USA VS CANADA

Comparing Sustainability Metrics for Schools

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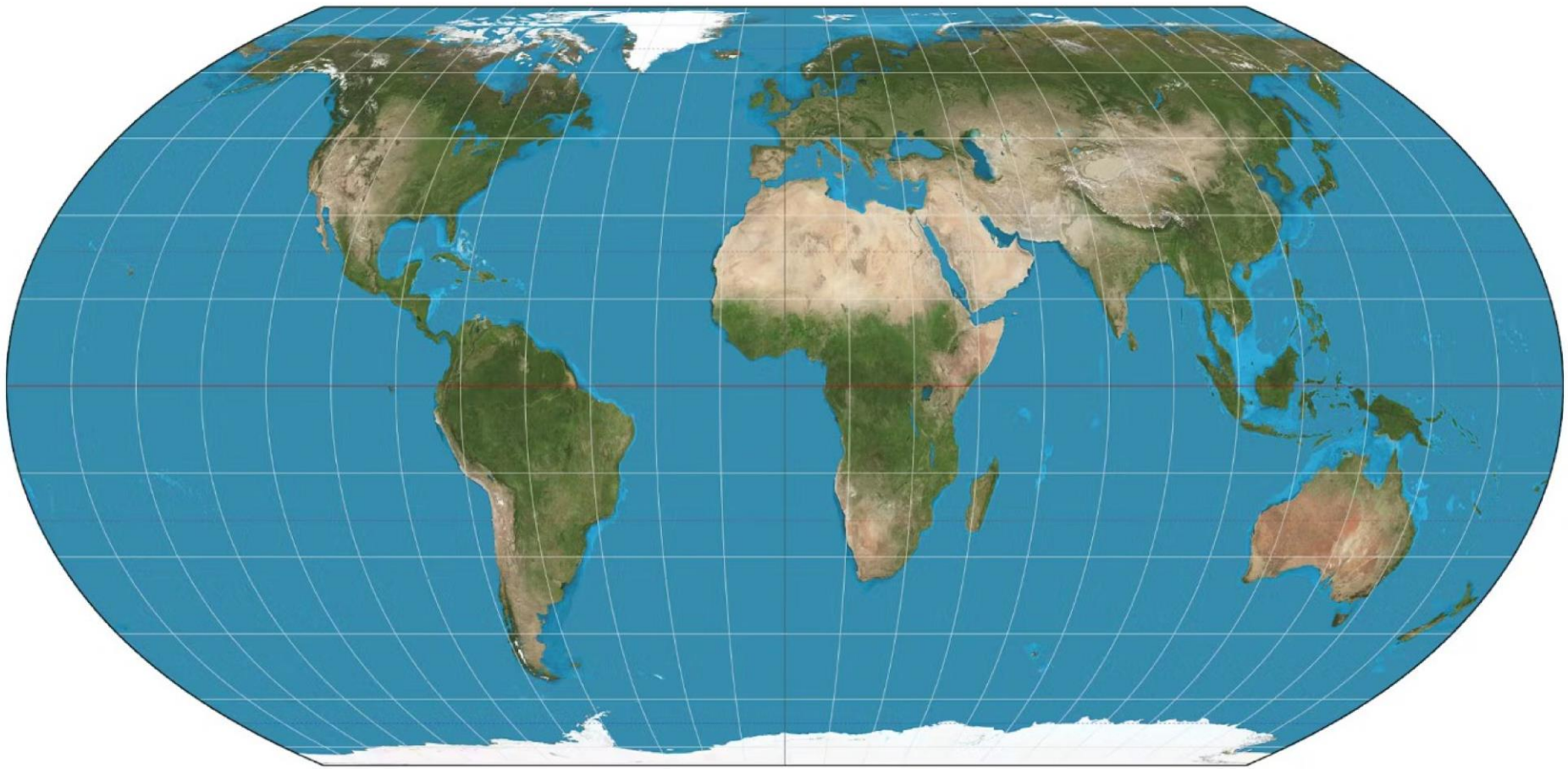
Mentimeter

Where are you from?



What is the most important sustainability metric?

Energy Efficiency (EUI)

Embodied Carbon

Whole Building Carbon

LEED or other Rating System

INTRODUCTIONS

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OVERVIEW / AGENDA

Part 1

Speaking the Same Language

Part 2

Looking at the Data Through Projects

Part 3

Best Practices for Owners Project Requirements / Statements of Requirements

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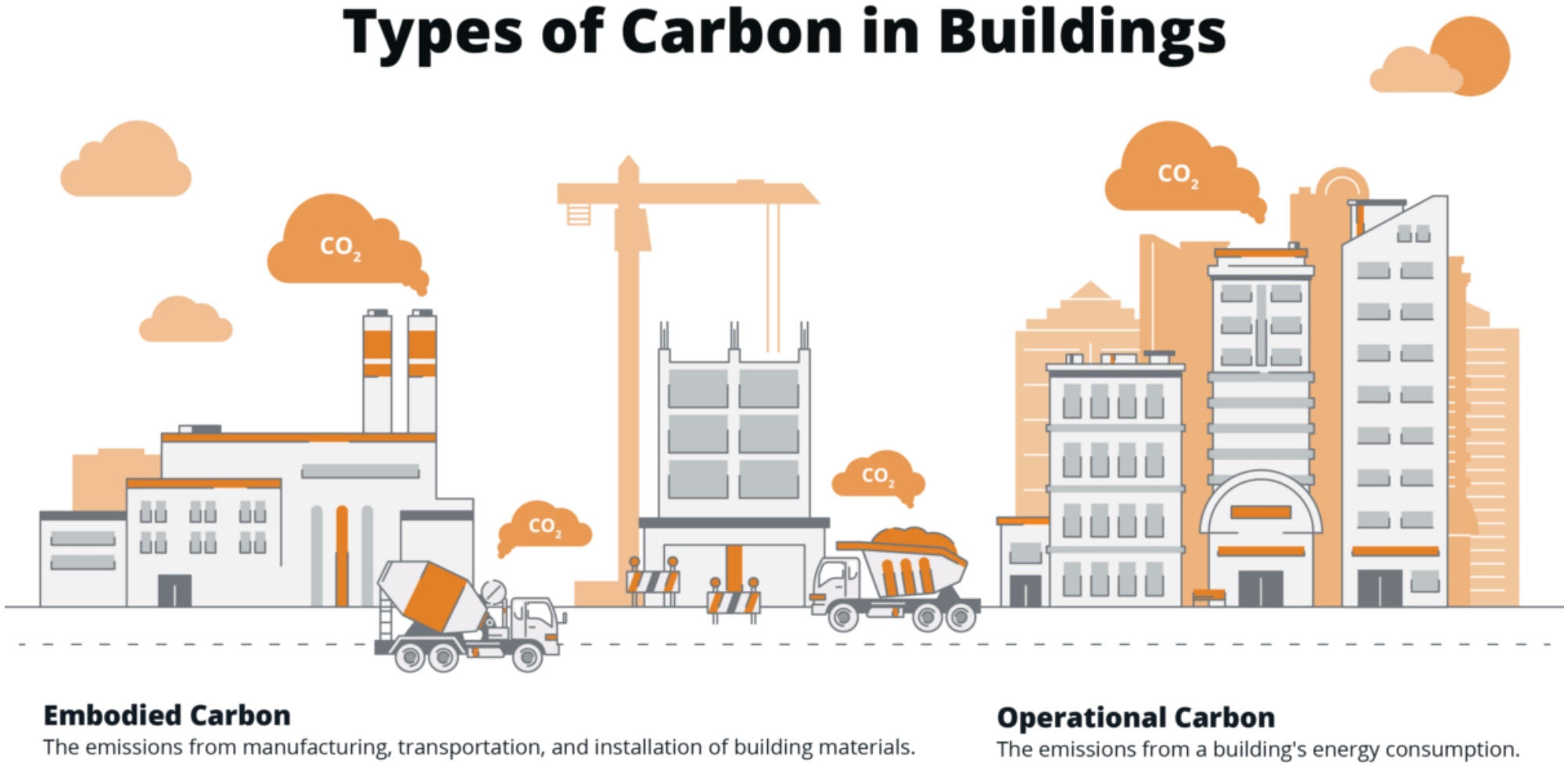
EMBODIED CARBON VS. OPERATIONAL CARBON

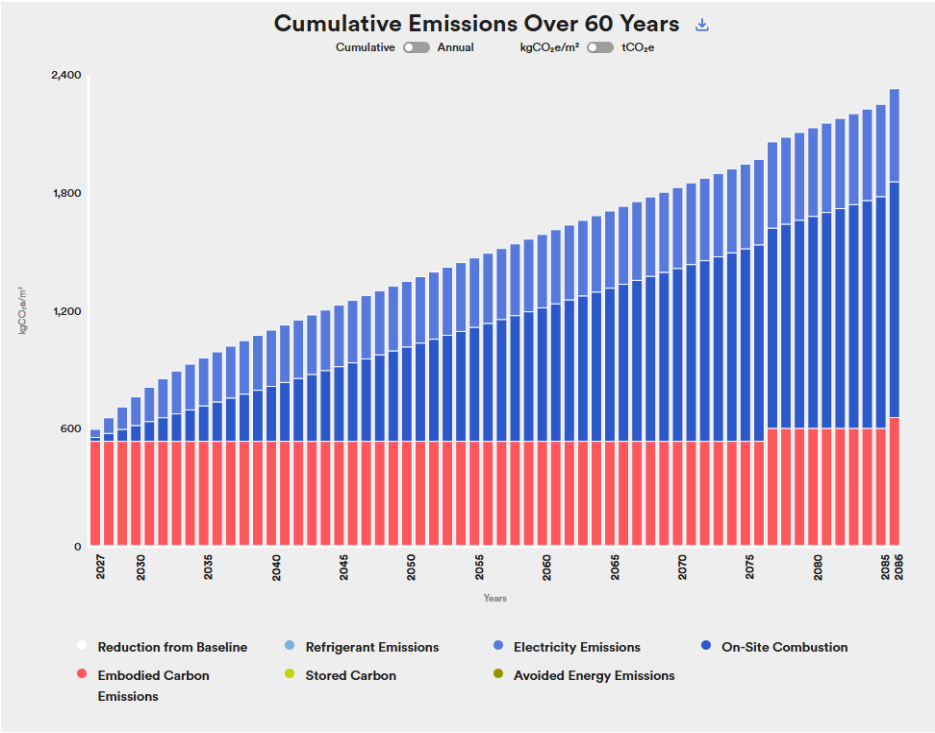


PART 1 | SPEAKING THE SAME LANGUAGE

Where have we been?

