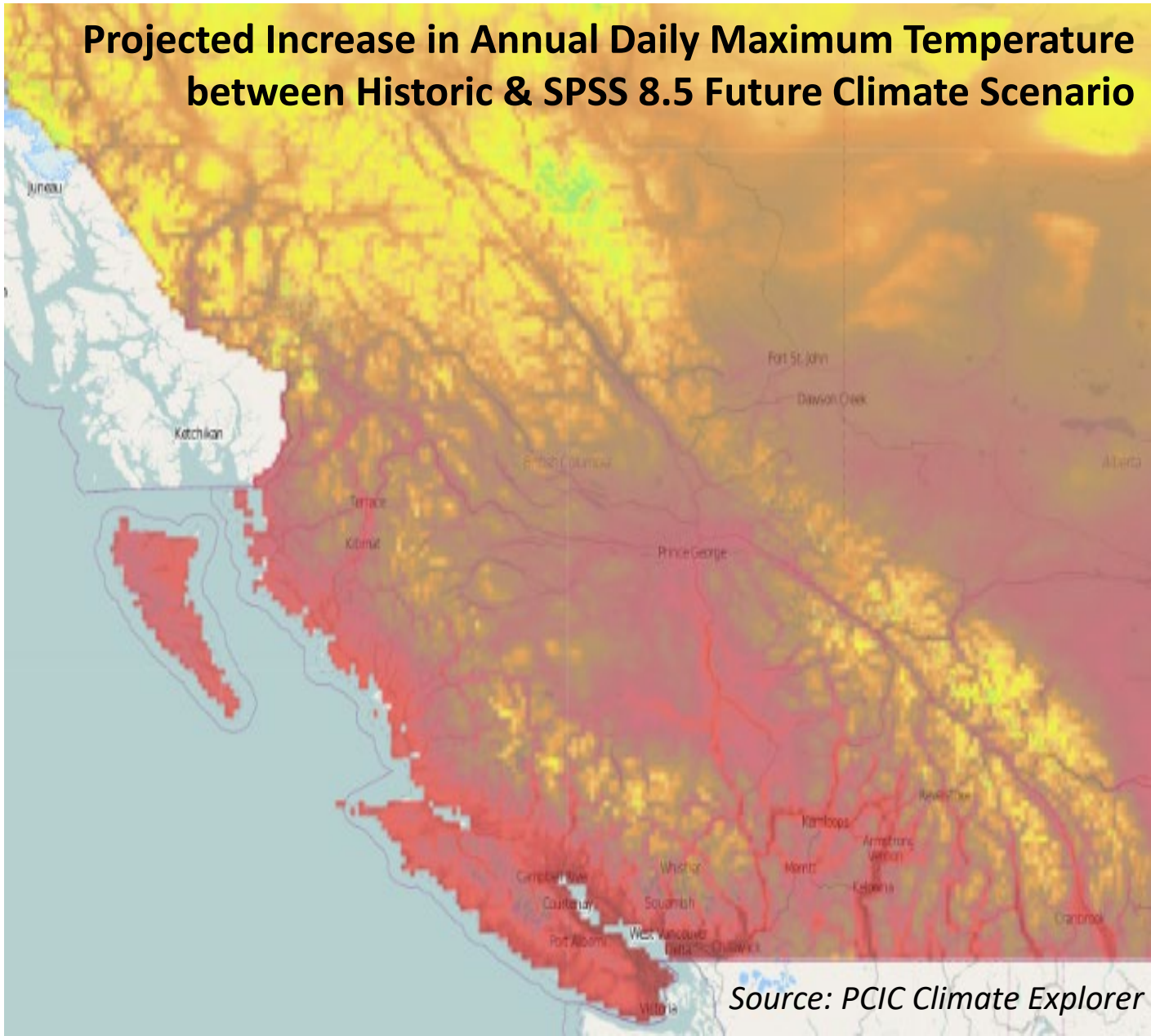
Broad Trends

- Greater temperature increase in southern regions that are less adapted to heatwaves

Potential Impacts to Housing

- **Overheating** & HVAC overload causing discomfort *especially for heat-sensitive people*
- Regional **brownouts** requiring backup power *particular risk to those medically dependent on power*
- Increased demand for **shelter spaces** due to extreme outdoor temperatures *especially for underhoused with mental illness*

