Efficient and Healthy Schools Recognition Program

Emission Reductions and Resilience

April 4, 2023

EFFICIENT AND HEALTHY SCHOOLS

Emission Reductions and Resilience Webinar 3:

Take Action on Climate! Planning for Climate Vulnerability and Resiliency in Schools

EFFICIENT AND HEALTHY SCHOOLS

Today's Presenters

Julia Rotondo
Project Manager
Pacific Northwest National Lab (PNNL)

Craig Schiller
Executive Director
Collaborative for High Performance Schools (CHPS)

Alex Buchanan
Technical Lead
Collaborative for High Performance Schools (CHPS)

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Today's Agenda

- Introductions and Level Setting
- Session Recap
- Framing Resilience within Schools: *Craig Schiller and Alex Buchanan*
- Leveraging Technical Resilience Navigator (TRN) for School Resilience Assessments: *Julia Rotondo*
- Developing your plan breakout groups

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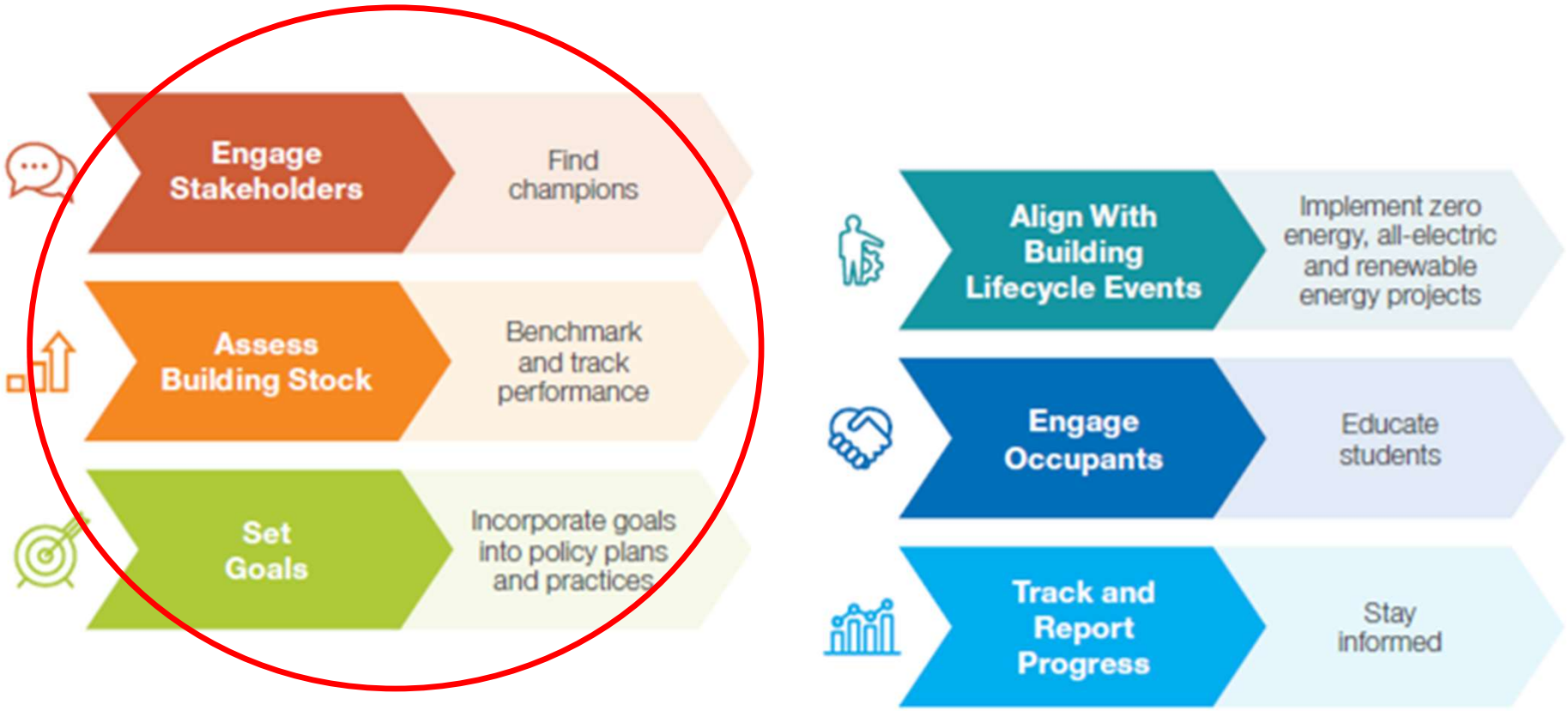
Let us know who is here!

Introduce yourselves in the chat with your **name**, **title**, and **school district**

Quick Session Recap

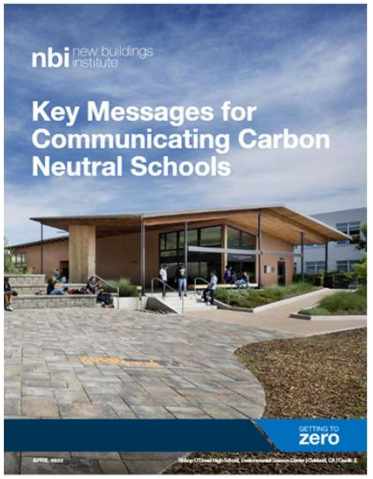
Key Approaches and Outcomes in Achieving Efficient and Healthy Schools

