



# Not Too Cool for School: Demystifying Costs and Accelerating Pathways for All-Electric Schools

*A4LE: October 18, 2024*

**nbi** new buildings  
institute

# Today's Presenters



**Reilly  
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Associate Director

New Buildings Institute



**Andrea Swiatocha**

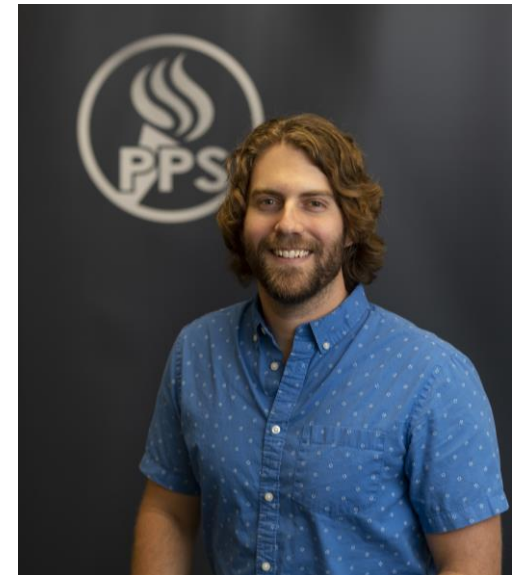
Renew America's  
Schools

US Department of Energy



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# New Buildings Institute (NBI)

**Mission:** We push for **better buildings** that achieve **zero energy, zero carbon, and beyond**—through research, policy, guidance, and market transformation—to protect people and the planet.



St James Intermediate School | Myrtle Beach, SC  
Credit: sfL+a Architects

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# Introduction

# School district portfolios, priorities and stakeholders are complicated



- With historic injustices,
- Operations, construction and maintenance of buildings significantly underfunded,
- Political opposition,
- Wildfires and extreme weather,
- and so much more...

**Our school infrastructure is struggling.**



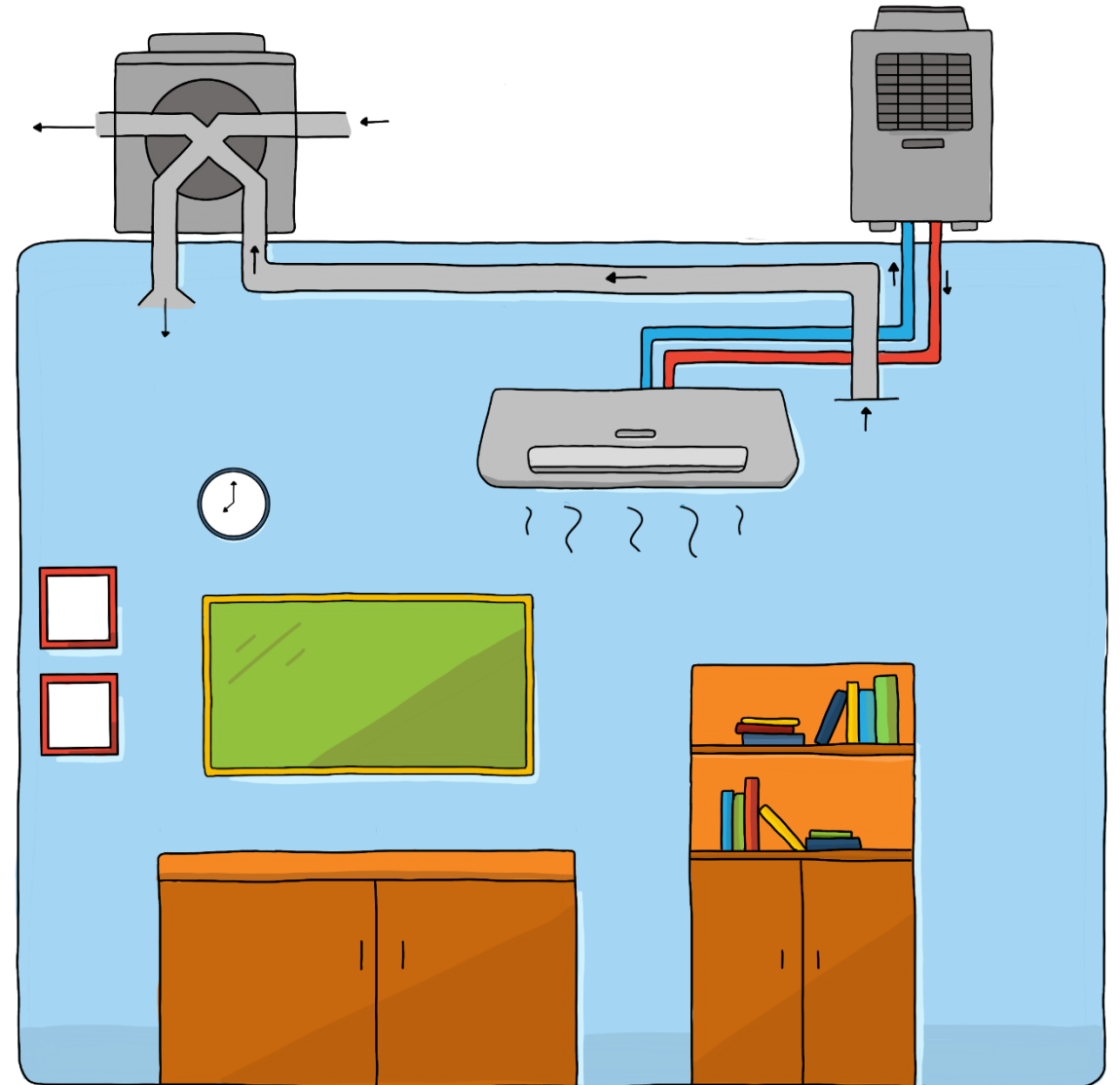
The average age of our public school infrastructure is 49 years old.



ASCE's 2021 Report Card for America's Infrastructure assessed schools with a **D+ grade** and estimated that the investment needed between 2021 and 2029 to modernize and maintain the nation's schools is at least **\$370 billion.**

# Critical systems are failing

The U.S. Government Accountability Office reported that approximately **one third of schools** need to update or replace heating, ventilation, and air conditioning (HVAC) equipment.



Artwork by Nicole Kelner

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What does this look like in terms of emissions?

America's K-12 schools emit an estimated **42 million metric tons** of operational emissions annually

*Sources: Why K-12 Schools Should Feature in America's National Climate Strategy*





