# Passive Buildings as Climate Adaptation Infrastructure:

## Enhancing Resilience in an Era of Extreme Weather

(An Overview)

And More!

phius con
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# Introduction

20 years of self employment providing high performance building products, renewable energy systems and consulting services.

8 Years as construction project supervisor for City of Duluth, MN (retired end of 2024).

2 periods working with CR-Building Performance Specialists (CR-BPS) where I’m currently working part time.

On the first Phius board of directors.

# Assumptions

I'll NOT be covering details of getting to Phius certification or why.

I'm assuming that we all know the climate and environmental reasons to build to Phius standards.

Today I am sharing ideas about things that we can add to projects to enhance resilience in the face of already present and coming climate change impacts and insure long-term durability of building performance goals.

# Setting your business apart in your market

- **I’m proposing trying to expand the list of reasons for clients to build with Phius to include increased resilience to climate change amplified weather and other events such as extreme temperatures, record breaking rainfalls, windstorms, power interruptions, wildfire and related smoke, energy cost increases and other factors.**

- **With increasing electrification of personal transportation, home EV charging has become a considerable component of a building's energy balance. Maybe it is time to incorporate that load into our building energy budget.**

- **I’m simply offering an overview of these potential enhancements to Phius certified projects to start us thinking.**

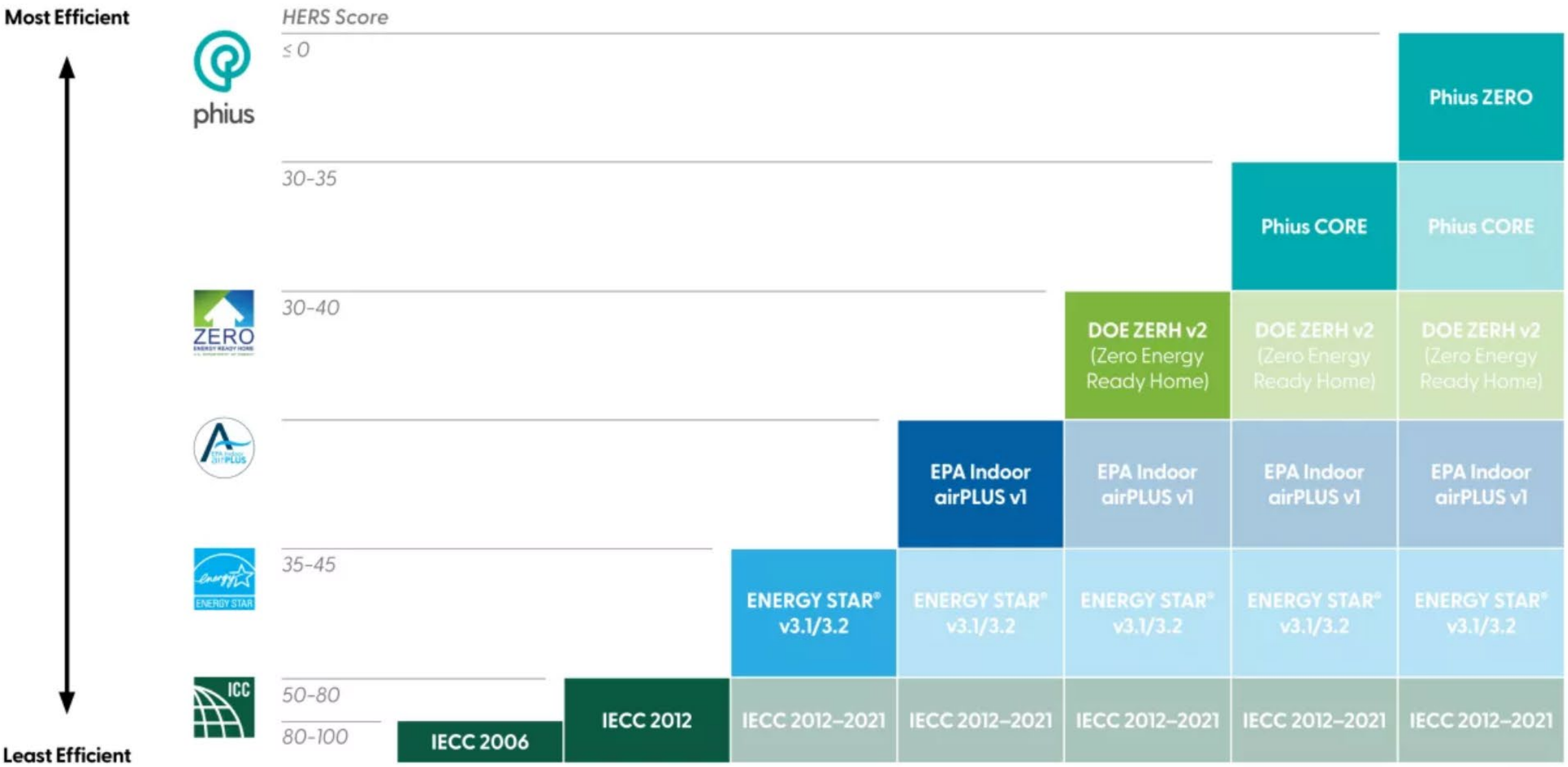
We are beyond just trying to avoid Climate Change

Unfortunately it is here and it is time to learn how to adapt the best we can

# Phius Certified Projects – The Foundation

- **Phius CORE**
- **Phius ZERO**
- **Phius REVIVE 2024**
- **Still Evolving**

# U.S. DOE High Performance Staircase

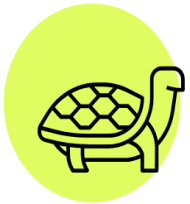


# What if Gov’t Checkbox Programs Went Away?

We must embrace and understand the goals met by gov’t programs.

