

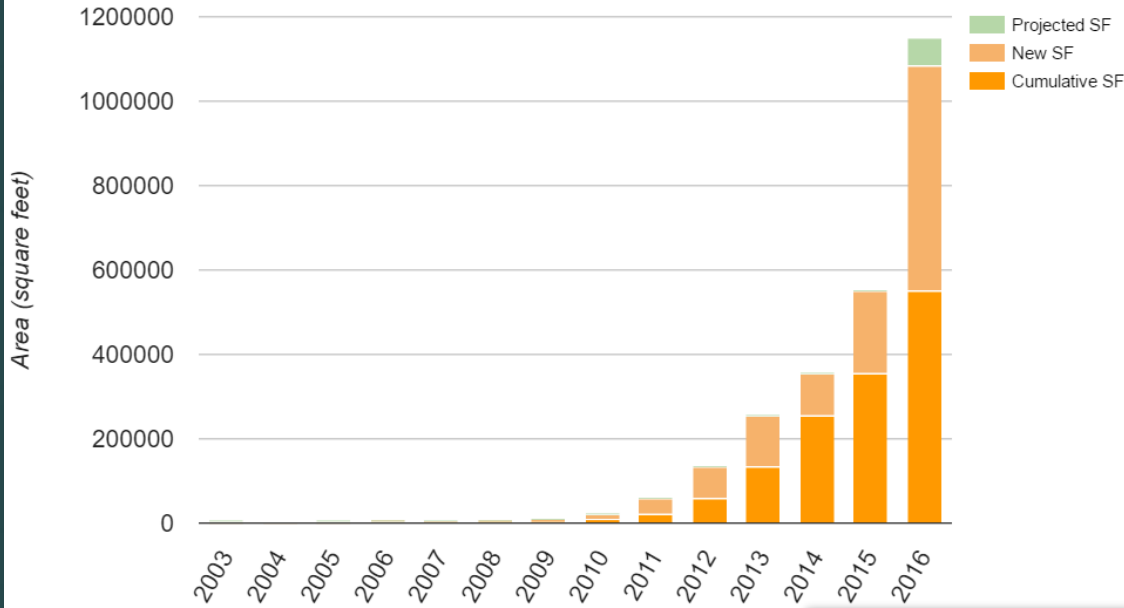
**PHIUS+2015**

**CLIMATE SPECIFIC PASSIVE  
BUILDING STANDARD:**

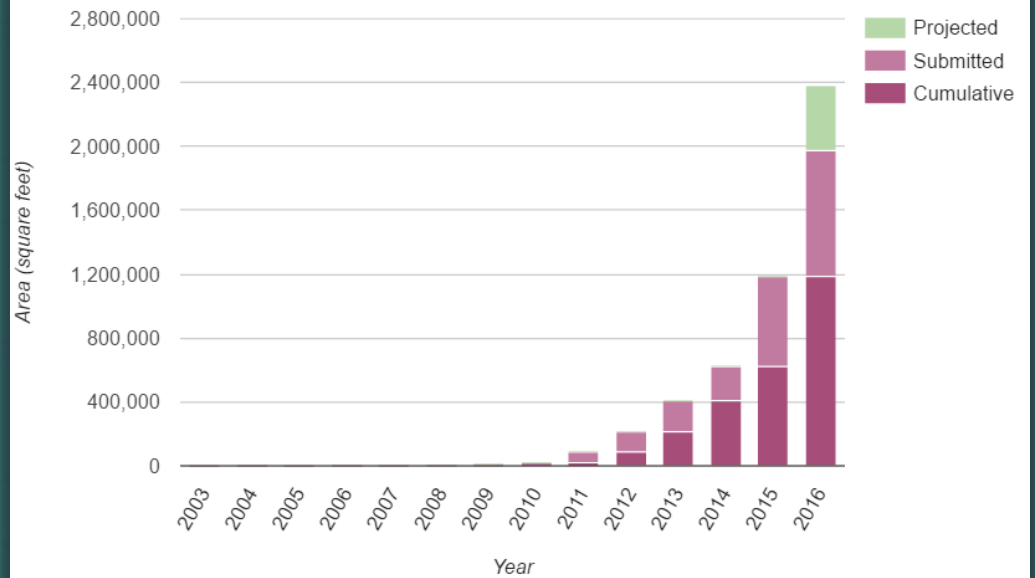
*Cliff Notes*

**PATHWAY TO ZERO CARBON**

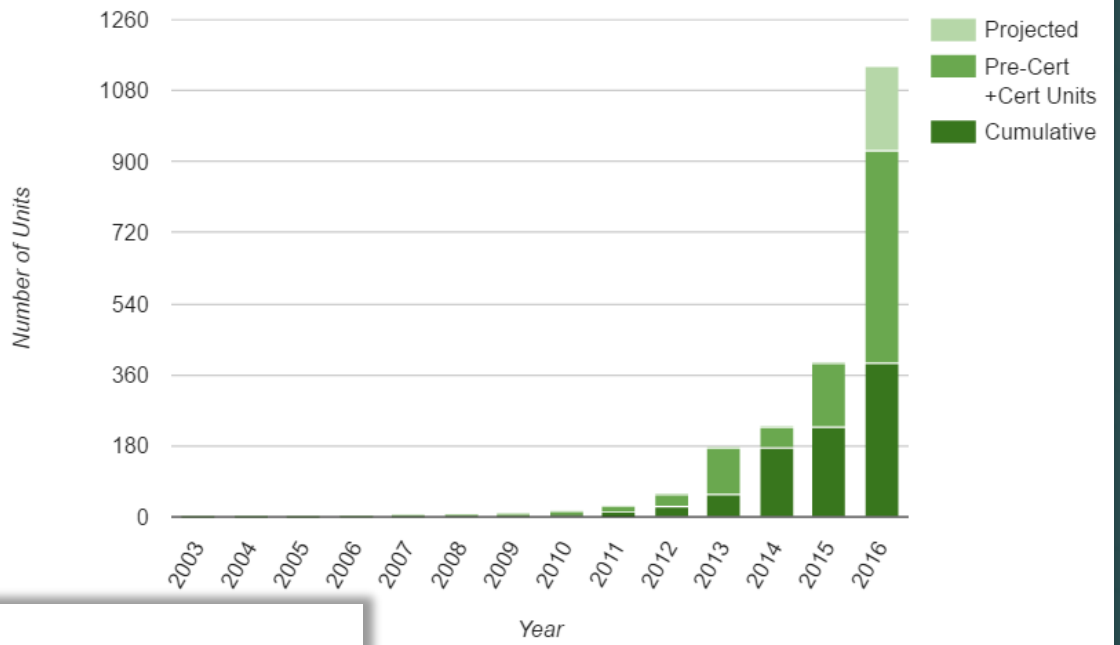
### PHIUS+ Certified & Pre-Certified Square Footage