NO REGULATION

Pre 1975



Example from C.scale

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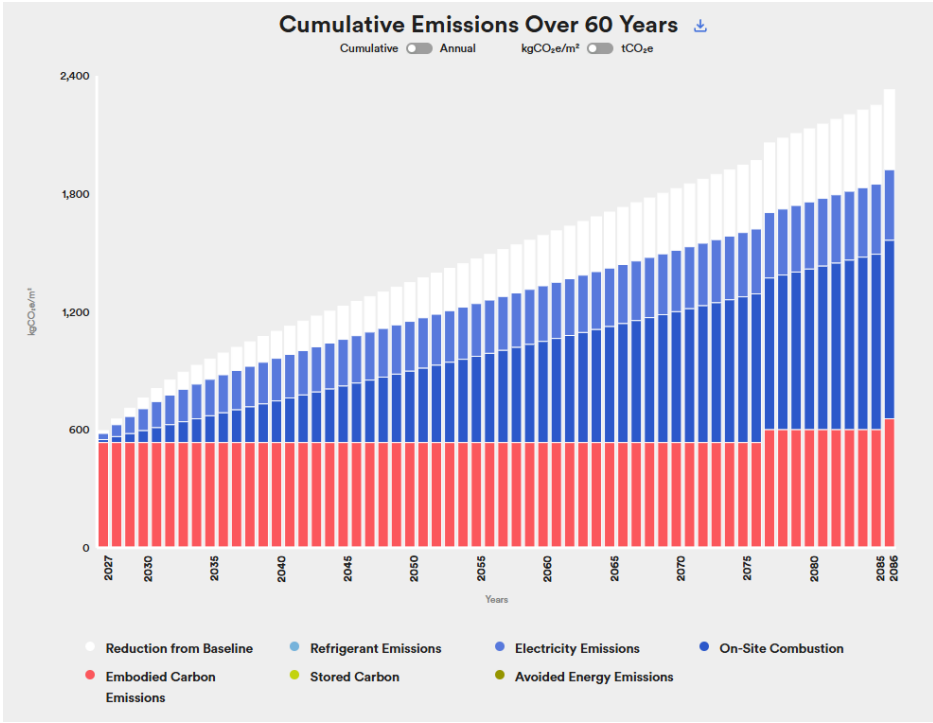
PART 1 | SPEAKING THE SAME LANGUAGE

Where have we been?



Example from C.scale

NO REGULATION

INSULATION LEVELS

1975 - ASHRAE 90-75

1978 - California Building Code established, including California Energy Code

1997 - Canada National Energy Code

2011 - California Green Building Code introduced (CALGreen)

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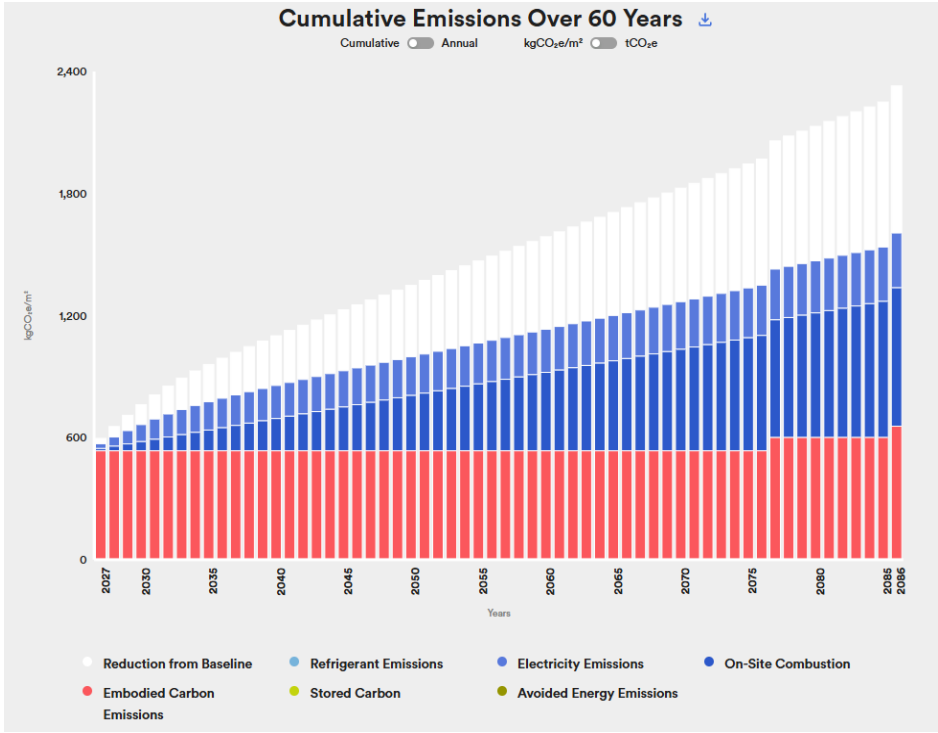
PART 1 | SPEAKING THE SAME LANGUAGE

Where have we been?



Example from C.scale

NO REGULATION

INSULATION LEVELS

ENERGY USE
TEDI & TEUI

1990's - Passive House Introduction
1999 - LEED & ASHRAE 90.1
2011 - NECB 2011 Canada

LEED
PASSIVE HOUSE
STEP CODE

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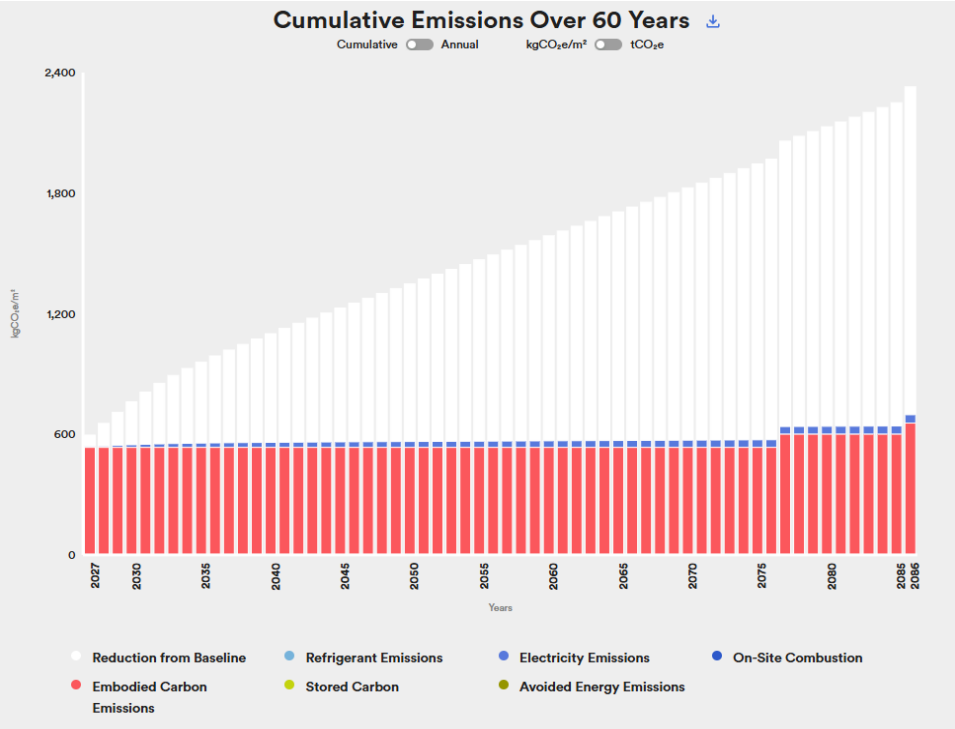
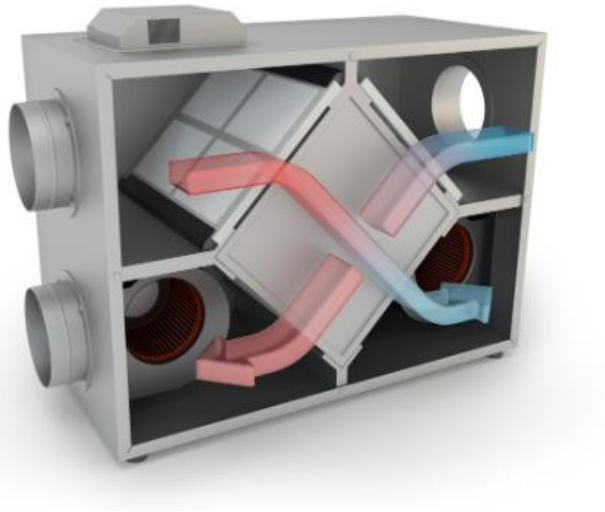
PART 1 | SPEAKING THE SAME LANGUAGE

Where have we been?





Example from C.scale

OPERATIONAL EMISSIONS
GHG INTENSITY

2006 - California Global Warming Solutions Act
2019 - LEED v4.1 Update
2024 - BC Zero Carbon Step Code

LEED
PASSIVE HOUSE
STEP CODE

LEED V5
ZERO CARBON CERT.
CARBON STEP CODE

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PART 1 | SPEAKING THE SAME LANGUAGE

Quick tangent: As each location cleans up their power grid, they need to move to the next step in decarbonization.

Source: Visual Capitalist

As grids get cleaner, operational carbon improvements become less impactful.

This means HVAC system selection, insulation levels, light bulbs, and other efficient equipment and envelope designs **don't reduce the carbon footprint as much as they once might have.**

Note: these sources are traded across state and national lines, so generation and usage are not the same. This image shows generation.

CA
65% non-fossil fuel

BC
95% non-fossil fuel

Arizona
46% non-fossil fuel

California shows as a primarily natural gas state because it relies so heavily on solar, which covers almost all daytime generation needs, but doesn't work at night. Natural gas fills that gap.

The building codes there have started pushing battery systems so that solar-generated power can be made available at night.

British Columbia functions on mostly hydroelectric plus a bit of natural gas and wind power.

The operational carbon footprint of any building in the province is effectively nothing as a result.

Arizona functions primarily on natural gas, with a significant nuclear component and some solar.

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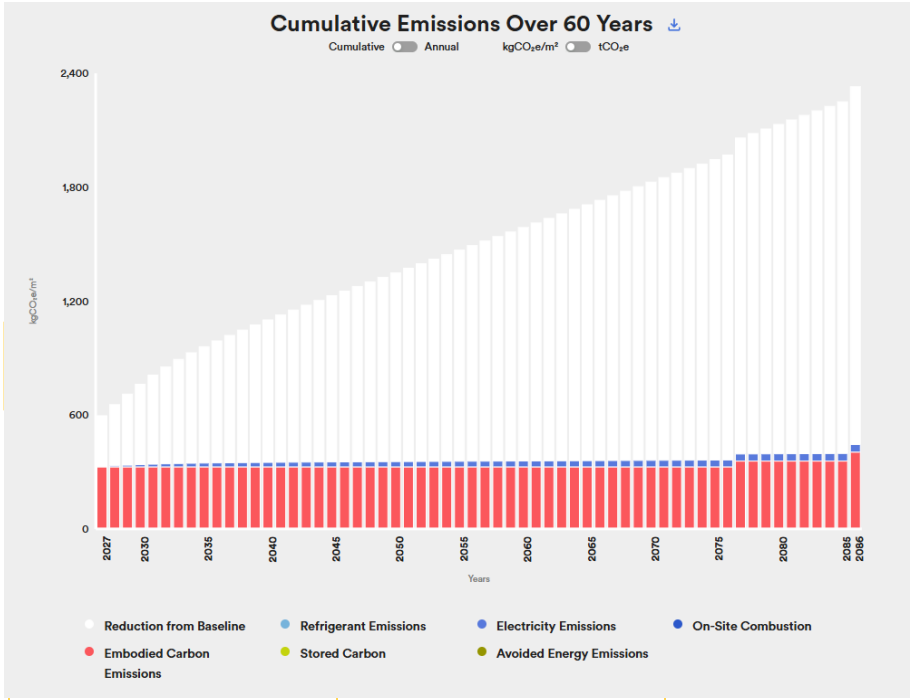
PART 1 | SPEAKING THE SAME LANGUAGE

Where are we headed?