The important stuff matters beyond the certificate.

# Phius Certification is Key to Resilience

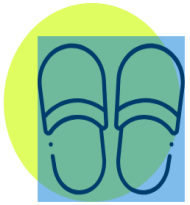


## Safe

Phius-certified buildings go through a rigorous quality control process, ensuring safety for the environment and the building inhabitants.

## Healthy

Superb indoor air quality is a prerequisite for Phius certification – you can count on a healthy environment.



## Comfortable

Superinsulation, high performance windows and efficient mechanical systems create a comfortable, quiet building.

## Resilient

Phius buildings have been proven to be more resilient in the event of natural disasters, such as wildfires and extreme heat and cold events.

## Durable

The holistic design of Phius buildings and attention to detail in the enclosure make them uniquely built for the long haul.

## Affordable

Phius projects require minimal to no additional upfront costs, while guaranteeing substantial energy cost savings in the future.

Phius.org

# Extreme Cold

- **Regional issue that is well covered by meeting Phius Certification.**
- **Building codes just assume higher energy use in colder climates.**
- **Northern MN locations average between 6,500 to 8,500 HDD/year.**
- **Warming climate in last 20 years brought that down from 10,000.**
- **Climate indexed Phius standards made certification feasible in regions where original standards didn’t.**

- **<u>Stretch goals could perhaps be offered?</u>**

# Extreme Heat

- **This regional issue is spreading geographically.**
- **Building codes simply assume higher cooling energy use in hotter climates.**
- **Compliance with Phius standards and careful attention to shading create a solid base.**
- **High efficiency cooling equipment, properly maintained, is key to reliable comfort and affordability.**
- **Enhanced projects may include good site design, utilization of massive elements.**

# Enhancing Outcomes

Once we excel at convincing potential clients to go for certification to do their part in addressing climate threats we can offer more.

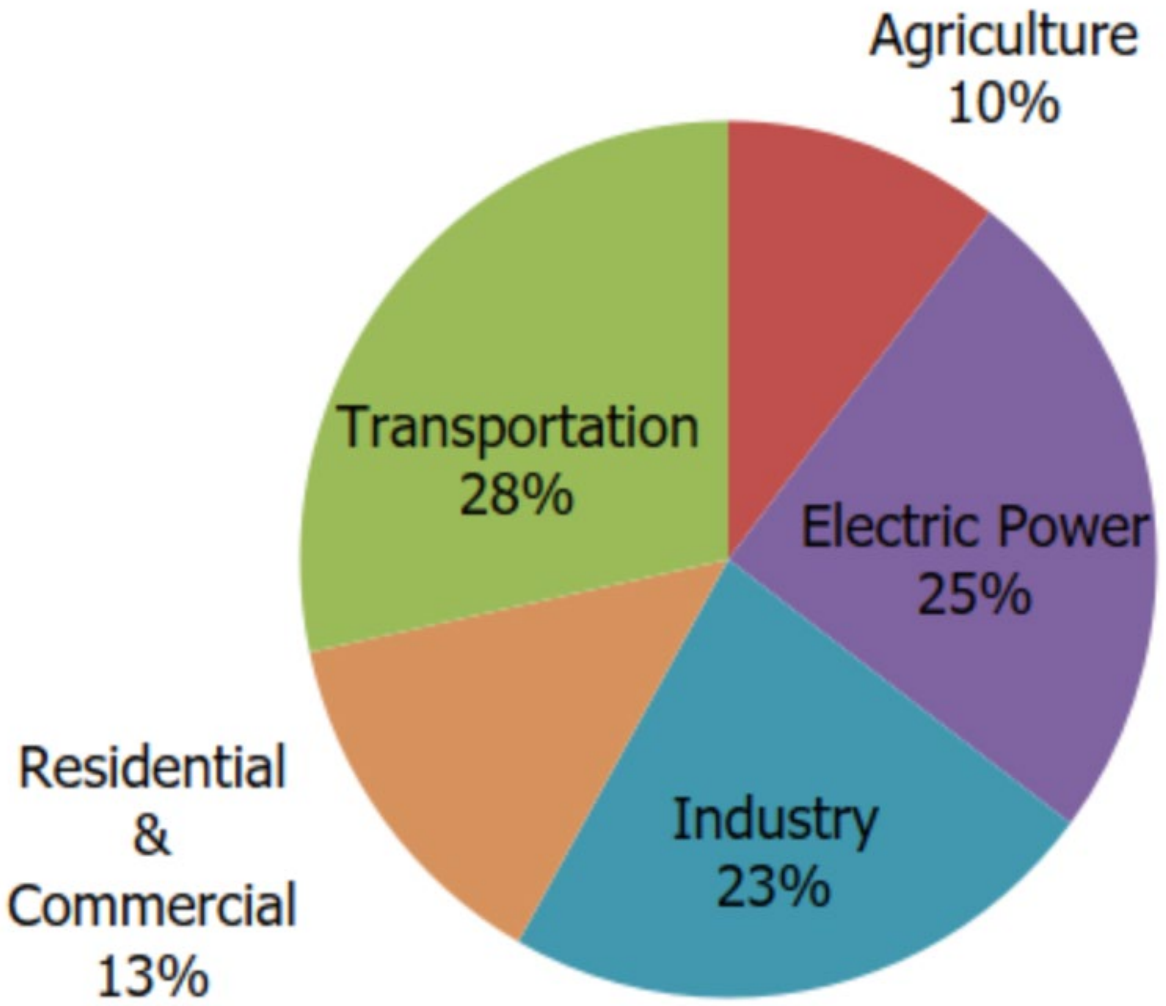
Acknowledging that the climate crisis has arrived we can offer design and construction enhancements to help our clients, and their projects, adapt to our already significantly changed environment and add resiliency to the end product.