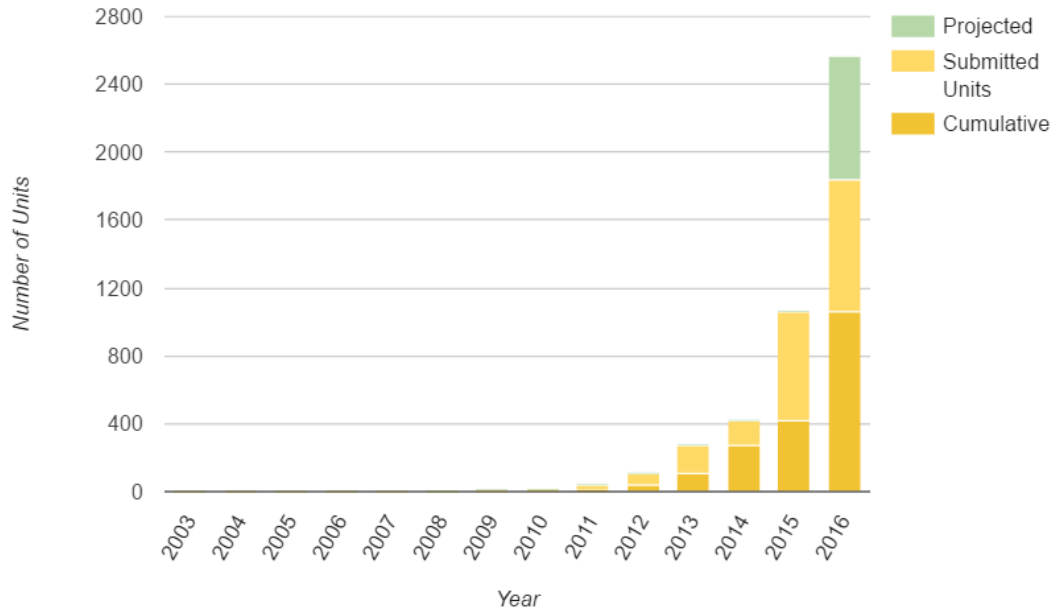
### PHIUS+ Submitted Square Footage



### PHIUS+ Certified & Pre-Certified Units



### PHIUS+ Submitted Units



# AGENDA:

## What is it?

Development and Resulting Requirements

PHIUS+ 2015 Certification Process & Stats

# PHIUS+ 2015: A performance based standard with prescriptive requirements





# PROJECT CERTIFICATION

## High-Performance Home Staircase



# A SET OF DESIGN PRINCIPLES:

## PASSIVE BUILDING

Defined by a set of principles

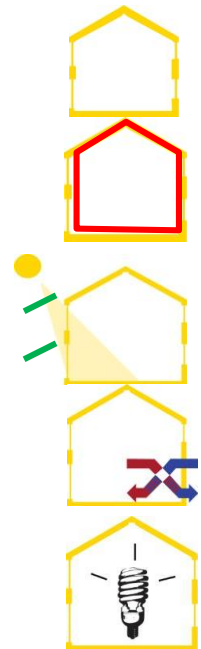
Continuous insulation, no thermal bridges

Air-tight construction

Optimized window performance & solar gain

Balanced heat/moisture recovery ventilation

Minimized mechanical system



# PHIUS+ CERTIFICATION

## SUMMARY OF REQUIREMENTS

1. Space Conditioning Criteria
2. Primary Energy Criteria
3. Air-tightness Criteria
4. Moisture Design Criteria for Assemblies and Details
5. Quality Related Prescriptive Design Requirements
6. Quality Assurance Requirements Rater/Verifier Information



# AGENDA:

What is it?

**Development and Resulting Requirements**

PHIUS+ 2015 Certification Process & Stats

# 3 “PILLARS”

Pass/Fail

1. Space Conditioning
2. Primary Energy
3. Air-Tightness

# TERMINOLOGY

## Demands & Peaks Loads

**Annual Demand [kBTU/yr.ft<sup>2</sup>]:** Space conditioning energy consumed over the course of the year, delivered by the equipment to the space.

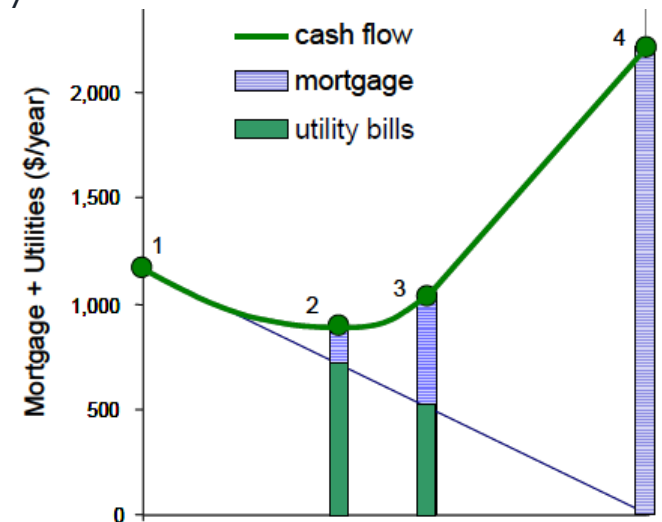
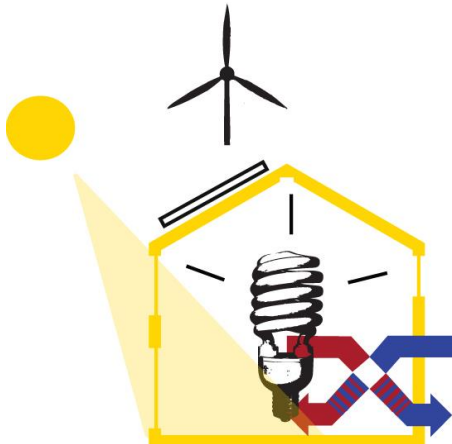
**Peak Load [BTU/hr.ft<sup>2</sup>]:** Space conditioning requirement during the peak climate conditions (average over the worst 24 hours). Determines the size of the mechanical system.