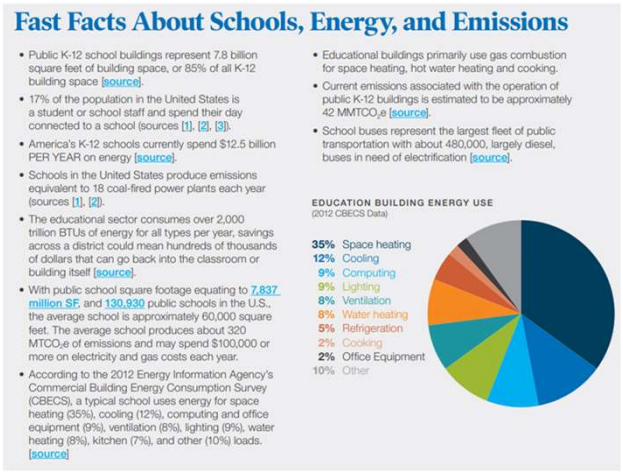


Stakeholder Engagement and Visioning

Making the case for efficiency and health

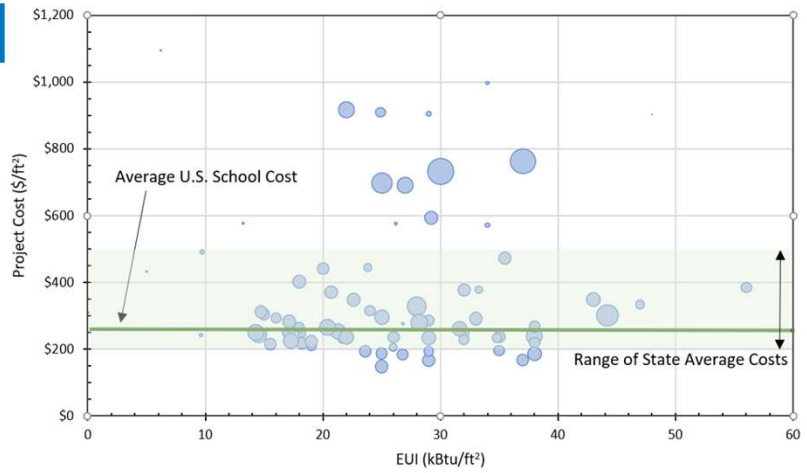
Engage Stakeholders → Find champions





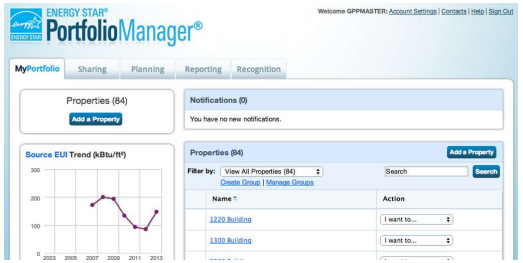
Zero Energy School Costs

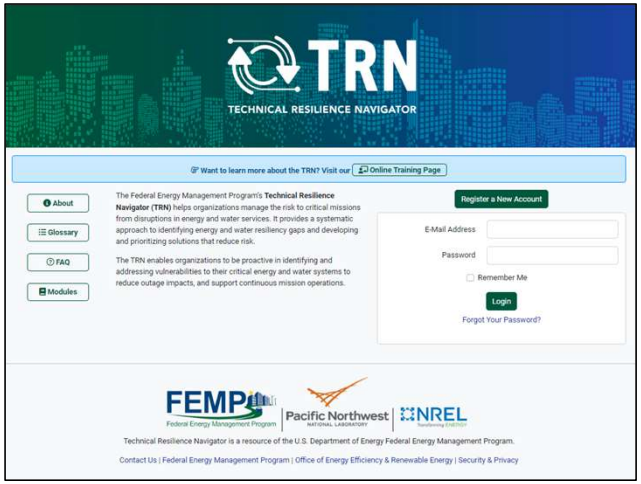
https://www.nrel.gov/docs/fy20osti/77414.pdf



Assessing Building Stock for Emissions, Climate, and Resiliency

Building Assessment Tools for School Energy Retrofits





Goal Setting

Portfolio Goals

Goals require clear ways to measure progress. The baseline leverages benchmarking data and documents energy performance and carbon emissions in the school district's facilities for a specific year. This baseline year is then used for future comparisons and to track changes over time. Ideally, it is a specified time in the past for which your district has a complete dataset on its buildings. For many of the example below we have suggested using a 2019 baseline.

Individual Building Goals and Targets

Having absolute energy goals measured as an EUI (as opposed to a percent better than code goal) in place early—before design even begins—is a helpful way to ensure buy in from the design team and manage costs. Use the Advanced Energy Design Guide for Zero Energy K-12 Schools (Table 3-1: Target EUI) to set climate-specific, new construction and major modernization EUI targets and goals. Appendix B in the Advanced Energy Design Guide for Zero Energy K-12 Schools can be utilized to identify the appropriate climate zone.

New Construction:

- Achieve LEED, CHPS, or another broad sustainability goal
- Be energy efficient and achieve a site energy use intensity of 17-25 kBtu/square foot/year
- Be all-electric and have no on-site fossil gas combustion
- Incorporate renewable energy sources to offset annual electricity use
- 5 total air changes per hour (ACH) for high indoor air quality
- Reduce life cycle impacts associated with high embodied carbon materials (like steel and concrete)
- Utilize low global warming refrigerants
- Integrate electric vehicle (EV) charging and fleet infrastructure
- Consider grid harmonization and battery storage

Major Modernization:

- Achieve LEED, CHPS, or some other sustainability goal
- Achieve a site energy use intensity of 25-35 kBtu/square foot/year or better
- 5 total air changes per hour (ACH) for high indoor air quality
- Eliminate on-site gas combustion or have a plan to eliminate gas by a target year signed off by the department director
- Reduce life cycle impacts associated with high embodied carbon materials (like steel and concrete),
- Utilize low global warming refrigerants

Retrofits:

- Improve the site energy use intensity by a minimum of 20%, targeting 50% from a YEAR *(decide on baseline year from benchmarking data. 2019 or 2018 suggested)* baseline.
- Include a written plan for future removal of all gas-combusting equipment, specify low global warming potential equipment and low embodied carbon materials

System Replacement:

- Phase out gas infrastructure where possible incorporate efficient, all-electric systems.

Framing Resilience within Schools

Craig Schiller and Alex Buchanan

Framing *Resilience* within Schools

Craig Schiller

Executive Director

April 4th, 2023

CHPS: A K12 Specific Standard

- Over **750** CHPS projects nationwide
- **70+** school districts have used CHPS
- **4** of top **20** largest schools require CHPS
- **Regularly Updated** by a National Technical Committee
- **250** Points Possible in 7 categories:
  - **Integration & Innovation, Indoor Environmental Quality, Energy, Water, Site, Materials & Waste Management, Operations and Maintenance**

CHPS
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Understanding the Language of Climate, Resilience, and Schools

Hazard Mitigation

Resilience

Vulnerability

Health

Adaptation

Climate Action

Sustainability

Net Zero Energy

Climate Mitigation

Climate Change

Key Definitions:

Sustainability	Actions to reduce the impact of human activity on the environment and future generations
Climate Change	The various ways in which our climate will change its effects due to anthropogenic sources
Climate Action	Actions to reduce greenhouse gas emissions (also called Climate Mitigation)
Risk	The probabilistic consequences of hazard x exposure and y vulnerability
Vulnerability	A combination of sensitive, condition, durability, and adaptive capacity
Resilience	The ability to withstand and adapt to a disturbance

Key School Resilience Concepts:

- **Human** Centric:
  - How does your school minimize disruption to student's learning and any negative impacts to mental health during natural or human caused disasters
- **Building** Centric:
  - How does your school stay operational during natural or human caused disasters?
- **Community** Centric:
  - How does your school support it's community during a natural or human caused disaster and throughout the recover process?

COVID, Shootings, Staff Shortages Etc.

Tornadoes, Hurricanes, Wildfires Etc.

'Resilience Hub'

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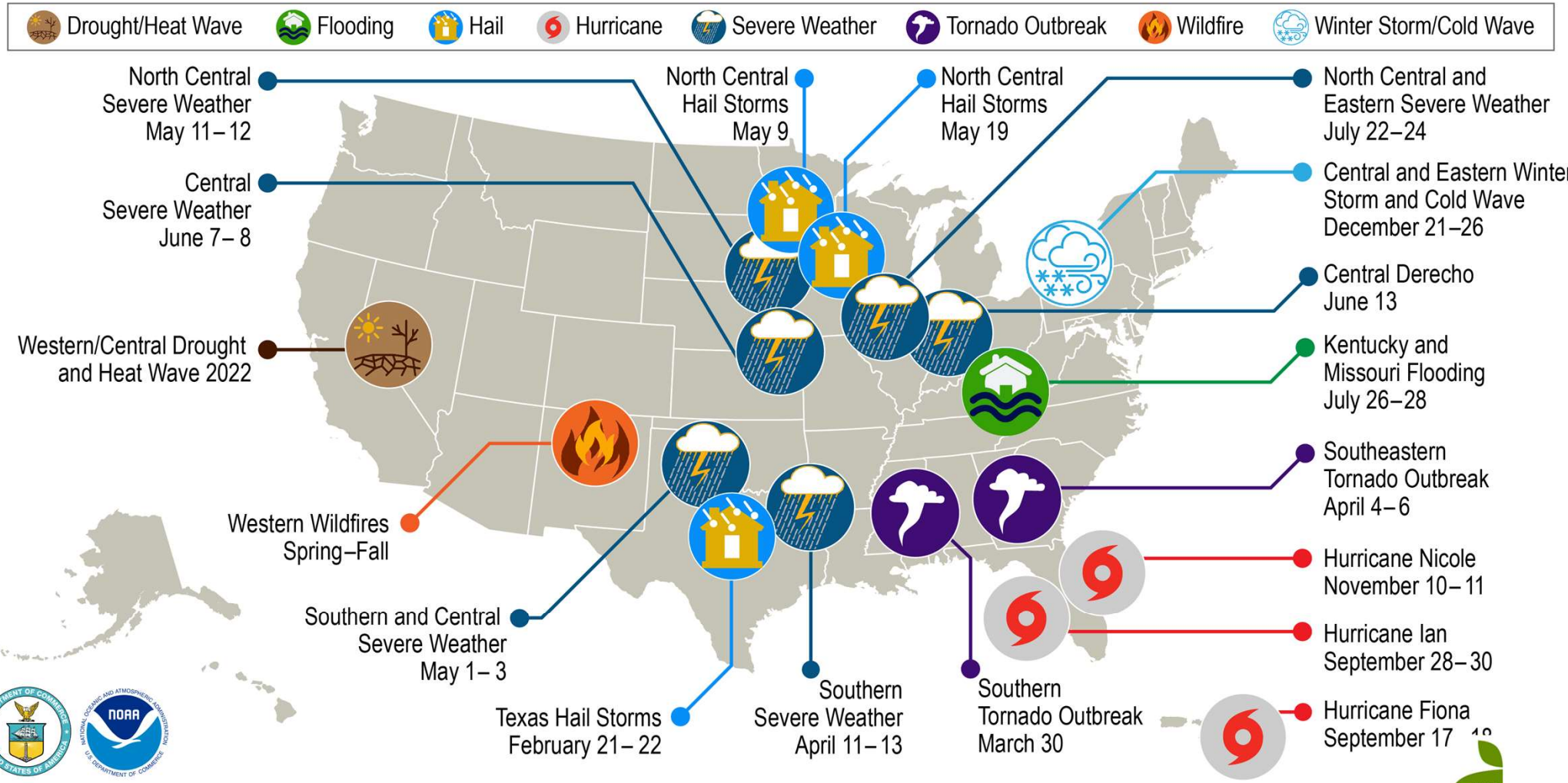
'Resilience Hub'