Projected Increase in Annual Daily Maximum Temperature between Historic & SPSS 8.5 Future Climate Scenario



Source: PCIC Climate Explorer

Risks & Strategies for Housing

British Columbia

Annual deaths from extreme heat in B.C. could double by 2030 without climate adaptations: report

Future deaths and hospitalizations could cost more than $12B a
Climate Institute analysis finds

Moira Wyton · CBC News · Posted: Jul 05, 2023 7:02 PM PDT | Last Updated

A paramedic outside St. Paul's Hospital in Vancouver on June 30, 2021, at the height of the deadly heat dome event. Analysis in a new report found the period of extreme heat cost nearly $6 billion in human life lost. (Ben Nelms/CBC)

Extreme Heat and Human Mortality:
A Review of Heat-Related Deaths in B.C.
in Summer 2021

Report to the Chief Coroner of British Columbia
Release Date: June 7, 2022

BRITISH COLUMBIA

Search | Menu

Emergency management / Public preparedness and recovery / Know your hazards / Severe weather / **Extreme heat & drought**

Be prepared for extreme heat and drought

Last updated on April 30, 2024

Available PDF guides: English (9.6MB) | Français (French)(9.5MB) | 简体中文 (Simplified Chinese)(6.3MB) | 繁體中文 (Traditional Chinese)(6.3MB) | ਪੰਜਾਬੀ (Punjabi)(6.2MB)

On this page

- What is extreme heat?
- Before summer
- As temperatures rise
- During an event
- Drought

New Regulations in B.C.

THE GLOBE AND MAIL

B.C. to require all new homes have a temperature-controlled room

ANDREA WOO >
INCLUDES CORRECTION
VANCOUVER
PUBLISHED AUGUST 17, 2023
UPDATED AUGUST 21, 2023

This article was published more than 6 months ago. Some information may no longer be current.

Cranes above a condo development and other housing projects under construction in Coquitlam, B.C. on May 16, 2023.

BRITISH COLUMBIA

BC Gov News

Home | Ministries | Sectors | Connect | Subscribe | News Archive

Office of the Premier

More small-scale, multi-unit homes barriers removed

Updated Nov. 2, 2023

Translations

繁體中文
Français
ਪੰਜਾਬੀ

Share

News Release

Victoria
Wednesday, November 1, 2023 1:55 PM

Media Contacts

New zoning rules will mean more housing options

StrongerBC for everyone

(flickr.com)

The Province is introducing new housing legislation to deliver more small-scale,

Journal of Commerce by ConstructConnect

NEWS | CERTIFICATES | TENDERS & LEADS | PODCASTS | FEATU

PRE-BID PROJECTS Click here to see Canada's most comprehensive

GOVERNMENT

B.C. issues RFP for new Standardized Housing Design Project

DCN-JOC News Services November 20, 2023

PROVINCE OF B.C. — Through the new Standardized Housing Design Project, the Province of B.C. is creating new standardized, customizable residential designs for small-scale, multi-unit housing built on single lots.

BRITISH COLUMBIA

BC HOUSING

MBAR
MOBILIZING BUILDING ADAPTATION AND RESILIENCE

Alignment of Climate Resilience with Zero-emission Buildings

Zero-emission building features	Resilient zero-emission building features	Equitable considerations
Energy efficient building envelopes and mechanical systems	→ Improve airtightness, and include good ventilation and air filtration effective for wildfire smoke	→ Prioritize older buildings with more vulnerable occupants
High-efficiency electric heating	→ Include high-efficiency cooling systems → Add backup power	→ Prioritize cooling in units or in rooms on site for populations more vulnerable to heat in units (e.g., reduced mobility, elderly, certain medical conditions)
On-site renewable energy	→ Add energy storage or backup power suitable for use during future hazard events	→ Consider diverse needs for backup power (e.g., refrigeration of medications, technology that supports those with disabilities)
Passive heating and cooling designs	→ Include options for active heating and cooling in preparation for more extreme conditions	→ Consider and prioritize cooling needs for populations more vulnerable to heat

Pinna Sustainability

British Columbia

BC HOUSING

MBAR
MOBILIZING BUILDING ADAPTATION AND RESILIENCE

Thank You!

Email: **Research@bchousing.org**

BC HOUSING
RESEARCH CENTRE

MBAR
MOBILIZING
BUILDING ADAPTATION
AND RESILIENCE