# METHODOLOGY

## Climate Specific & Cost Competitive Space Conditioning Criteria

Developed by US Industry

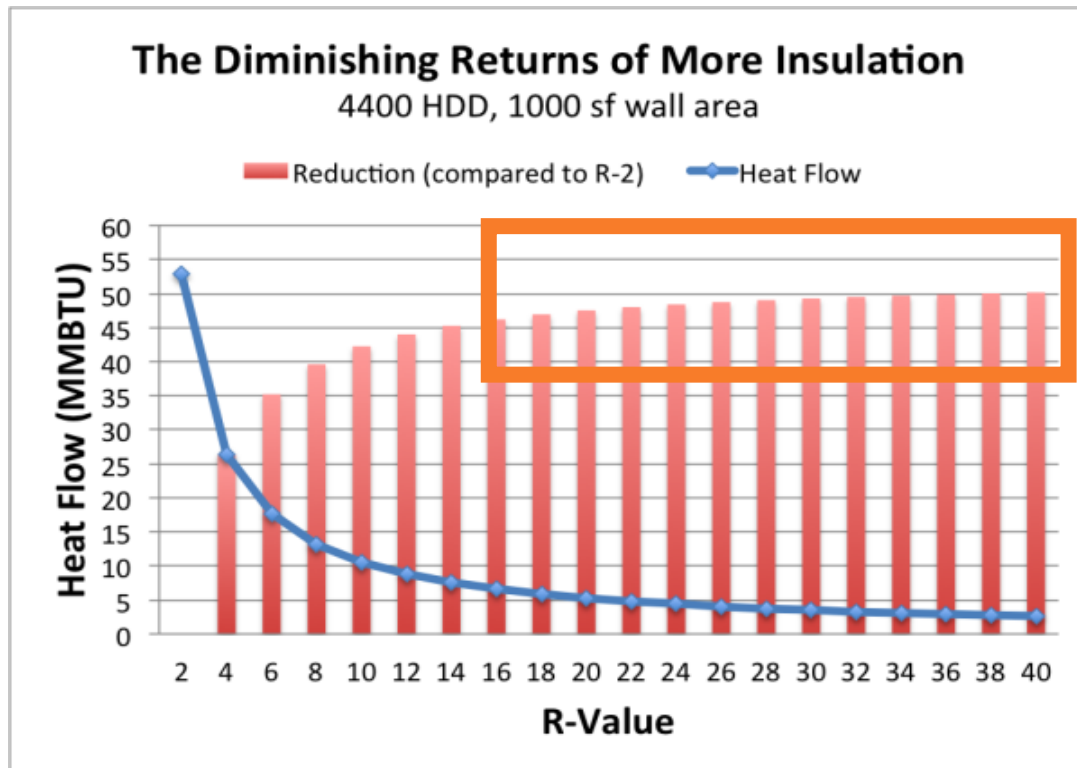
NREL BEopt optimizes  
upgrade package  
by climate



Standards defined as cost optimal/competitive  
sweetspot between conservation and generation