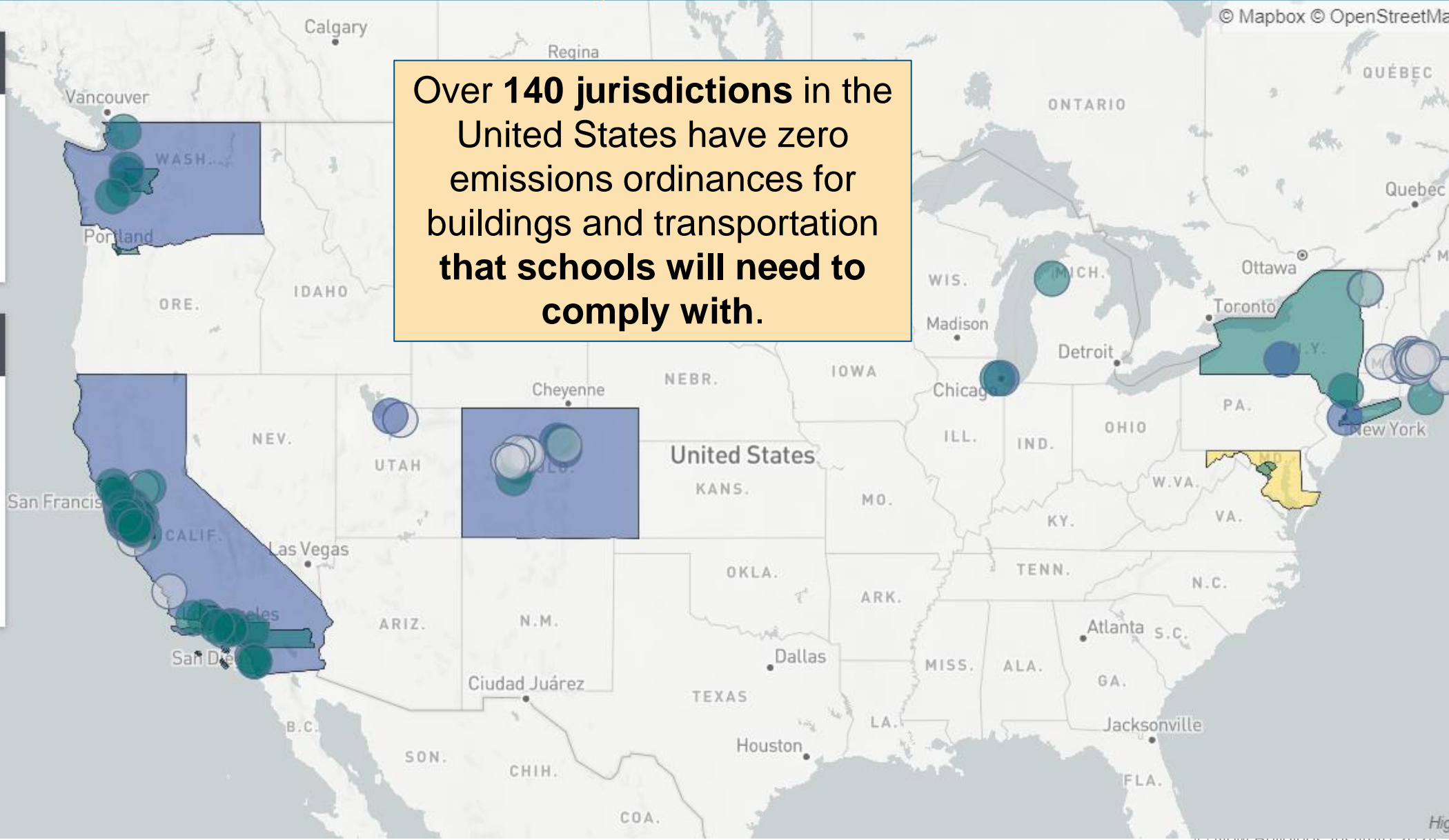
**Level of Government**

- State
- Regional Entity
- County
- City

**Policy Scope** ?

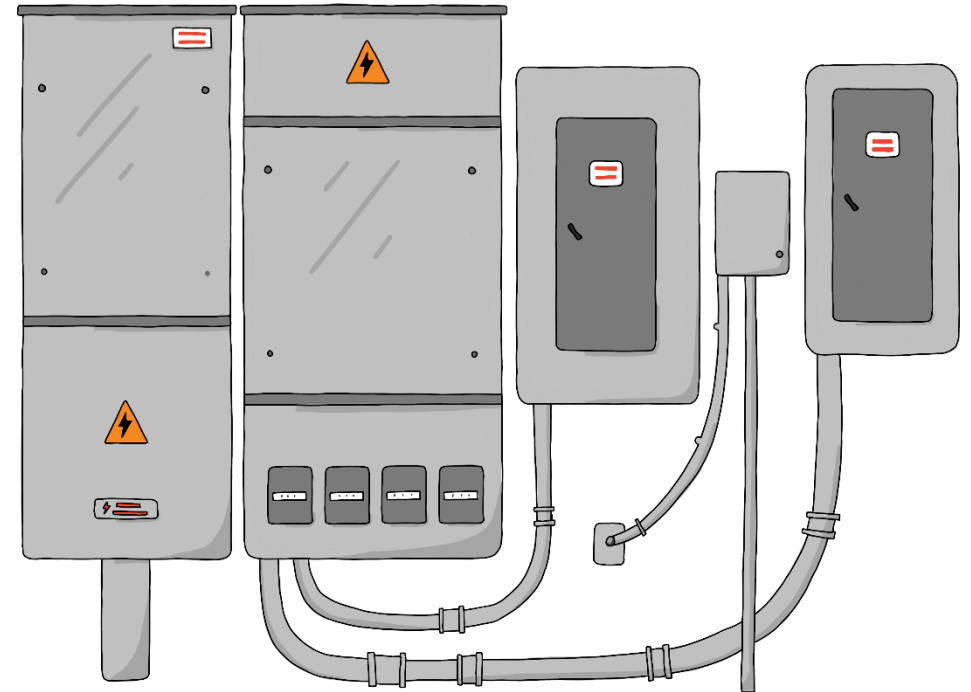
- Building Emissions Standard
- All-Electric Requirement
- Encouraging Decarbonization
- Multiple Policy Scopes

Over **140 jurisdictions** in the United States have zero emissions ordinances for buildings and transportation that schools will need to comply with.



# Electrification – a VERY important strategy

- To address *failing systems, climate adaptation, and rising costs.*
- However! Electrification is not always guaranteed to be beneficial or cost less.
- The approach matters and is influenced by many factors:
  - timing,
  - improvements to adjacent systems,
  - and/or occupant/facilities manager buy-in
  - .... **and other barriers**



