BUILD BETTER TOGETHER

Off-Grid at 50 Below with No Margin for Error

Phius Certification at the Alaska Land Port of Entry Campus

Thorsten Chlupp | National Laboratory of the Rockies (NLR)

NLR Alaska Campus, Applied Research for Communities in Extreme Environments (ARCEE)

PhiusCon 2026 | Phoenix

National Laboratory of the Rockies

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PhiusCon 2026 | Phoenix

October 9, 2026

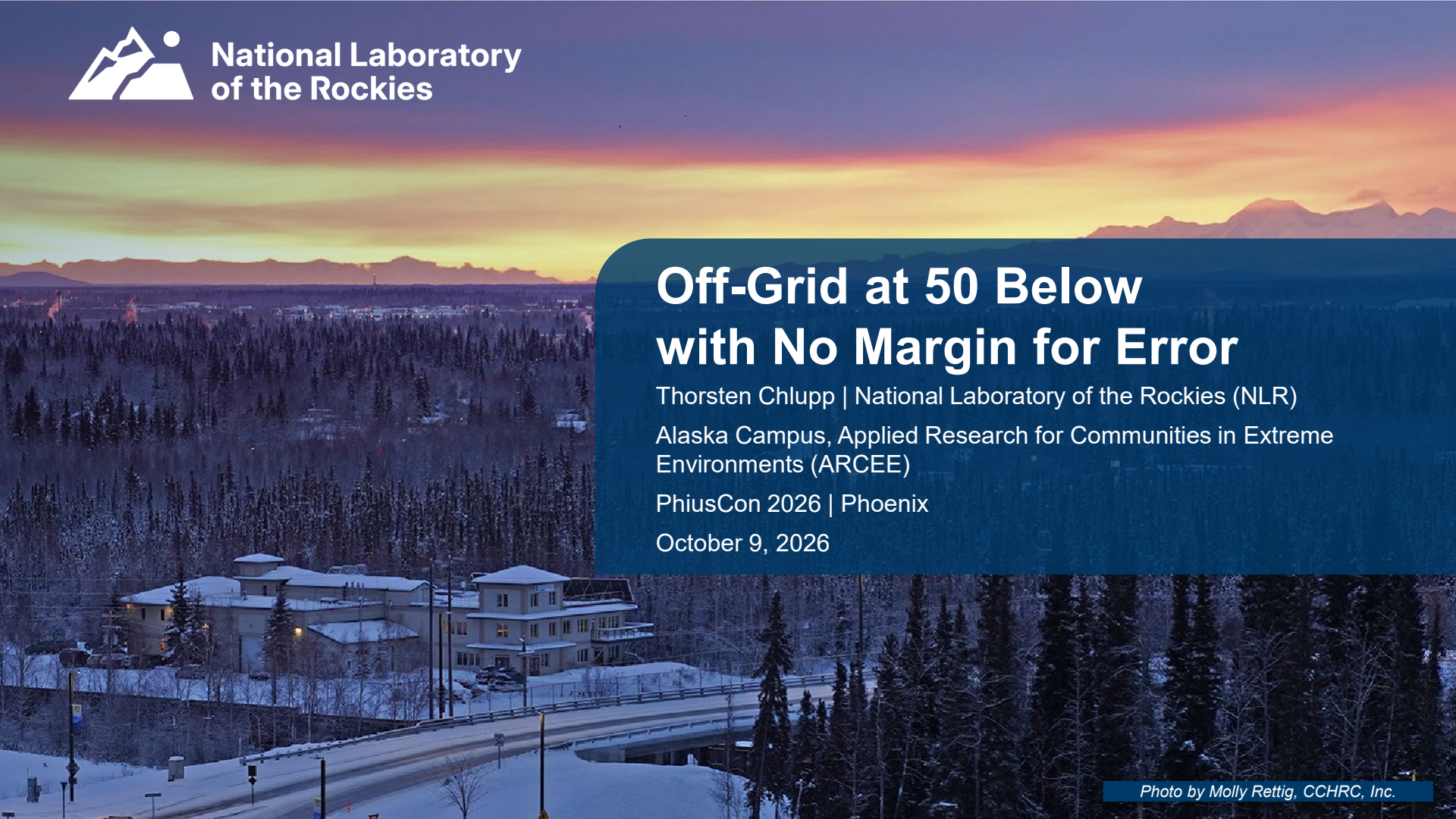


Photo by Molly Rettig, CCHRC, Inc.

NLR Alaska Campus

Applied Research for Communities in Extreme Environments

Based in Fairbanks and working across the traditional territories of Alaska's Indigenous Peoples. We partner with communities, industry, and government to improve energy security and resilience in extreme climates.

Photo by NLR

Roles and Responsibilities

- NLR is an Owner Representative for GSA in an Advisory Role through an Interagency Agreement
- NLR provides Subject Matter Expertise
- NLR is not the designer or decision maker

Photo from Denali, Thorsten Chlupp

Alcan Port of Entry Today

- Built in 1972
- The only 24/7 port to mainland Alaska
- 14,000 HDD, lows near -50°F
- Off-grid: power, heat, water, wastewater on site
- Officers and families live at the Port

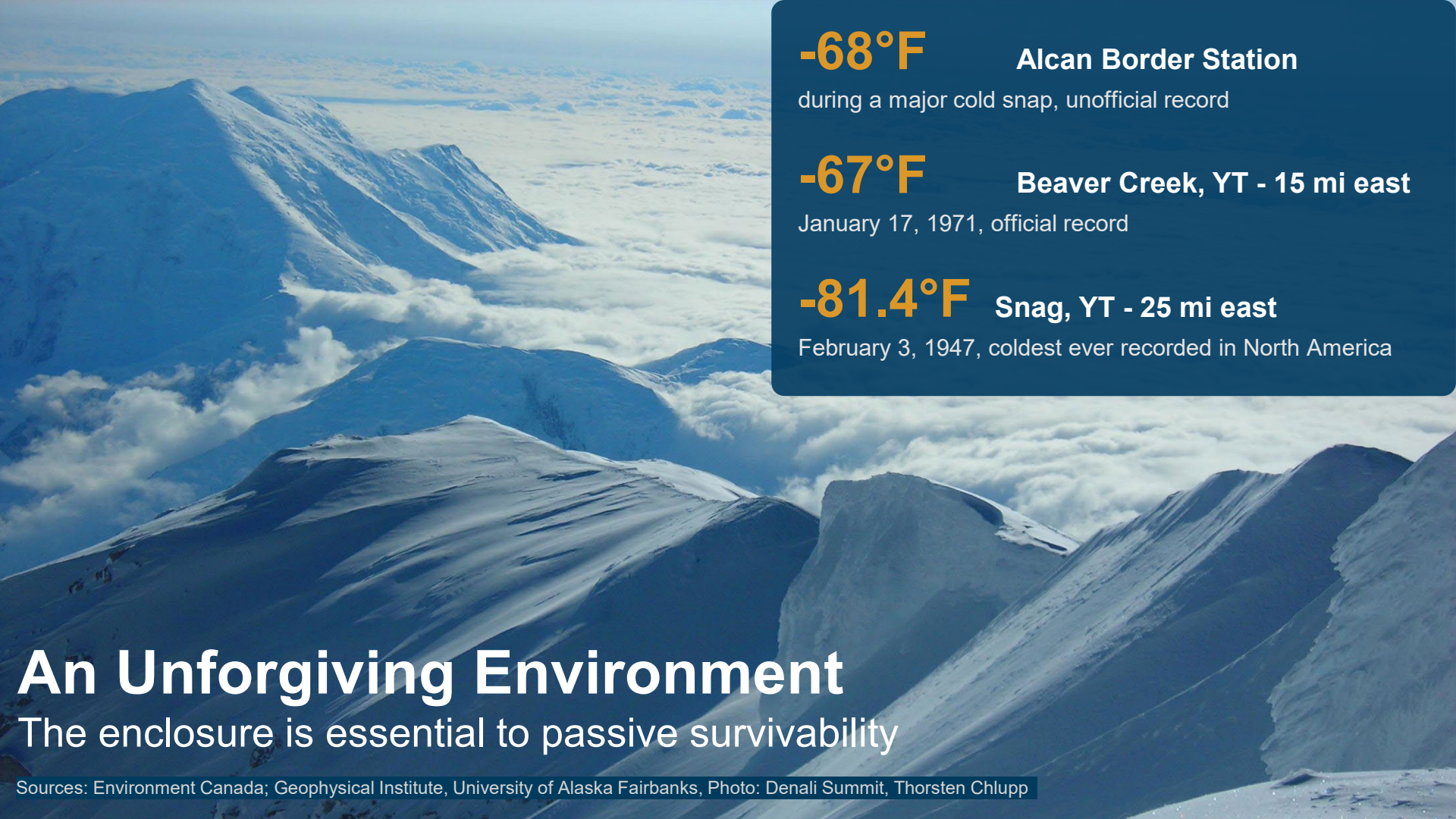
Photo from GSA. Sources: GSA (2026); The MILEPOST (2026); Phius (2025) climate data set.

How Remote Is Alcan?

CBSA Beaver Creek, YT	25 mi	40 min
Tok	92 mi	1.5 h
Fairbanks	296 mi	5.5 h
Anchorage	420 mi	7.5 h

One Highway.
At −50°F, help is hours away.

Sources: The MILEPOST (2026); Google Maps (2026); GSA (2026). Maps by NLR using Natural Earth data.