# Energy and Environmental Footprint

Not just Buildings

As we electrify everything this breakdown will keep shifting

**2022 US EPA Emissions Data**



# Comparison Matrix of Resilience Features

- **A starting list of potential climate adaptation / resilience add-ons to begin the conversation.**

| RESILIENCE FACTOR | Code Built | Phius Certified | Enhancements | Universal or Regional |
|---|---|---|---|---|
| Extreme Cold | Minimal | Yes | Stretch standards? | R |
| Loss of Heating | No | Yes | Add backup | R |
| Extreme Heat | No | Yes | Enhance shading | R and U |
| Loss of Cooling | No | Yes | Add battery backup | R and U |
| Windstorms | Spotty | Per code | Use best practices | R and U |
| Heavy Rain Events | No | Per code | Site and building design | U |
| Power Outage | No | Temporary | Add battery backup | U |
| Fire Resistance | No | No | Use best practices | U |
| Wild Fire Resistance | No | No | Site and building design | R |
| Outdoor Air Quality | No | No | Enhanced filtration | U |
| Operating Costs | Minimal | Yes | Add PV | U |
| Energy Cost Increases | No | Yes | Stretch Standards? | U |
| Long Term Durability | No | No | Durable airtightness design, exterior water management, overhangs, material choices. | U |
| Long Term Affordability | No | No | Stretch standards, durability, on site renewables beyond minimum. Simple and affordable design. | U |
| Transportation Energy | No | No | Add EV to energy budget? | U |
| Clean and abundant water | No | Some | Add rainwater catchment where relevant and xeriscaping to site design. Filtration. | U and R |
| Food resilience | No | No | Add site design for food forest, gardens and composting. | U |

# Proposed Resilience Factors and Options

And More

**The following sections explore climate adaptation and resilience factors to consider offering or highlighting as a Phius Provider.**

**Depending on your market area these and other add-ons may be ways to add value to your professional offerings.**

# Loss of Heating During Extreme Cold

- **A serious issues in very cold climates.**
- **Building code compliance offers little resilience.**
- **Power outages or equipment failure can risk frozen pipes in hours.**
- **Vulnerable populations / shut-ins at significant risk.**
- **Compliance with Phius standards adds excellent cushion for days.**
- **Multi day power outage or equipment failure when unattended brings added vulnerabity.**
- **Adding backup power, backup heat and remote monitoring to a project can add significant added value that is marketable.**

# Loss of Cooling During Extreme Heat

- **This can be life threatening especially if caused by widespread  power outage and disruption of access and services.**
- **Building to Phius standards adds considerable cushion for awhile.**
- **During prolonged power outages backup power is needed.**
- **Backup power offerings can include batteries with or without solar, fossil fuel generator or a combination of them but must be sized for cooling loads.**
- **Compliance with Phius standards lessens these loads.**

# Windstorms

- **Building codes offer guidance in hurricane prone areas.**
- **In other regions, with increasingly intense storms and high winds, codes are silent beyond basic connections.**
- **Phius standards do not address high winds or resilience from wind related damage.**
- **Windstorms often cause extended power outages which we are getting to.**
- **Site design including managing risk from falling trees may be marketable. Buried power lines instead of overhead wires.**

# Heavy Rain Events

- **Duluth, MN – where I live – had record breaking rain in 2012.**
  - **8-10” over 2 days of heavy rain. 0ver 12” at my house.**
  - **Over $100 million in damages locally.**
- **Coastal storms are increasing in frequency and intensity.**
- **Building codes are no help.**
- **Phius doesn’t focus on big rains beyond building envelope.**
- **Added value includes integrating enhanced foundation drainage design, site storm water management and backup power.**

# Electric Power Outages

- **Loss of electric power creates multiple vulnerabilities.**
  - **Loss of heating in extreme cold – blizzards and ice storms – trees on lines.**
  - **Loss of cooling in extreme heat – overtaxed grid causing crash.**
  - **Loss of water in private wells or municipal water systems.**
  - **Loss of ventilation.**
  - **Loss of critical life support and communication.**