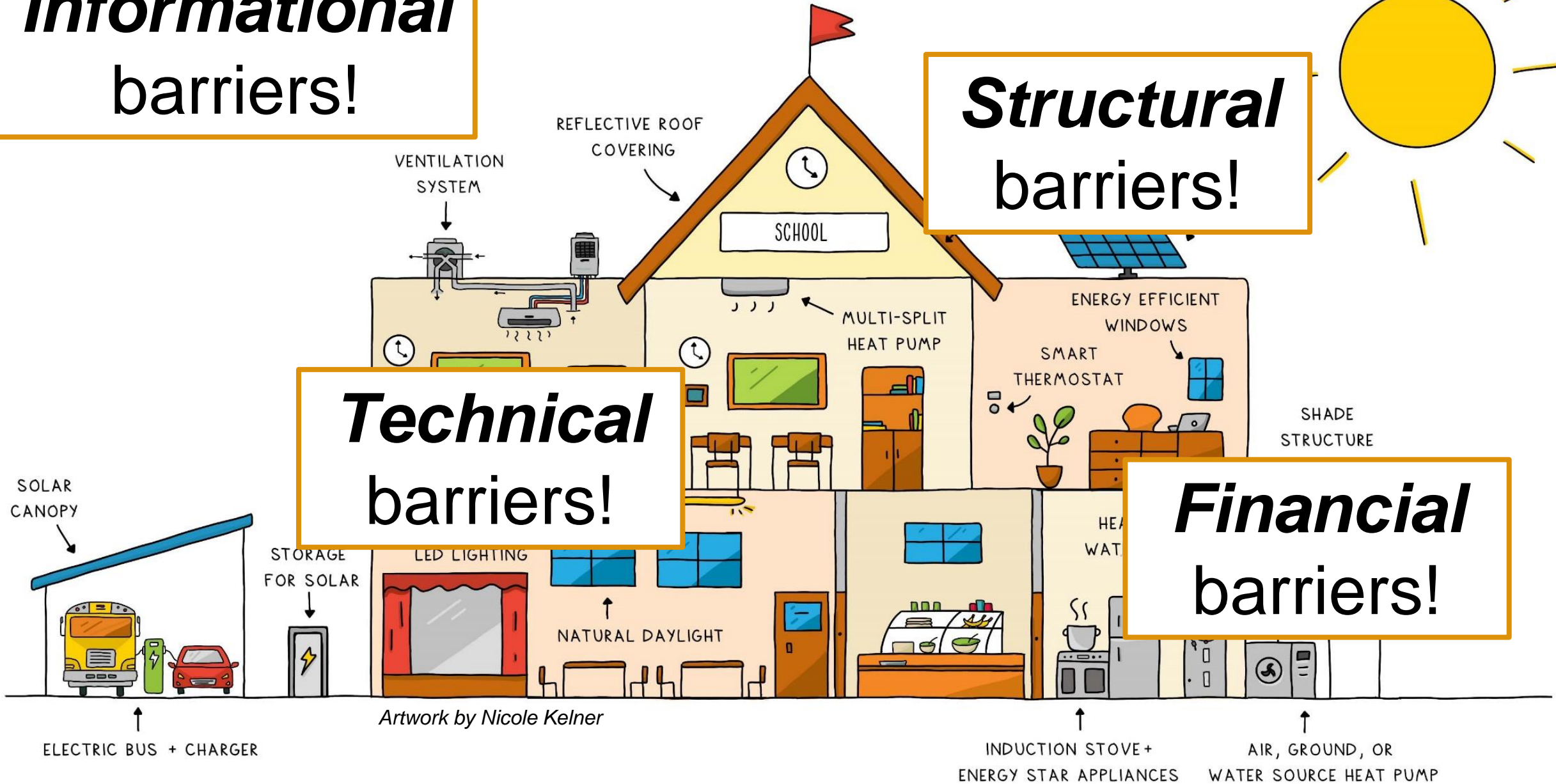
Artwork by Nicole Kelner

**Informational**  
barriers!

**Structural**  
barriers!

**Technical**  
barriers!

**Financial**  
barriers!



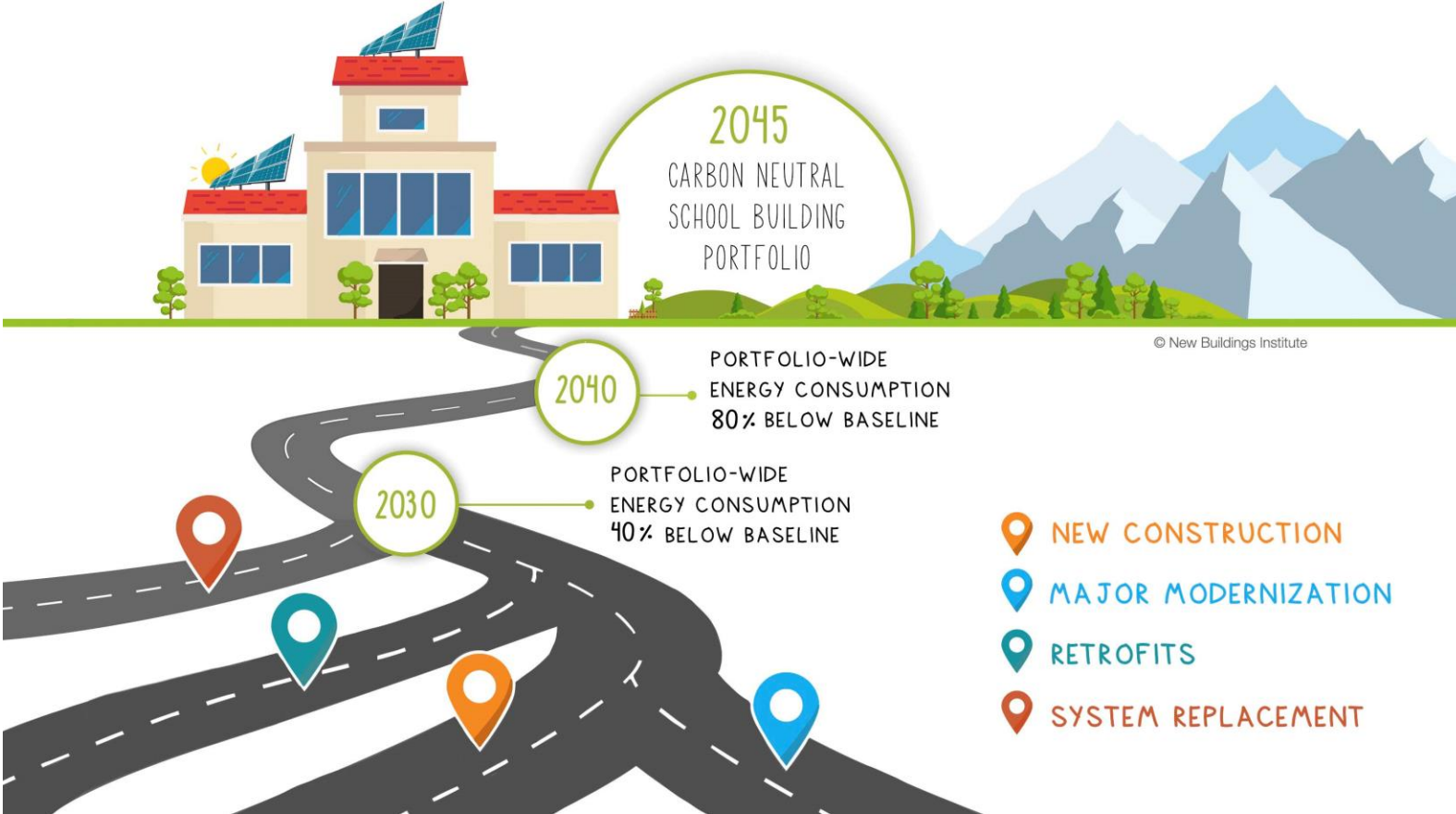


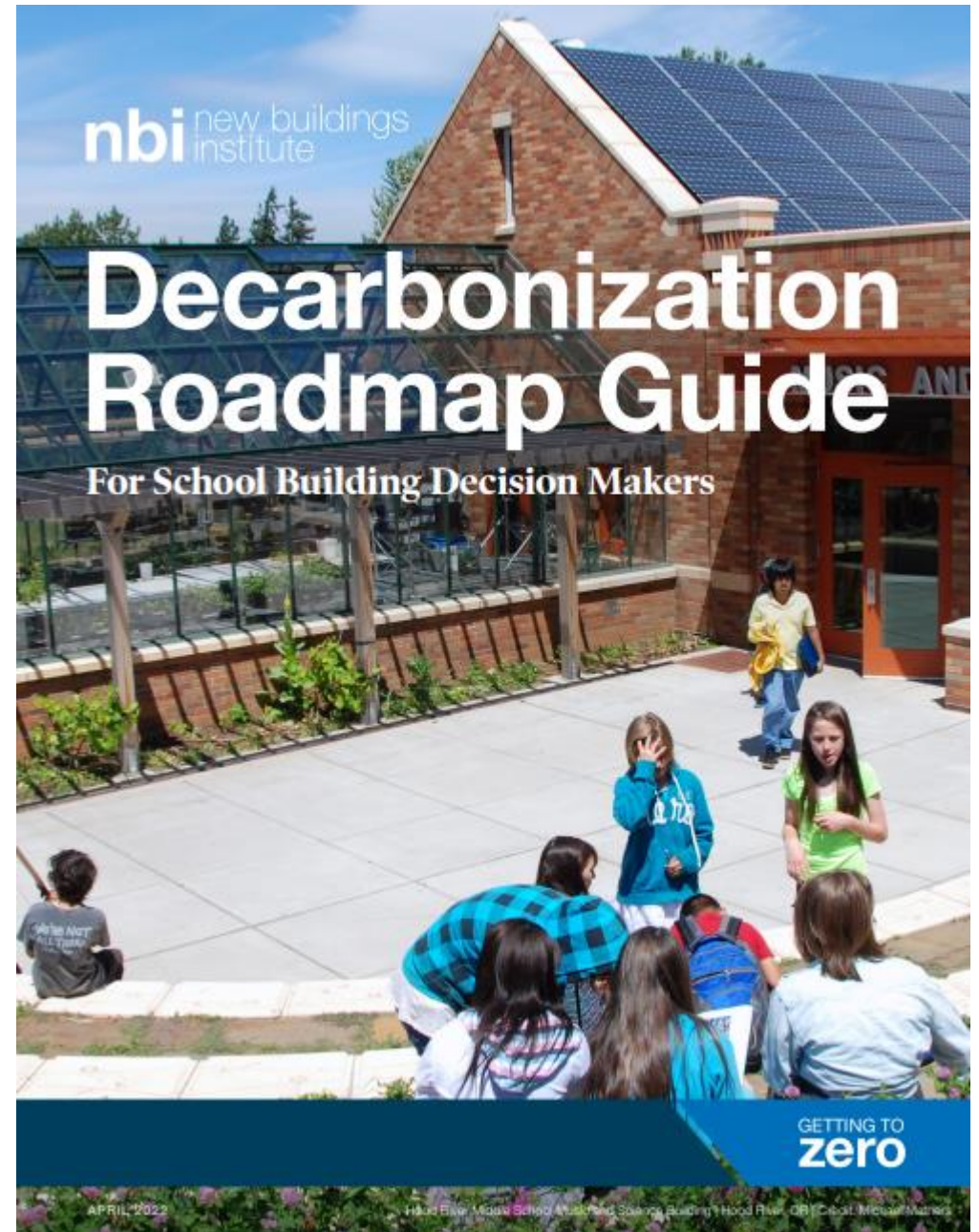
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# Planning for Lifecycle Events

# Overall approach

**Getting to zero over time** is a concept that ensures the correct tools are in place to address a building lifecycle event in a way that aligns with the school district's long-term energy, electrification, and carbon reduction goals.







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# Electrification scenarios

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## Event in Building Lifecycle

## Goals

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### Emergency Replacement

Minimal upfront costs, non-invasive installation, readily available equipment

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### Planned/Routine Capital Improvement & Deferred Maintenance

Minimal upfront costs, non-invasive installation, some lead time and planning for improved air quality

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### Efficiency & Cost Savings Project (Deep Efficiency Retrofit)

Lifecycle cost savings on utility bills and maintenance

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### Addition to Existing Building

Minimal upfront cost, lifecycle cost savings, improved air quality, fitting in with existing systems

# Electrification scenarios

## Event in Building Lifecycle

## Goals

**Be proactive to avoid this one!**

### Emergency Replacement

Minimal upfront costs, non-invasive installation, readily available equipment

### Planned/Routine Capital Improvement & Deferred Maintenance

Minimal upfront costs, non-invasive installation, some lead time and planning for improved air quality