-68°F **Alcan Border Station**

during a major cold snap, unofficial record

-67°F **Beaver Creek, YT - 15 mi east**

January 17, 1971, official record

-81.4°F **Snag, YT - 25 mi east**

February 3, 1947, coldest ever recorded in North America

An Unforgiving Environment

The enclosure is essential to passive survivability

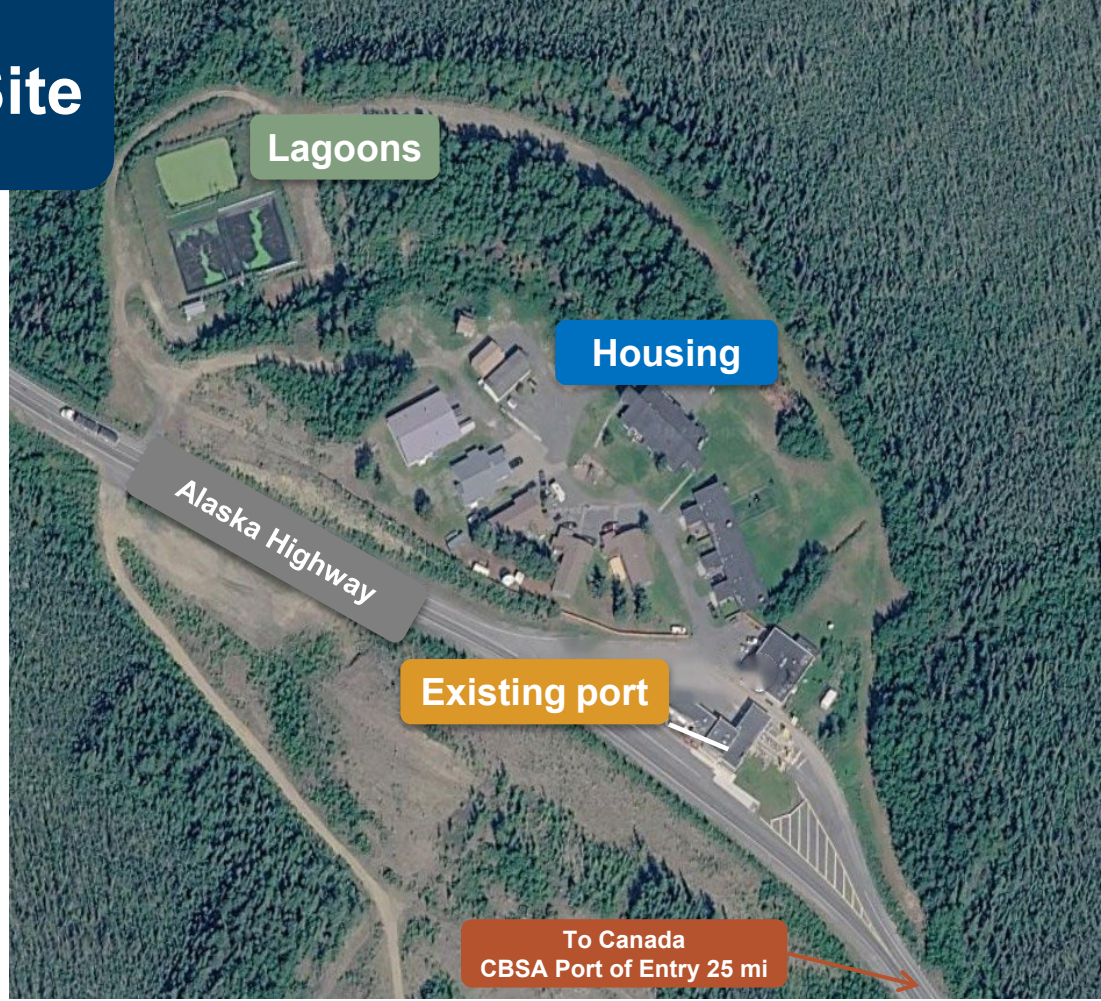
Sources: Environment Canada; Geophysical Institute, University of Alaska Fairbanks, Photo: Denali Summit, Thorsten Chlupp

A Constrained Existing Site

One small remote bluff

Alaska Highway on one side

Forest and wetlands on the others

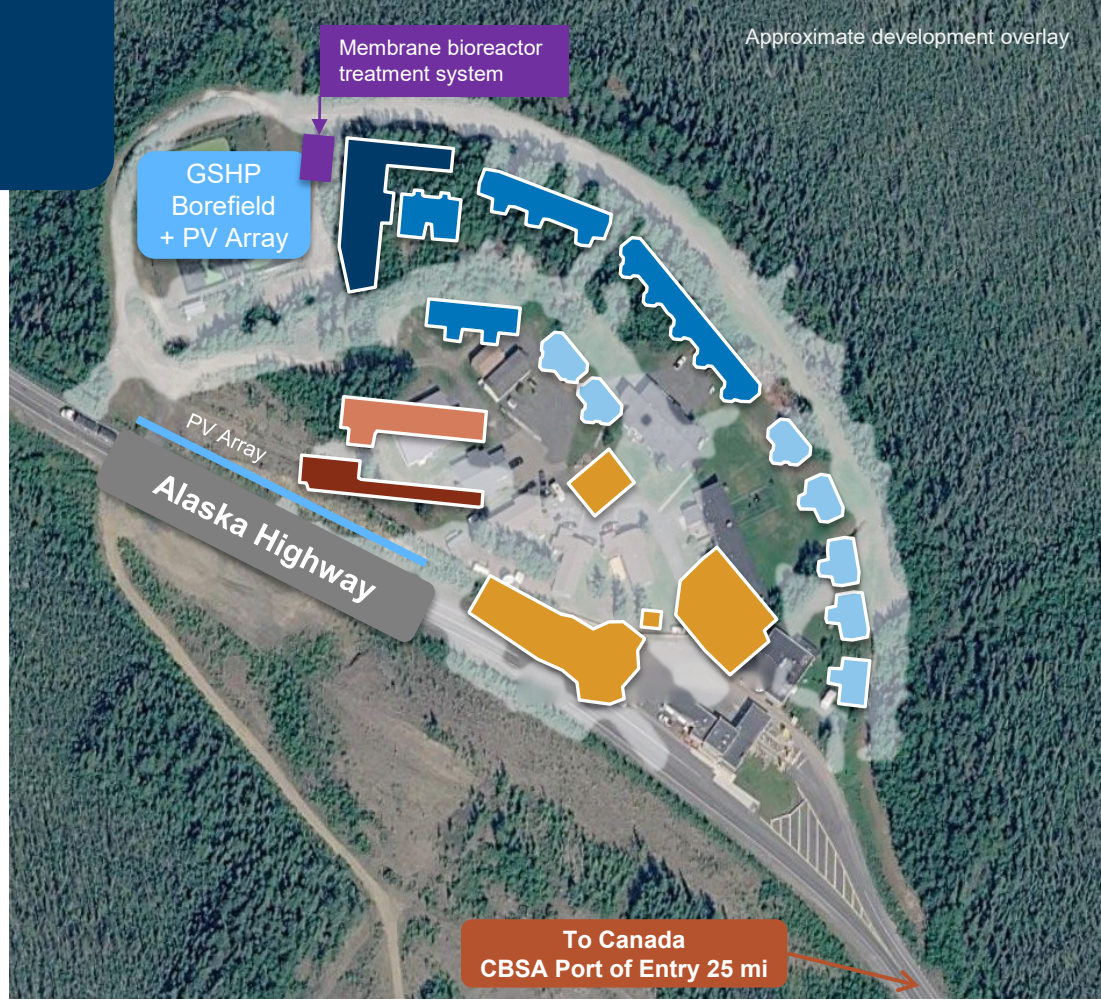


Imagery: Google Earth, 2026.

No Room to Spare

Operations, housing, community facilities, utilities, energy systems, and wastewater treatment. All on one constrained, remote campus.

- Port operations
- Multifamily housing
- Single-family homes
- Community Health & Fitness
- Firearms range
- Utility building
- Membrane bioreactor treatment system



Imagery: Google Earth, 2026. Site plan: HDR, Project Development Study; overlay approximate, by NLR.

Why Modernize

- Expand for additional staffing
- Improve traffic flow and operations
- Housing comfort and efficiency
- Update technology and equipment
- Reduce the carbon footprint
- **A joint port with Canada**
  CBSA co-locates in the new LPOE, closing the 25-mile gap.

Sources: GSA (2026); Phius (2025), Alcan LPOE Phius feasibility study Photo by Thorsten Chlupp

Complex Before Climate Enters the Equation

62+ Codes, standards, and directives govern this project

CBP / GSA

- CBP LPOE Design Standard, 2023
- GSA Order 5621.1 – PBS Fire Protection Policy, 2020
- Alcan LPOE PDS – Design Program & Directives, 100% Report, Oct 2024
- GSA Memo – PBS Interim Core Building Standards, 2/24/25
- 2020 Guiding Principles for Sustainable Federal Buildings
- Build America, Buy America Act, 2021
- HSPD-12 – Homeland Security Presidential Directive 12
- FISMA – Federal Information Security Modernization Act
- FIPS 201 – PIV for Federal Employees and Contractors

Federal Codes & Standards

- ABAAS Accessibility Standards, 2015
- Federal Fire and Safety Act of 1992 (H.R. 3360)
- 15 U.S.C. § 2227 – Fire Safety Systems in Fed. Buildings, 1992
- 40 U.S.C. §§ 3301–3315 (Public Buildings Act of 1959)
- 41 CFR Part 102-80 – Real Property Facility Design
- 29 CFR § 1910, 1926 (OSHA) – Occupational Safety & Health
- 29 CFR 1910 Subpart G – Occupational Health & Env. Control
- 29 CFR 1910 Subpart Z – Toxic and Hazardous Substances
- Clean Water Act
- Safe Drinking Water Act