Climate resilience is…

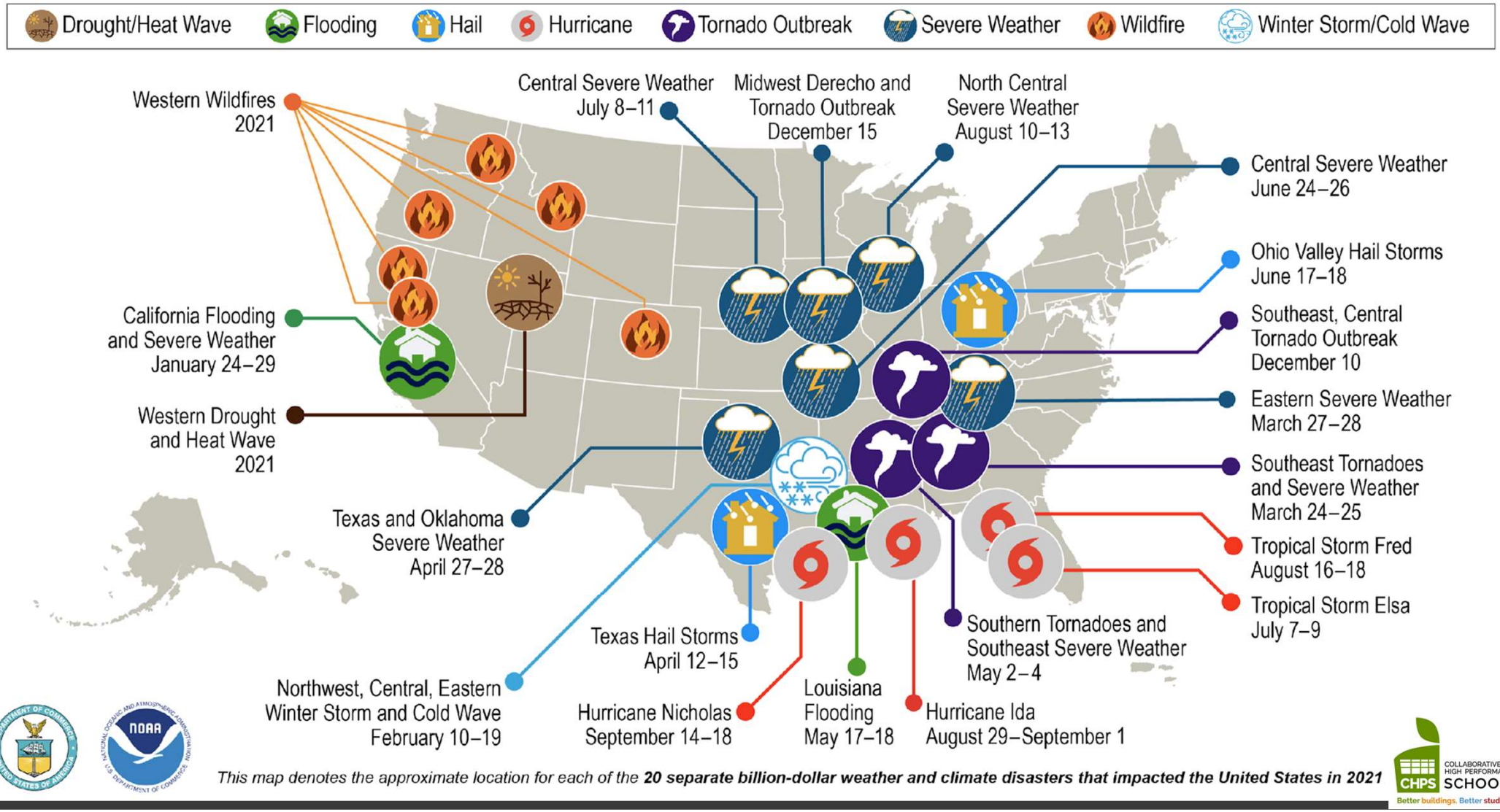
> “Drawing from the inherent strength of communities to bounce back stronger after an extreme weather event, as well as adapting to our changing climate.”

U.S. 2022 Billion-Dollar Weather and Climate Disasters



*This map denotes the approximate location for each of the **18 separate billion-dollar weather and climate disasters that impacted the United States in 2022.***

U.S. 2021 Billion-Dollar Weather and Climate Disasters



This map denotes the approximate location for each of the ***20 separate billion-dollar weather and climate disasters that impacted the United States in 2021***

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60 MINUTES OVERTIME ›

Babcock Ranch: Solar-powered "hurricane-proof" town takes direct hit from Hurricane Ian, never loses electricity

OCTOBER 9, 2022 / 6:56 PM / CBS NEWS

Photo courtesy of CMTA Inc.

Photo courtesy of CMTA Inc.

Photo courtesy of Sheman Carter Barnhart Architects

Richardsville Elementary School, Kentucky

- ✓ ICF Construction
- ✓ Can withstand 100+ mph winds
- ✓ Gymnasium is a shelter that withstands 250 mph winds

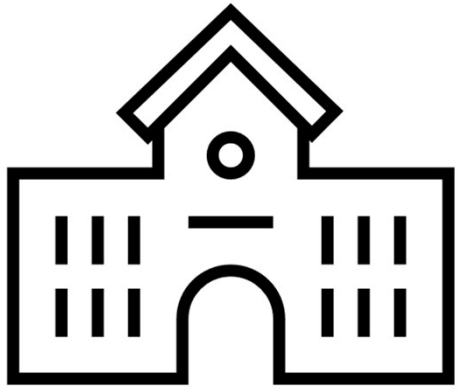
Specific *Criteria* for Resilient Schools

Alex Buchanan
Technical Lead
April 4th, 2023

Design for Adaptation & Resilience

Intent:

- Plan now for future changing conditions and disruptive events
- Mitigate the vulnerability of school facilities to climate change
- Allow schools to serve as sustainable centers of community resilience