### Efficiency & Cost Savings Project (Deep Efficiency Retrofit)

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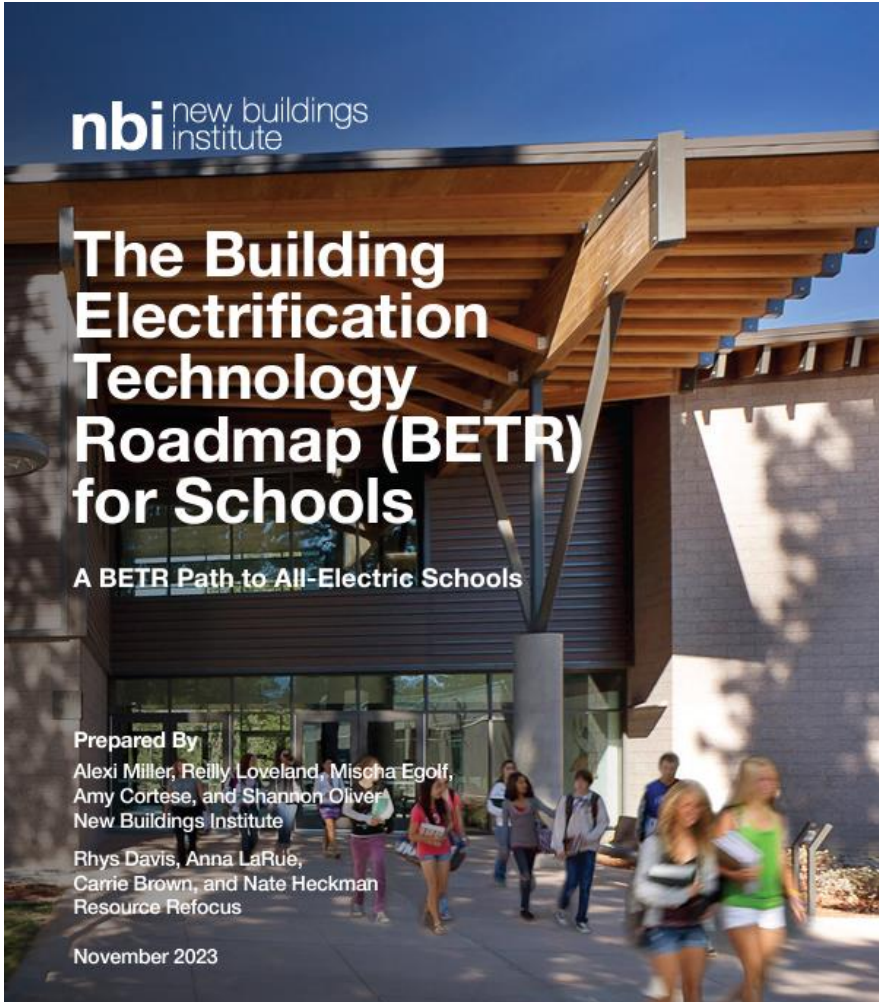
Minimal upfront cost, lifecycle cost savings, improved air quality, fitting in with existing systems

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# Electrification Technology and Cost in Schools



# BETR Report and Interactive Tool



Intro Cost Estimator Overall Summary Upfront Costs per ft<sup>2</sup> Upfront Total Costs

## Upfront Cost Estimation Tool

Input your school building size and select the prompts from the dropdown menus below to calculate upfront cost estimates by equipment type and end use. See intro tab for more details on the inputs.

Input Your Building Size in ft<sup>2</sup>

15,000

*Note: For most equipment, this tool uses average \$/sq ft values to estimate upfront project costs. If your square footage is greater than 25,000 square feet, select "Large" as your building type.*

Select your project type

Emergency Replacement

Select your building type

Small

What type of equipment are you planning to upgrade?

(All)

Select the specific equipment to estimate

(All)

## Range of Total Upfront Electrified Equipment Investment Costs

End Use	Electric Equipment	Total Cost Estimate Low	Total Cost Estimate High
Cooking	Countertop Kitchen Equipment	\$500	\$5,800
	Domestic Hot Water		
Domestic Hot Water	120 Volt HPWH	\$2,100	\$3,400
	Tankless Water Heater	\$4,100	\$26,900
Laundry	Heat Pump Dryer	\$400	\$2,200
Space Conditioning	Multi-Zone Rooftop Heat Pump	\$121,500	\$272,200
	Single-Zone Rooftop Heat Pump	\$148,500	\$515,700
<b>Grand Total</b>		<b>\$277,200</b>	<b>\$826,200</b>

With Sponsorship From

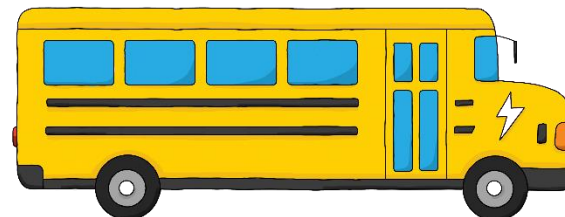
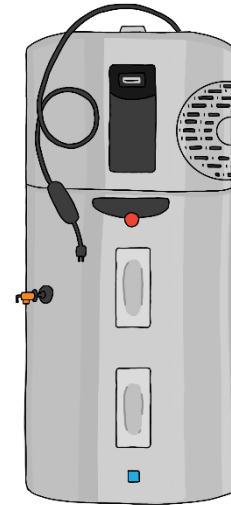


South Tahoe High School | South Lake Tahoe, CA  
Photo Credit: LPA Architects

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# Electric technologies for schools

- Space conditioning and ventilation (HVAC)
- Water heating
- Kitchens and cooking
- Laundry
- Transportation



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# What do we need to know about electrification options?

- In what **scenarios** are they feasible?
- In what **building types** are they appropriate?
- Upfront **cost** and **installation** challenges
- **Energy** and **GHG** impacts
- **Air quality** impacts

# BETR Report Electrification Matrix Example



○ Low    ◐ Medium    ● High  
Full circles are most desirable.

TECHNOLOGY	UPFRONT COST RANGE (\$/SF)		SCENARIO				BUILDING TYPES			UTILITY COST IMPACT		BENEFITS				
	Low	High	Emergency Replacement	Planned Capital Improvement	Deep Efficiency Retrofit	Addition to Existing Building	Small	Large	Relocatable	Lower or similar utility costs	Likely to increase utility costs	Ease of Maintenance	Ease of Install	IAQ improvement potential	GHG emission reduction	Low GWP Refrigerant Option
Packaged Terminal Heat Pump	\$1.03	\$1.48	✓						✓	✓		●	●	-	○	✓
Single-Zone Ducted Package ASHP + MERV 13	\$9.90	\$34.38	✓	✓		✓	✓	✓	✓	✓		○	●	○	◐	
Single-Zone Non-Ducted Minisplit ASHP w/ DOAS	\$11.90	\$17.47		✓	✓	✓	✓		✓	✓		◐	◐	●	●	✓
Multi-Zone Ducted ASHP + MERV 13	\$8.10	\$18.15	✓	✓		✓	✓		✓	✓		○	●	○	◐	
Multi-Zone Multi-split ASHP w/ DOAS	\$10.82	\$25.27			✓		✓	✓		✓		◐	◐	●	●	✓
Air-to-Water Hydronic Heat Pump	\$4.09	\$8.40		✓	✓	✓		✓			✓	○	○	-	◐	



# Existing Gas Equipment: Electric Options

Existing Gas Equipment	Emergency Replacement Electrification Option	Replacement Electrification Option
Wall mounted A/C & gas furnace	Yes	Yes
Single zone A/C & gas RTU	Some	Yes
Multizone A/C & gas RTU	No	Yes
Central boiler	No	Some
Instantaneous gas water heater	Some	Yes
Unitary gas storage water heater	Some	Yes
Central gas water heater	No	Yes
Small countertop gas kitchen equipment	Yes	Yes
Commercial gas kitchen equipment	No	Yes
Small gas laundry equipment	Yes	Yes
Commercial laundry equipment	Some	Yes

# Existing Gas Equipment: Electric Options

Existing Gas Equipment	Emergency Replacement Electrification Option	Replacement Electrification Option	Electrification Option with:		
			Similar First Cost	Lower Utility Cost	IAQ Improvement
Wall mounted A/C & gas furnace	Yes	Yes	Yes	Yes	Some*
Single zone A/C & gas RTU	Some	Yes	No	Yes	Some*
Multizone A/C & gas RTU	No	Yes	No	Yes	Some*
Central boiler	No	Some	No	No	Some*
Instantaneous gas water heater	Some	Yes	Some	Some	
Unitary gas storage water heater	Some	Yes	Some	Yes	
Central gas water heater	No	Yes	No	Some	
Small countertop gas kitchen equipment	Yes	Yes	Some	Yes	Yes
Commercial gas kitchen equipment	No	Yes	Yes	Some	Yes
Small gas laundry equipment	Yes	Yes	Some	Yes	
Commercial laundry equipment	Some	Yes	Some	Yes	

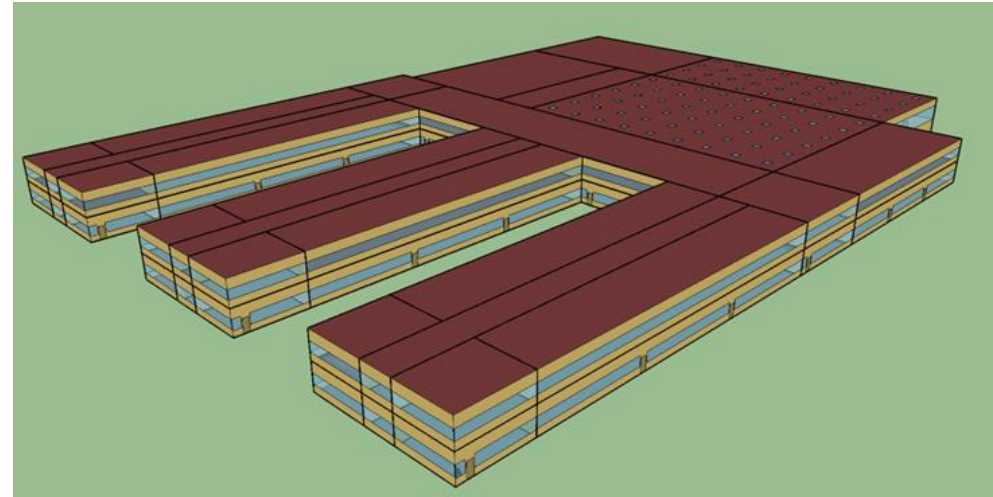
# Installation Considerations

- Do panels need to be upsized?
- Can existing infrastructure be used?
  - Wiring
  - Piping
  - VAV boxes
  - Ducts
- Are there many components?
- Is a regulatory review required?