Alaska & Security

- Alaska Dept. of Public Safety – Authority Having Jurisdiction
- Alaska Division of Fire & Life Safety
- 13 AAC 30 – Concealed Handgun Permits
- AS § 18.70.080 (2025)
- 18 AAC 72 – Wastewater Treatment and Disposal
- 18 AAC 80 – Drinking Water Regulations
- Alaska Highway Preconstruction Manual
- UFC 4-179-02 – Small Arms Ranges, 5 March 2020
- 27 CFR § 555.208 – Construction of Type 2 Magazines

ASHRAE

- ASHRAE 52.2 – Testing Air-Cleaning Devices by Particle Size
- ASHRAE 55 – Thermal Environmental Conditions for Occupancy
- ASHRAE 62.1 – Ventilation for Acceptable Indoor Air Quality
- ASHRAE 62.2 – Ventilation for IAQ in Housing Units
- ASHRAE 90.1 – Energy Standard, Except Low-Rise Residential, 2019
- ASHRAE 189.1 – High-Performance Green Buildings
- ASHRAE 209 – Energy Simulation Aided Design
- ASHRAE Guidance – Protecting Occupants from Wildfire Smoke
- ASHRAE Cold-Climate Buildings Design Guide, 2nd Ed.
- ASHRAE Guide – Resilient Thermal Energy Systems, Cold & Arctic

NFPA

- NFPA 1 – Fire Code, 2024
- NFPA 4 – Integrated Fire Protection & Life Safety Testing, 2024
- NFPA 10 – Portable Fire Extinguishers, 2022
- NFPA 13 – Sprinklers, 1–2 Family Dwellings, 2025
- NFPA 13D – Sprinklers, 1–2 Family & Manufactured Homes, 2025
- NFPA 13R – Sprinklers, Low-Rise Residential, 2025
- NFPA 20 – Stationary Fire Pumps, 2025
- NFPA 22 – Water Tanks for Fire Protection, 2023
- NFPA 24 – Private Fire Service Mains, 2025

NFPA (cont.)

- NFPA 25 – ITM of Water-Based Fire Systems, 2023
- NFPA 72 – Fire Alarm and Signaling Code, 2022
- NFPA 75 – IT Equipment Protection, 2024
- NFPA 90A – Air-Conditioning & Ventilating Systems, 2024
- NFPA 101 – Life Safety Code, 2024 (egress, per PBS 5621.1)
- NFPA 241 – Construction & Demolition Safety, 2022
- NFPA 1142 – Rural Water Supplies for Firefighting, 2022
- NFPA 1963 – Fire Hose Connections, 2019

ICC

- IBC – International Building Code, 2021
- IFC – International Fire Code, 2021
- IRC – International Residential Code, 2021
- IMC – International Mechanical Code, 2021
- UPC – Uniform Plumbing Code, 2018
- IFGC – International Fuel Gas Code, 2021
- NEC – National Electrical Code (NFPA 70), 2020

Sources: GSA (2024), Alcan LPOE PDS, Design Program and Directives, 100% Report (Oct. 28, 2024); GSA design-build submission code list.

Complex Before Climate Enters the Equation

62+ Codes, standards, and directives govern this project

Blast-resistant walls. Ballistic-resistant glazing. Secure inspection facilities.

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CBP LPOE Design Standard, 2023	ABAAS Accessibility Standards, 2015	Alaska Dept. of Public Safety – Authority Having Jurisdiction	ASHRAE 52.2 – Testing Air-Cleaning Devices by Particle	NFPA 1 – Fire Code, 2024	NFPA 25 – ITM of Water-Based Fire Systems, 2023	IBC – International Building Code, 2021
GSA Memo – PBS Interim Core Building Standards, 2/24/25	40 U.S.C. §§ 3301–3315 (Public Buildings Act of 1959)	18 AAC 72 – Wastewater Treatment and Disposal	ASHRAE 62.2 – Ventilation for IAQ in Housing Units	NFPA 4 – Integrated Fire Protection & Life Safety Testing, 2024	NFPA 72 – Fire Alarm and Signaling Code, 2022	IFC – International Fire Code, 2021
2020 Guiding Principles for Sustainable Federal Buildings	41 CFR Part 102-80 – Real Property Facility Design	18 AAC 80 – Drinking Water Regulations	ASHRAE 90.1 – Energy Standard, Except Low-Rise Residential, 2019	NFPA 10 – Portable Fire Extinguishers, 2022	NFPA 75 – IT Equipment Protection, 2024	IRC – International Residential Code, 2021
Build America, Buy America Act, 2021	29 CFR § 1910, 1926 (OSHA) – Occupational Safety & Health	Alaska Highway Preconstruction Manual	ASHRAE 189.1 – High-Performance Green Buildings	NFPA 13 – Sprinklers, 1–2 Family Dwellings, 2025	NFPA 90A – Air-Conditioning & Ventilating Systems, 2024	IMC – International Mechanical Code, 2021
HSPD-12 – Homeland Security Presidential Directive 12	29 CFR 1910 Subpart G – Occupational Health & Env. Control	UFC 4-179-02 – Small Arms Ranges, 5 March 2020	ASHRAE 209 – Energy Simulation Aided Design	NFPA 13D – Sprinklers, 1–2 Family & Manufactured Homes, 2025	NFPA 101 – Life Safety Code, 2024 (egress, per PBS 5621.1)	UPC – Uniform Plumbing Code, 2018
FISMA – Federal Information Security Modernization Act	29 CFR 1910 Subpart Z – Toxic and Hazardous Substances	27 CFR § 555.208 – Construction of Type 2 Magazines	ASHRAE Guidance – Protecting Occupants from Wildfire Smoke	NFPA 13R – Sprinklers, Low-Rise Residential, 2025	NFPA 241 – Construction & Demolition Safety, 2022	IFGC – International Fuel Gas Code, 2021
FIPS 201 – PIV for Federal Employees and Contractors	Clean Water Act		ASHRAE Cold-Climate Buildings Design Guide, 2nd Ed.	NFPA 20 – Stationary Fire Pumps, 2025	NFPA 1142 – Rural Water Supplies for Firefighting, 2022	NEC – National Electrical Code (NFPA 70), 2020
	Safe Drinking Water Act		ASHRAE Guide – Resilient Thermal Energy Systems, Cold & Arctic	NFPA 22 – Water Tanks for Fire Protection, 2023	NFPA 1963 – Fire Hose Connections, 2019	
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Blast-resistant walls. Ballistic-resistant glazing. Secure inspection facilities.

Extreme cold, remote logistics, and islanded utilities.

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			ASHRAE [illegible] Thermal Energy Systems, Cold & Arctic			

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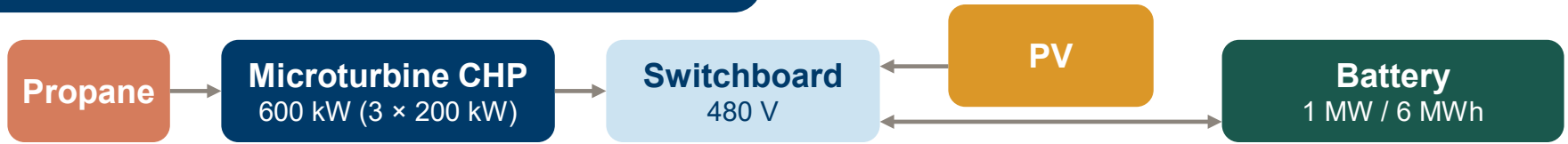
Phius Core 2024
Independent verification of building performance

Sources: GSA (2024), Alcan LPOE PDS, Design Program and Directives, 100% Report (Oct. 28, 2024); GSA design-build submission code list.

Everything Has to Work Off Grid

Electricity, heat, cooling, storage, water, and wastewater operate as one islanded campus system

Mission-Critical Power: Right-Size the Plant



One microgrid controller dispatches turbines, PV, and battery. **Campus peak electrical load defines N.**

Right-size N first, then add redundancy

Mission-critical operation requires contingency capacity beyond the immediate load.

Verify load → **Size N** → **Add redundancy** → **Add storage**

Phius model → *kW to serve* → *N+1 or N+2* → *ride-through*

Phius connection: independently reviewed building loads establish the electrical and thermal design basis and drive generator, battery, borefield, pumping, PV, and fuel planning.

Mission-critical + islanded: verified load is infrastructure design.