Example from C.scale

OPERATIONAL EMISSIONS
GHG INTENSITY

EMBODIED EMISSIONS
GHG INTENSITY

2008 - Living Building Challenge - offsets
2013 - Living Building Challenge - accounting
2023 - Toronto Green Standard
2024 - CALGreen Embodied Carbon
2025 - Vancouver Building Bylaw

LEED
PASSIVE HOUSE
STEP CODE

LEED V5
CARBON STEP CODE
MOE GHG REDUCTION

VANCOUVER ZONING
TORONTO GBS
CALGREEN

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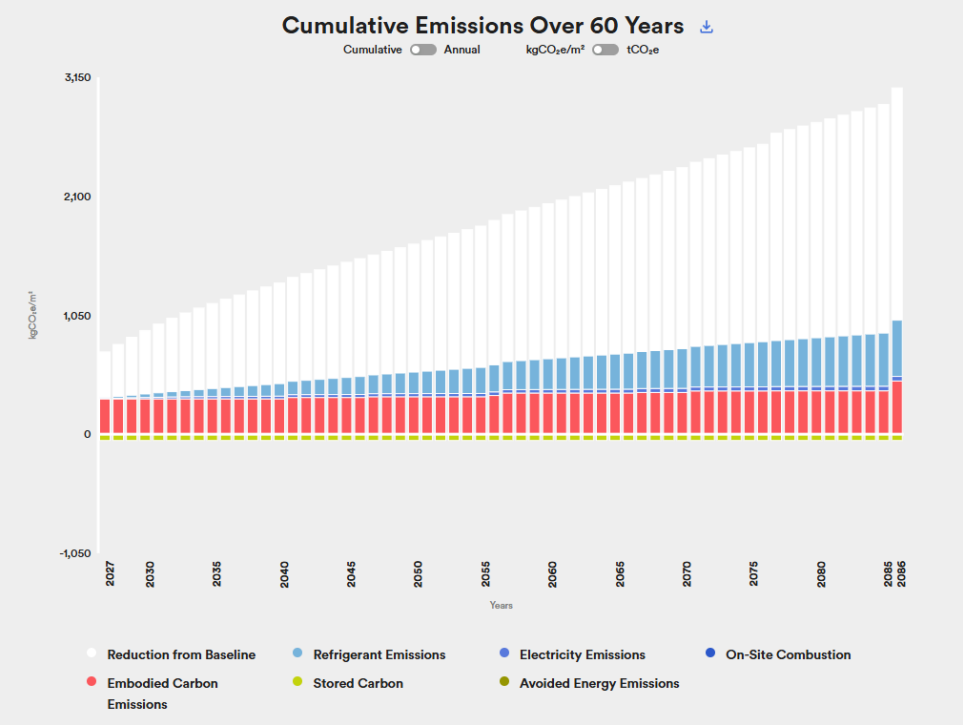
PART 1 | SPEAKING THE SAME LANGUAGE

Where are we headed?



Example from C.scale

OPERATIONAL EMISSIONS
GHG INTENSITY

LEED V5
CARBON STEP CODE
MOE GHG REDUCTION

EMBODIED EMISSIONS
GHG INTENSITY

VANCOUVER ZONING
TORONTO GBS
CALGREEN

WHOLE LIFE CARBON
GHG INTENSITY

2023 - 2025

DENMARK

LEED
PASSIVE HOUSE
STEP CODE

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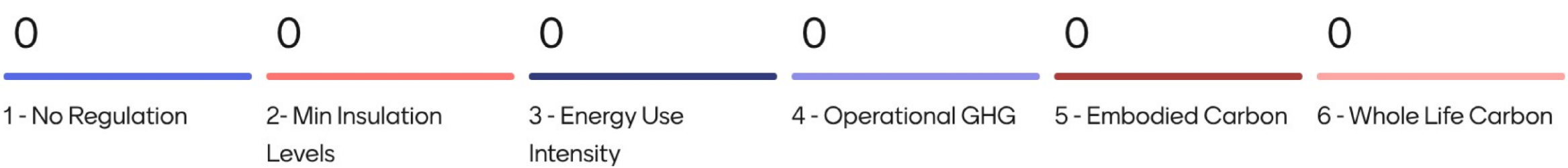
Where is your jurisdiction on this progression?



PART 1 | SPEAKING THE SAME LANGUAGE: MANY WAYS TO MEASURE

Variety of standards in use

MANY WAYS TO MEASURE

Variety of baselines/benchmarks
Which ones are mutually compatible?

% Reduction from CBECS 2003 *(US EPA Dataset)*

Reduction from local 1990 data *(per Kyoto Protocol)*

Reduction from local data, various years *(unreliable 1990 data at the municipal scale)*

City of Vancouver 2007

Sustainable Scottsdale 2022

Zero Carbon STEPCODE 2007

County of Marin California 2005

% Reduction from Statistics Canada Dataset *(various years)*

2019 RAIC | IRAC Royal Architectural Institute of Canada Institut royal d'architecture du Canada

2005 NECB National Energy Code of Canada For Buildings

Level of Improvement over Local Minimum

Annual Industry Averages and Emissions Inventories *(Annual Benchmarking)*

Absolute 100% Reduction *(no baseline)*

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MANY WAYS TO MEASURE

Variety of goals/targets

CARBON NEUTRALITY (aka: Net Zero)

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AIA 2030 COMMITMENT

TIMELINE

- 2006 - Architecture 2030 Challenge Launched by NM architect Edward Mazria
- 2009 - AIA Adopts 2030 Challenge - 2030 Commitment created
- 2011 - First reporting year for AIA 2030 Commitment
- 2019 - Carbon Smart Materials Palette launched
- 2023 - First reporting year for AIA Materials Pledge

ADVANTAGES

- ✓ **Baseline is in alignment with standards commonly referenced in codes**
- ✓ **Standard can accommodate projects across the US and Canada**
- ✓ **DDx tool makes data conversion from local standard easy**

Photo from architecture2030.org

architecture 2030

AIA 2030 COMMITMENT

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QUATTROCCHI KWOK ARCHITECTS

ESTABLISHING A BASELINE AND THEN A GOAL

STEP 1 | FIND OUT WHAT YOUR LOCAL STANDARD'S BASELINE IS

- The Kyoto Protocol had the whole world agree to use 1990 data, but in many locations, that data is incomplete and unreliable.
- **California** uses 1990 data at the state level but advises cities and counties to establish their own baselines using the data they have available, thus Marin County is using 2005 data.
- **Canada** has decided to use 2005 as well, though British Columbia and Vancouver are using 2007.
- **Scottsdale, AZ** did a new carbon inventory in 2022 to use as their baseline. This can be done at any scale, from school district to global.

Search for language describing the % reduction, and ask "reduction from what?" That answer is your baseline dataset.

BRITISH COLUMBIA

CALGreen

CITY OF VANCOUVER

ZERO CARBON STEPCODE

SUSTAINABLE SCOTTSDALE

COUNTY OF MARIN CALIFORNIA

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QUATTROCCHI KWOK ARCHITECTS

ESTABLISHING A BASELINE AND THEN A GOAL

STEP 2 | FIND OUT WHAT YOUR LOCAL STANDARD'S TARGET IS

- Calculations have put our global carbon budget for 1.5-2 degrees of change within the range of 2030 to 2050. This budget is constantly being updated as science collects more data and learns more about climate behaviors.
- **Perfection is the enemy of good - every incremental improvement buys us more time to make more improvements.** Just do something and don't worry about perfect carbon neutrality right out of the gate.
- If you have a local target, it will either tell you what percentage improvement your area is at today through annual benchmarking, or it will have a % reduction target that increases over time.
- **Local targets are set up to be paced, not all at once.** Doing nothing during the ramp up phases and then trying to do everything all at once is a formula for failure.

architecture 2030

AIA 2030 COMMITMENT

MEP 2040
Committing to Zero

SEI STRUCTURAL ENGINEERING INSTITUTE ASCE | SE2050 COMMITTING TO NET ZERO

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ESTABLISHING A BASELINE AND THEN A GOAL

STEP 3 | DECIDE WHAT YOU CAN AND WANT TO ACHIEVE

- Maybe your local standard is robust enough that you can adopt it as is.
- Maybe you want to customize it, because you want your efforts to be more precise, or because your local information just isn't as usable as you need it to be.
- Get in the habit of looking at your consumption and participate in benchmarking efforts to see how your school district compares. California now mandates all buildings of 50k sq ft (~4600 sq m) or greater report their annual performance to the state.
- Consider if you want to match the pace of your local goal or do a little better.
    - **Consider branding.** USGBC's LEED program is probably the best known in the world, but there are concerns about performance matching predicted outcomes.
    - **Consider rigor.** The Living Building Challenge is the most rigorous standard but is less well known than LEED.
    - **Consider expense.** An unfortunate reality is that meeting a green standard costs a bit more simply due to paperwork. Hopefully, this changes down the line.

U.S. GREEN BUILDING COUNCIL LEED USGBC

LIVING BUILDING CHALLENGE℠

International PASSIVE HOUSE Association iPHA

energy ENERGY STAR

CODE FOR A SUSTAINABLE BUILT ENVIRONMENT BREEAM

GREEN GLOBE CERTIFIED

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ESTABLISHING A BASELINE AND THEN A GOAL

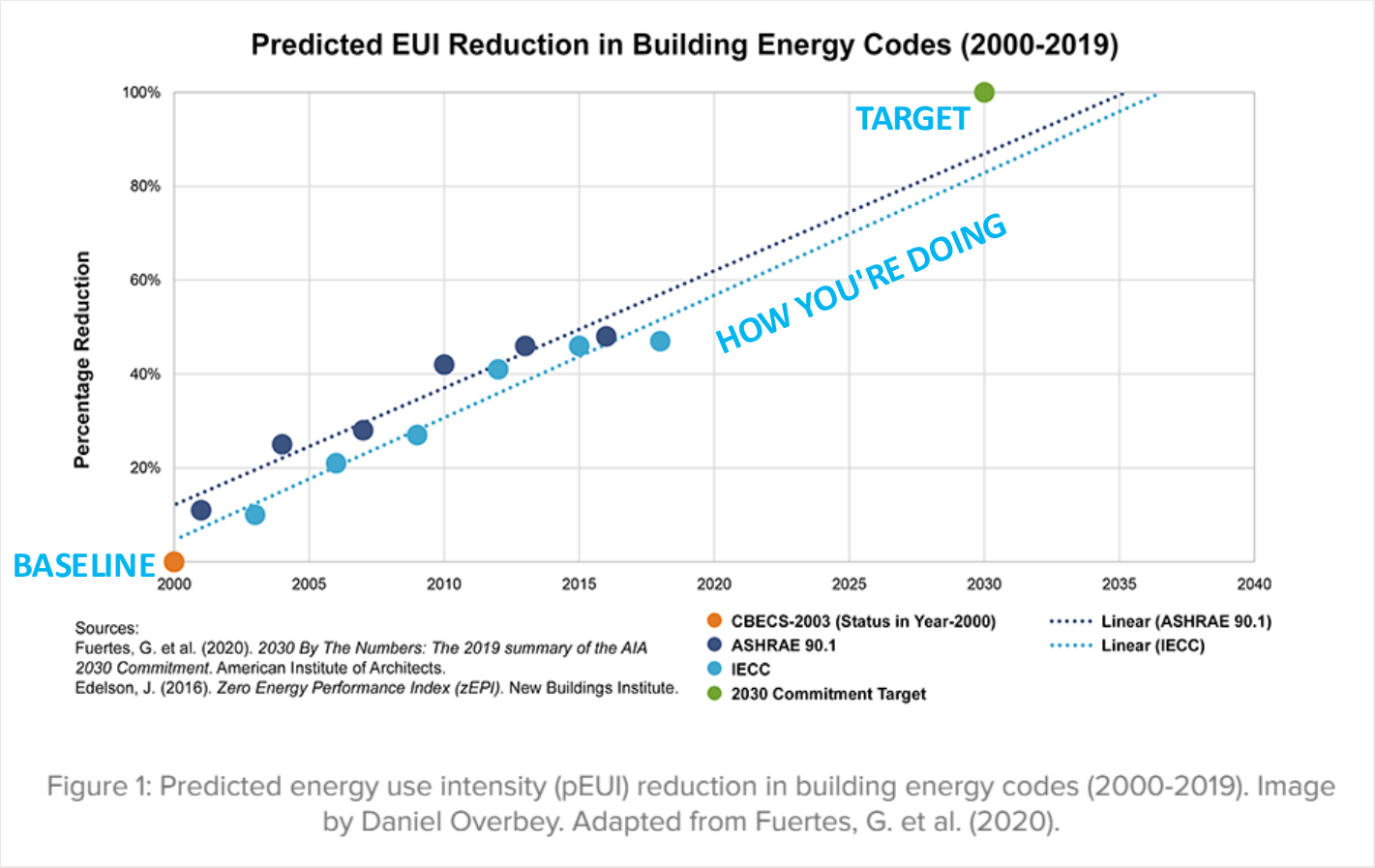

Figure 1: Predicted energy use intensity (pEUI) reduction in building energy codes (2000-2019). Image by Daniel Overbey. Adapted from Fuertes, G. et al. (2020).