# Operation Considerations

- Each project will require **custom hourly energy modeling** to determine **specific** energy cost and GHG impacts
- However, based on system efficiencies and typical designs, we can **estimate impacts** of technologies **relative to the existing system**

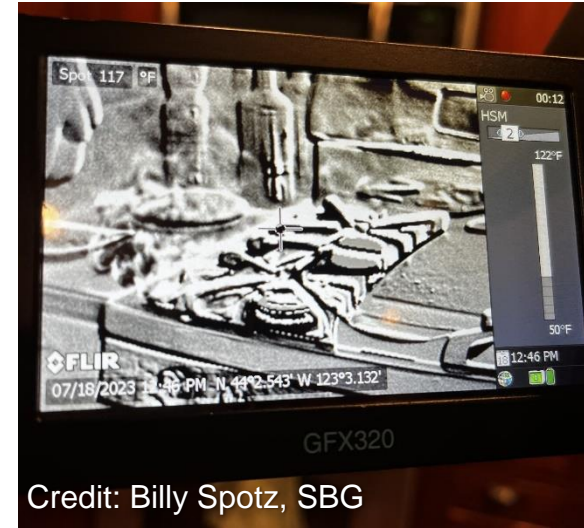


Credit: Department of Energy

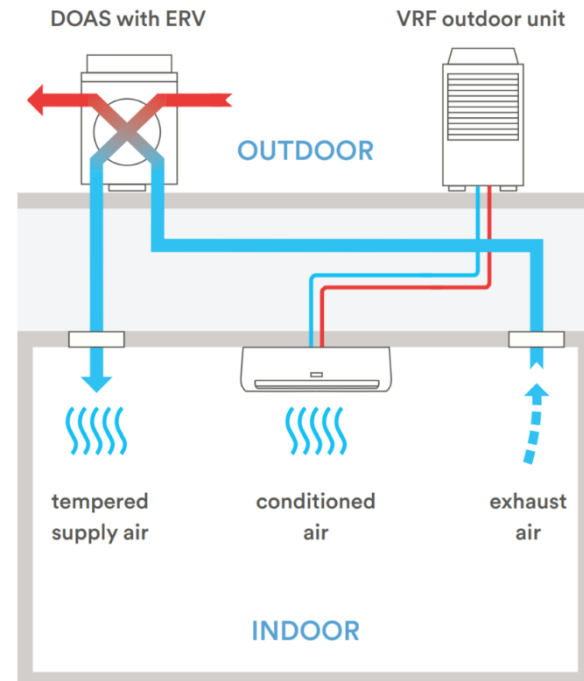


# Air Quality Considerations

- **Existing** school building systems often do not provide **sufficient air quality needs**
- Electrification retrofits can address air quality issues
  - **Indoor** gas combustion **replaced** by electric
  - **Retrofitted ventilation systems** combined with electric space conditioning



Credit: Billy Spotz, SBG



Credit: Building Energy Exchange

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# Electric technologies for schools: key takeaways

- **Make a plan!**
- **HVAC** replacements will have the **biggest impact**
- Always choose **heat pumps!**
  - Look for **low-GWP** refrigerant
- Select **ENERGY STAR** certified equipment
- Consider how retrofits can support **air quality improvements**
- Consider electrical panel and transformer upgrades

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# Stacking the Opportunities to Pay for Electrification

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# Funding Stacking

- Schools experience a minimum annual funding gap of \$38 billion for facility upgrades and repairs (ASCE 2021).
- Funding stacking, the process of utilizing multiple funding streams for a larger result, is necessary to fill these gaps.



Socastee Elementary School | Horry County, SC

Credit: SfL+a Architects



# Common Stacking Mechanisms

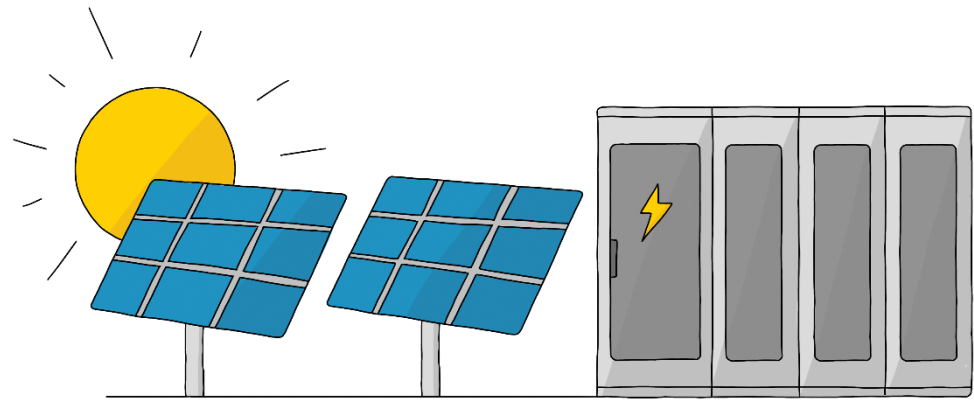
- Local bonds (or levies)
- State matching funds
- Utility incentives
- Low interest loans
- Grants
- Power Purchase Agreements (PPAs)
- Energy Savings Performance Contracts (ESPC's)
- ... **\*Creativity\***



Kellogg Middle School | Portland, OR

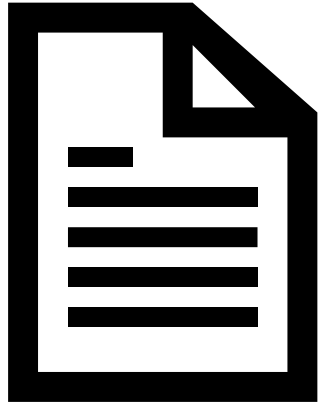
Credit: OhPD

But this creative approach stacking together funding opportunities can exhaust district staff and resource channels.



*Artwork by Nicole Kelner*

# Enter stage right... A generational funding event!



The Bipartisan  
Infrastructure Law  
(BIL)



The Inflation  
Reduction Act  
(IRA)



DOE Renew America's Schools



EPA Clean School Bus



IRS Investment Tax Credit (ITC)

+ Energy CLASS Prize, Supporting America's School Infrastructure (SASI) and more!

# The Bipartisan Infrastructure Law (BIL)

**RENEW AMERICA'S SCHOOLS** = Competitive grant program for energy improvements at public school facilities

## Funding

\$500M (\$100M over five years, FY22-FY26), until expended, through competitive grants.



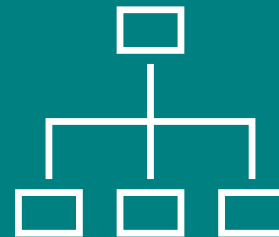
## Qualifying Energy Improvements

Improvements, repairs, or renovations that reduce energy costs or lead to improved teacher and student health and achieve energy savings.



## Eligible Entities

Consortia of 1 local educational agency (LEA) and one or more schools, non-profits, for-profits, or community partners.