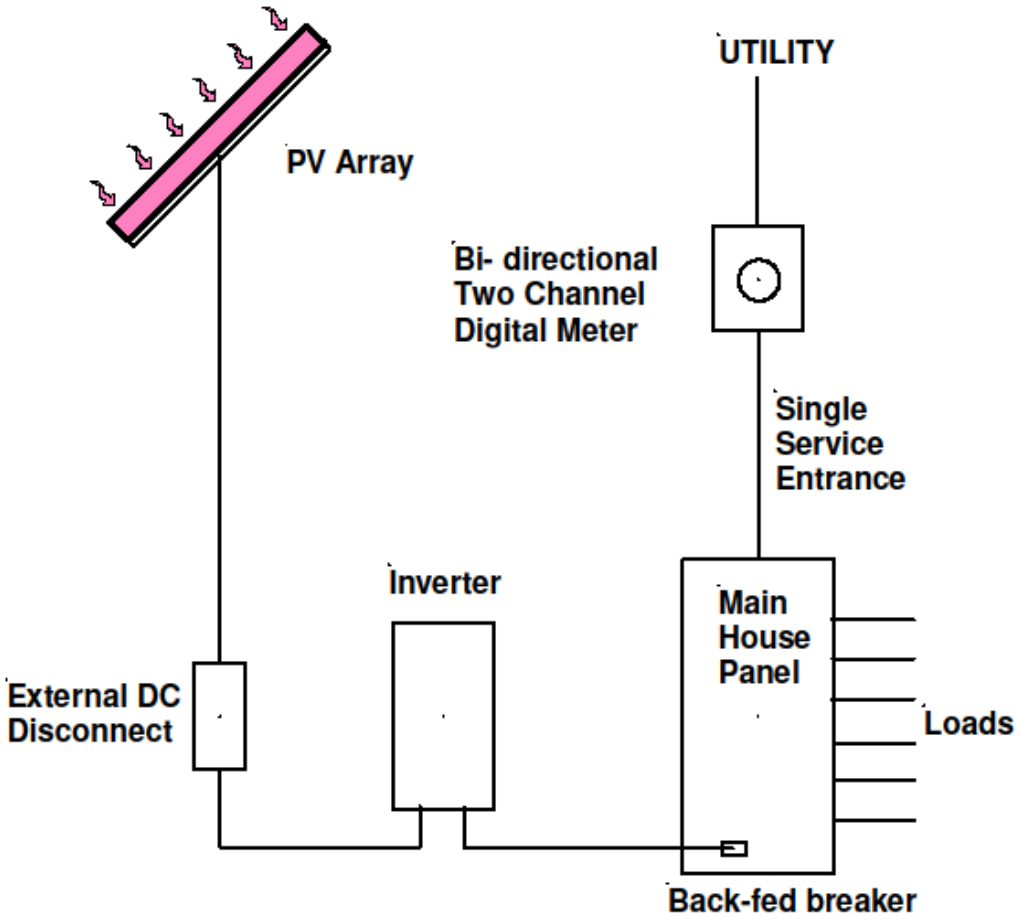
- **Code offers no relief.**

- **Phius compliance offers a coasting cushion for thermal comfort.**

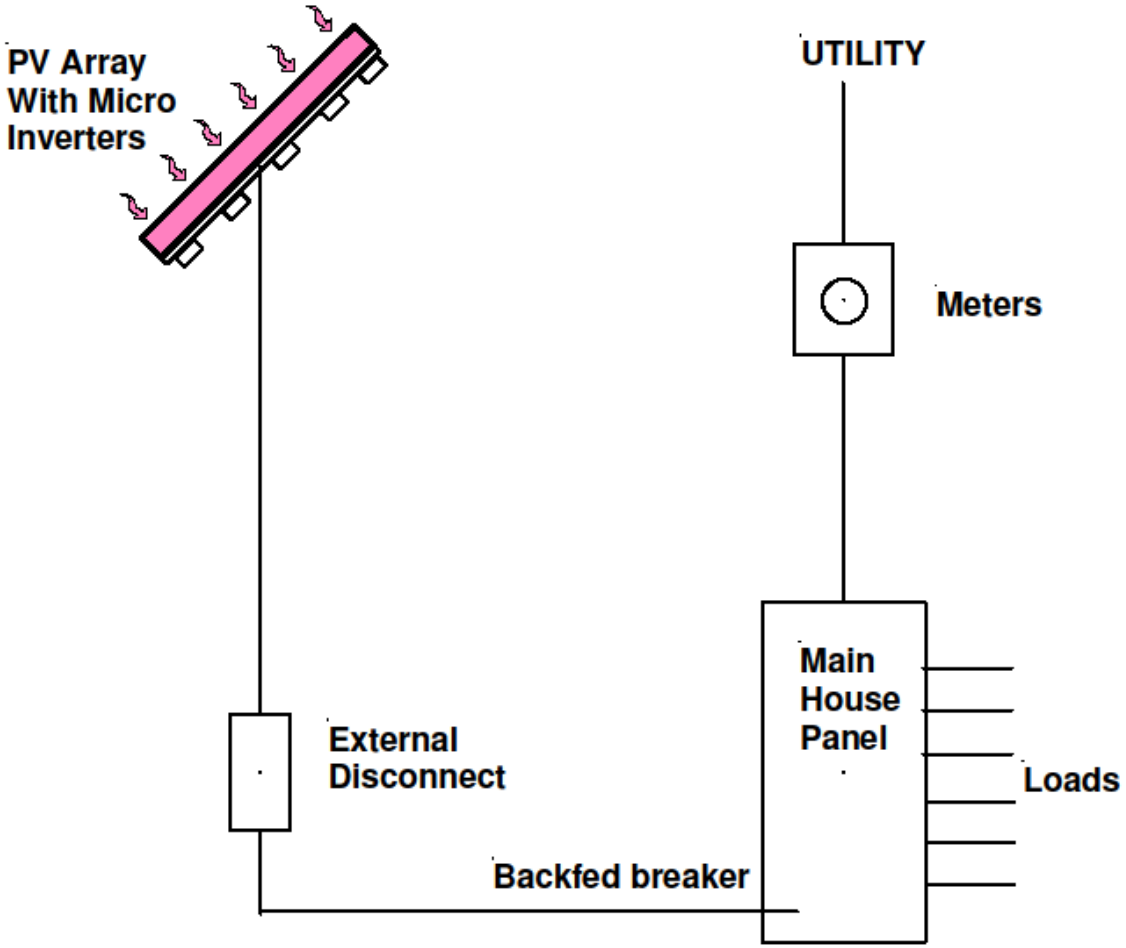
# Electrical Power Outages (continued)