**on the path to zero**

# COST FOR TOO MUCH INSULATION PUSHES DESIGNS BACK INTO **DIMINISHING RETURNS**



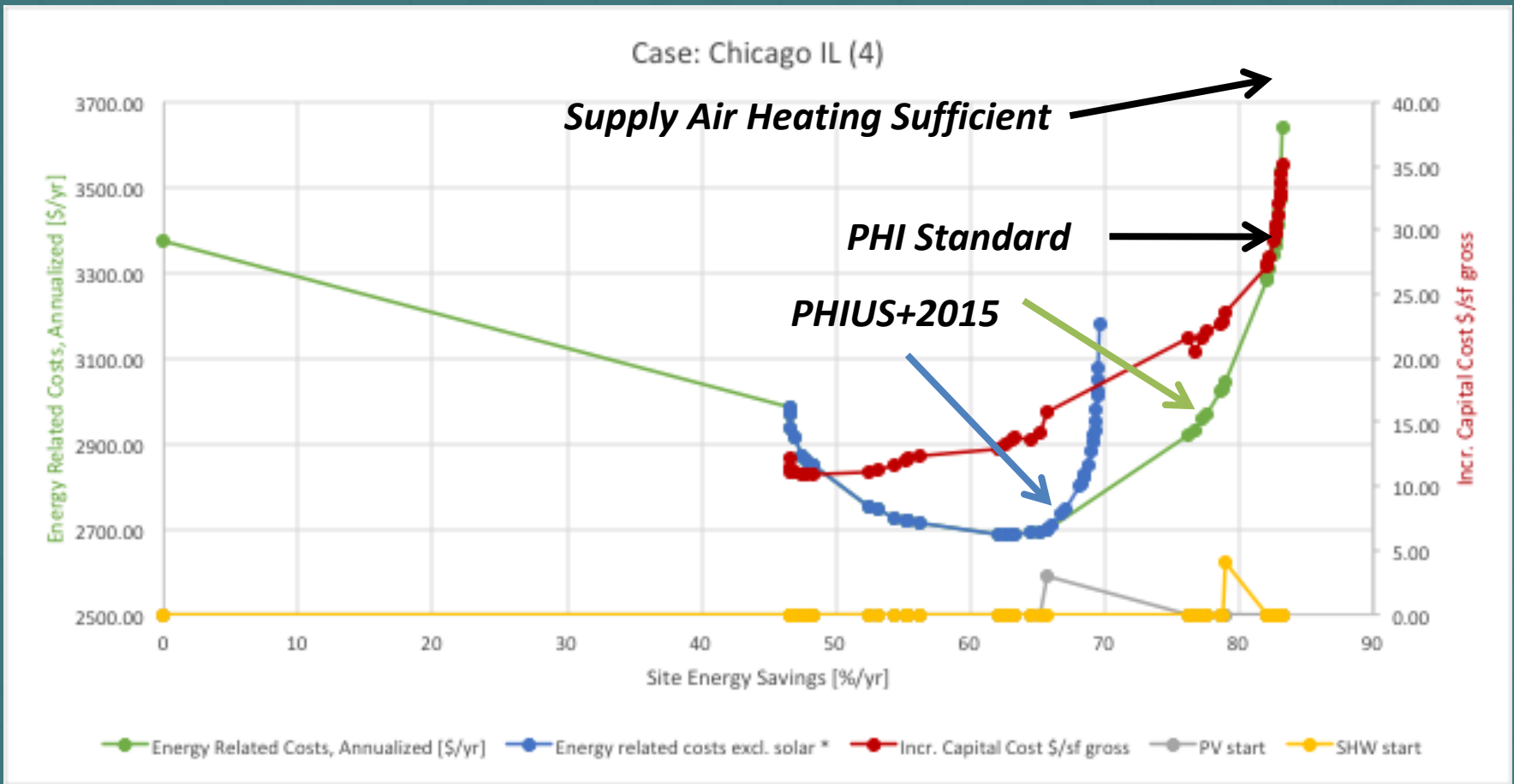
(Source: [www.energyvanguard.com](http://www.energyvanguard.com))

LAST INCH OF INSULATION  
IN PASSIVE HOUSE PROJECT  
IN SOUTH DAKOTA SAVED  
200 kWh ANNUALLY!