Source: Building Enclosure magazine, "Raising the Floor on Building Efficiency Standards" by Daniel Overbey, March 26, 2021

STEP 4 | DOCUMENT YOUR BASELINE AND TARGET

- Include your **baseline, target**, and any **certification standard** to be met in master planning documents so your project teams know what the goals are.
- Use your **master planning documents** to inform your project's Owner's Project Requirements (OPR - US terminology) or Statement of Requirements (SOR - Canadian terminology).
- **Tell your teams what you are aiming for.** Repeat. Repeat often. If the district school board, operations & facilities staff, and campus admin & staff are not on the same page, those closest to the project could make decisions that may be in conflict with adopted documents.

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COMPARING LOCAL CONDITIONS AND REQUIREMENTS

SYSTEM	JURISDICTION	BASELINE	PRESENT DAY TARGET	NET ZERO GOAL	UNITS	SUCCESS RATE	CURRENT EMISSIONS	PEAK EMISSIONS
AIA 2030 COMMITMENT (AIA- USA)	Voluntary, US	CBECS 2003 (2000 data) (USA: 6,100 MMTCO2e)	90% reduction	2030	EUI	Reported projects average ~60% reduction (2% of US firms signed, less than half report data)	4,910 MMTCO2e (2023)	6,130 MMTCO2e (2007)
AIA 2030 COMMITMENT (AIA/RAIC)	Voluntary, Canada	CICES 2000 (?) (Canada: 566 MMTCO2e)	90% reduction	2030	EUI		549 MMTCO2e (2023)	591 MMTCO2e (2007)
LEED (USGBC/GBCI)	Voluntary, global	CBECS 2003 (by reference to other standards)	Varies, points awarded by reduction achieved	N/A	% (EUI, GHGI)	34% average reduction (3% of built area in US and Canada is certified)	N/A	N/A
CALGREEN	Mandatory, State of California	1990 state data (CA: 718 MMTCO2e)	40% reduction (431 MMTCO2e)	2045	TDV* (EUI), kgCO2e	32% average reduction across all new construction projects	371 MMTCO2e (2022)	
BC STEP CODE	Mandatory, Province of British Columbia	2007 provincial data (BC: 67 MMTCO2e)	50% reduction (34 MMTCO2e)	2050	GHGI		66 MMTCO2e (2022)	

Source: See Selected References slide for data sources

**Time Dependent Valuation*

- **Canada, particularly BC**, started out with an already fairly clean power grid and relatively small carbon footprint. They struggle to improve performance.
- **The US** has been pretty dirty. It has been able to improve significantly but still emits a lot.

Voluntary standards show what's possible, while mandatory standards achieve widespread impact at a lower level.

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COMPARING LOCAL CONDITIONS AND REQUIREMENTS

Some bad math for guesstimating (data scientists, look away)

BENCHMARK	AIA 2030	CALGREEN	BC STEP CODE
Baseline	CBECS 2003 (2000 data) CICES 2000 (?)	CBECS 1989 (about 5% worse than CBECS 2003 – used as a proxy for 1990 data)	CICES 2005 (about 17% worse than CICES 2000 – used as a proxy for 2007 data)
Baseline Value (Business as Usual)	100 (0% reduction)	105 (100 + 5)	117 (100 + 17)
Present Day Target (Code Minimum)	20 (80% reduction)	63 (37% reduction: 105 x .6)	59 (50% reduction: 117 x .5)
Firm Average in AIA 2030 Terms	-	**QKA:** 55 (45% reduction)	**Thinkspace**: 38 (62% reduction)
Firm Average in Local Terms	-	**QKA:** 58 (55 x 1.05)	**Thinkspace**: 44 (38 x 1.17)

Source: See Selected References slide for data sources

- How different is the year of your baseline from the year of the more commonly accepted data?
- Is a 40% improvement from 1990 better or worse than a 60% improvement from 2000?

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PART 2 | LOOKING AT THE DATA THROUGH PROJECTS

Source: Visual Capitalist

Thinkspace Architecture

PROJECT 1

Whitehorse, Yukon |CANADA

Whistle Bend Elementary School

Thinkspace Architecture

PROJECT 2

Langford, British Columbia | CANADA

South Langford Elementary School

Quattrocchi Kwok Architects

PROJECT 3

Morgan Hill, California | USA

Britton Middle School

Quattrocchi Kwok Architects

PROJECT 4

Sunnyvale, California | USA

Sunnyvale Middle School

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QUATTROCCHI KWOK ARCHITECTS

PROJECT 1 | Whistle Bend Elementary School

Completed in 2023

KEY PROJECT INFORMATION

LOCATION

- Whitehorse, Yukon | Canada

CLIMATE ZONE

- 7B

GROSS FLOOR AREA

- 47,000SF (4400m2)

STUDENTS

- 605

GRADE STRUCTURE

- Kindergarten to Grade 7

CONTRACT TYPE

- Design-Build

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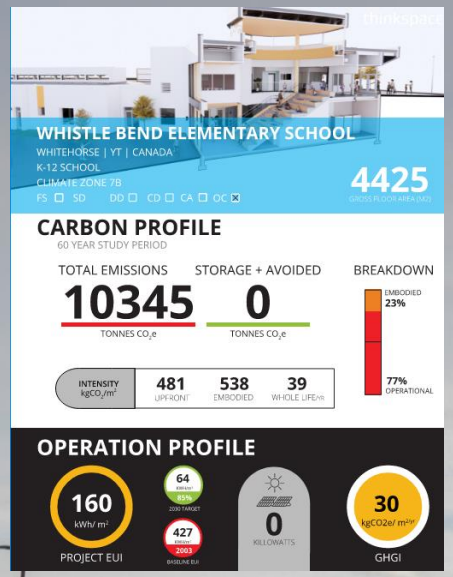
PROJECT 1 | Whistle Bend Elementary School



KEY SUSTAINABILITY FEATURES

STRATEGIES

- High performance envelope
- 7" exterior insulation
- Future wood pellet plant
- Mass Timber Gymnasium
- Rooftop Solar

AIA BASELINE EUI:
427 kwh/m2

PROJECT EUI:
160 kwh/m2

% REDUCTION FROM AIA
62.50%

GHGI
30 kgCO2e/m2

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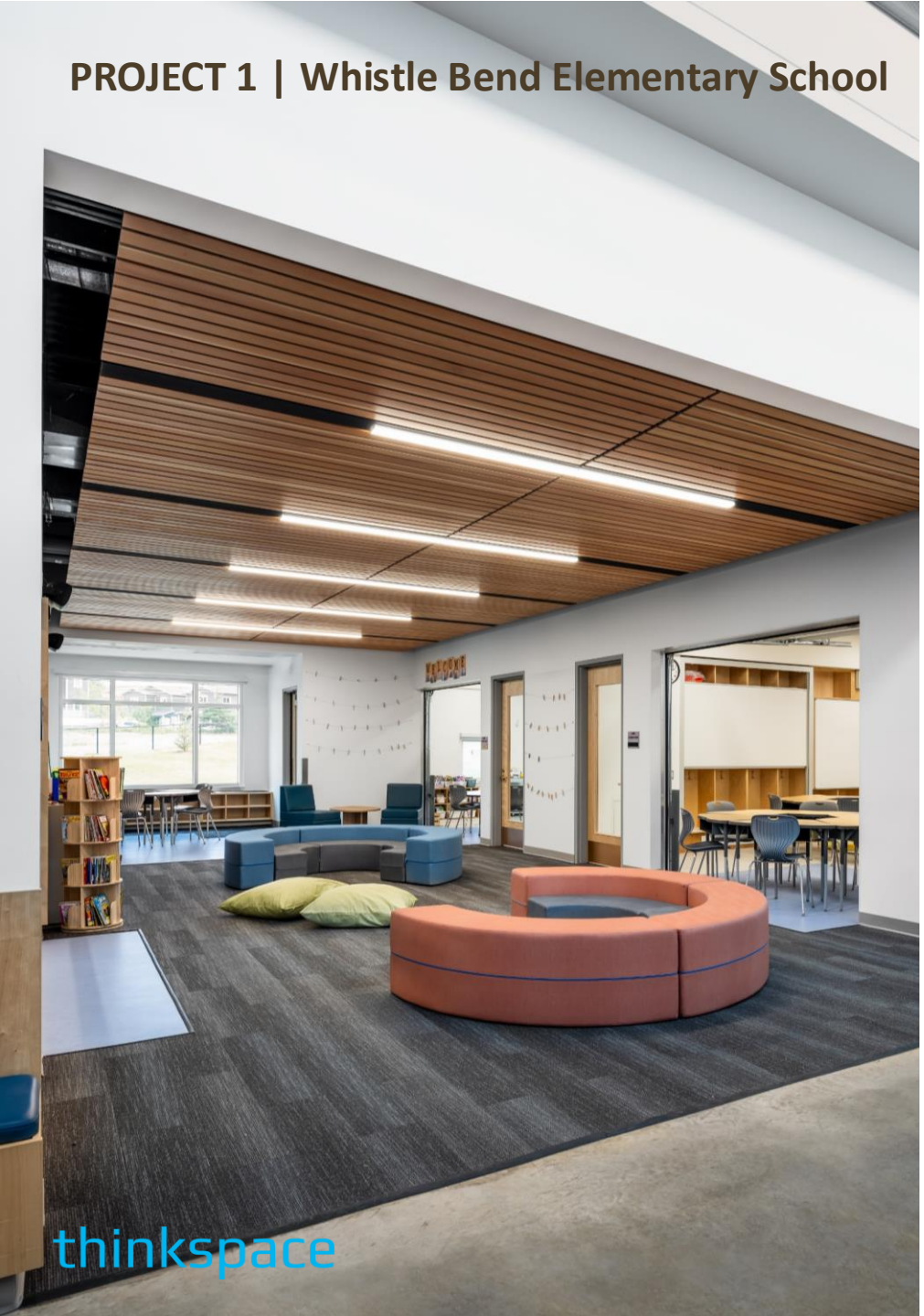
PROJECT 1 | Whistle Bend Elementary School