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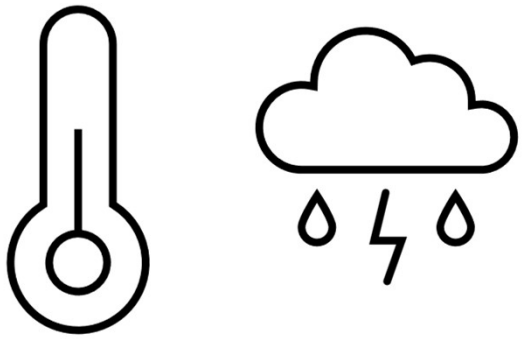
Design for Adaptation & Resilience

Considerations:

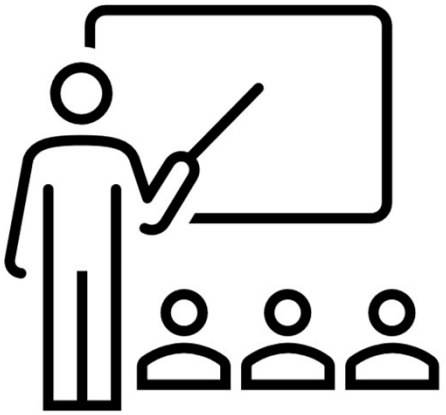
- Lifespan of the building (60-100 years)
- Climate change vulnerability
- Changing climatic conditions and weather-related hazards



Design for Adaptation & Resilience

How do we avoid:

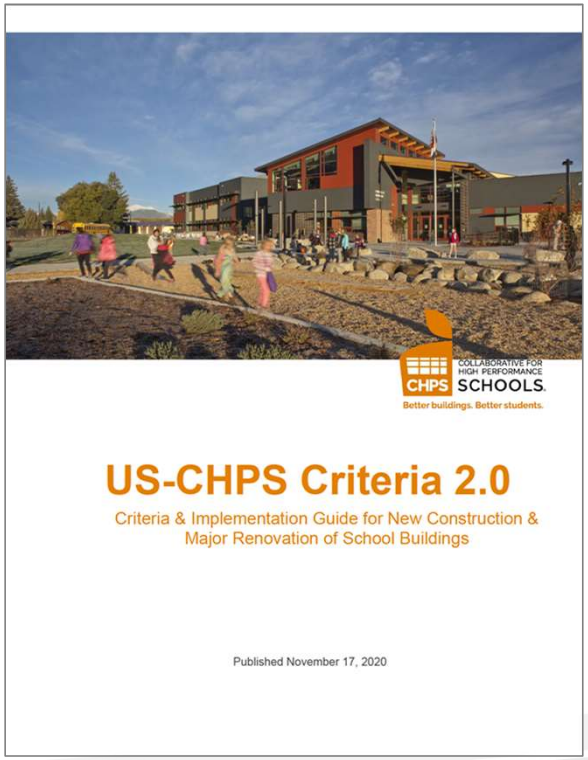
- Excessive energy costs?
- Repair costs?
- Carbon emissions?
- Liability risks?
- Health impacts?
- Student and staff performance impacts?



Design for Adaptation & Resilience

Integration Credit: II C7.1

- Climate Vulnerability Assessment
- Design for Climate Adaptation
- Energy Resilience
- Passive Habitability/Survivability



Design for Adaptation & Resilience

Climate Vulnerability Assessment

- Conduct an assessment of the location's vulnerability to significant weather events
  - Extreme heat, Wildfires, Power outages, Water shortage, Air pollution, Wind, Sea level rise, Winter storms, Tornadoes, Flooding, etc.
- Identify top hazards
- Consider:
  - What actions can be taken to minimize the hazards?
  - What design strategies can be used to mitigate the hazards?
  - What opportunities exist to adapt the school building, site, district design standards, and/or operational policies?
  - Are any outreach or partnering opportunities available?

Design for Adaptation & Resilience

Design for Climate Adaptation

- Design for ZNE (Zero Net Energy)
- Identify adaptation measures in response to top hazards
- Evaluate potential benefits of measures:
  - Energy, water, and cost savings
  - Disruption of services
  - Improved staff and student performance
  - Health and safety
  - Reduced liability
- Incorporate feasible adaptation measures in the project design

Design for Adaptation & Resilience

Energy Resilience

- Design for ZNE (Zero Net Energy)
- Design the building to meet at least two of the following:
  - No less than 75% of the floor area is located within a daylit zone
  - No less than 75% of the floor area is located in a space with operable fenestration
  - Divide power systems into primary (critical) and secondary (non-critical) subsystems
  - Provide on-site energy storage sized to serve loads on the primary subsystem for 4 days or more

Design for Adaptation & Resilience

Passive Habitability/Survivability

- Establish readiness for emergencies with the Red Cross or other local agency
- Use dynamic thermal modeling to maximize energy efficiency and passive strategies. Use 100% renewable energy systems and provide energy storage to support a 4-day power outage.
- Provide energy storage/backup power to cover critical services: sanitation, potable water, refrigeration, communication, etc.
- Provide access to potable water by providing backup filtration or a backup water source
- Include all passive features in an O&M manual and ensure facility staff is trained on operation of the features

Leveraging the Technical Resilience Navigator (TRN) for School Resilience Assessments

Julia Rotondo

Pacific Northwest
NATIONAL LABORATORY

Leveraging the TRN for School Resilience Assessments

April 4, 2023

Julia Rotondo
Pacific Northwest National Laboratory

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PNNL-SA-183239

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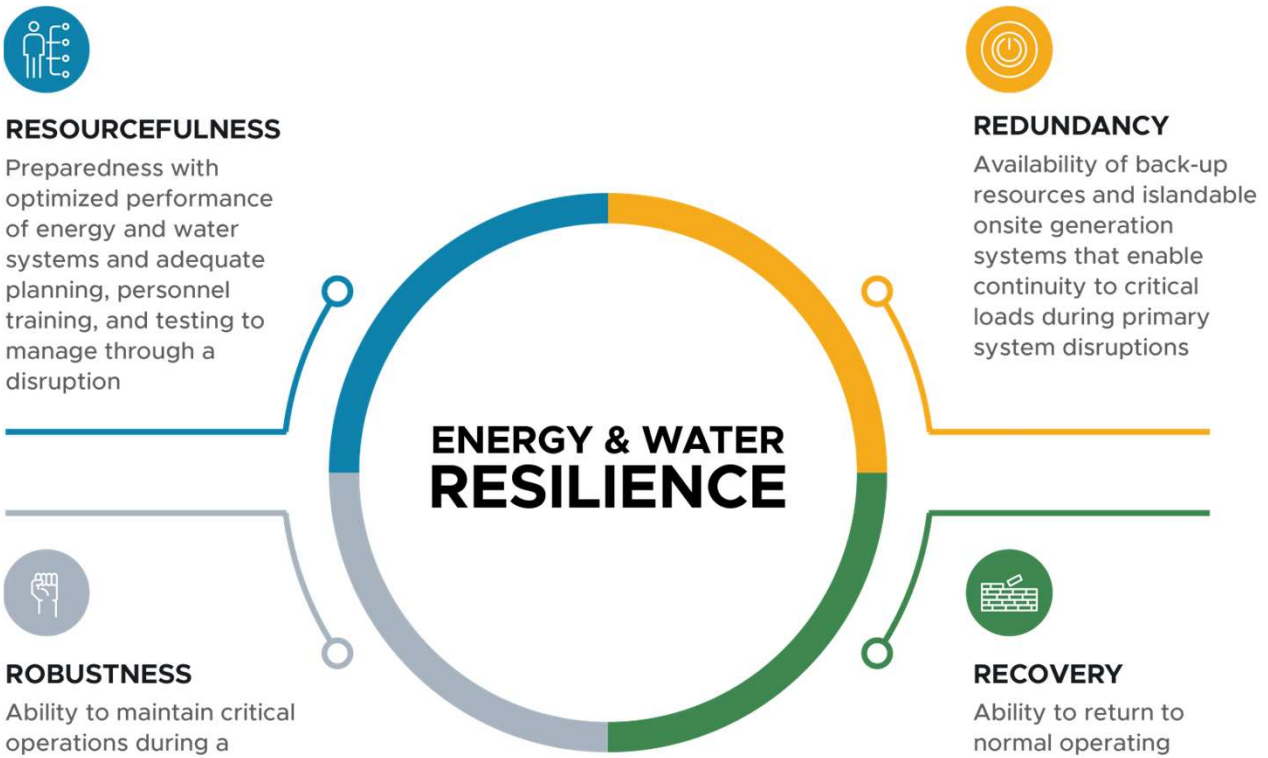
What is Resilience?