Same 3 × 200 kW plant

Normal condition - N = 200 kW

U1	U2	U3	
run	res	res	N+2

Peak condition - N = 400 kW

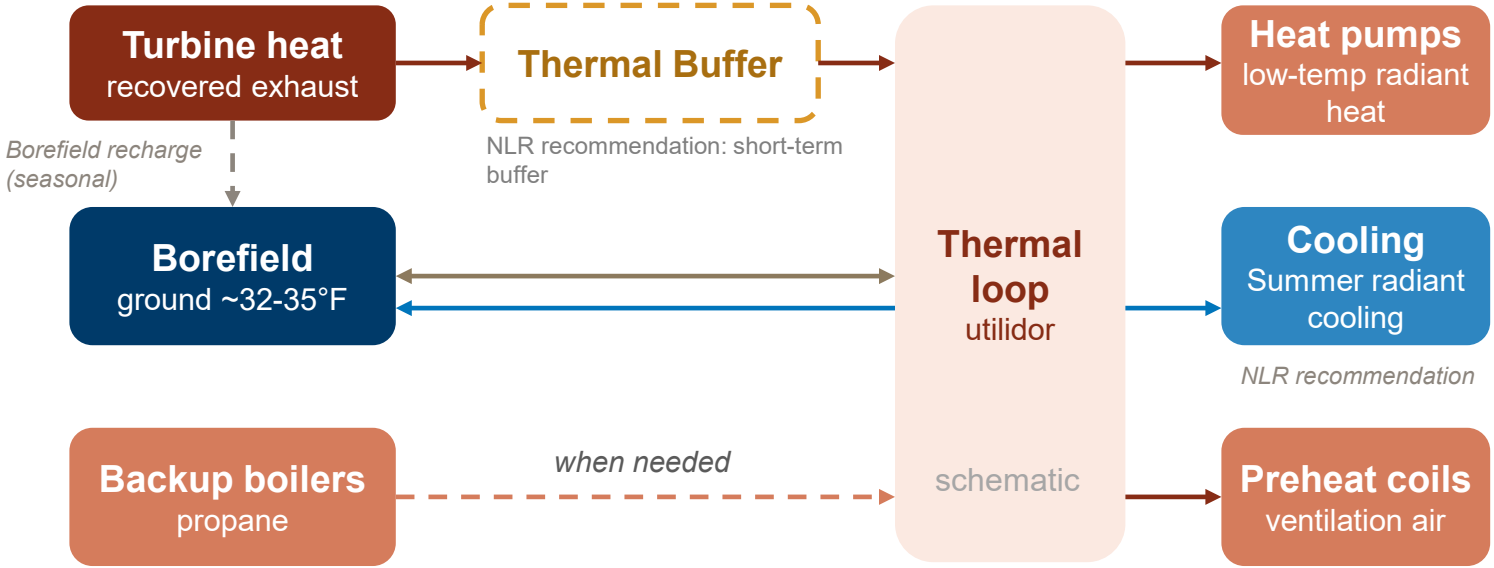
U1	U2	U3	
run	run	res	N+1

Battery capacity at high SOC:
16 h campus, 40 h critical

Source: Project concept (2026); PDS generation redundancy language; NLR analysis.

Heating and Cooling

When operating, power generation creates a steady recovered-heat supply. Buildings determine when - and at what temperature - that heat is useful.



Match the storage timescale to the load: buffer short-term heat; use the borefield for long-term thermal balance and cooling.

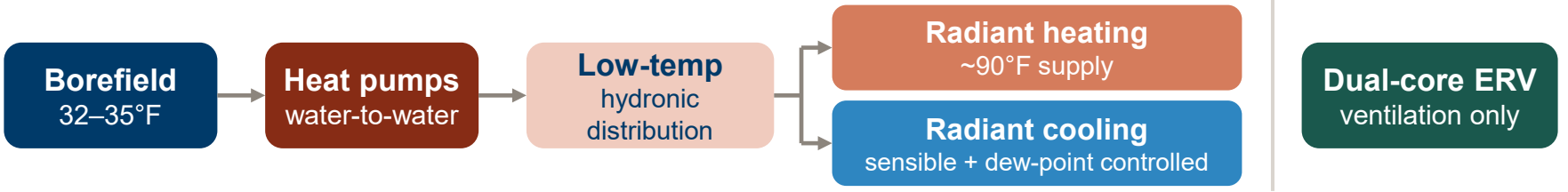
Why a buffer?

Turbine heat is relatively steady; building demand changes hour to hour. A well-insulated buffer preserves recovered heat at useful temperature for short-term reuse. Borefield recharge supports longer-term ground energy balance, but stores heat diffusely and can lose availability through ground conduction and groundwater movement.

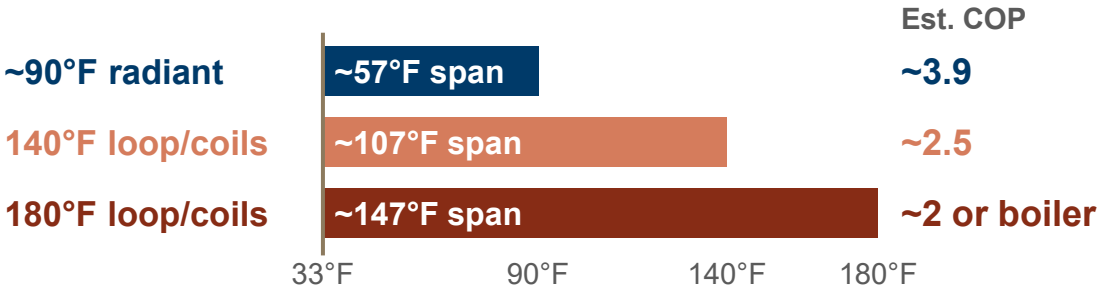
Source: NLR review of project concept (2026). Schematic.

Low-Temperature Hydronic Distribution

A 32–35°F ground source works best when space heating is delivered with low temperature distribution systems. Decoupling high-temperature ventilation preheat allows the system to operate at lower temperatures.



Source-to-supply temperature span *illustrative*



Avoid high-temperature penalties

- 140–180°F terminal loads
- Unit heaters or baseboard
- Hydronic ventilation preheat coils
- Larger span → lower COP → more kW → more fuel

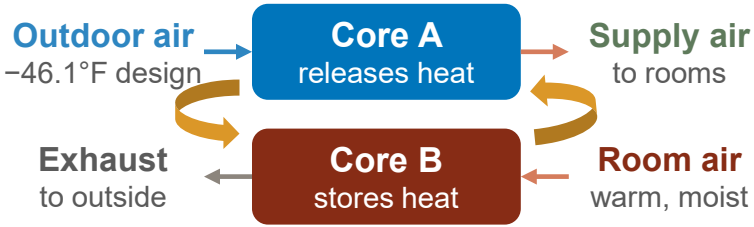
Phius connection: low loads make ~90°F radiant practical. Design the campus around low-temperature distribution, not the hottest terminal.

Span from a 33°F source; illustrative, not refrigerant lift. COP estimated at ~50% of Carnot with ~15°F total approach; confirm with manufacturer data. NLR analysis.

Ventilation at -46°F

Four frost-protection strategies.

Dual-core ERV: Continuous recovery without active defrost.

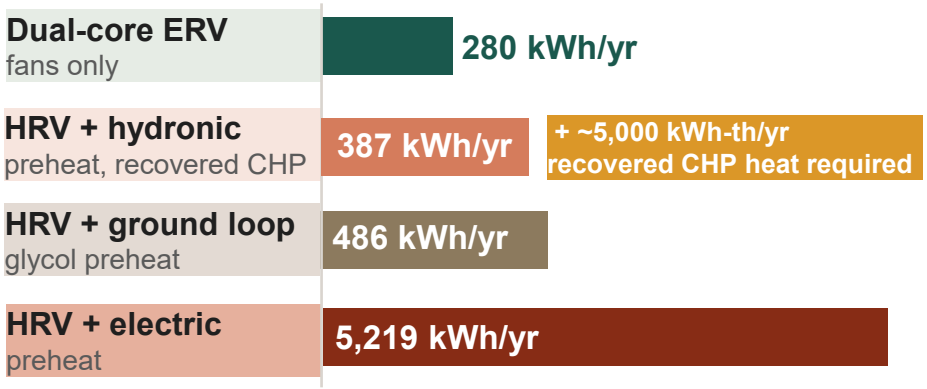


Cores alternate roles every 60 s. No defrost, no preheat, continuous fresh air.

0 h	defrost with dual core; single core **lost up to 7.5 h/day of fresh air** (NRC)
88% → 49%	49% SRE at −13°F when electric preheat is included (CCHRC)

Annual auxiliary electricity, 3-bed home

95 cfm; 35°F preheat target; ~4,960 h/yr below 35°F at Alcan

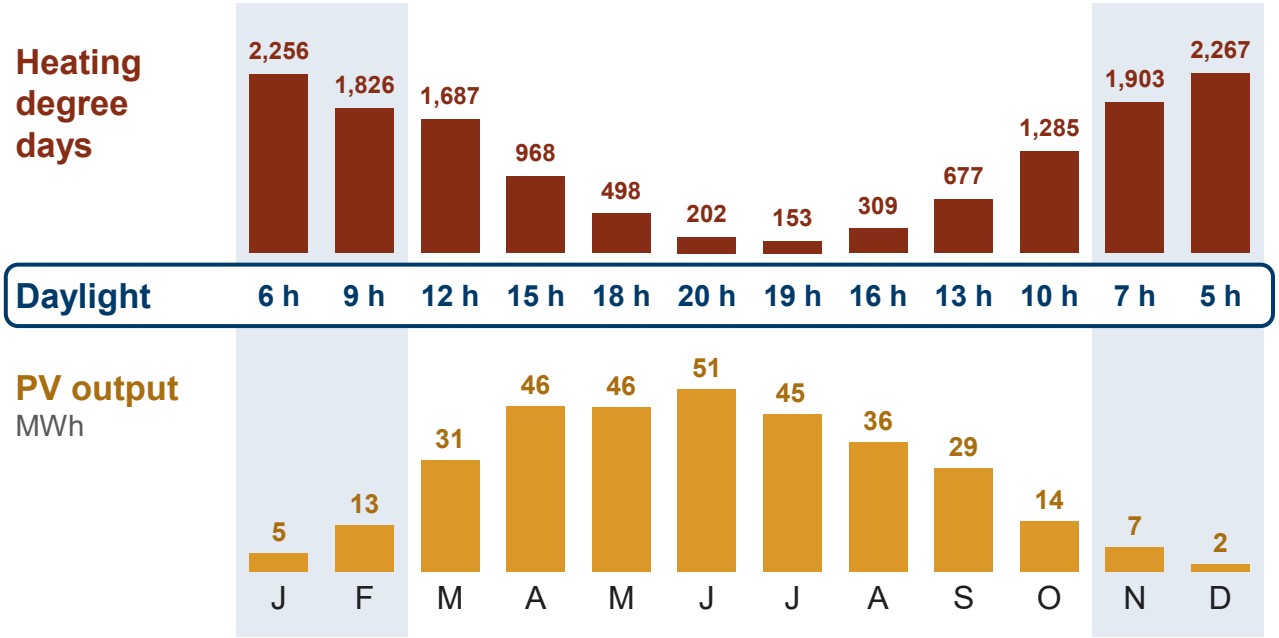


Field experience: a Tempeff dual-core ERV is operational at NLR's Fairbanks campus since 2020.