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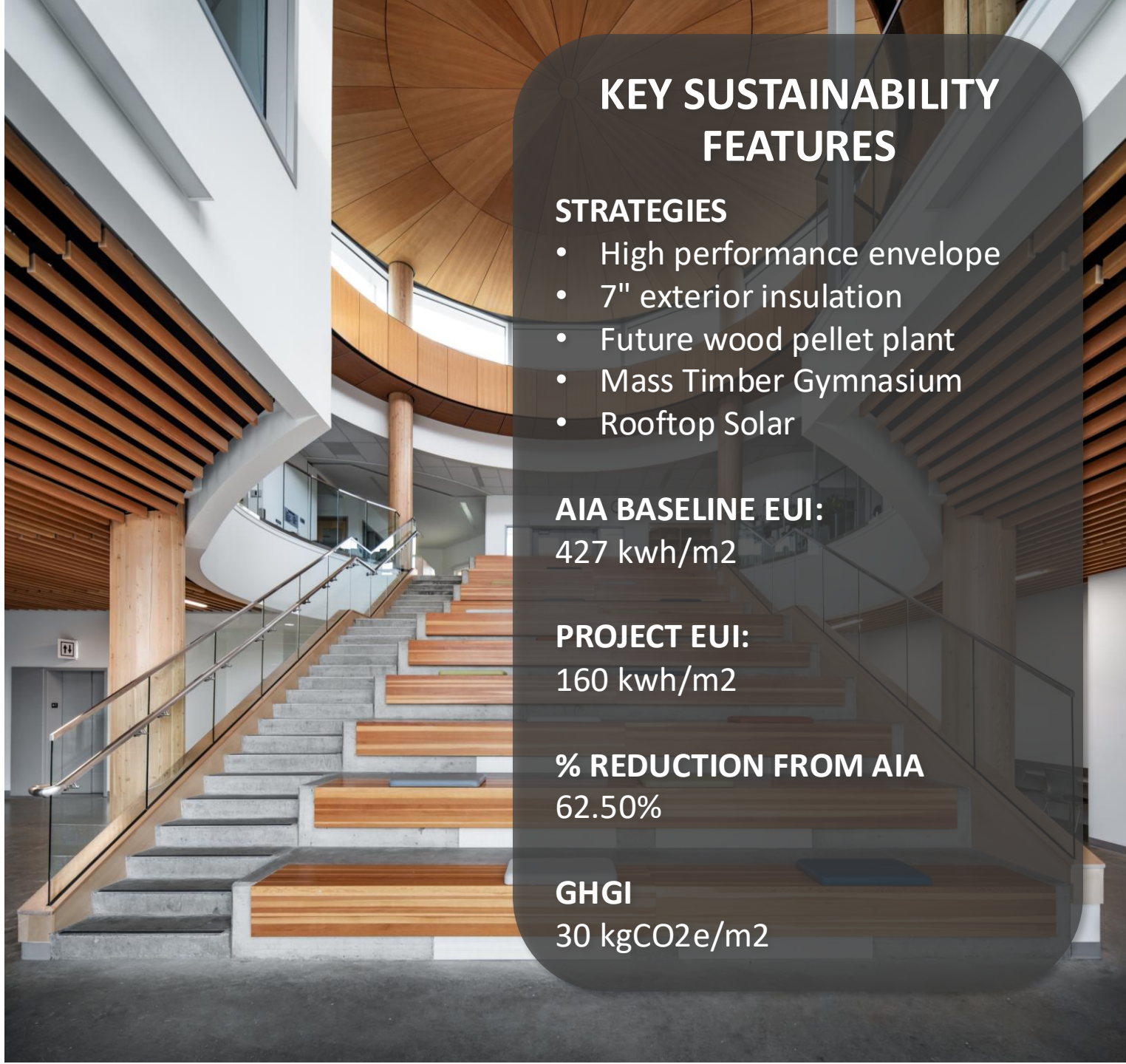

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427 kwh/m2

PROJECT EUI:
160 kwh/m2

% REDUCTION FROM AIA
62.50%

GHGI
30 kgCO2e/m2

PROJECT 2 | South Langford Elementary School

Completed in 2025

KEY PROJECT INFORMATION

LOCATION

- Langford, British Columbia

CLIMATE ZONE

- 4

GROSS FLOOR AREA

- 44,600SF (4150m2)

STUDENTS

- 605

GRADE STRUCTURE

- Kindergarten to Grade 5

CONTRACT TYPE

- Design-Bid-Build

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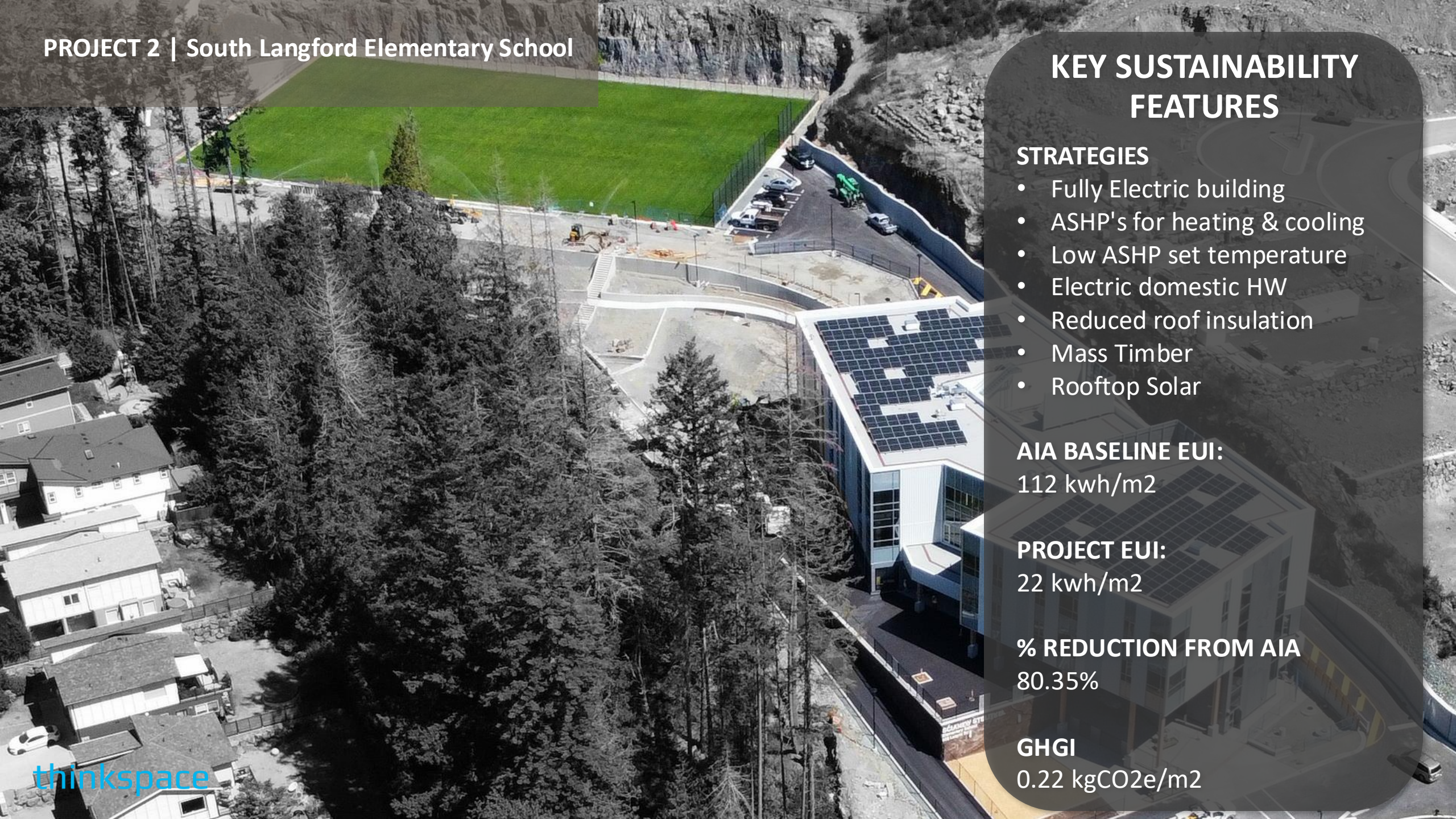


PROJECT 2 | South Langford Elementary School

KEY SUSTAINABILITY FEATURES

STRATEGIES

- Fully Electric building
- ASHP's for heating & cooling
- Low ASHP set temperature
- Electric domestic HW
- Reduced roof insulation
- Mass Timber
- Rooftop Solar

AIA BASELINE EUI:
112 kwh/m2

PROJECT EUI:
22 kwh/m2

% REDUCTION FROM AIA
80.35%

GHGI
0.22 kgCO2e/m2

thinkspace

KEY SUSTAINABILITY FEATURES

STRATEGIES

- Fully Electric building
- ASHP's for heating & cooling
- Low ASHP set temperature
- Electric domestic HW
- Reduced roof insulation
- Mass Timber
- Rooftop Solar

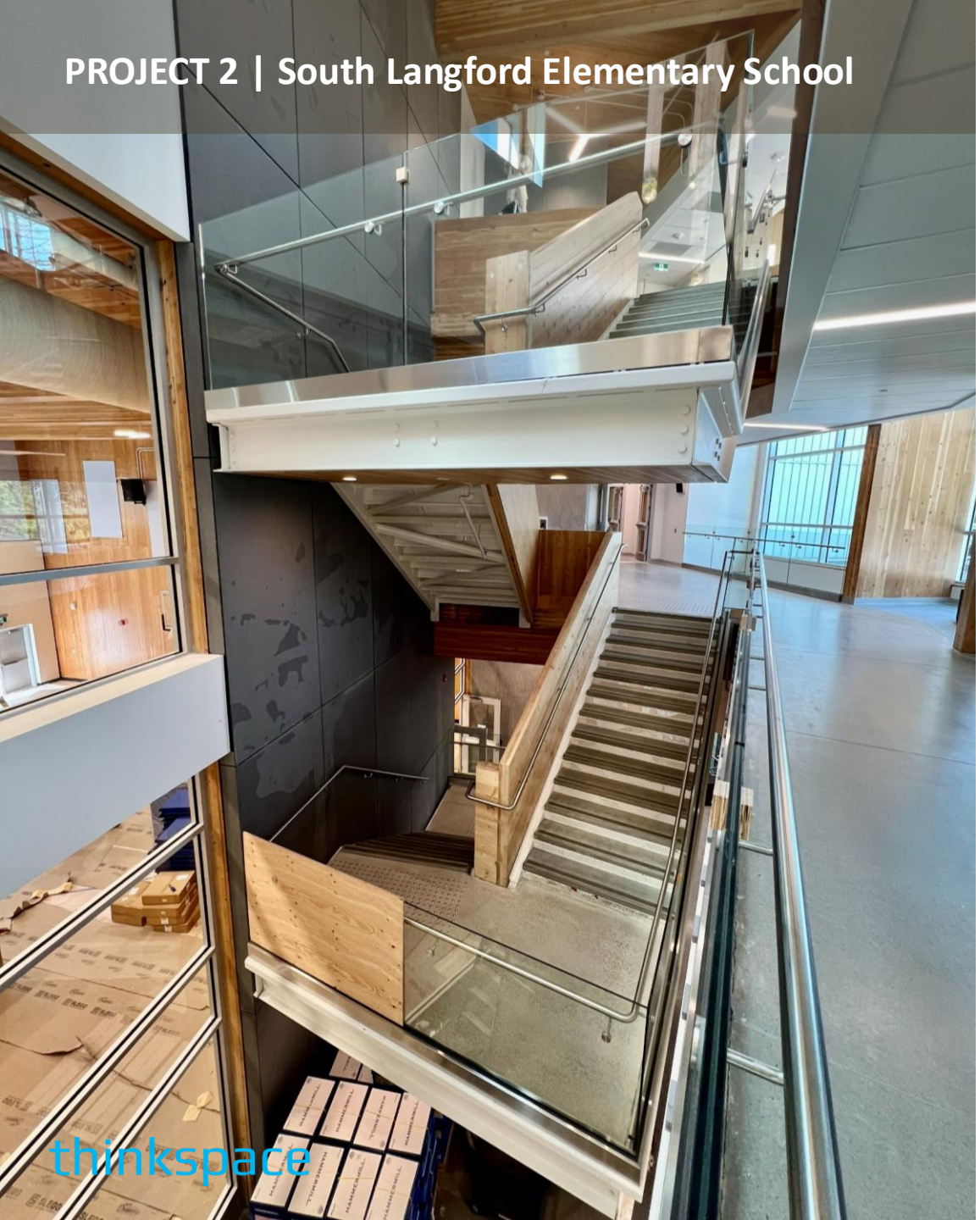
AIA BASELINE EUI:
112 kwh/m2

PROJECT EUI:
22 kwh/m2

% REDUCTION FROM AIA
80.35%

GHGI
0.22 kgCO2e/m2

thinkspace



KEY SUSTAINABILITY FEATURES

STRATEGIES

- Fully Electric building
- ASHP's for heating & cooling
- Low ASHP set temperature
- Electric domestic HW
- Reduced roof insulation
- Mass Timber
- Rooftop Solar