RESOURCEFULNESS

Preparedness with optimized performance of energy and water systems and adequate planning, personnel training, and testing to manage through a disruption

REDUNDANCY

Availability of back-up resources and islandable onsite generation systems that enable continuity to critical loads during primary system disruptions

ROBUSTNESS

Ability to maintain critical operations during a disruptive event through building, infrastructure, and redundant system design, as well as system substitution capability

RECOVERY

Ability to return to normal operating conditions as quickly and efficiently as possible after a disruption

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TRN Overview

Visit: https://trn.pnnl.gov/

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Risk-Informed Resilience Planning

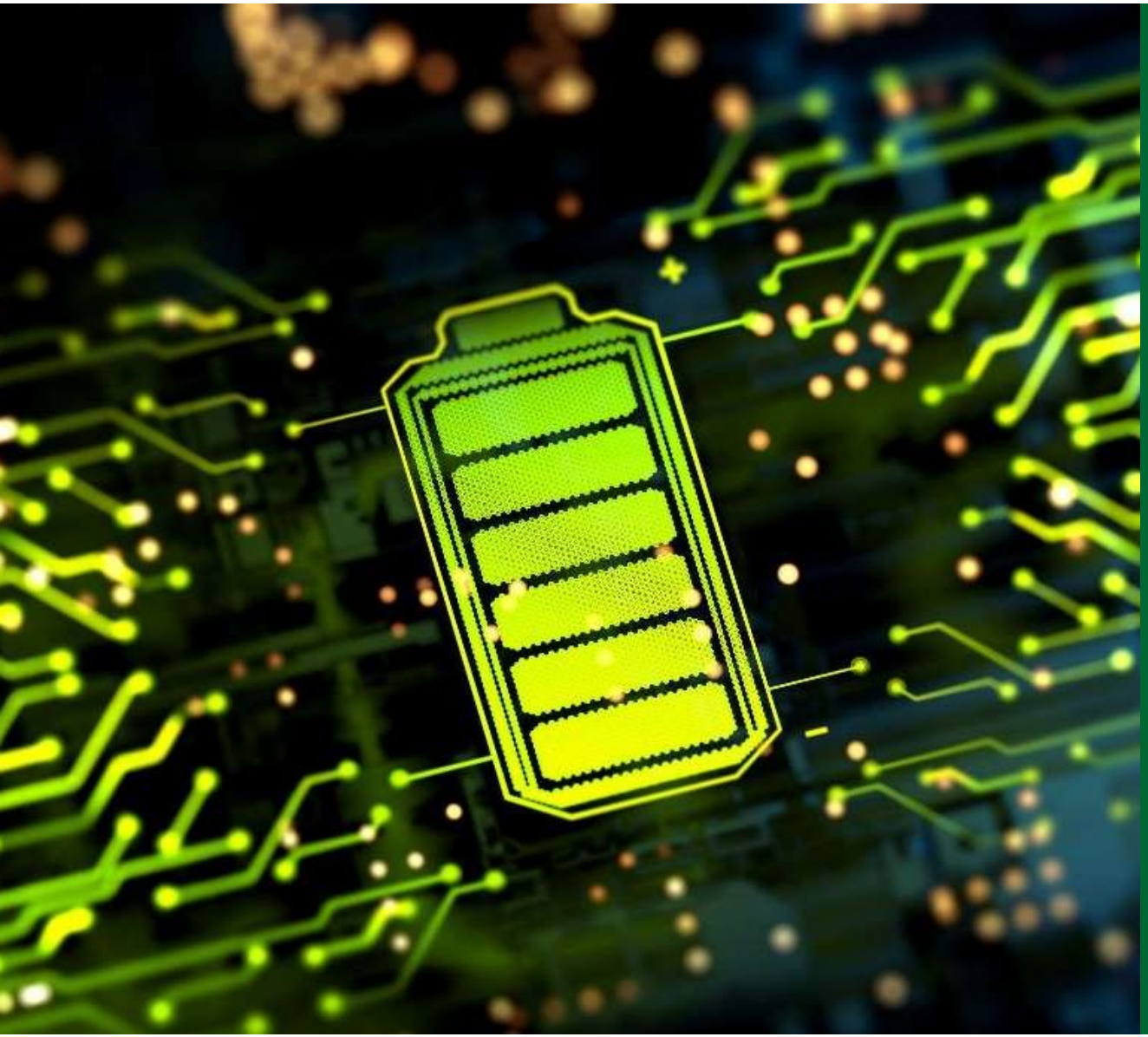
What can go wrong?
(A *scenario*)

How likely is it?
(*A probability or frequency*)

How bad would it be?
(*A consequence severity*)

The TRN follows best practices in risk assessment.

By identifying drivers of risk, users can focus on creating solutions in areas likely to have the biggest impact.



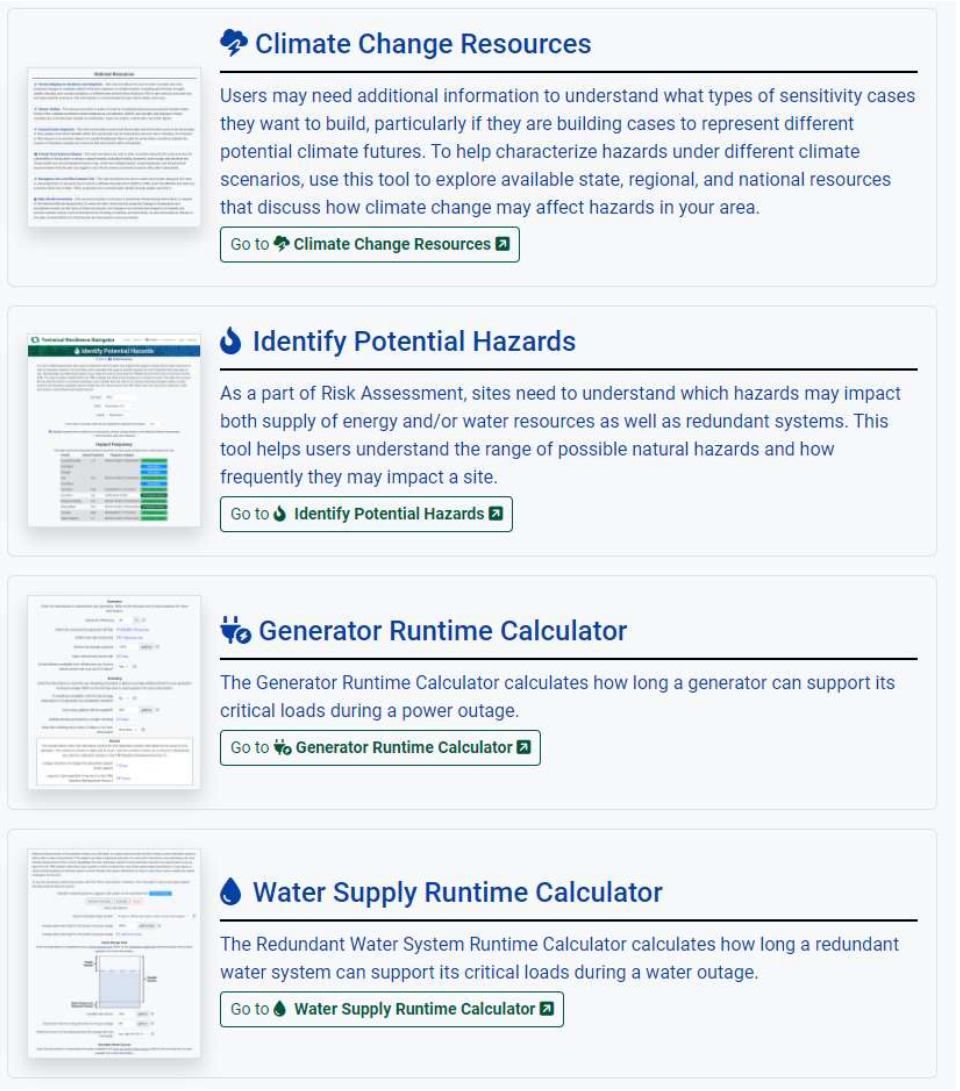
Resilience solutions address key gaps and risk drivers identified from analysis.