- **Resilience against loss of electrical power supply provides multiple opportunities for value added features to offer projects.**
  - **Ultra efficient electrical load design to optimize backup capacity.**
  - **Properly sized battery backup system.**
    - **Defined critical load panel and/or dispatchable load control**
  - **Grid tied pv system with properly sized battery backup.**
  - **Hybrid system with pv, battery and fossil fuel generator.**
  - **EV to home / grid integrated into home power system.**
  - **Buried power lines instead of overhead wires.**

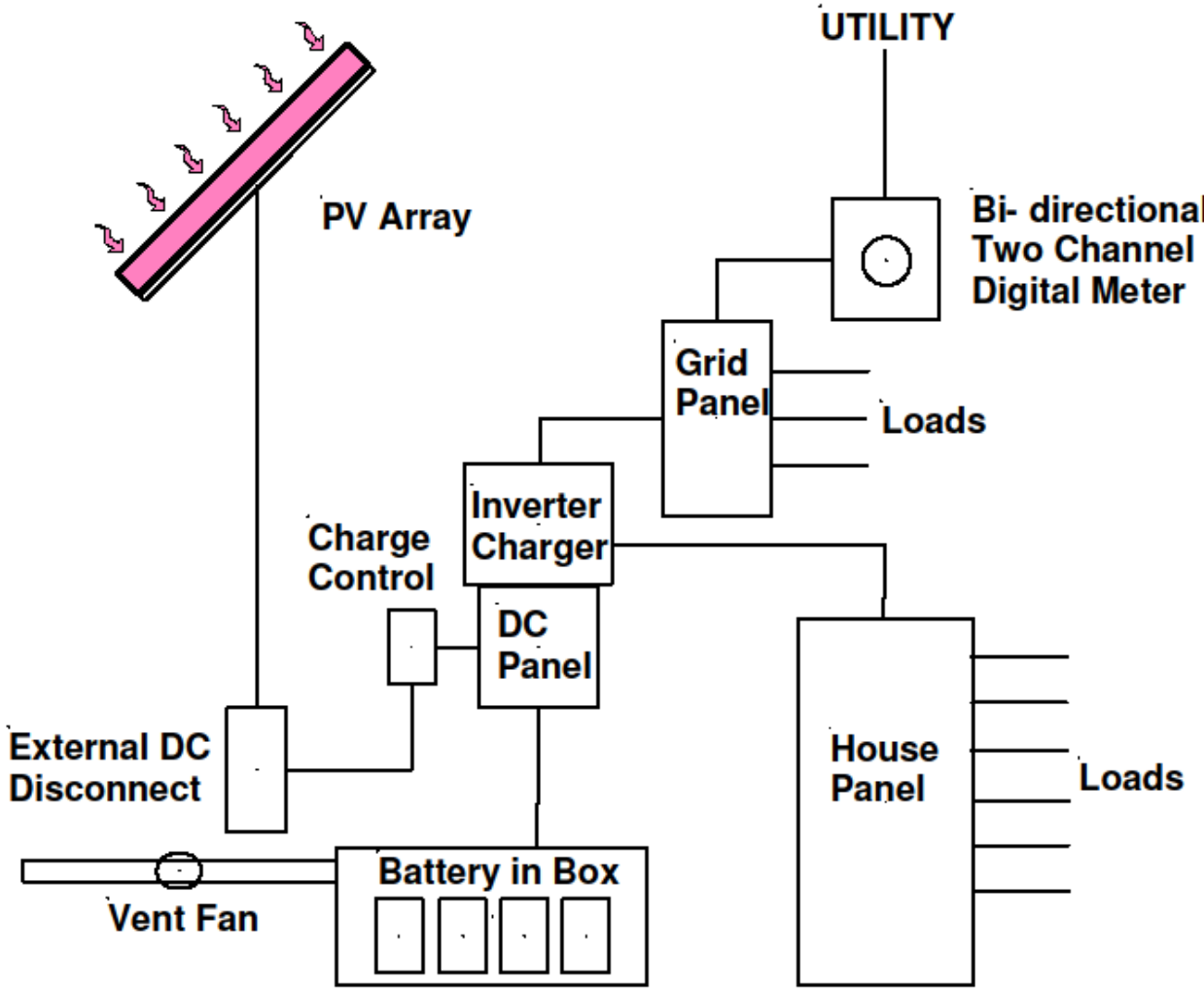
# Grid Intertie –Central Inverter – NO Backup Capabilities