Frost protection is essential. The strategy determines the energy and system cost.

Sources: NLR Alcan ventilation analysis (2025; updated 2026); NOAA/NCEI Northway EWD; Ouazia et al., NRC (2025); Grunau & Craven, CCHRC (2015).

-46°F with almost no Sun



November to February

59% of annual HDD

8% of annual PV

5 h of daylight in Dec

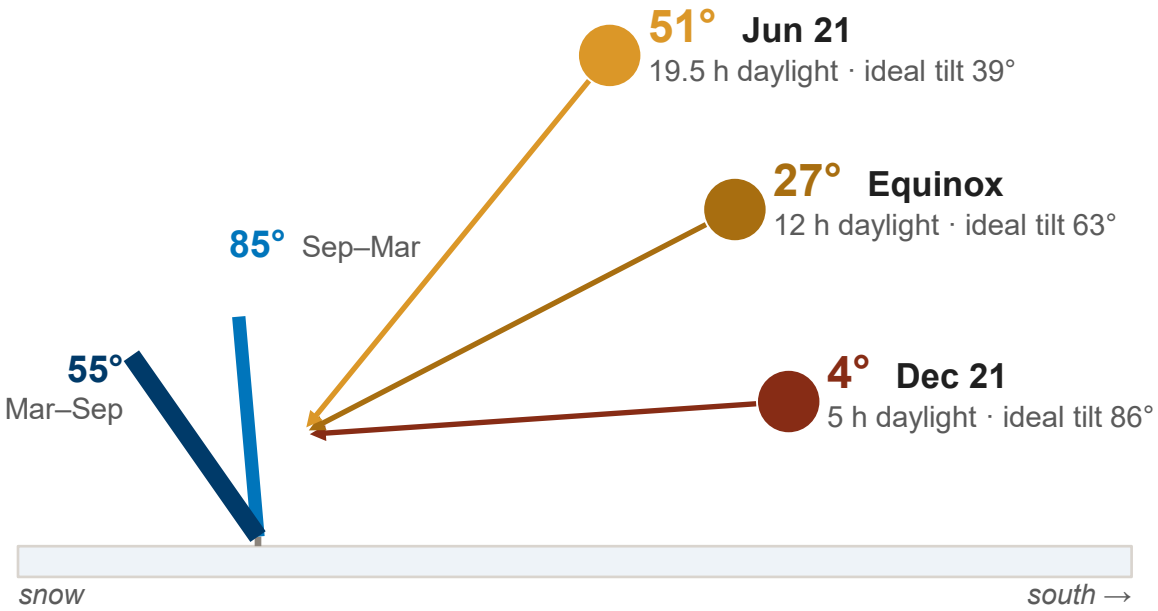
~4° noon sun in Dec

Winter: turbines run 24/7
battery held full as reserve

Winter runs on propane: every kWh the envelope saves is fuel not burned.

Sources: Phius (2025) climate data set (HDD, 65°F base); Phius (2025) FS-211 PV, 486 kWdc; daylight and noon sun angle computed for 62.6° N.

Sun Angles at 62° North



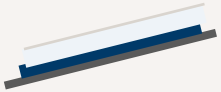
Re-tilt at the equinox

55° March to September: spring sun and the long summer arc.

85° September to March: faces the low sun and the snow, and sheds snow.

Flush roof mount

3:12 (14°)
flush on standing seam: under snow to spring, no rear-side gain

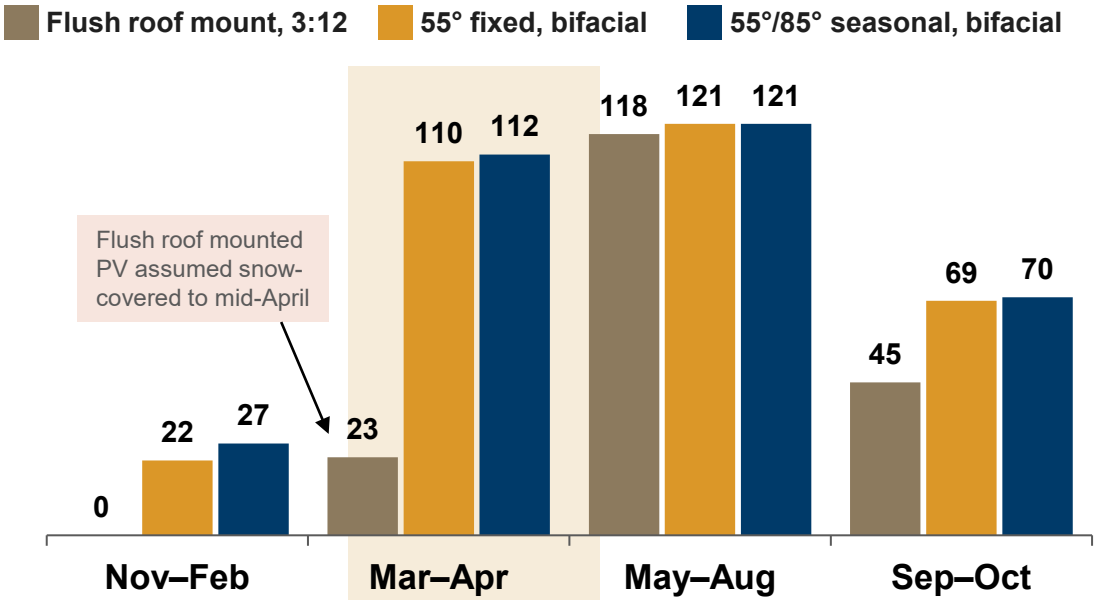


Ideal tilt: 63° at the equinox, *nearly vertical in December.*

Noon sun elevation and day length computed for 62.6° N. Seasonal tilts per NLR PV analysis for the Alcan LPOE. No real PV generation is expected in December. Schematic, not to scale.

Design for the Spring Solar Bump

Average monthly specific yield by season, kWh/kWdc-month, due south



Annual yield: 607 flush · 930 fixed · 957 seasonal - kWh/kWdc,

+15–30%

snow reflection on steeply tilted arrays

UAF Solar Design Manual for Alaska, 2022

+19%

bifacial vs. monofacial in winter; snow losses 16% vs. 33%

Hayibo et al., Renewable Energy, 2022

+5–8%

cold panels, Jan–Mar, at −0.35%/°C below the 25°C rating

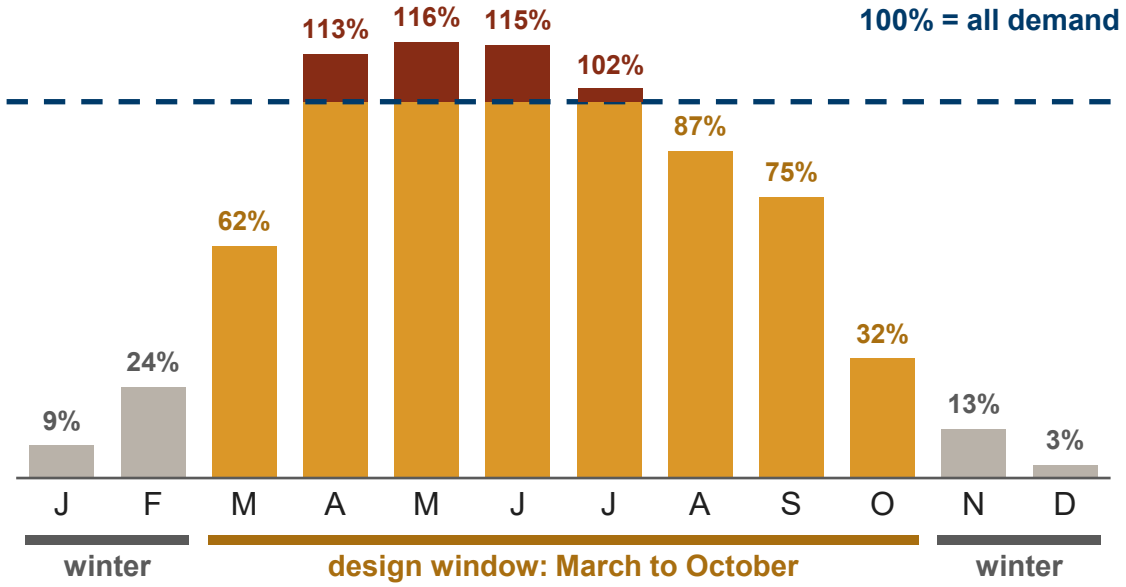
module temperature coefficient

Steep+bifacial: March-April months nearly match summer. Flush on the roof: about one-fifth.

NLR monthly estimate: Phius climate file irradiance, SunEye site shade, snow albedo 0.7 (Nov–April), bifaciality 0.7, −0.35%/°C, 14% losses; flush roof snow-covered to mid-April. Illustrative.

What Do We Size the PV For?

PV as a share of modeled campus site energy, by month



Below 100%
PV has room to serve campus load directly. Greatest headroom: March, September, October.

Above 100%
April–July monthly PV exceeds monthly demand. Hourly surplus must charge the BESS or be curtailed.