TRN users then model each solution to see its potential benefit on the site in terms of risk reduction, emissions impact, and other user-defined decision criteria

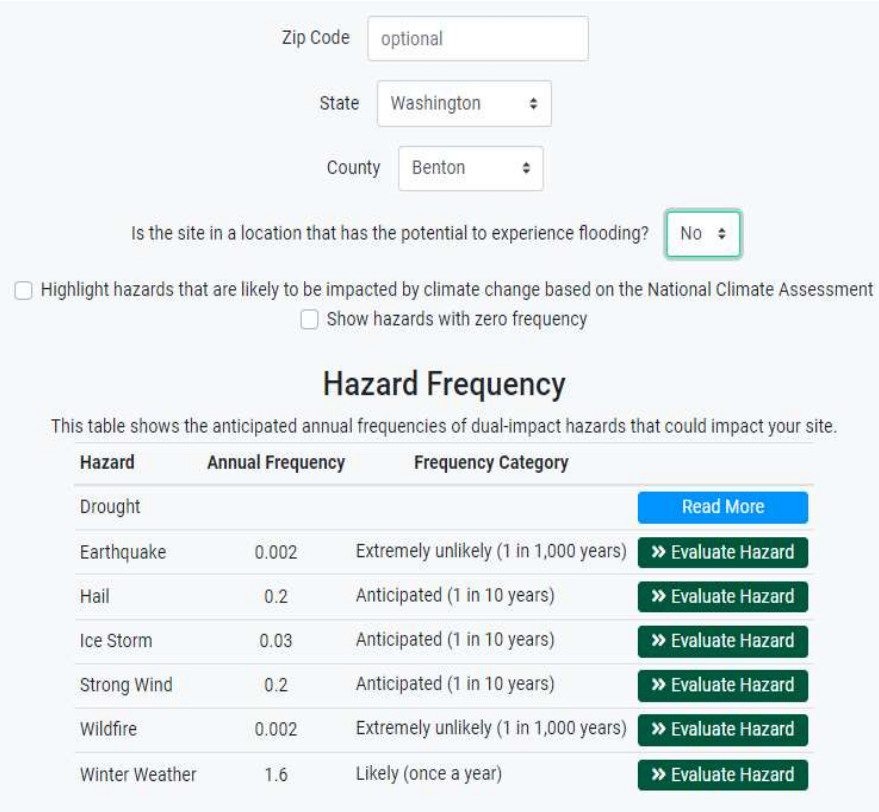
TRN Toolkits

Available outside the log-in:
https://trn.pnnl.gov/toolkit

- Find climate change resources
- Look up hazard frequencies
- Calculate runtimes



TRN Identify Potential Hazards Tool



- Using zip code or county information, this tool helps users understand the range of possible hazards and how frequently they may impact a site.
- Uses historic data from FEMA's National Risk Index (NRI), modified to display the likely annual frequency of a hazard at a site.

https://trn.pnnl.gov/toolkit/potential-hazards

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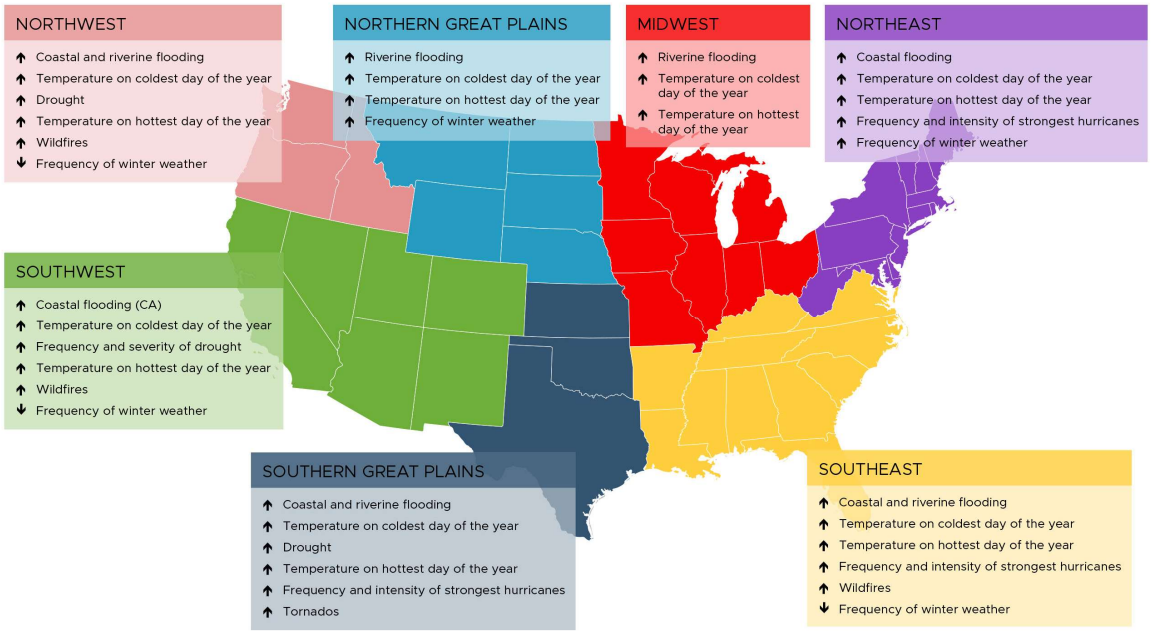
Climate Change Impact on Hazards

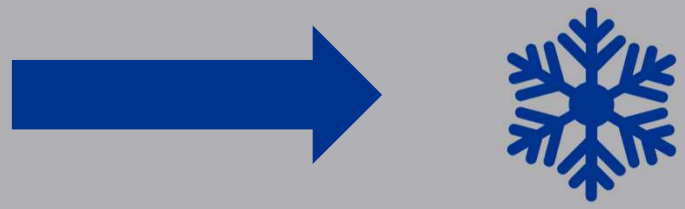
- With climate change, past is not predictor of future
- But how to interpret climate change projections and incorporate them into resilience planning and vulnerability assessment?
- At issue: climate change reports often framed as changes (e.g., increased coastal flooding)… but that doesn't help you understand **increase from what?**
- Proposed: climate projections are typically presented as ***changes from a historical average***, meaning you must first understand the historical baseline and then overlay climate change projection