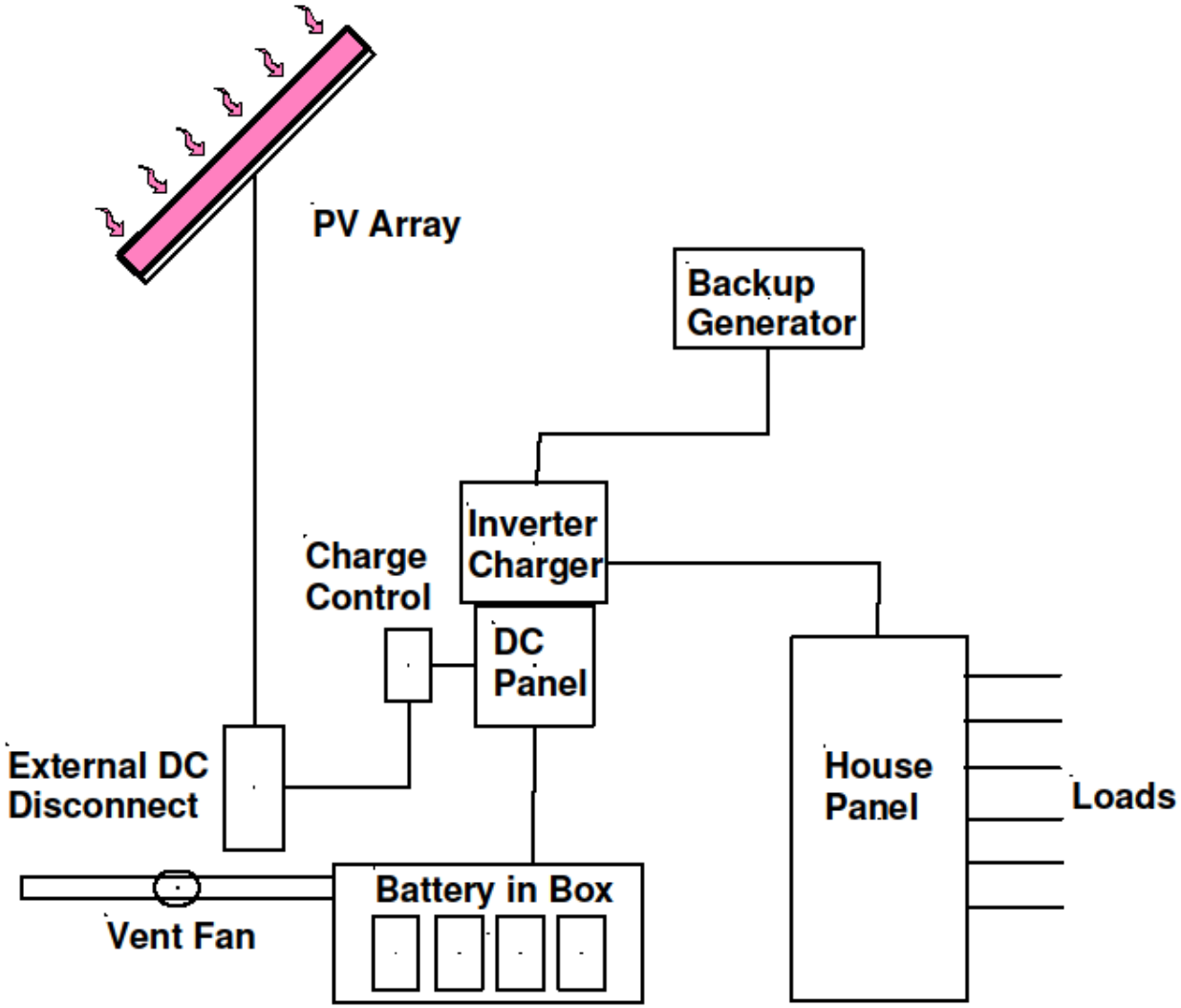
# Grid Intertie – Micro Inverters – NO Backup Capabilities



# PV With Battery Backup



# Stand Alone – (Off Grid)



# Fire Resistance

- **Building and electrical codes and appliance certifications offer the biggest protection against most causes of house fires.**
  - **Projects outside of municipal inspection jurisdiction can be tempted to utilize products not rated by US standards. Just make sure clients know…**
- **This is not really a Phius certification covered issue.**
- **There may not be many expanded offerings for projects beyond enhanced fire alarm systems and sprinklers even when not required by code.**

# Wild Fire Resistance

- **Wildfires have become normal summertime occurrences in much of western North America.**
- **Fires are increasingly common in northern Minnesota lately.**
- **Fire resistant exterior materials**
- **Defensible spaces around buildings**
- **Fire resistant site design**
- **Sprinkler systems for building and site**
- **Model codes are catching up**
- **This seems like an obvious added value offering in relevant regions. Market it.**

## FIRE RATED Vents



**BrandGuard Fire Resistant Dormer Vents**

Fire-resistant dormer vents featuring a patented design with overlapping baffle that is tested and approved for use in high-wildfire-risk areas.

**BrandGuard Fire Resistant Gable Vents**

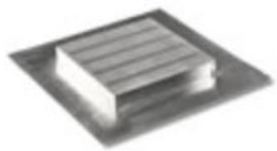
Gable vents that stop embers from entering your attic during a wildfire. Available in several standard sizes.