## Prioritization

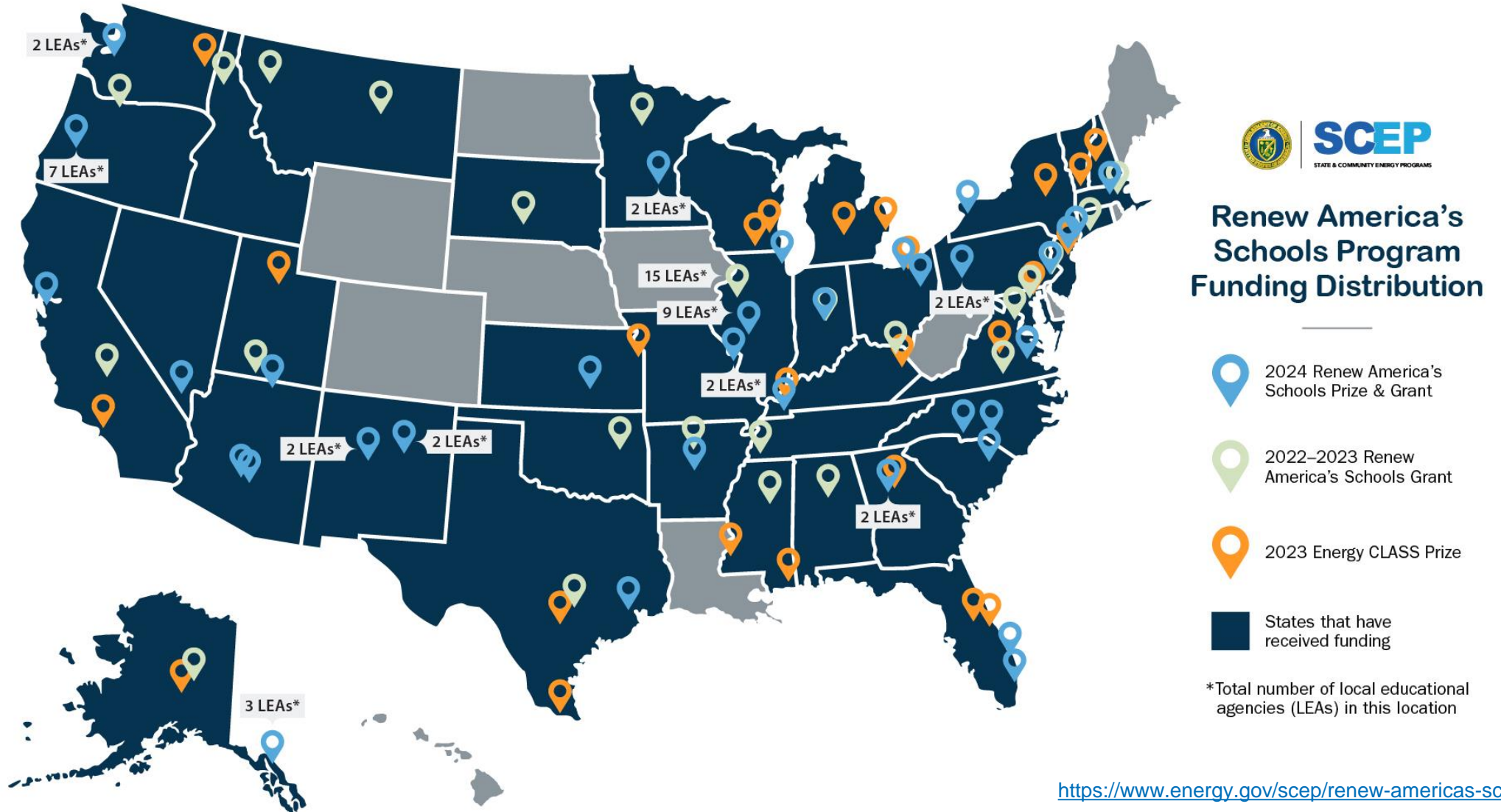
Schools with improvement funding needs, high free and reduced-price lunch percentage or rural locale, and leverage private sector funding through performance contracting.





# The Bipartisan Infrastructure Law (BIL)

**RENEW AMERICA'S SCHOOLS** = Competitive grant program for energy improvements at public school facilities



# The Bipartisan Infrastructure Law (BIL)

EPA Clean School Bus Program = Competitive rebate and grant program



## Funding

\$5 billion over five years (FY 2022-2026) to clean a substantial portion of the nation's fleet of nearly 500,000 school buses



## Bus Replacement

These new cleaner school bus replacements will produce either zero or low emissions compared to their older diesel predecessors, resulting in cleaner air on the bus, in bus loading areas, and in the communities in which they operate.



## Impact

School buses travel over four billion miles each year, providing the safest transportation to and from school for more than 25 million children every day. What if Electric School Buses could be used to supply power when off Duty?



## Benefits

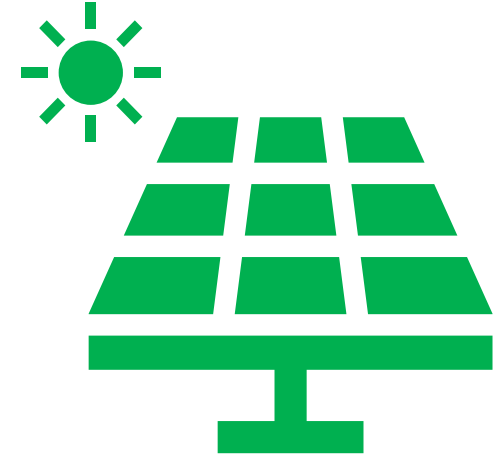
- **Cleaner air.** Clean school buses eliminate or reduce school bus exhaust, which is linked to asthma.
- **Reduced health risks,** especially for children whose lungs are still developing.
- **Reduced greenhouse gas emissions,** which contribute to climate change.
- **Cost savings** from reduced maintenance and fuel costs.
- **Resiliency.** can provide power to the grid or buildings during power shutdowns.

# Inflation Reduction Act

The largest investment in climate and clean energy in United States history.

## Direct Pay/Elective Pay: Tax-free cash payments

- **Investment Tax Credit (ITCs):** Applied to upfront costs of clean energy systems (solar, storage, geothermal, etc.)
- **Commercial Clean Vehicle Credit:** Applied to upfront costs of installing electric school buses.
  - Max credit \$40k
  - Non-competitive, uncapped, can be combined with grants for EV buses
- **Alternative Fuel Refueling Property Credit:** Applied upfront to costs of EV charging equipment for buses or passenger vehicles.
  - Max 30% of costs, or \$100,000 per unit
  - Non-competitive, uncapped, can be combined with grants for charging equipment



### Direct Pay Technologies covered:

- Solar & Wind
- Ground Source Heat Pumps
- Energy Storage
- Electric Vehicle Chargers

# Inflation Reduction Act

Direct Pay/Elective Pay – Cash for Clean Energy Examples

Elective pay allows **tax-exempt and governmental entities to receive a cash payment** from the IRS for eligible clean energy investments.

- Example: school district invests \$1,000,000 in tax-credit eligible solar, battery storage, and EV chargers at a school.
- Cash-back: Through elective pay, school district receives a **\$300,000 cash payment from the IRS** if it qualifies for relevant 30% investment tax credits.



## More Details

- [IRS.gov/ElectivePay](https://www.irs.gov/ElectivePay)
- [IRS Elective Pay FAQ](#)
- [CleanEnergy.gov/DirectPay](https://www.CleanEnergy.gov/DirectPay)
- [Publication 5817-G \(6-2023\) \(irs.gov\)](#)



# Inflation Reduction Act



[Inflation Reduction Act](#)

[Our Latest](#)

[Where We Work](#)

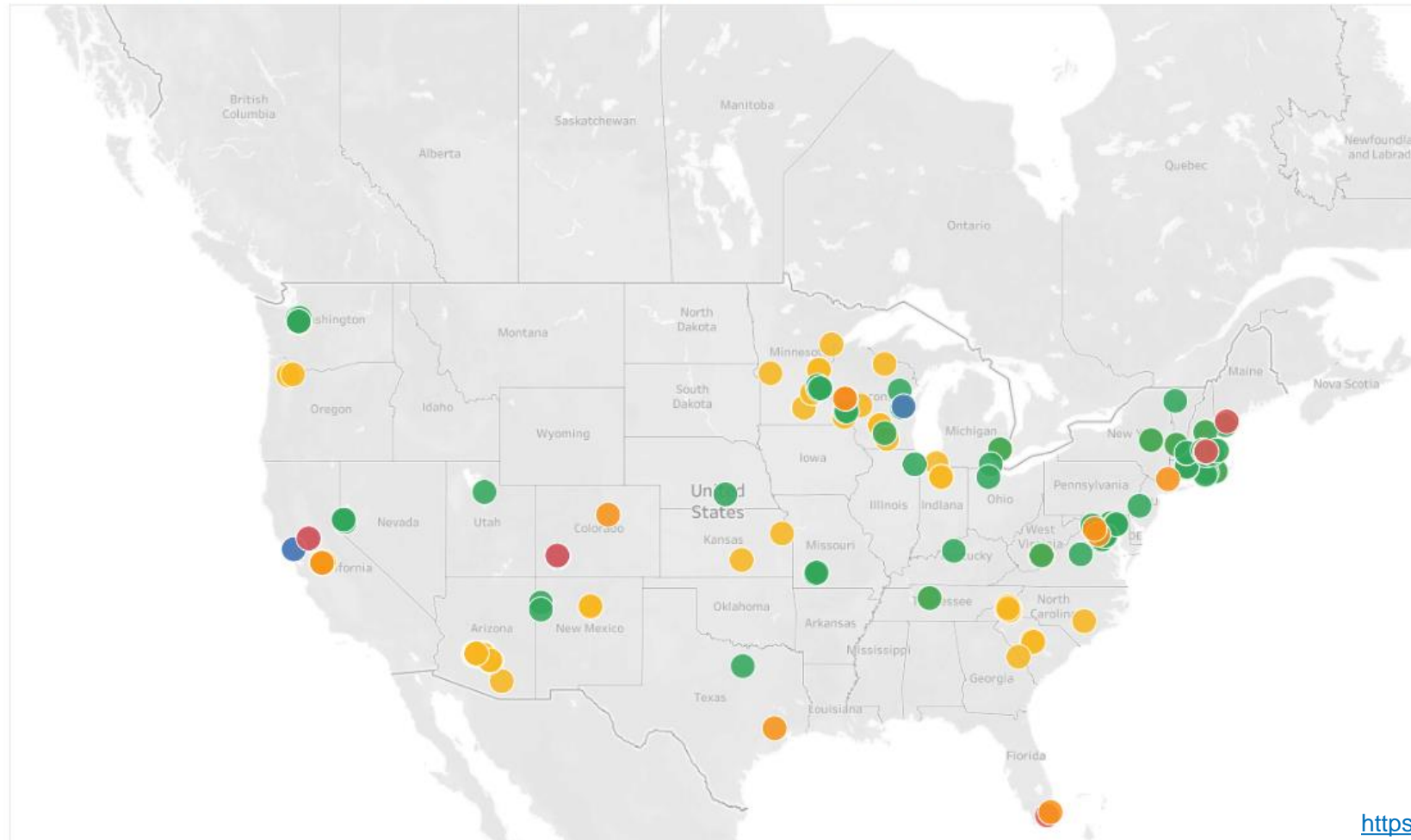
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## School Investments in Clean Energy with the Inflation Reduction Act