Delgado and Rabinowitz, 2021

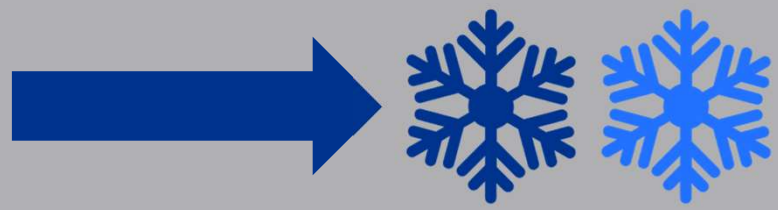
Considering Climate Change in Risk Assessment

Simplified Risk Assessment: Use Historic Data



Ice Storm Hazard Historic Frequency: 1 per year

Incorporating Climate: Review Available Projections



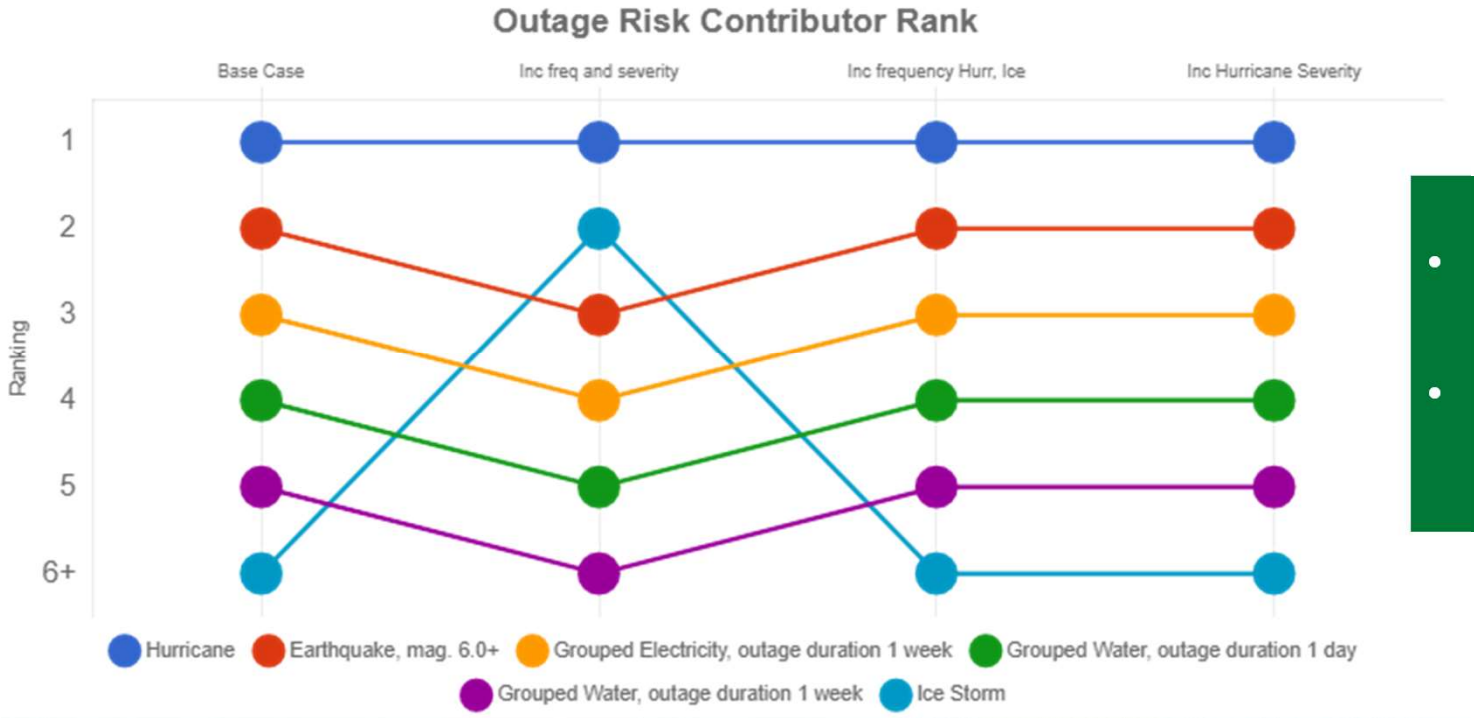
Ice Storm Hazard Project Future Frequency: 3 times every year

Understand directionality of forecasts

Consider simple data shift (e.g., change from one TRN frequency/ severity category to next)

Use Sensitivity Analysis to Explore Potential Changes

Sensitivity cases can explore potential impact from changes to hazards impacting the site and how that impacts which hazards are driving risk… and should be addressed via resilience solutions



- Change annual frequency
- Change outage duration

COMING SOON

TRN LITE

TECHNICAL RESILIENCE NAVIGATOR

Site-Wide Information 1 — Detailed Information 2 — Risk Drivers 3 — Resilience Solutions 4

The TRN Lite is a streamlined version of the Technical Resilience Navigator. Following the same methodology, the TRN Lite provides users with a faster resilience assessment by reducing the number of inputs required for a complete TRN assessment. The TRN Lite ends with a short-list of potential solution categories based on key risk drivers identified in the risk assessment; for a comprehensive solution development effort that includes institutional considerations and allows users to review and prioritize solutions based on potential resilience benefits, complete a full TRN assessment as your next step.

Start Now

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Find Out More – Visit TRN Today

- View TRN action text
- Check out FAQs
- Create & verify account
- Take TRN Accredited Training
- Explore Identify Potential Hazards Tool

TRN
TECHNICAL RESILIENCE NAVIGATOR

Visit: https://trn.pnnl.gov/

Contact Information

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Thank you

Next Steps: Develop Your Plan!

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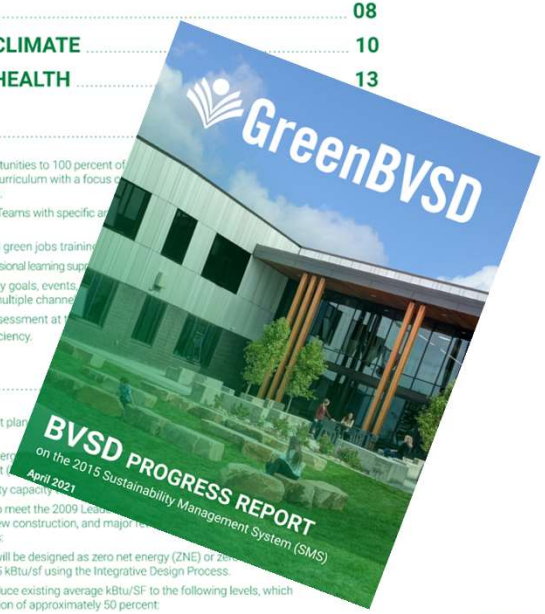
What could my plan look like?

Key pieces of a plan:

- Audience
- Team
- Assessment data
- Timelines
- Goals

Table of Contents



LAKE TAHOE UNIFIED SCHOOL DISTRICT — PURSUE EXCELLENCE

Guiding Standards for Lake Tahoe Unified School Construction Projects

SCOPE *See further details below*	MODERNIZATION: Mandatory	MODERNIZATION: Case-by-case
Envelope air sealing, insulating walls and openings	✓	
Roofs insulation, rainwater collection		✓
Glazing & Shading heat minimization, high performance windows		✓
Lighting LED lighting & controls	✓	
Electrical energy monitoring	✓	
Metering submetering		✓
Kitchen electrification & Energy Star energy-efficient equipment	✓	
Heating electrification & maintainability		✓
Ventilation heat recovery & filtration		✓
Controls set points & operating hours	✓	
Domestic Hot Water recirculation pumps & pipe insulation	✓	
Plug Loads are measured & controlled	✓	
Water backflow device & high-efficiency fixtures	✓	
Schoolyard green schoolyards, stormwater mgmt. & rainwater collection		✓
Materials CalGreen, CA Section 01350 & CA Buy Clean	✓	
Renewables Onsite solar PV, storage		✓
Zero Net Energy Capable roof solar readiness	✓	

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Templates in the toolbox

Carbon Neutral Schools Resolution Template

School District logo – click to place

Enter School District Name

Enter Resolution Number #

RESOLUTION TO ESTABLISH GOALS FOR ENERGY EFFICIENCY, CLEAN ENERGY AND CARBON NEUTRALITY

Instructions: Fill in any of the sections underlined in green. You may add any other local information or aligned initiatives into this release. Be sure to include your logo, photos, and secure quotes from involved board members, your Superintendent, or anyone else in support of your work. There are several examples of language for quotes and other sections you can use in the blue boxes below certain sections. Feel free to use this language or develop your own. This sample language is noted and in italics and can be easily deleted by clicking on the blue box and deleting.