**BrandGuard Fire Resistant Round Eave Vents**

Round under eave vents resist the intrusion of embers, radiant heat, and flames, as well as wind-driven rain.

**BrandGuard Fire Resistant Sub Flashing Roof Vents**

Fire-resistant sub-base vents are installed from the attic. They convert standard roof vents into Wildland-Urban Interface-compliant, ember-stopping vents.



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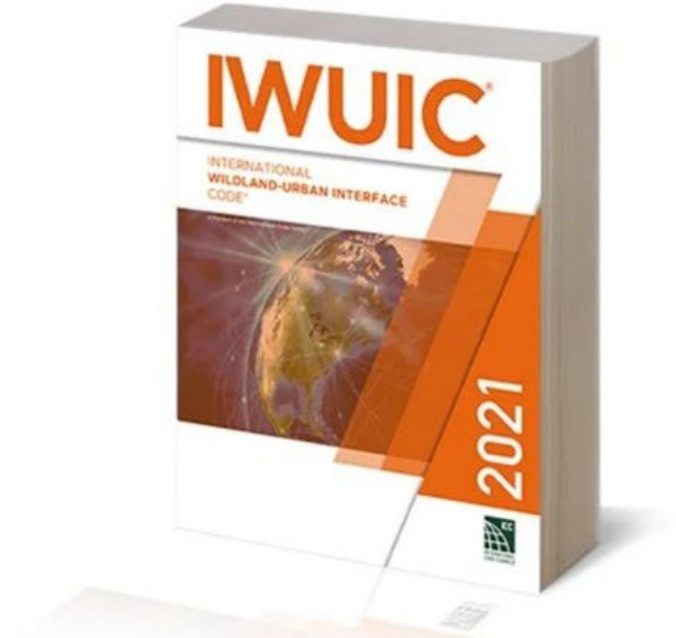
# What is the International Wildland-Urban Interface Code?

The International Wildland-Urban Interface Code (IWUIC) establishes requirements for land use and the built environment within designated Wildland Urban Interface (WUI) areas using prescriptive and performance provisions. The IWUIC establishes minimum special regulations for the safeguarding of life and property from the intrusion of wildfire and:

- Regulates ignition-resistant construction techniques and defensible space as well as fire department access and available water supplies for fire suppression.
- Focuses on preventing ignition of buildings and vegetative fuels from direct exposure to wildfire and fire exposure from adjacent structures.
- Helps prevent structure fires in the WUI from spreading to wildland fuels, even in the absence of fire department intervention.