# Example of Stacking

EPA Clean School Bus + DOE Renew America's Schools Grant + PPA + Local Bond/Operating Budget

Completion of this project will result in Electric School Bus-2-Grid assisted resilient microgrids on the campuses of fifteen Illinois public school districts

Each microgrid will integrate solar, stationary storage, mechanical switchgear, Vehicle-to-Grid (V2G) Electric Vehicle (EV) charging, and at least 1 electric school bus per district with energy discharge capabilities. Our project anticipates the following installed system capacities.

- 3 schools with 400 Kilowatt (KW) solar arrays coupled with 500-kWh (kilowatt hour) stationary battery storage
- 9 schools with 800 KW solar arrays coupled with 1,000-Kilowatt hour (kWh) stationary battery storage
- 3 schools with 1,000 KW solar arrays coupled with 1,000 kWh stationary battery storage

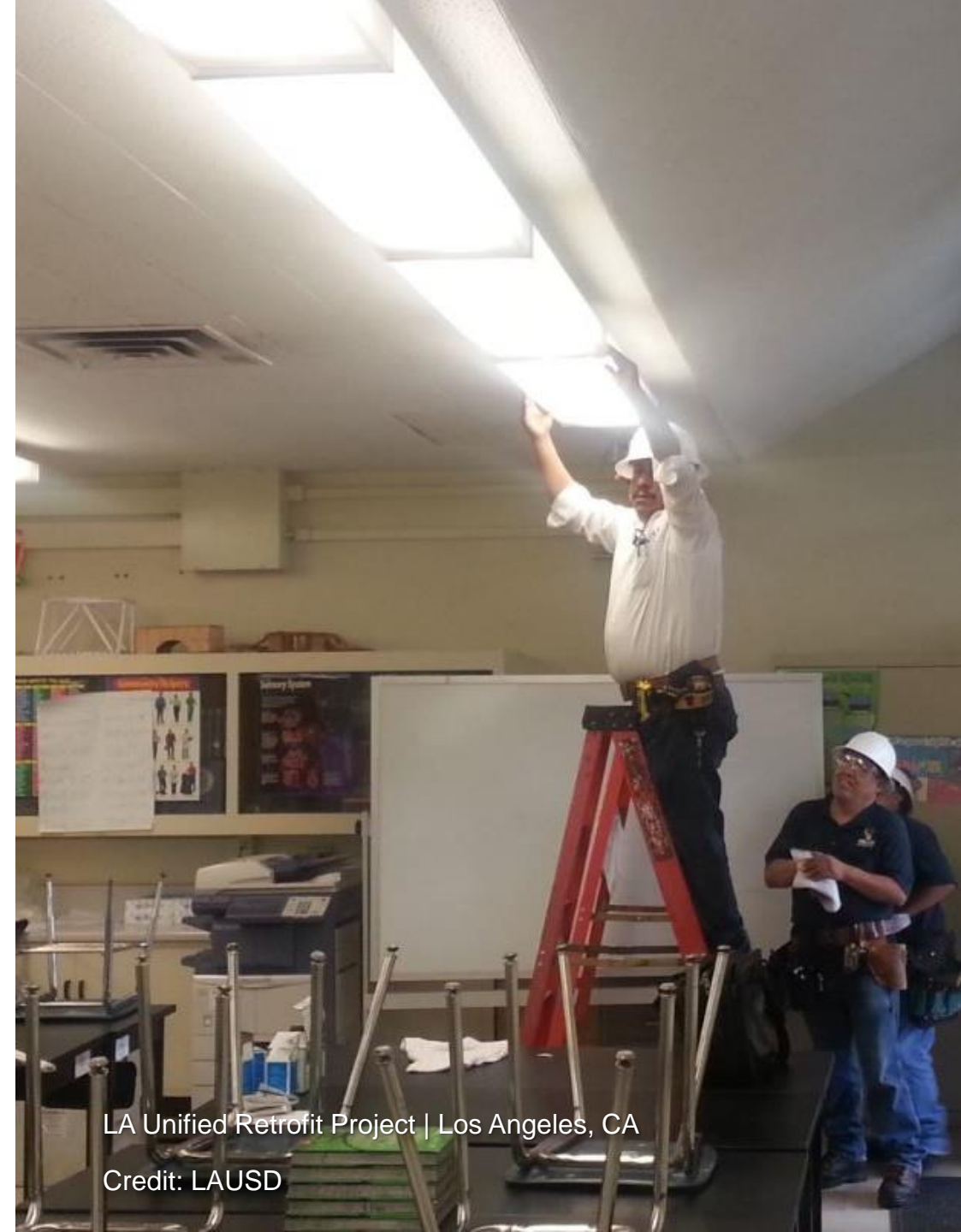
It is anticipated that at least 10 participating school districts will enter into a PPA.

**EPA CLEAN SCHOOL BUS** + **DOE RENEW AMERICA'S SCHOOLS** + **POWER PURCHASE AGREEMENT** + **LOCAL DOLLARS**

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# Barriers still exist with this funding event

- Funding stacking has limitations, such as "double-dipping" restrictions and reduced funding if other sources are secured
- Short term funding may be needed to bridge first costs before rebates and incentives kick in
- State and federal funding have different project activity eligibility requirements/timelines
- Staff capacity limitations



LA Unified Retrofit Project | Los Angeles, CA

Credit: LAUSD



# District Decarbonization Roadmap

**Aaron Presberg**





# District Overview

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**44,771  
Students**

**81  
Schools**

**10 million  
Square Feet**

**8,200  
Employees**

# Climate Justice

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The Policy states:

***Climate change disproportionately impacts the vulnerable members of our community. Implementation of this policy will prioritize serving people with disabilities, communities of color, and other vulnerable populations.***

## **Advancing the Graduate Portrait**

- Transformative Racial Equity Leaders
- Influential and Informed Global Stewards
- Optimistic and Future-Oriented Graduates



# PPS Climate Crisis Response, Climate Justice, and Sustainable Practices Policy (CCRP)

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Passed March 2022

## PPS Commits to swiftly mobilize resources for climate action to:

- **Reducing greenhouse gas (GHG) emissions** and minimizing other negative environmental impacts;
- improving our school communities' **health and wellness**; and
- building a **culture of learning**, responsibility, and sustainability centered on our values of **racial equity and climate justice**.
- educate and **empower students as leaders** in the just transition to a sustainable city and restorative society.



# Policy Commitment

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## 10 Goals, 75+ Objectives over Three Policy Pillars:

- **Pillar 1:** Reduce Environmental Costs and Impacts
- **Pillar 2:** Improve Health and Wellness
- **Pillar 3:** Provide Effective Environmental and Sustainability Education

## Decarbonization Commitment

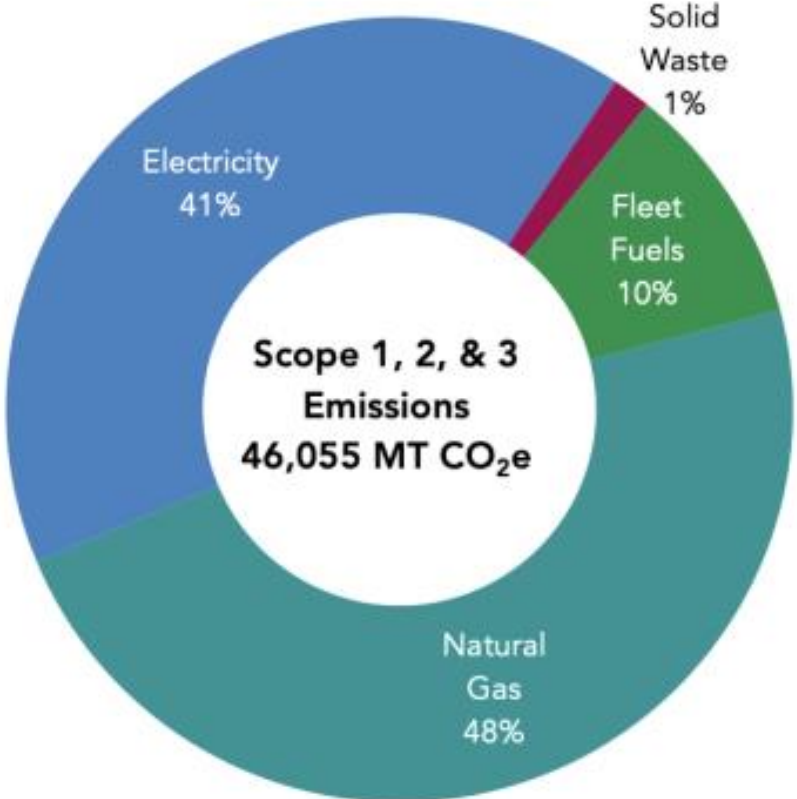
- **2030: 50% Reduction** GHG of 2018-2019 baseline
- **2040:** Reach **Net Zero** GHG Emissions
- **2050:** Phase out **all fossil fuel** infrastructure and equipment in new construction and existing buildings



# Greenhouse Gas Inventory

Buildings = majority of operational emissions → greatest opportunity

Figure 4: PPS's emissions by category



# Decarb Roadmap

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## How do we meet our decarb goals?