AIA BASELINE EUI:
112 kwh/m2

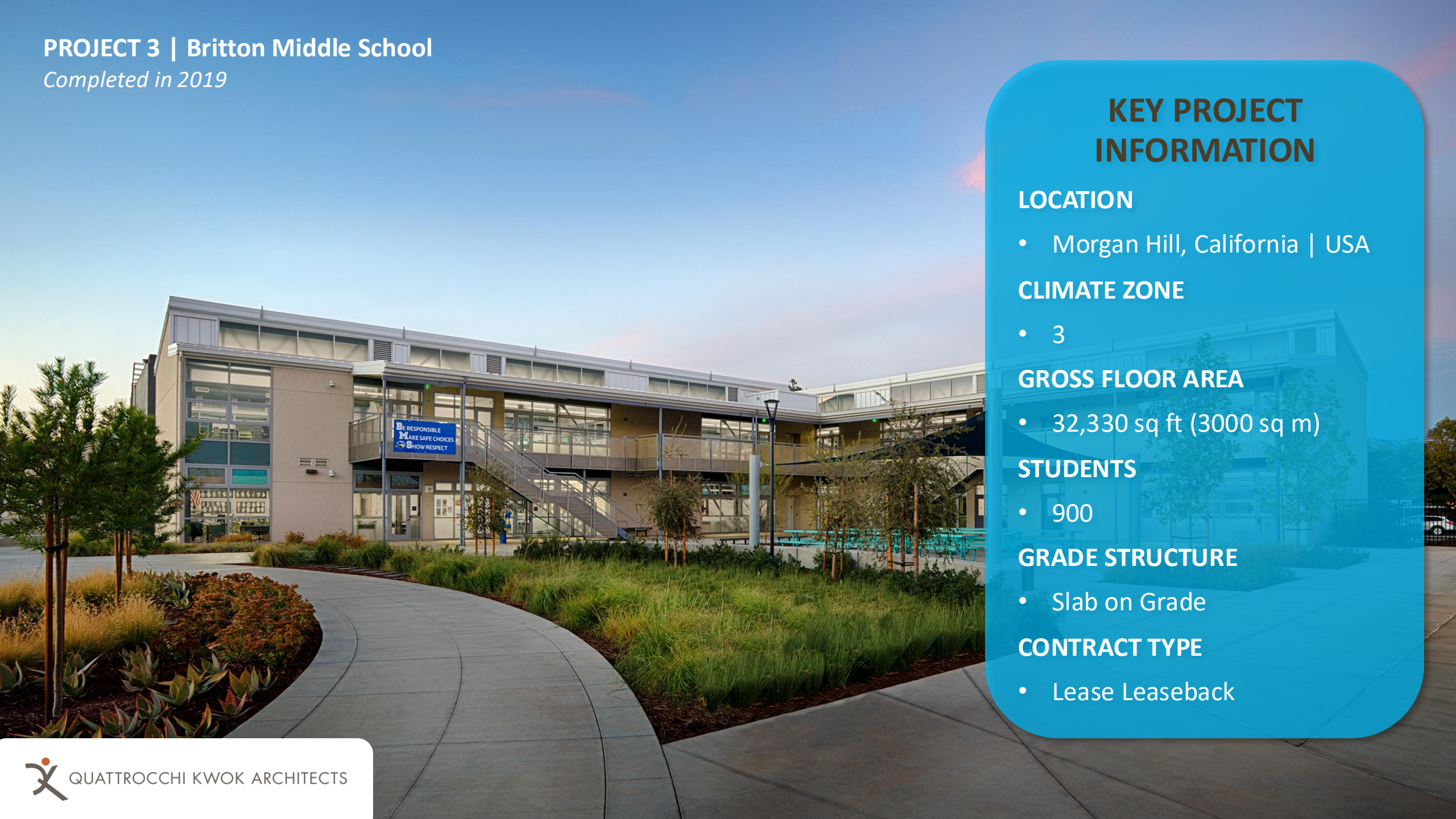
PROJECT EUI:
22 kwh/m2

% REDUCTION FROM AIA
80.35%

GHGI
0.22 kgCO2e/m2

PROJECT 3 | Britton Middle School

Completed in 2019



KEY PROJECT INFORMATION

LOCATION

- Morgan Hill, California | USA

CLIMATE ZONE

- 3

GROSS FLOOR AREA

- 32,330 sq ft (3000 sq m)

STUDENTS

- 900

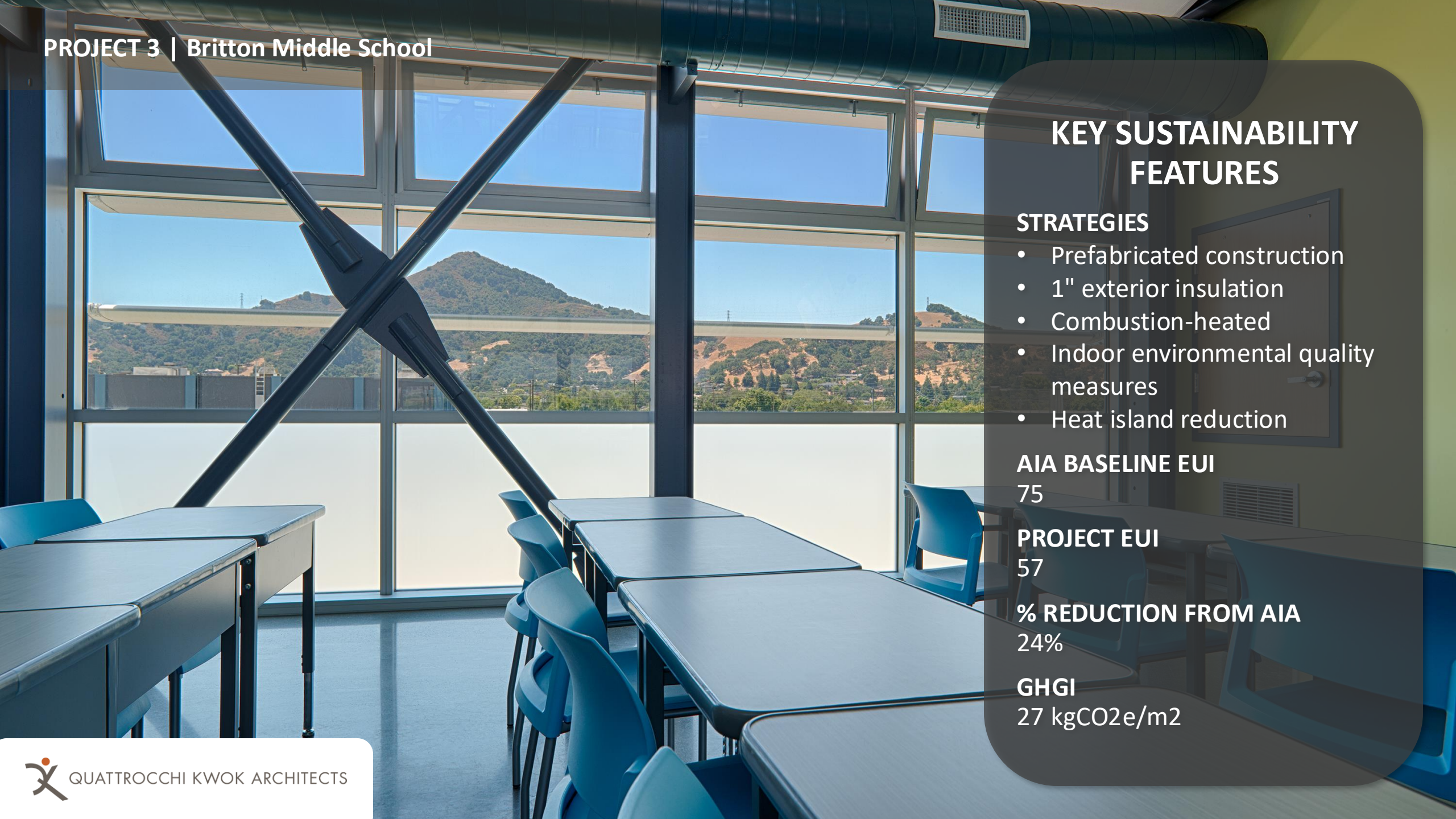
GRADE STRUCTURE

- Slab on Grade

CONTRACT TYPE

- Lease Leaseback

QUATTROCCHI KWOK ARCHITECTS



PROJECT 3 | Britton Middle School

KEY SUSTAINABILITY FEATURES

STRATEGIES

- Prefabricated construction
- 1" exterior insulation
- Combustion-heated
- Indoor environmental quality measures
- Heat island reduction

AIA BASELINE EUI
75

PROJECT EUI
57

% REDUCTION FROM AIA
24%

GHGI
27 kgCO2e/m2

QUATTROCCHI KWOK ARCHITECTS

PROJECT 3 | Britton Middle School

KEY SUSTAINABILITY FEATURES

STRATEGIES

- Prefabricated construction
- 1" exterior insulation
- Combustion-heated
- Indoor environmental quality measures
- Heat island reduction

AIA BASELINE EUI
75

PROJECT EUI
57

% REDUCTION FROM AIA
24%

GHGI
27 kgCO2e/m2

QUATTROCCHI KWOK ARCHITECTS

PROJECT 3 | Britton Middle School

KEY SUSTAINABILITY FEATURES

STRATEGIES

- Prefabricated construction
- 1" exterior insulation
- Combustion-heated
- Indoor environmental quality measures
- Heat island reduction

AIA BASELINE EUI
75

PROJECT EUI
57

% REDUCTION FROM AIA
24%

GHGI
27 kgCO2e/m2

QUATTROCCHI KWOK ARCHITECTS

PROJECT 4 | Sunnyvale Middle School

Completed in 2025

KEY PROJECT INFORMATION

LOCATION

- Sunnyvale, California | USA

CLIMATE ZONE

- 3C

GROSS FLOOR AREA

- 36,000 sq ft (3344 sq m)