# California strengthens resiliency with 2024 International Wildland-Urban Interface Code

March 4, 2025 Isabelle Crow

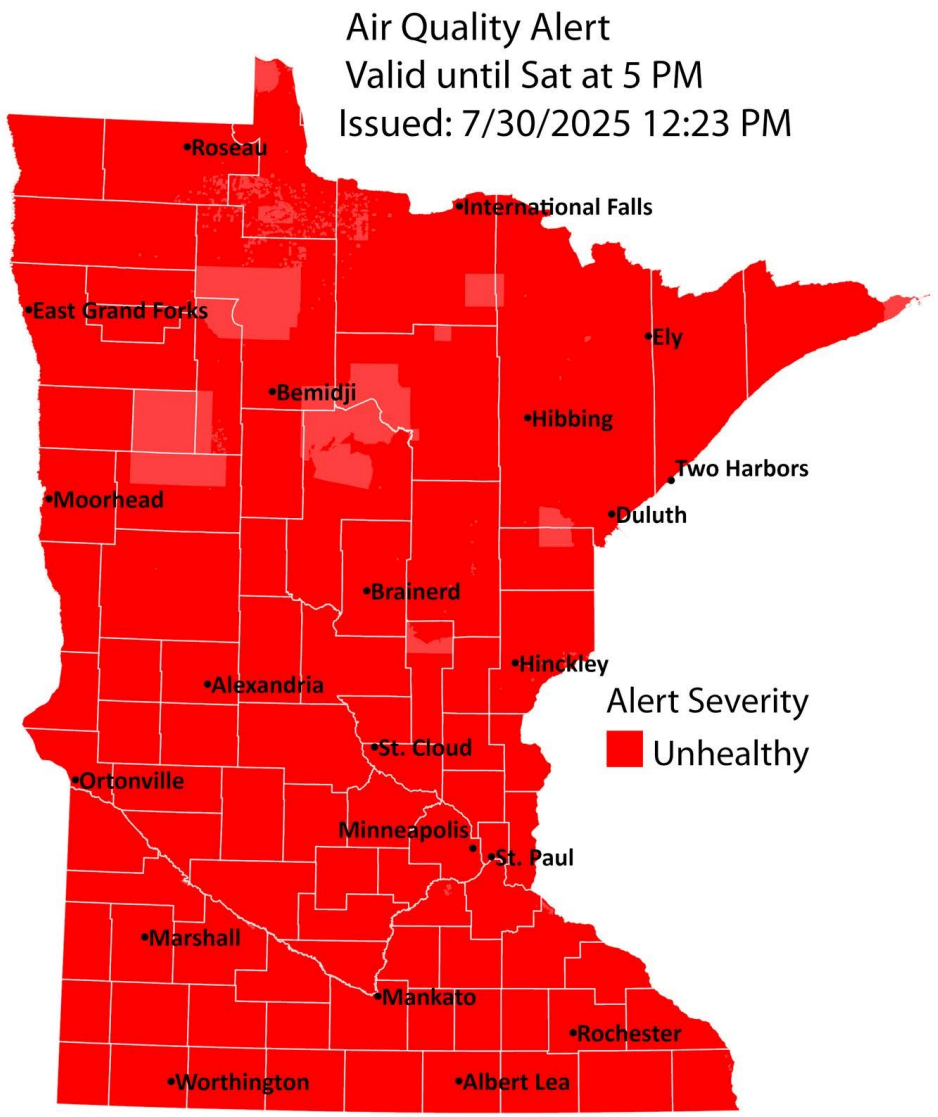
fireandsafetyjournalamericas.com



# Wildland-Urban Interface Code

# Outdoor Air Quality Crisis Events

- **Wide areas of North America have been increasingly subjected to smoke from wildfires in the US and Canada in recent years.**
- **Other events causing poor outdoor air quality include chemical spills and structure fires.**
- **Enhanced filtration should be considered for outdoor air supplies.**
- **Switching to recirculated air only should be easy to control.**
- **One could offer enhanced indoor air filtration and monitoring options.**




**Details of the 2025 MN Record:**
**Location: Grand Portage, at the state's northeastern tip.**
**Date: Early morning of June 3, 2025.**
**Cause: Heavy wildfire smoke.**
**Significance: This reading of 800 AQI in Grand Portage was the highest ever recorded in Minnesota due to wildfire smoke.**

# High Operating Costs

- **Phius practitioners understand the operating cost savings.**
  - **How to sell this added value?**
- **Marketability challenges include separating the added cost of meeting Phius standards from other client driven building costs.**
- **Phius standards help us in “Tunneling through the cost barrier.”**
  - **(Amory Lovins)**
- **Enhancements may include offering “stretch” standards where relevant.**
  - **Climate adjusted standards help with certification by accepting higher energy use in extreme climates…**

# Future Energy Cost Increases

- **A good building should last 100 years.**
- **Future energy cost increases are impossible to predict.**
- **With electrification of all loads those energy costs will prevail.**
- **Buildings need to stay relevant.**
- **Phius standards insure very stable and low operating costs.**
- **Enhancements to projects in this regard could include:**
  - **Thinking ahead to how a building can “learn” as it matures.**
  - **Offering “stretch” standards beyond certification in relevant markets.**
  - **Offering significantly sized PV as “inflation proofing”.**

# Long Term Durability

- **A well-designed building should last at least 100 years.**
- **Shorter lived systems like roofing, exterior cladding, and windows should be designed and integrated in ways that facilitate full or partial reset without compromising adjacent components.**
- **With increasing frequency of extreme weather durable control layers become increasingly important.**
- **Low maintenance really matters in how long something lasts.**
- **A package emphasizing long term, easy to maintain, durable performance AND physical plant might be convincing.**
- **Offer an ongoing maintenance contract.**

# Long Term Affordability

- **This item wraps in some of the others.**
  - **Durability makes initial investment pay off for a longer time.**
  - **Resilience against extreme temperatures helps control energy costs.**
  - **Resilience against other weather extremes provides safe harbor from damage and related costs.**
  - **Well integrated, and significantly sized, PV system can reduce operating costs and provide a buffer against future electrical cost increases.**
  - **EV home charging loads factored into PV sizing can also reduce transportation costs and help control electrical cost inflation.**

# Personal Transportation Energy

- **Private electric vehicles are becoming popular among people concerned about their overall environmental impact.**
- **Home EV charging is the cheapest and most convenient method to power our local transportation needs.**
- **Having the ability to charge EV's at home also provides added resiliency during regional power outages providing that the home power system is equipped to handle these loads.**
- **Adequately sized battery backup PV systems can provide this backup capacity if managed properly.**

# Personal Transportation Energy (cont.)

- **EV's with the capability for two-way power sharing can also provide a home with limited backup power.**
- **As personal EV's become a significant feature of high-performance homes perhaps it is time to include those loads in critical energy balance calculations:**
  - **In sizing of PV systems.**
  - **In a new category of building / site energy budgets for certification?**
- **EV integration into projects feels like a solid feature for practitioners to offer clients.**

# Home + Transportation Loads


# Ongoing Maintenance Service Offerings

Stay in the loop and learn from your projects.

Architects could design a service package to offer projects.

Builders could team up with their subs to sell to clients.

Ideas include:

- Annual ventilation system maintenance.
- PV / Battery / Backup Power system testing and maintenance.
- Window adjustment and warranty checkup.
- 5-year airtightness testing and tune-ups / Retro Commissioning
- Basic interior and exterior maintenance.

# Learn it and Sell it

- **What resilience add on offerings might apply to your business?**

# Conclusions

- **We are all here because we want to offer the best, and most efficient, buildings available.**
- **Phius has taken concepts originally developed elsewhere and adapted them very well to North America.**
- **Phius has added multiple layers of added value to enhance passive building practices over the years.**
- **Our climate has already changed dramatically.**
- **How can we offer our projects added features to help buildings and occupants to continue to thrive in the face of climate disruptions and insure long term performance and durability?**

# Thank You

## Comments or Questions?

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