WHEREAS, the insert School District name community is experiencing the detrimental effects of climate change through increased temperatures, extreme weather events, changes in the forms and timing of precipitation and runoff, any regionally specific effects, and other environmental disruptions; and

[Example for text above]:
... increased wildfires and associated poor air quality, more frequent and intense storms, major flooding events

WHEREAS, any local or jurisdictional adopted and aligned resolutions; and

[Example for text above]:
WHEREAS, City Council formally adopted a resolution to achieve 100% renewable energy by 2032; and

WHEREAS, the School District Board is committed to making positive, tangible changes to mitigate climate change, and to ensure that every effort is made to conserve energy and natural resources while exercising sound financial management; and

WHEREAS, School District students and staff are entitled to safe and healthy working and learning environments that reflect recommendations of reliable scientific studies indicating that student achievement and attendance and teacher and staff retention are improved when their

1 This form powered by nbi new buildings institute

Contents

District Overview and Goals

This section includes brief boilerplate language abo... already may have in other district documents. An ex...

School District serves number of students across grade levels building space across # of cities, counties, acres, etc. Facilities

- # of facilities, preschools or early childhood centers
- # of elementary schools
- # of middle schools
- # of high schools and secondary schools
- # of K-8 schools
- # of administrative and maintenance buildings
- # of any other facility types

Roadmap Planner Table 10

Trajectory Graphs for Carbon Neutral Schools can be used to track this information graphically. A visual representation of your goals can be a useful tool for communicating with stakeholders.

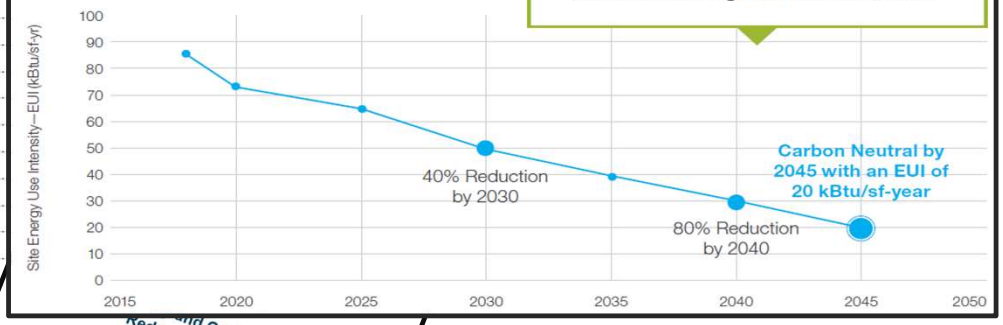

Table 9: School District Portfolio Roadmap Goals

Using your baseline benchmarking data, customize the table below to note the district's portfolio goals and how they change over time. Table 14 in this workbook also includes a template track this graphically as a useful tool for communicating with stakeholders. Additional rows are included in this table for additional portfolio goals as appropriate for your portfolio.

GOAL: All buildings in the district will be carbon neutral by **[target year]** and the average portfolio site EUI will adhere to the following targets over time:

	Baseline [YEAR]	2025	2030	2035	2040	2045
Average Portfolio Site EUI	*[2019] EUI: 60*	*52*	*44*	*36*	*28*	*20*
Average Portfolio Site EUI (kBtu/ft2/year)	80	68	56	44	32	20
Total Portfolio Greenhouse Gas Emissions (Metric Tons CO2e/year)						
Total Portfolio Greenhouse Gas Emissions (kgCO2e/ft2/year)						

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What could be in my plan?

Plans might include:

- Key messaging and stakeholder documentation
- List of relevant goals and plans
- List of documents to be developed (resolutions, tech specs, etc.)
- Benchmarking and assessment data – emissions and energy
- Project and portfolio level goals
- Planning timelines and project list

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Submitting for Planning Recognition

Plans will be tailored to school district needs and may evolve over the course of this series.

Goal: an actionable plan that is not extra busywork for your district.

Plans can be:

- Focused on a particular topic (energy, emissions, IAQ, etc.)
- Focused on a particular action (ex. building assessment)
- Be part of an existing plan or a larger plan focused on whole district sustainability
- In any format! PPT, word doc, one pager, infographic, etc.

EFFICIENT AND HEALTHY SCHOOLS

Webinar Series

Interested schools and districts will participate in a webinar series between January and March 2023.

Winter 2023

Spring 2023

Preparation

Schools and districts will prepare their materials for the final submission.

Final Submission

Schools and districts will complete a final submission by **May 1, 2023** to summarize key learnings and describe how tools or approaches can be applied in their school facilities.

May 2023

June 2023

Announcement

Schools and districts receiving recognition will be invited to attend an in-person celebration in June 2023.

Office Hours

EFFICIENT AND HEALTHY SCHOOLS

Stock Take

- What has been done so far in the district?
- What goals are in place?
- What is in process?
- What is being planned?

EFFICIENT AND HEALTHY SCHOOLS

Stock take: Documents your district may have

- ❑ District sustainability goals
- ❑ Formal district resolutions
- ❑ Technical specifications for district facilities
- ❑ Procurement requirements
- ❑ Owner's Project Requirements (OPR) for new construction or major renovation projects
- ❑ Energy or carbon report to school board
- ❑ School district org chart
- ❑ Energy benchmarking data
- ❑ Facilities, characteristics, and equipment lists
- ❑ Facility master plans and assessments
- ❑ Capital project plans, including bond planning documents
- ❑ Operations and maintenance (O&M) requirements
- ❑ Fleet vehicle fuel use information
- ❑ Climate Action plan

EFFICIENT AND HEALTHY SCHOOLS

What recent energy efficiency / health improvements has your district completed? What goals do you already have?

Ex. Presented to board about emissions reduction goals of 20% reduction by Year 2030
Ex. Performed resiliency assessment in all schools; began retrofits in some schools

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EFFICIENT AND HEALTHY SCHOOLS

What recent energy efficiency / health improvements has your district completed? What goals do you already have?

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EFFICIENT AND HEALTHY SCHOOLS

What new (or existing) goals are you trying to achieve?

Ex. achieve an EUI of 25 kBtu/sf/year portfolio-wide by Year 2030
Ex. Improve ventilation in all schools; create IAQ management plan

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Ideas to consider

- Gather stocktake data
- Benchmarking
- Building Assessment
- Ventilation assessment
- Stakeholder engagement and visioning
- Set goals and formally adopt

EFFICIENT AND HEALTHY SCHOOLS

What new (or existing) goals are you trying to achieve?

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EFFICIENT AND HEALTHY SCHOOLS

What are your near-term and longer term steps to achieve your goals? (Create your plan)

Ex. (near-term) plan to use [tool/approach] to identify emissions reduction measures; (longer term) plan to apply results to inform facilities planning

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Reminder! We learned a series of tools over the course of this series.

- Energy Star Portfolio Manager (benchmarking)
- USGBC ARC (emissions tracking)
- Technical Resilience Navigator
- CHPS (resiliency standards)

EFFICIENT AND HEALTHY SCHOOLS

What are your near-term and longer term steps to achieve your goals? (Create your plan)

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