STUDENTS

- 960

GRADE STRUCTURE

- Slab on grade

CONTRACT TYPE

- Lease leaseback

QUATTROCCHI KWOK ARCHITECTS

PROJECT 4 | Sunnyvale Middle School

KEY SUSTAINABILITY FEATURES

STRATEGIES

- Prefabricated construction
- 1.25" exterior insulation
- All electric and uses ¼ the electricity of Britton version
- Indoor environmental quality measures
- Rooftop solar

AIA BASELINE EUI

76

PROJECT EUI

15

% REDUCTION FROM AIA

80%

GHGI

16 kgCO2e/m2

QUATTROCCHI KWOK ARCHITECTS

PROJECT 4 | Sunnyvale Middle School

KEY SUSTAINABILITY FEATURES

STRATEGIES

- Prefabricated construction
- 1.25" exterior insulation
- All electric and uses ¼ the electricity of Britton version
- Indoor environmental quality measures
- Rooftop solar

AIA BASELINE EUI
76

PROJECT EUI
15

% REDUCTION FROM AIA
80%

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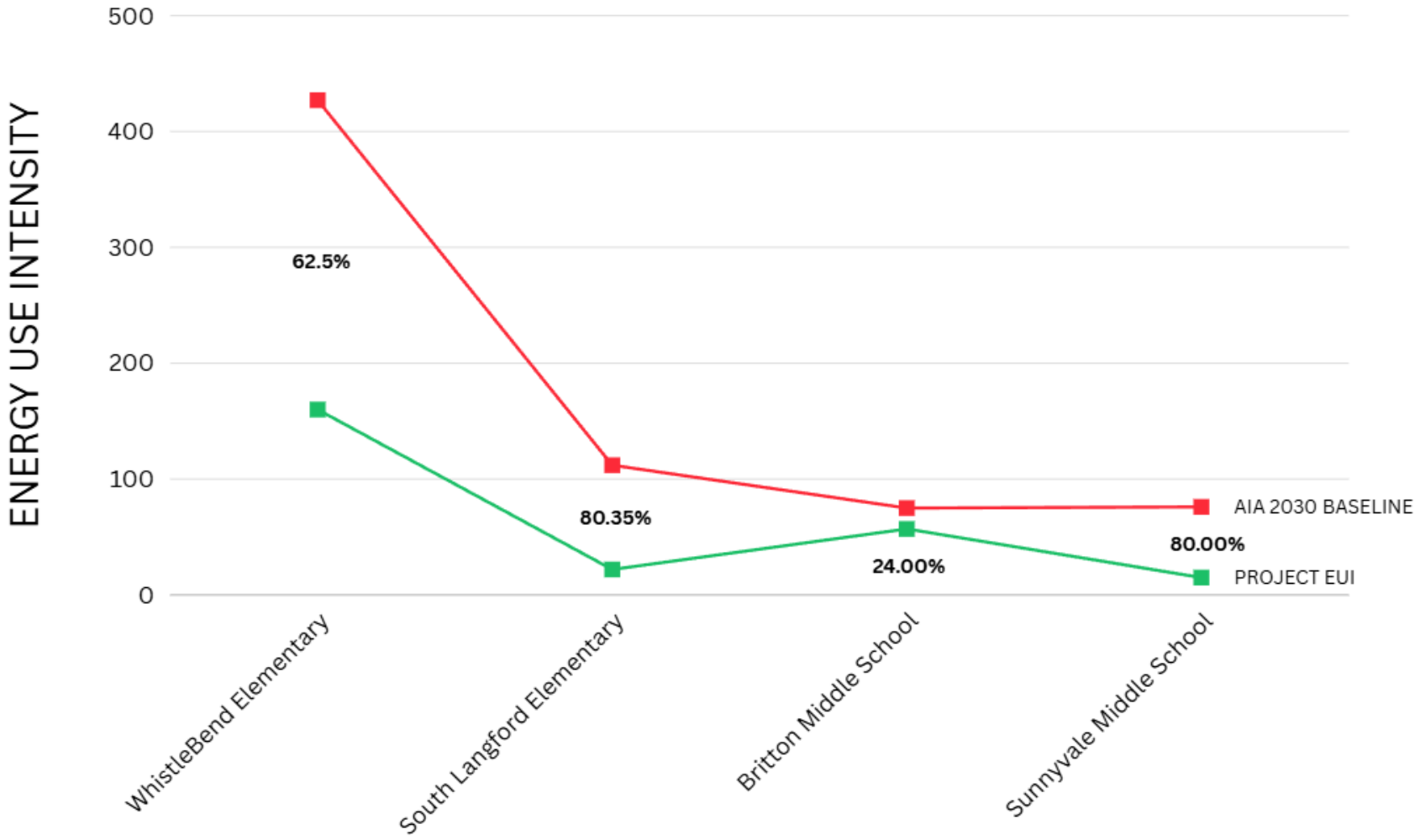
PERFORMANCE SUMMARY

How do these schools compare?



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QUATTROCCHI KWOK ARCHITECTS

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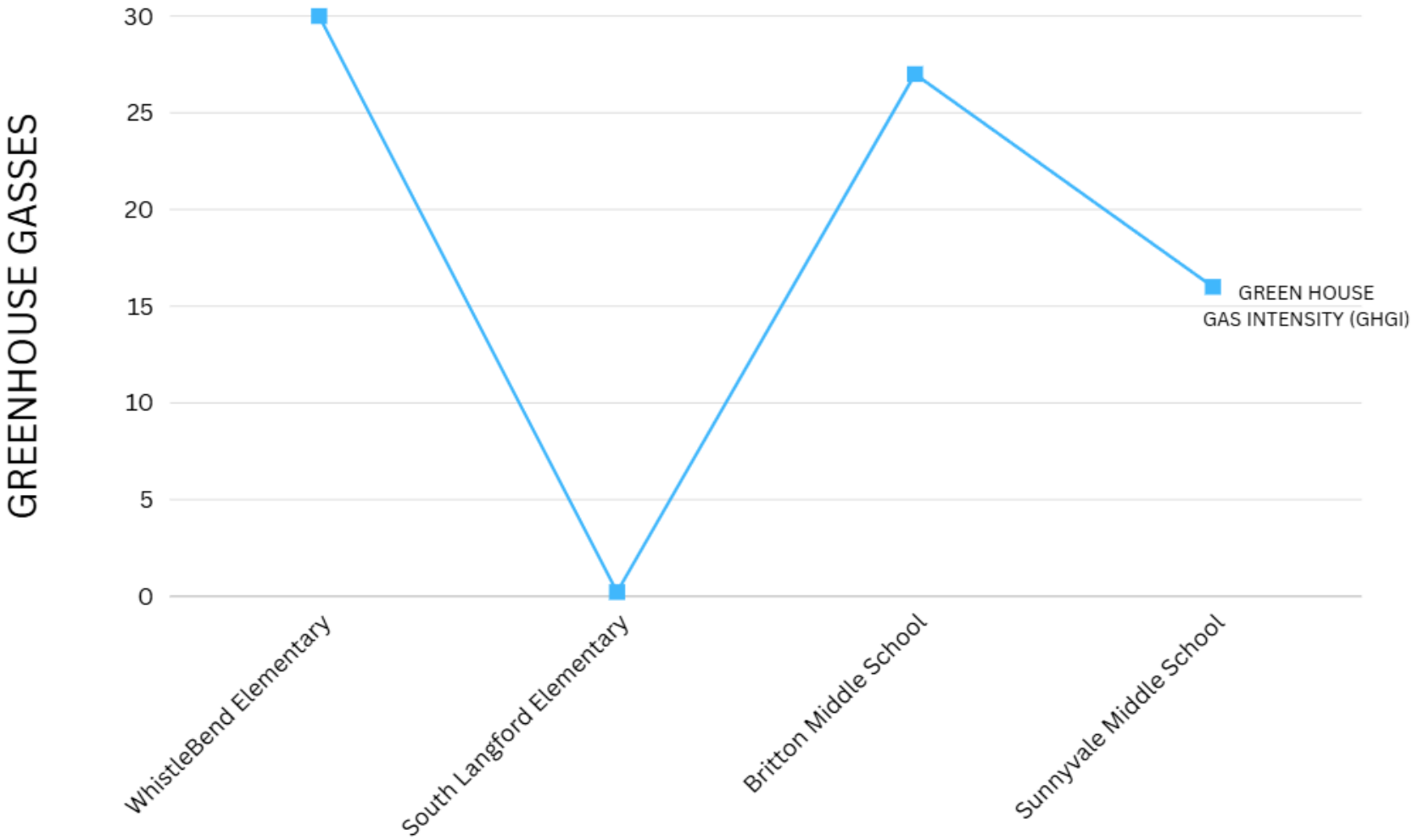

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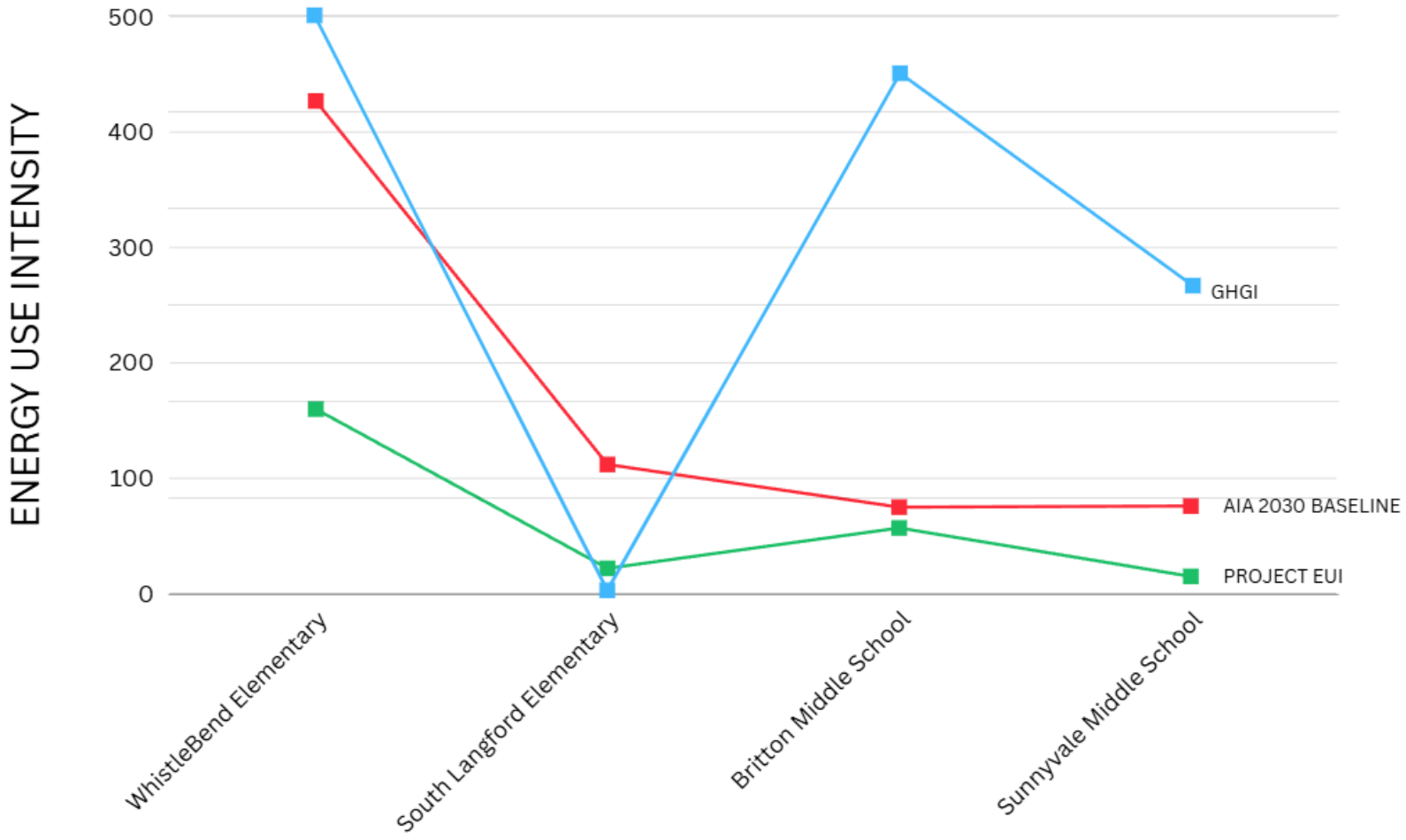