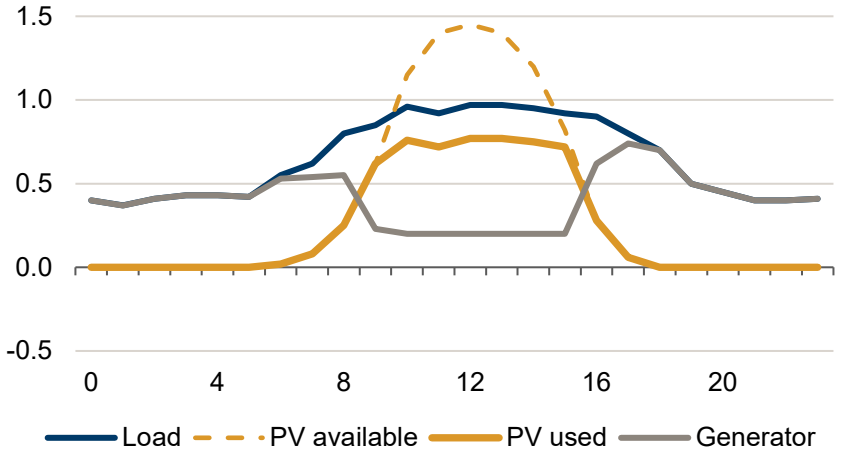
Design move
Tilt and bifacial shift production toward the shoulder months before adding more DC capacity.

Optimize PV for useful March–October production, not maximum annual kWh.

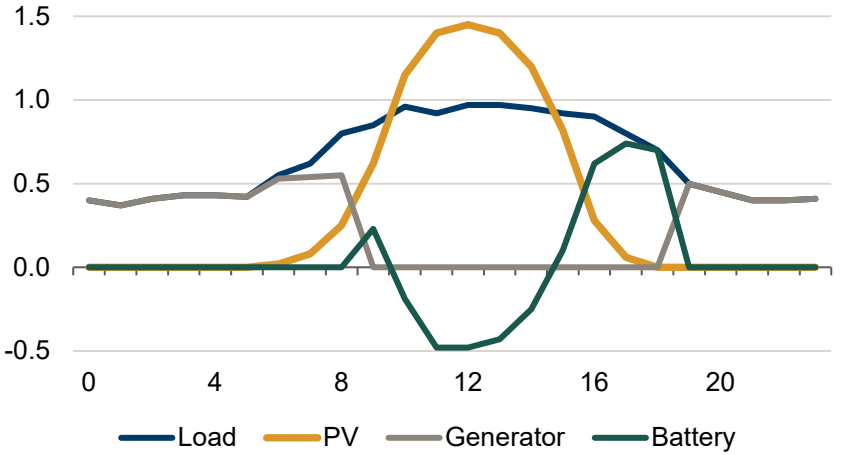
Phius (2025) FS-211 campus workbook: PV (486 kWdc, 55°–90° racks) vs. Phius-case campus site energy, by month (July/Nov corrected). Monthly totals understate hourly surplus.

Without a Battery, PV Gets Curtailed

Generator + PV



Generator + PV + battery



- Generator stays on to form the grid, at minimum load
- PV above the load minus generator minimum is curtailed

- Battery forms the grid: generator off all day
- Battery charges from surplus PV, covers the evening

The battery turns surplus PV into turbine-off hours. Without storage, more PV is curtailed.

Illustrative daily profile for a spring/fall shoulder-season day in an islanded microgrid, hour of day vs. normalized power; battery negative when charging. Adapted from NLR microgrid examples.

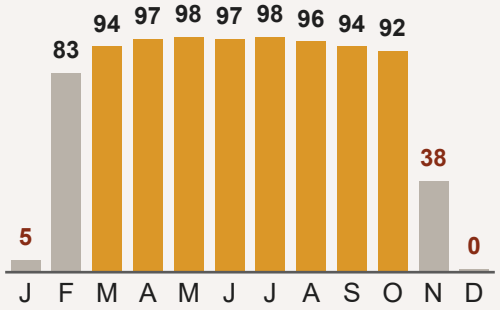
From Site Survey to PV Size

1 Survey the shade

SunEye 210 readings on site

2 See the season

% of unobstructed sol



3 Size with REopt

NLR's free optimization tool

In: loads, solar resource, costs, off-grid and resilience goals

Out: optimal PV and battery size, and operating strategy

reopt.nlr.gov

Also: wind, generators, CHP, geothermal heat pumps

Decentralized PV: serve building loads first; send surplus to central storage

Centralized battery: one managed storage system serving campus loads

Measure on site. Optimize the system. Distribute PV. Keep storage central.

Source: NLR PV and REopt analysis, Alcan LPOE PDS. Shade: Solmetric SunEye 210. Image: Google Earth.

One Microgrid, Three Operating Modes

	Winter	Spring and fall	Summer
	Sun ●○○ Load ●●●	Sun ●●○ Load ●●○	Sun ●●● Load ●○○
Microturbine	**24/7 power + recovered heat** *backup boilers when needed*	Load-following	Off when possible
Battery	High charge / reserve	**Carries base load** *limits fast cycling*	Stores surplus solar
PV	Minimal	Offsets turbine hours	Maximized
Heat buffer *recommended*	Stores turbine heat *for demand peaks*	Shifts surplus heat *to when it is needed*	Standby
Borefield	Heat-pump source	Low thermal demand	**Low-energy cooling**

Same equipment. Different dispatch strategy by season.

Source: Project microgrid concept (2026); heat buffer and cooling are NLR recommendations.

The Phius Feasibility Study

13 buildings. One campus source-energy budget.

Special thanks to Haley M. Harlow and the Phius team for their excellent work and support throughout the feasibility study

Feasibility Study Certification Scope

13 buildings, 20 dwelling units

Main LPOE Building, Community Health & Fitness, Utility Building with three attached apartments, and ten residential housing buildings containing 17 dwelling units.

Three comparison cases

1. **IECC 2018 (AK)**
   Code baseline: standard construction with oil-fired heat
2. **PDS reference**
   Project Development Study design, with passive house targets suggested by NLR
3. **Phius CORE 2024**
   One modeled design pathway to meet Phius CORE 2024 performance targets

Buildings evaluated against Phius CORE 2024 energy-performance targets. Utilidor energy included in the combined campus source-energy budget.

IECC results for other building types extrapolated from representative baseline models

Source: Phius (2025), Alcan LPOE Phius Feasibility Study (FS-211).

Outside the Certificate

Scope set jointly with Phius: buildings driven by high ventilation rates were left out.

Not Phius certified

Commercial Secondary Inspection
vehicle inspection bays

Non-Commercial Secondary Inspection
vehicle inspection bays

Firearms Range
continuous range ventilation

Why: ventilation-dominated loads

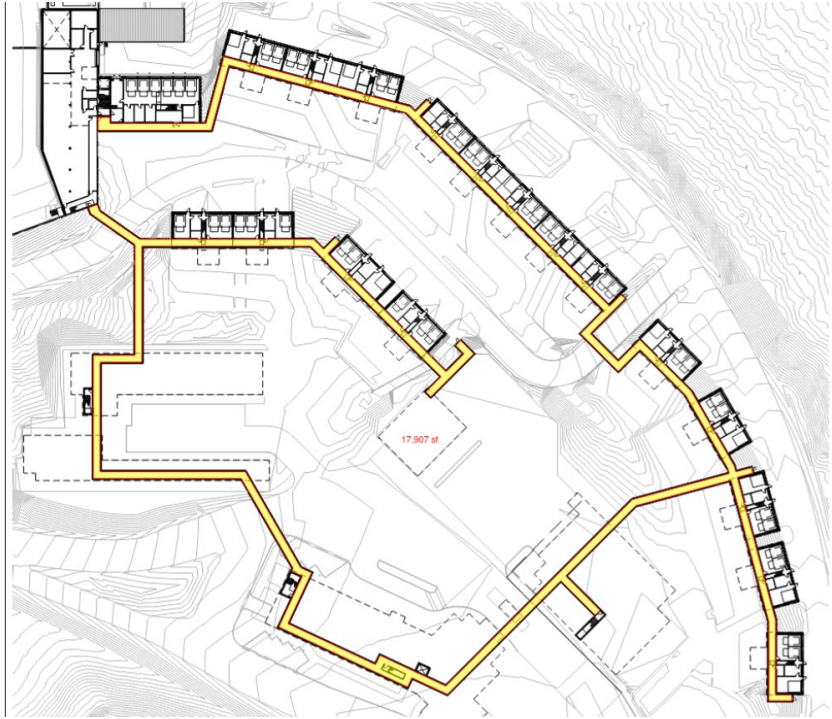
Still in the energy system

- **Same microgrid**
  Their loads still size turbines, battery, and fuel, without third-party Phius verification.
- **Federal energy rules**
  Both inspection buildings are public buildings under EISA 2007 §433: 90% fossil-fuel reduction.
- **Garages**
  Outside the Phius enclosure / iCFA, but their heating energy still counts in source energy.

Outside the certificate, not outside the energy system.

Sources: Phius (2025) FS-211; certification scope agreed between NLR and Phius; Alcan PDS §A.1.2 (EISA 2007 §433; **DOE compliance date stayed to March 2027**).

The Utilidor



Every building connected underground

17,907 ft²
conditioned floor area

80,303 ft²
of envelope

4.48
envelope-to-floor ratio

No standalone Phius target
Modeled separately, but its energy counts against the campus source-energy budget.

Connections everywhere
Each building tie-in is a thermal-bridge and air-barrier transition to detail and verify

Always on
Heated and lit; 1,000 cfm ventilation modeled 24/7, with occasional maintenance access

Sources: Phius (2025), FS-211; based on PDS project drawings; NLR review.