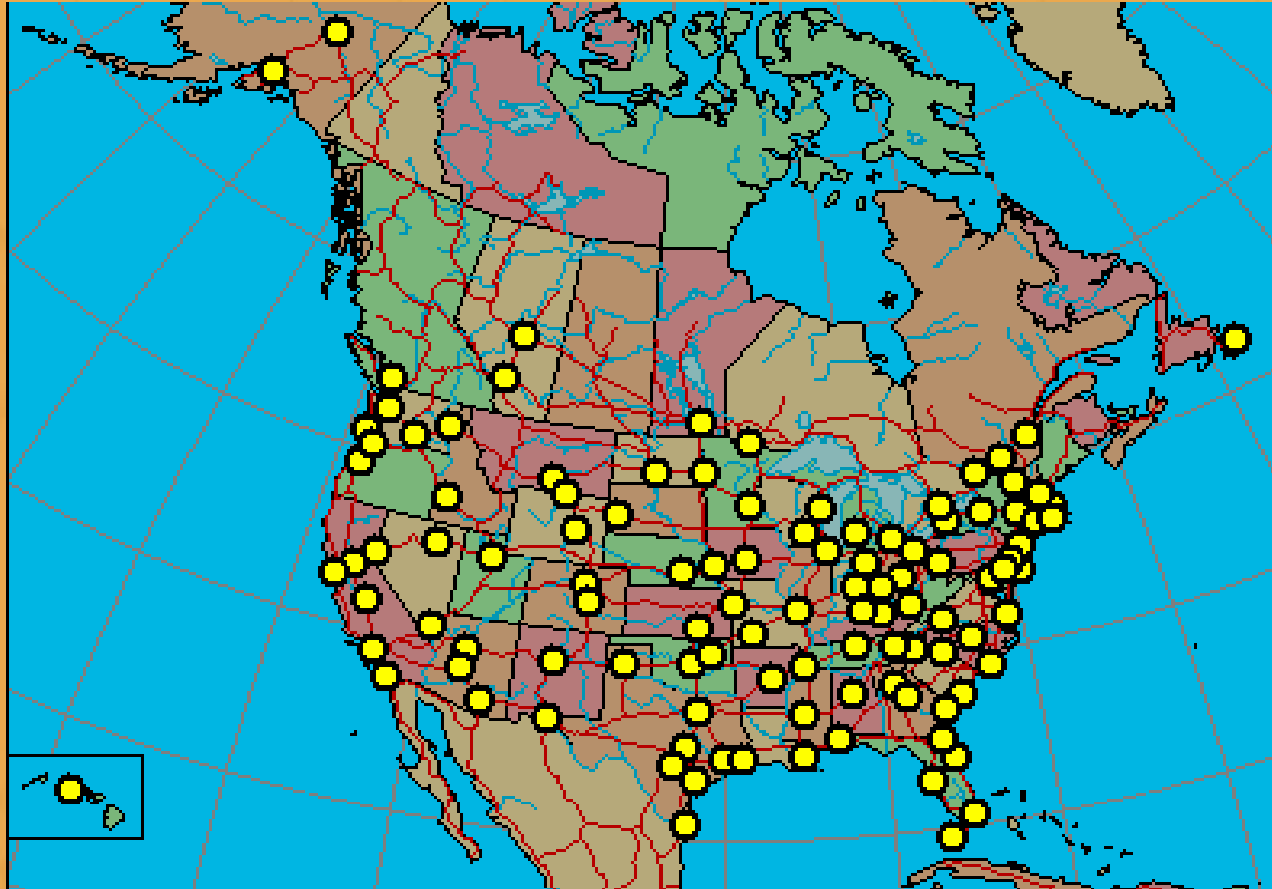
HOW FLAT IS TOO FLAT?



# Climate Specific Passive Standards- BEopt Cost