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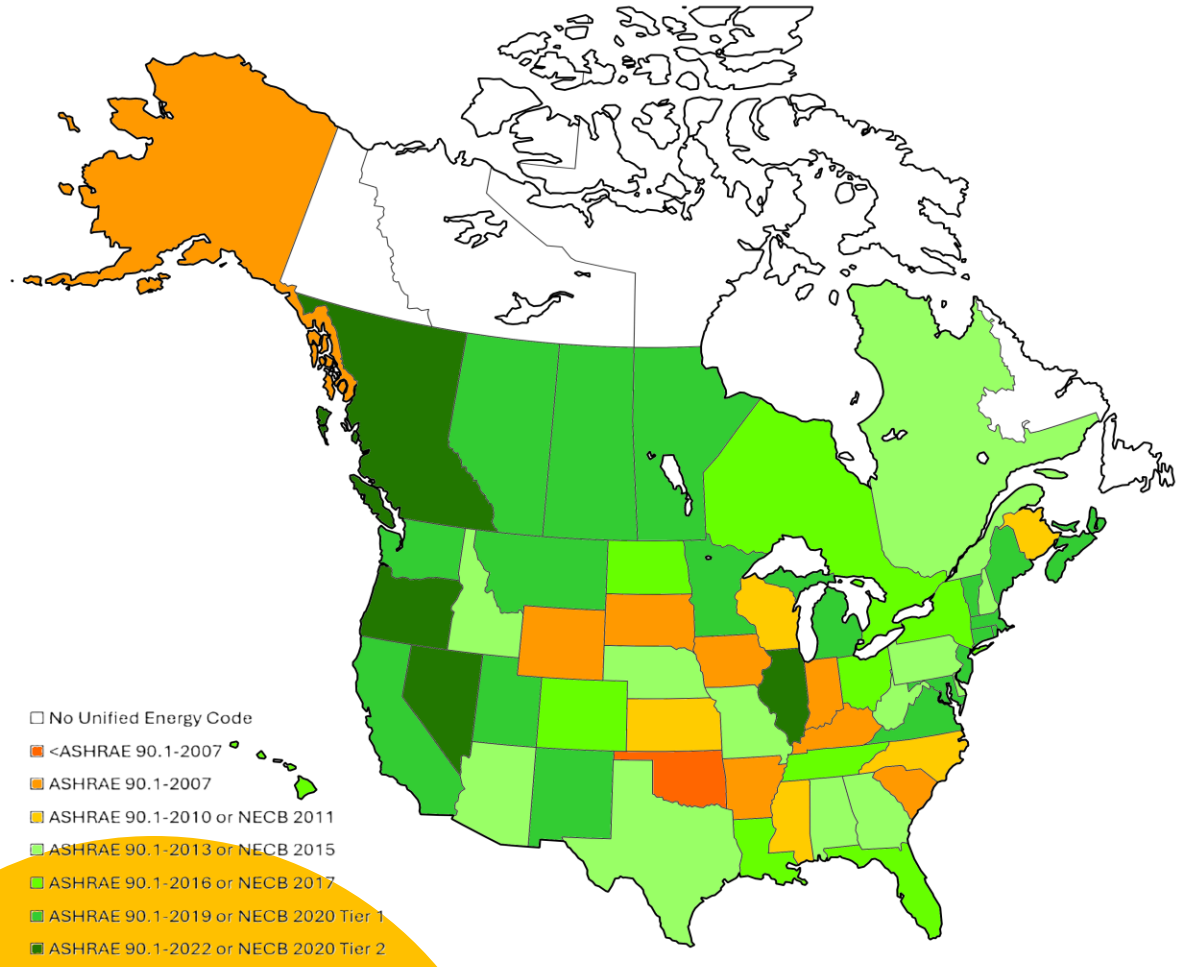
QUATTROCCHI KWOK ARCHITECTS

PART 3 – BEST PRACTICES

For OPRs (Owner's Project Requirements and SORs (Statement of Requirements)

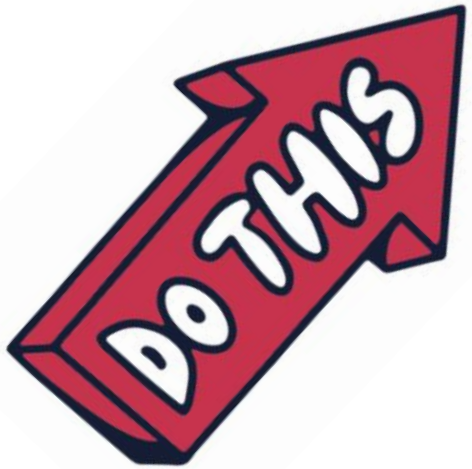


Source: See Selected References slide for sources used to assemble this map. Base outline from Ultimaps.

COMPARING LOCAL CONDITIONS AND REQUIREMENTS

Assess if your local codes have an embedded target

- **If not**, consider adding a voluntary certification standard to your planning efforts to act as a substitute and hold your projects to a higher standard.
- **If so**, how does it compare to independent reference standards?



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QUATTROCCHI KWOK ARCHITECTS

PART 3 – BEST PRACTICES

For OPRs (Owner's Project Requirements and SORs (Statement of Requirements)

TRACK PERFORMANCE AND WORK WITH OTHERS WHO DO, TOO

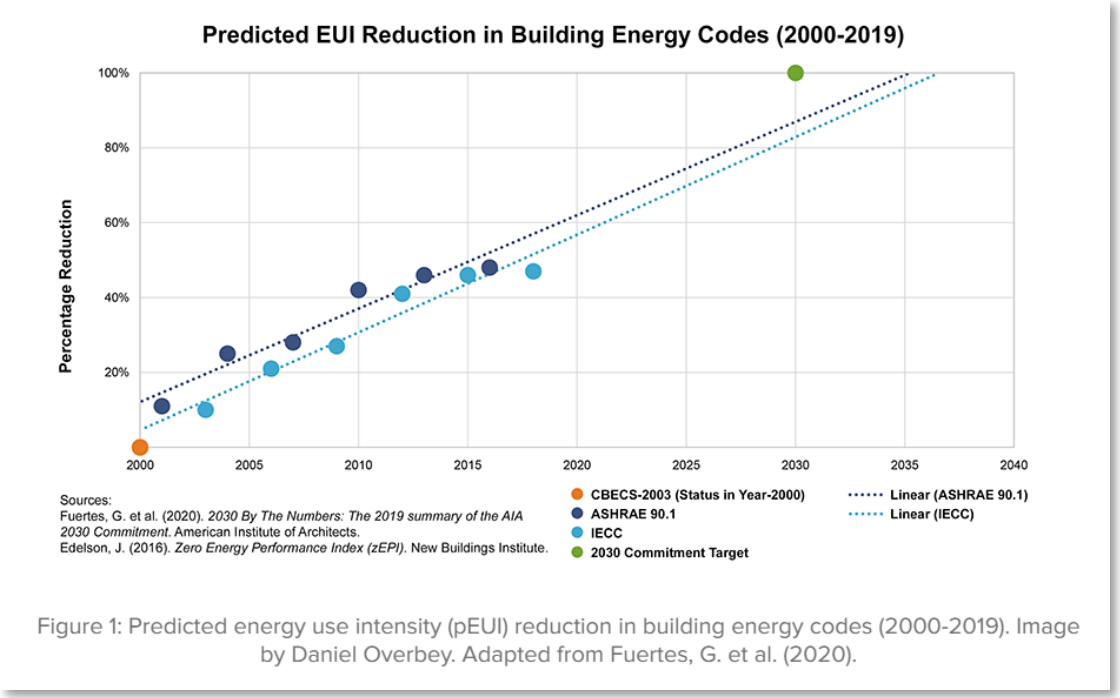
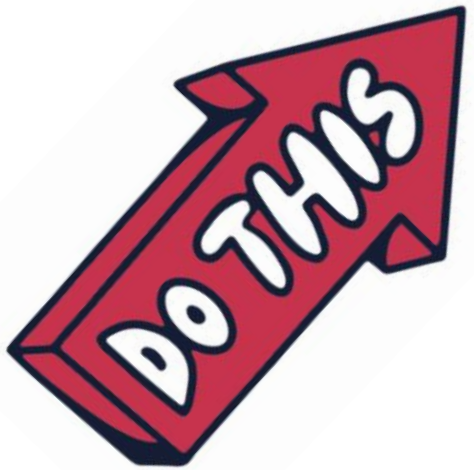


Figure 1: Predicted energy use intensity (pEUI) reduction in building energy codes (2000-2019). Image by Daniel Overbey. Adapted from Fuertes, G. et al. (2020).

- **Sign up for AIA 2030** and track your projects or work with firms that do. Ask if the engineers participate in MEP 2040 and SE 2050 as well. (QKA and Thinkspace both track projects!)
- **Be curious about your facilities' performance.** How much are your energy bills? Water bills? Is your equipment tuned up? Your Building Management Systems should be able to tell you.



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QUATTROCCHI KWOK ARCHITECTS

PART 3 – BEST PRACTICES

For OPRs (Owner's Project Requirements and SORs (Statement of Requirements)

MAKE YOUR OPR/SOR WORK FOR YOU

- **Complete programming documents early.** The purpose of these documents is to tell the team what standard they have to meet. If you are generating them after the design is done, they aren't doing anything for you. Generate them before design starts.
- **Reference guiding documents** where available (master plans, implementation plans) so that project teams know to refer to them.
- **Specify the baseline** (or benchmark against local averages each year) and the **improvement targets** (%) for operational and embodied carbon, and an overall carbon footprint improvement target.
- **Specify a green rating system** to achieve or use as an equivalency. If doing an equivalence instead of full certification, specify how it is to be verified. (Special inspector, final report, additional commissioning and training scope, post-occupancy evaluation, etc.)
- **Do your research on alternate systems and get your maintenance staff on board.** This can be done at the project level so that your engineers can advise, but then update your OPR/SOR to reflect the range of acceptable systems and check that the BOD (Basis of Design - CANADIAN TERM?) responds appropriately.

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SELECTED REFERENCES

- California Air Resources Board (CARB); 2022 California GHG Emission Inventory Data
- Ministry of Environment, British Columbia; British Columbia Greenhouse Gas Inventory Report 2007 Summary
- Canada Energy Regulator (CER); Provincial and Territorial Energy Profiles - British Columbia
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- Natural Resources Canada, Office of Energy Efficiency; Energy Efficiency Trends in Canada 1990-1999
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- US Energy Information Administration; State Energy Profiles 2024
- Cove Tool website
- Architecture 2030 website
- Zero Tool website
- C.scale online embodied carbon estimating tool
- US Department of Energy code adoption map
- 2024 Canadian Energy Efficiency Scorecard: Provinces and Territories

QUESTIONS?