Phius CORE 2024 Off-Grid

How one performance standard accommodates an islanded LPOE at 62° north in Alaska

FIT TO THE SITE

14,031 HDD

Custom climate file

Phius model uses a −34°F design condition

13 → 1 budget

One pooled budget

All 13 buildings in scope share one source-energy target

17,907 ft²

Utilidor separately

Own WUFI model; its energy counts in the certification-scope total

FIT TO OFF-GRID

+800 kWh

Off-grid allowances

per person·yr in housing; +14 kWh per 1,000 gal of treated water

100% PV

PV credited

All PV production credited because battery storage is in project scope.

0 kWh counted

Defrost excluded

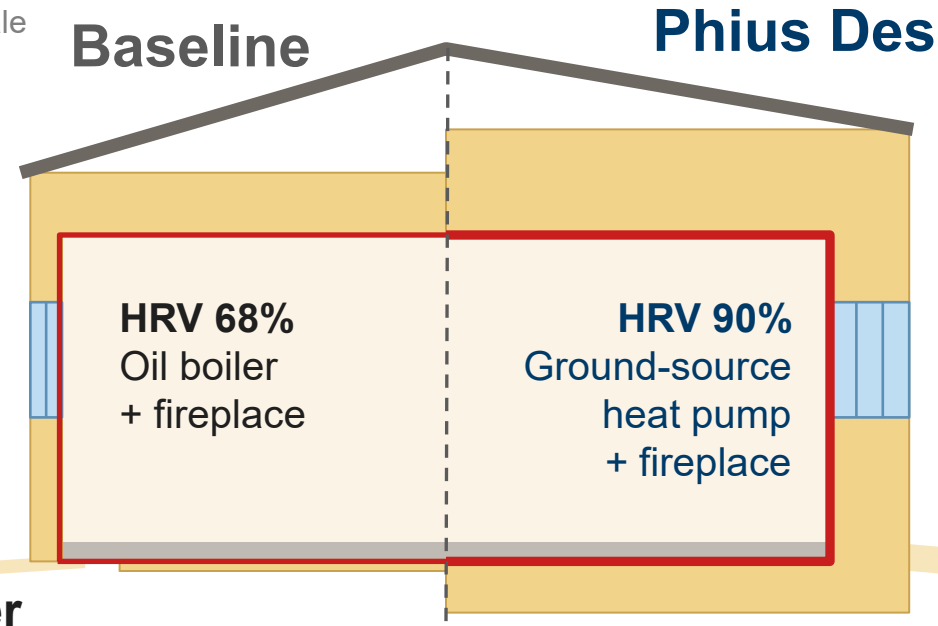
Excluded from source-energy under assumed GSHP preheat use

Same standard, site-specific accounting.

Source: Phius (2025), FS-211 and campus source energy workbook (2026); Phius climate data set for Alcan LPOE; Northway temperature bins (NLR ventilation analysis, 2025).

From Baseline to the Phius Design Case

Conceptual section; not to scale



R-59
attic

R-30
walls

U 0.22 · ψ 0.030
Window U · installation ψ

4.0 ACH50
airtightness

R-15, 4 ft perimeter
slab, as modeled

R-100
attic

R-75
walls

U 0.11 · ψ 0.015
Window U · installation ψ

0.8 ACH50
airtightness

R-48.5
Slab insulation

Representative 3-bedroom home, improvements varied by building

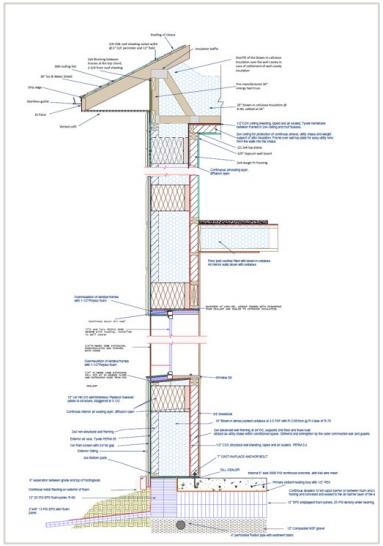
Continuous insulation. Continuous air barrier.

Source: Phius, FS-211, Dec. 1, 2025, pp. 3–4. Three-bedroom home; effective R-values; values rounded.

The Arctic Wall

*REMOTE/PERSIST **exterior insulation** principles with dense-pack cellulose instead of foam.*

A reference assembly, not the Alcan design.



~26 in

Total wall, up to R-80

Plywood control layer

Sealed CDX: air and vapor control

Dense-pack cellulose

Min. 4.0 lb/ft³ installed density

Diffusion-open

Dries any direction; vented rainscreen

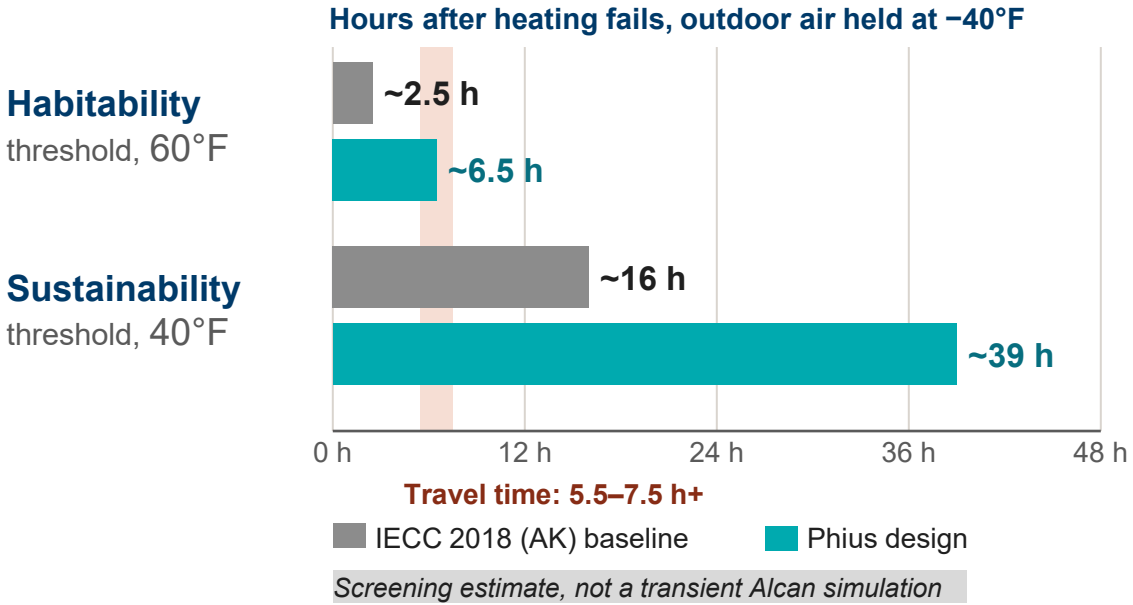
Interior service space can add up to one-third of the total wall R-value

Climate Zone 8: at least two-thirds of the insulation outside the sheathing keeps it warm and dry.

Arctic Wall, Fairbanks. Photo and wall detail: T. Chlupp. Field study: Grunau, CCHRC (2013), Arctic Wall Report, cchrc.org.
Insulation ratio: CCHRC, REMOTE Manual.

Thermal Resilience Buys Time

Heating fails at −40°F. How much time does the enclosure buy?



~2.4×

longer maximum time to repair (MaxTTR)
to the sustainability threshold

Help is hours away

Fairbanks 296 mi · 5.5 h

Anchorage 420 mi · 7.5 h

Travel alone can outlast the habitability window. Add mobilization, diagnosis, parts, and winter roads.

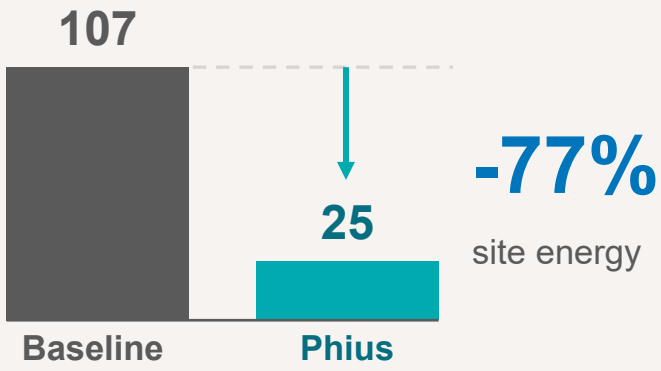
Enclosure first: passive performance keeps buying time when systems fail.

Thresholds and MaxTTR: Zhivov et al., Guide for Resilient Thermal Energy Systems Design in Cold and Arctic Climates, Table 8-1 (frame, −40°F), scaled by NLR by envelope heat loss to Phius (2025) FS-211 3-bed home assemblies. Drive times: Google Maps (2026).

Site Energy Comparison

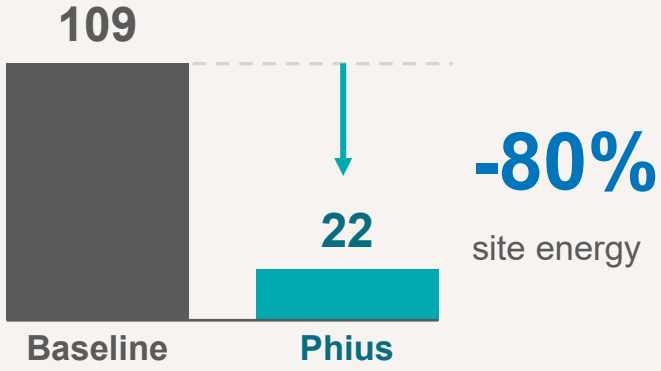
Modeled site energy use intensity IECC 2018 baseline case vs Phius, kBtu/ft²·yr

3-bedroom home



IECC baseline → Phius envelope + GSHP

Main LPOE Building



IECC baseline → Phius envelope + GSHP

77–80% less site energy modeled per building, before any PV.