Optimum Output



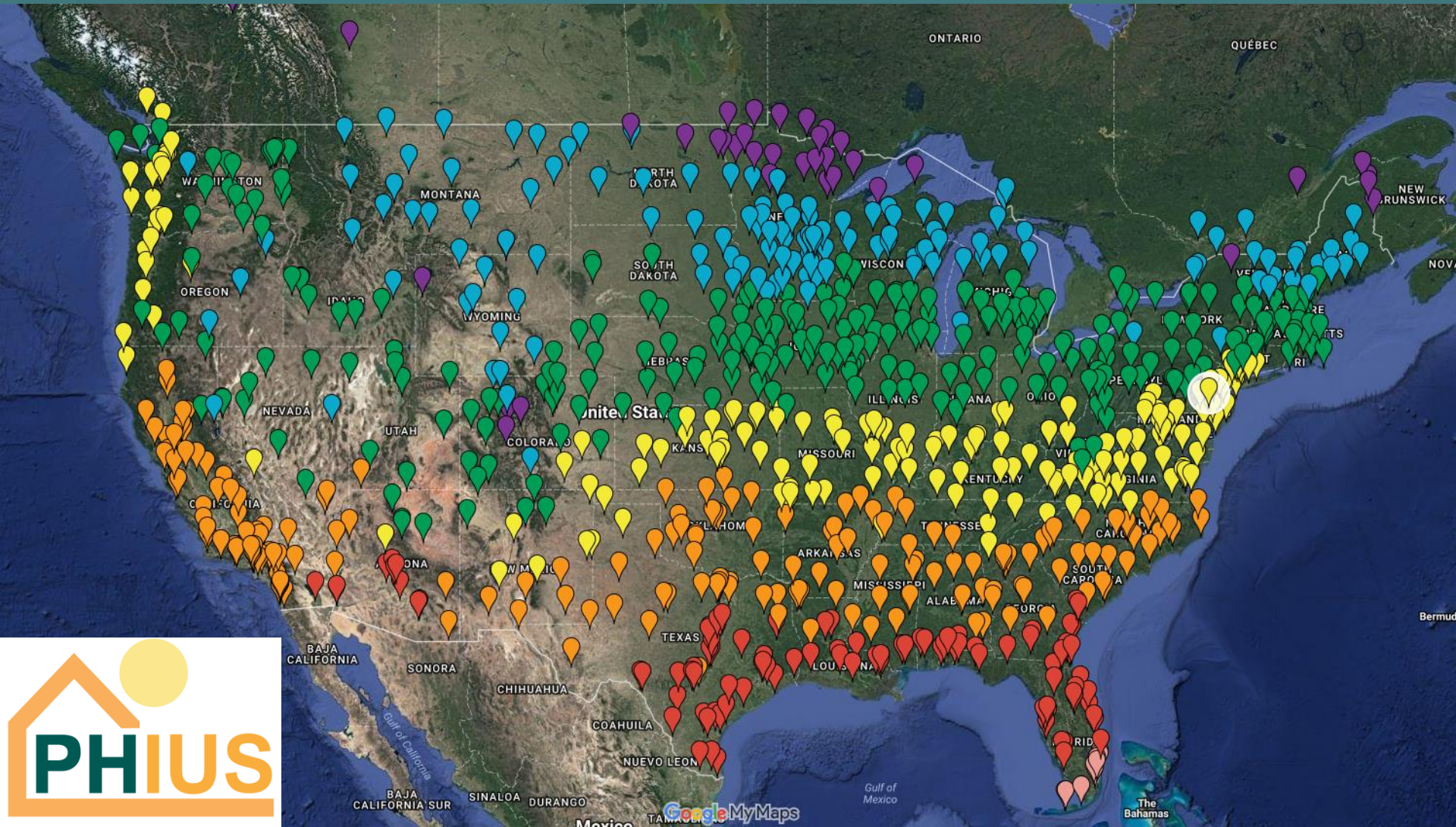
# DOE Study 100+ Cities – Climate Specific Passive Standards