- **In what order should PPS implement GHG emissions reductions measures across schools and admin buildings in order to provide the best chance of meeting PPS emissions goals, given financial, industry, and facility constraints, while considering historic inequities in the distribution of resources across PPS?**
- **How do we incorporate this into ‘already planned’ projects?**
- **How much will it cost?**
- **What other factors do we need to consider?**
  - **Equity, health, thermal comfort, facility condition**

# Decarb Roadmap

HS Cluster, Display Name

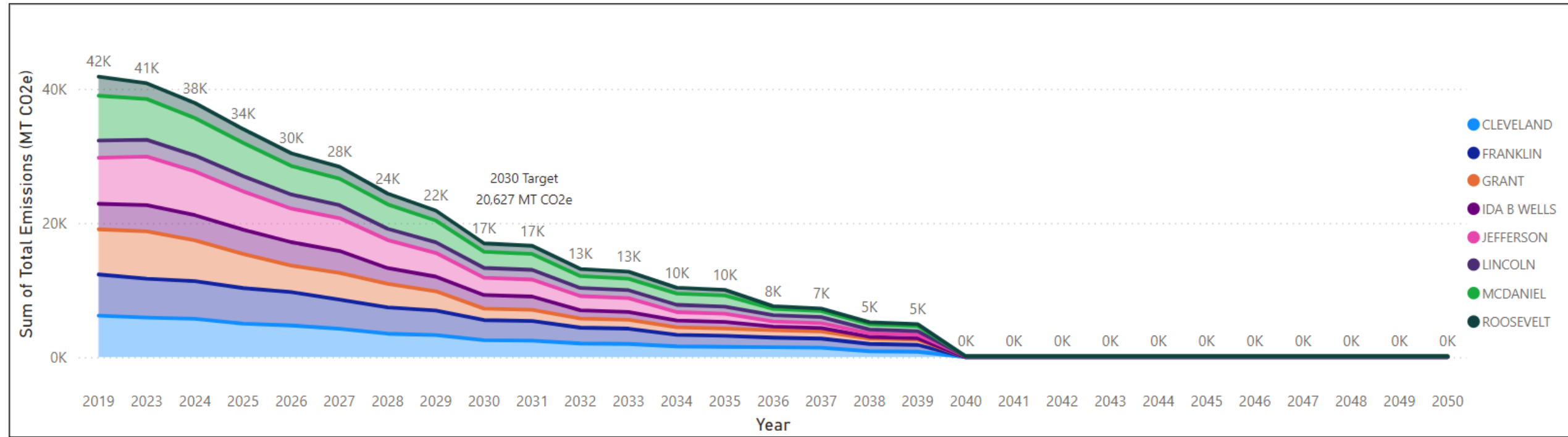
All

Facility Type, Primary Use

All

Priority School

All







# Building Electrification: The Key to Decarb?

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**Grid mix:  
Renewable vs.  
Fossil fuels**

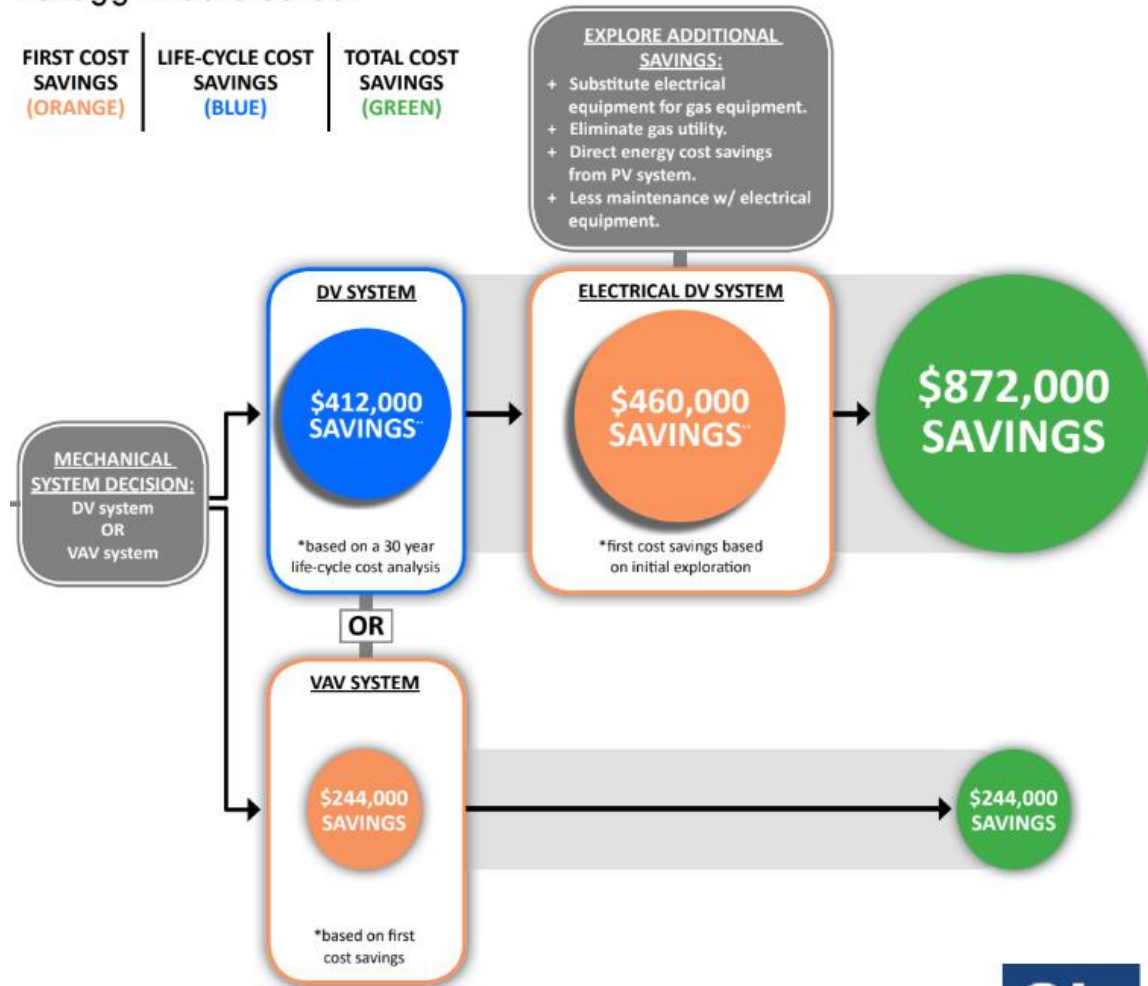
**State goals for  
100% renewable  
grid**

**What about  
electrical  
capacity?**

**What about  
Culinary Arts and  
Bunsen burners?**

# Building Electrification: Kellogg Middle School

Kellogg Middle School



# Stacked Funding

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**SB 1149**

**Energy Trust of  
Oregon**

**Portland Clean  
Energy Fund**

**Bond**

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# Where We Go From Here




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# Key Takeaways

- Building electrification can **enhance educational environments** and **mitigate climate impacts**.
- **Electrifying schools is not a one-size fits-all endeavor.** It requires careful consideration of local contexts, available resources, and long-term goals.
- **Planning for lifecycle events** and incorporating electrification strategies into routine capital improvements can **help minimize cost**.
- **Make the most of available funding** by tapping into and stacking opportunities such as federal grants, tax credits, and low-interest loans, local funds, etc.



- 
- 
- There is a **pressing need for action** and attention on our school infrastructure
  - Despite the relatively large financial investments from the federal government in schools, **the available funding is only a small percentage of what is needed.**
  - **Districts lack capacity** and know how to plan for long-term electrification approach

**So what can YOU do?**

- 
- Help districts **develop long-term plans** to take advantage of lifecycle events
  - Support districts with **staff training** and identifying and applying for **funding opportunities**
  - Encourage districts to **formalize goals into documentation**
  - **Share success stories!**



Want to support schools, find assistance and resources related to decarbonization, planning, funding, and more?

Join the Efficient Healthy Schools Program!

<https://efficienthealthyschools.lbl.gov/form/join>



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Questions?