Source: Phius (2025), FS-211, WUFI Passive results for the two buildings modeled against the IECC 2018 (AK) baseline: 107.4 → 24.9 and 108.89 → 21.7.

Space Conditioning Criteria

Phius case result / limit	Heating demand kBtu/ft²·yr	Heating load Btu/h·ft²	Cooling demand kBtu/ft²·yr	Cooling load Btu/h·ft²	PDS case criteria over limit
3-bed home (x6)	**16.4** / 16.6	**9.7** / 10.7	**1.3** / 5.7	**1.2** / 2.1	HD, HL
4-bed home	**15.4** / 16.6	**9.3** / 10.7	**2.4** / 5.7	**1.5** / 2.1	HD, HL
3-bed duplex	**16.0** / 16.6	**9.8** / 10.7	**0.6** / 5.7	**0.9** / 2.1	HD, HL
3-bed triplex	**15.5** / 16.6	**9.5** / 10.7	**2.0** / 5.7	**1.3** / 2.1	HD, HL
2-bed 5-plex	**16.1** / 16.7	**9.4** / 10.9	**2.4** / 5.6	**1.5** / 2.0	HD, HL
Main LPOE Building	**17.0** / 17.2	**11.5** / 11.8	**3.4** / 5.2	**1.8** / 1.8	HD, HL, CL
Utility + 2-bed apts	**9.1** / 13.6	**7.2** / 9.6	**1.7** / 4.3	**1.2** / 1.2	none
Community H&F	**11.5** / 17.2	**11.4** / 11.8	**5.0** / 5.2	**2.3** / 3.0	CD

95–100% of limit 85–95% below 85%

HD = heating demand · HL = heating load · CD = cooling demand · CL = cooling load

All eight pass. Six are within 5% of at least one limit. **No margin for error.**

Source: Phius (2025), FS-211, modeled heating and cooling results vs. Phius CORE 2024 limits, pp. 4, 9, 14, 19, 24, 29, 40, 44. Utility Building and apartments modeled together.

What Consumes the Margin

Six of eight building types are within 5% of at least one limit. Small changes can erase that margin.

Heating demand margin

0.2

kBtu/ft²·yr

About 1% of the limit

3-bed homes (x6) and the Main LPOE Building

Design and boundary changes

Added glazing, revised geometry, or moving spaces across the Phius boundary changes the modeled building.

Thermal bridges

Slab edges, glazing interfaces, structural connections, and utilidor tie-ins can add losses that are easy to miss.

Windows and curtain wall

More glass, security requirements, or weaker frame and installation performance can quickly consume the margin.

Airtightness

Small leaks accumulate across transitions, penetrations, doors, glazing, and security assemblies.

Envelope assembly performance

Effective wall, roof, slab, and foundation performance must match the model, not just nominal R-values.

Ventilation and heat recovery

Airflow, recovery efficiency, and frost strategy affect heating demand and source-energy performance.

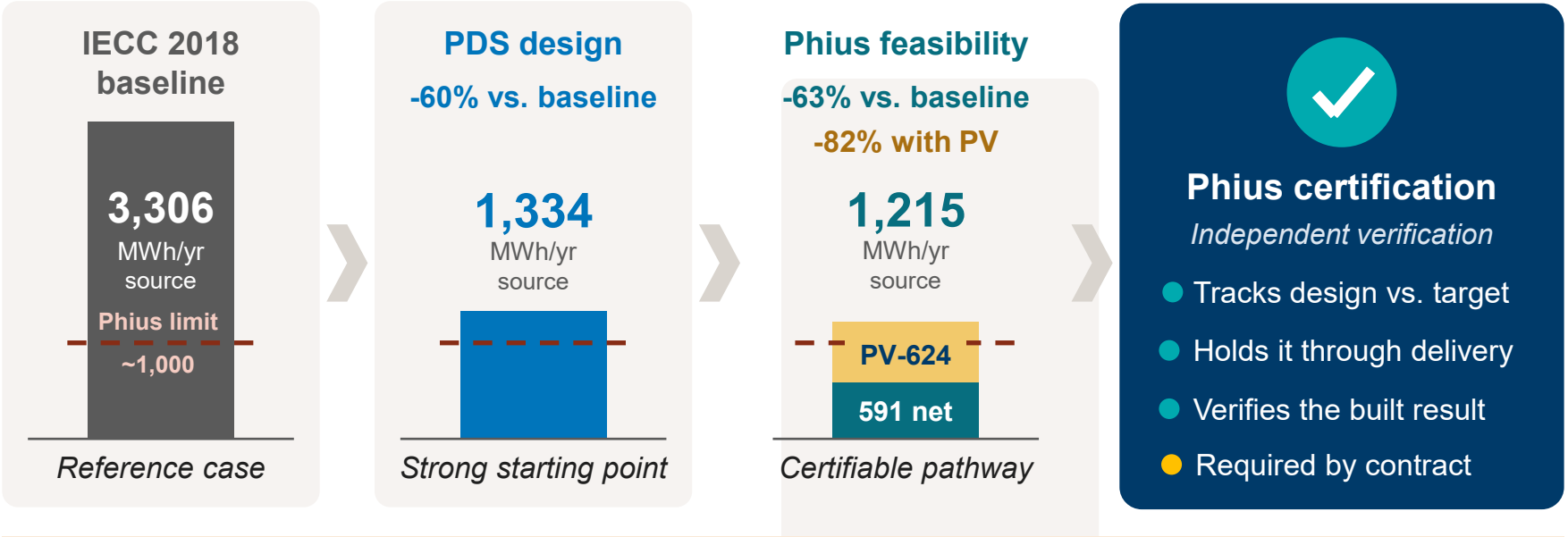
With a 1% margin, every change goes back through the model.

Sources: Phius (2025), FS-211 criteria results; NLR ventilation analysis (2026); NLR review.

From Efficient Design to Verified Performance

PDS established the starting point. Phius feasibility defined the pathway. Certification verifies delivery.

Campus source energy, certified buildings plus utilidor



Feasibility proved there was a path. **The contract requires certification to stay on it.**

Source: Phius (2025), FS-211 and campus workbook, corrected by NLR; baseline extrapolated from the two modeled buildings.

Writing Phius into the Contract

Getting certification into the contract took a lot of work.

2023–2024
Project Development Study
Phius certification required while many design decisions remained open and unresolved.

Dec 2025
Proposal package
Phius feasibility study included: A modeled certification pathway was available before final pricing.

Jul 2026
Design-build contract
Certification becomes a contractual pass/fail deliverable, as defined by the Phius feasibility study.

The design-builder delivers. Phius verifies.

DB provides: Phius CPHC | Phius verifier | Phius rater

Independent review continues through design, construction, field testing, and final certification.

The case for certification

- Quality and performance needed a verifiable pathway
- Too much was still open to rely on design intent alone
- Certification placed responsibility with the design-builder

Design intent sets the target. **Certification puts the burden of proof on delivery.**

Sources: GSA (2024), Alcan LPOE PDS; GSA design-build solicitation and contract (2025–2026); Phius (2025) FS-211.

The Alcan Port as a Precedent for GSA

GSA manages one of the largest real estate portfolios in the world

363M
Square feet owned and leased

8,300+
Buildings

2,200+
Communities Nationwide

The Alcan LPOE is the first GSA design-build project to **require Phius certification**

Why this Project Matters

- Remote, islanded operations with extreme cold and federal security requirements
- Contractual performance targets supported by independent verification
- Measured performance and occupant comfort can inform subsequent GSA projects

Sources: GSA (2025–2026); Federal News Network (2025, 2026); Phius (2025).

Why Certification Matters

What independent Phius certification protects across the project

General Services Administration
Owner and project delivery

Performance that can be enforced

Independent review against contract requirements, not self-reported performance.

CBP and CBSA
The people at the port

Comfort and resilience at −50°F

Warm, comfortable places to live and work, safe and resilient through extreme cold.

Phius certification
one independent yardstick

Design-build team
Davis Constructors & Engineers

A clear target from day one

A defined pathway and independent review before construction locks it in.

Microgrid and operations
Power, heat, and fuel

Verified loads size the plant

Turbines, battery, borefield, pumps, and fuel storage all follow from building demand.

A verified performance target connects the people, the buildings, and the infrastructure.

Sources: GSA (2024), Alcan LPOE PDS; GSA (2025–2026) portfolio data; Phius (2025) FS-211; NLR review.

Five Lessons from Alcan

1. **At −50°F, there is no room for error**
   Remote, off-grid, and mission-critical: performance is resilience.

2. **Challenging. Not impossible.**
   All 13 buildings in scope have a modeled path to Phius certification in a 14,000 HDD climate.

3. **Integration is not optional**
   Architecture, enclosure, MEP, controls, and microgrid must be designed as one system.

4. **Design mechanical systems from verified loads**
   Low loads change equipment sizing, distribution temperatures, ventilation, and plant strategy.

5. **Certification keeps everyone on the same path**
   Clear targets, independent review, and accountability from design and construction through final verification.

At −50°F and off grid, every discipline becomes part of the performance strategy.

Source: NLR experience on the Alcan LPOE; Phius (2025), FS-211.

National Laboratory of the Rockies

Thank You.

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This work was authored by the National Laboratory of the Rockies for the U.S. Department of Energy (DOE), operated under Contract No. DE-AC36-08GO28308. Support for the work was also provided by U.S. General Services Administration under IAG-23-23787. The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government. The U.S. Government retains and the publisher, by accepting the article for publication, acknowledges that the U.S. Government retains a nonexclusive, paid-up, irrevocable, worldwide license to publish or reproduce the published form of this work, or allow others to do so, for U.S. Government purposes.

Photo: Denali Summit, Thorsten Chlupp