These are the locations for which WUFI weather data is available, which supports dynamic calculations for comfort verification and hygrothermal checks.

# SPACE CONDITIONING

## TARGETS for 1000+ CLIMATES





# SPACE CONDITIONING

*MUST MEET ALL 4 TARGETS!*

- Annual Heating Demand  $\leq A$  (kBTU/ft<sup>2</sup>.yr)
- Annual Cooling Demand  $\leq B$  (kBTU/ft<sup>2</sup>.yr)
- Peak Heating Load  $\leq C$  (BTU/ft<sup>2</sup>.hr)
- Peak Cooling Load  $\leq D$  (BTU/ft<sup>2</sup>.hr)

Different advantages for each:

- Low **annual demand** saves energy
- Low **peak loads** ensure comfort, resilience, and reduce mechanical system size

# TERMINOLOGY

## Site Energy & Primary Energy

### **Site Energy [kWh/person.yr] OR [kBtu/yr.ft<sup>2</sup>]:**

Total energy consumed over the course of the year, including space conditioning, hot water, plug loads, lighting, appliances, systems, etc. (Excludes electrical vehicle charging energy, and lighting energy specific to vehicle parking areas)

\*No requirement for PHIUS+ Certification

### **Source (Primary) Energy [kWh/person.yr]**

**OR [kBtu/yr.ft<sup>2</sup>]:** Site energy as described above, multiplied

by the source/primary energy factor for the specific fuel type used.

Ex: Electricity has a PE factor of 3.16 kWh/kWh (generation at the source vs use on site)



# PRIMARY ENERGY BUDGET VARIES BY BUILDING TYPE

**Residential**: Per person limit, based on “fair share”  
of CO<sub>2</sub>

**6200 kWh.person/yr**

(temporary increase from goal of 4200 kWh/person.yr)

**Commercial**: Per square foot limit

**38 kBTU/ft<sup>2</sup>.yr**

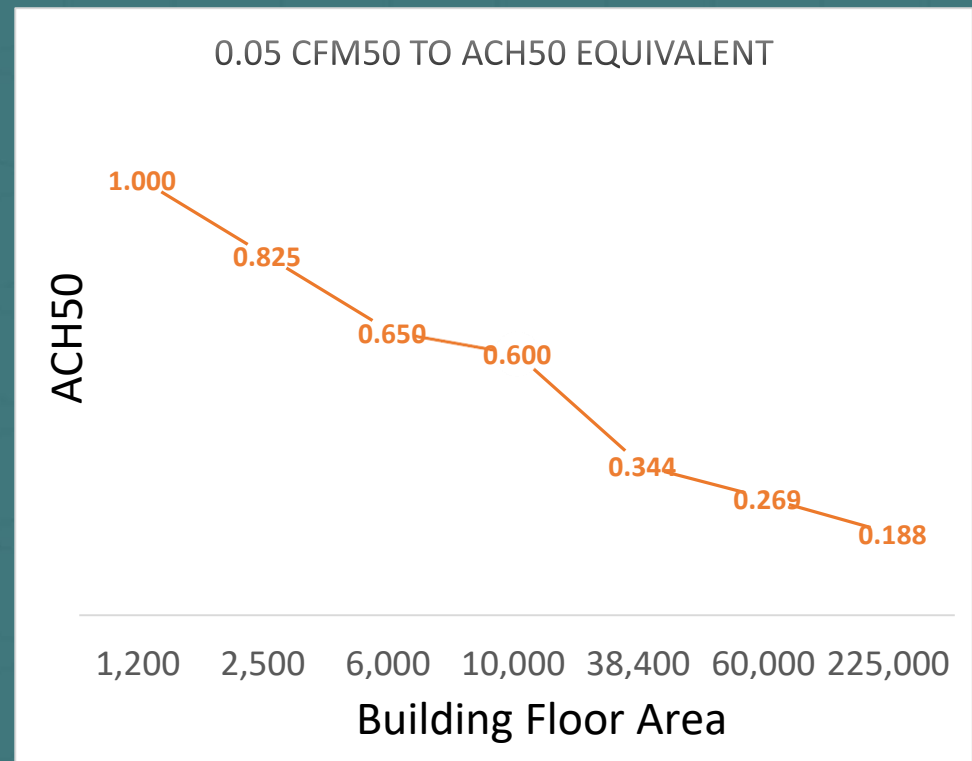
\*Additional allowance for process loads on case-  
by-case basis

# AIRTIGHTNESS

## PER SQUARE FOOT of ENVELOPE AREA

**Primary reason** = Building durability, based on hygrothermal analysis by PHIUS Tech Committee

\*When Leakage per square foot is held constant, ACH50 varies by building size



# ENERGY MODELING PROTOCOL

## 1. REFERENCE FLOOR AREA (iCFA)

CHANGED TO SIMPLIFIED DEFINITION

## 2. LIGHTING & PLUG LOAD ASSUMPTIONS

ADJUSTED TO ALIGN BETTER WITH US NORMS

MORE REALISTIC

80% RESNET ASSUMPTIONS

## 3. OCCUPANCY & INTERNAL HEAT GAINS

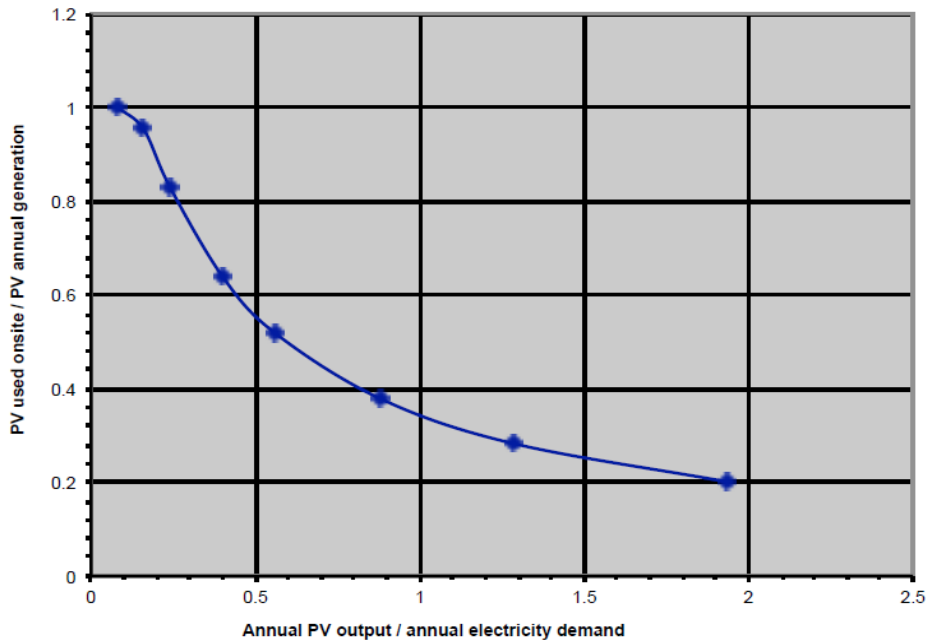
ADJUSTED TO REFLECT ACTUAL BUILDING

- # BEDROOMS +1
- CALCULATED INTERNAL GAINS
- BASED ON EQUIP & PEOPLE

# INCLUSION OF RENEWABLES

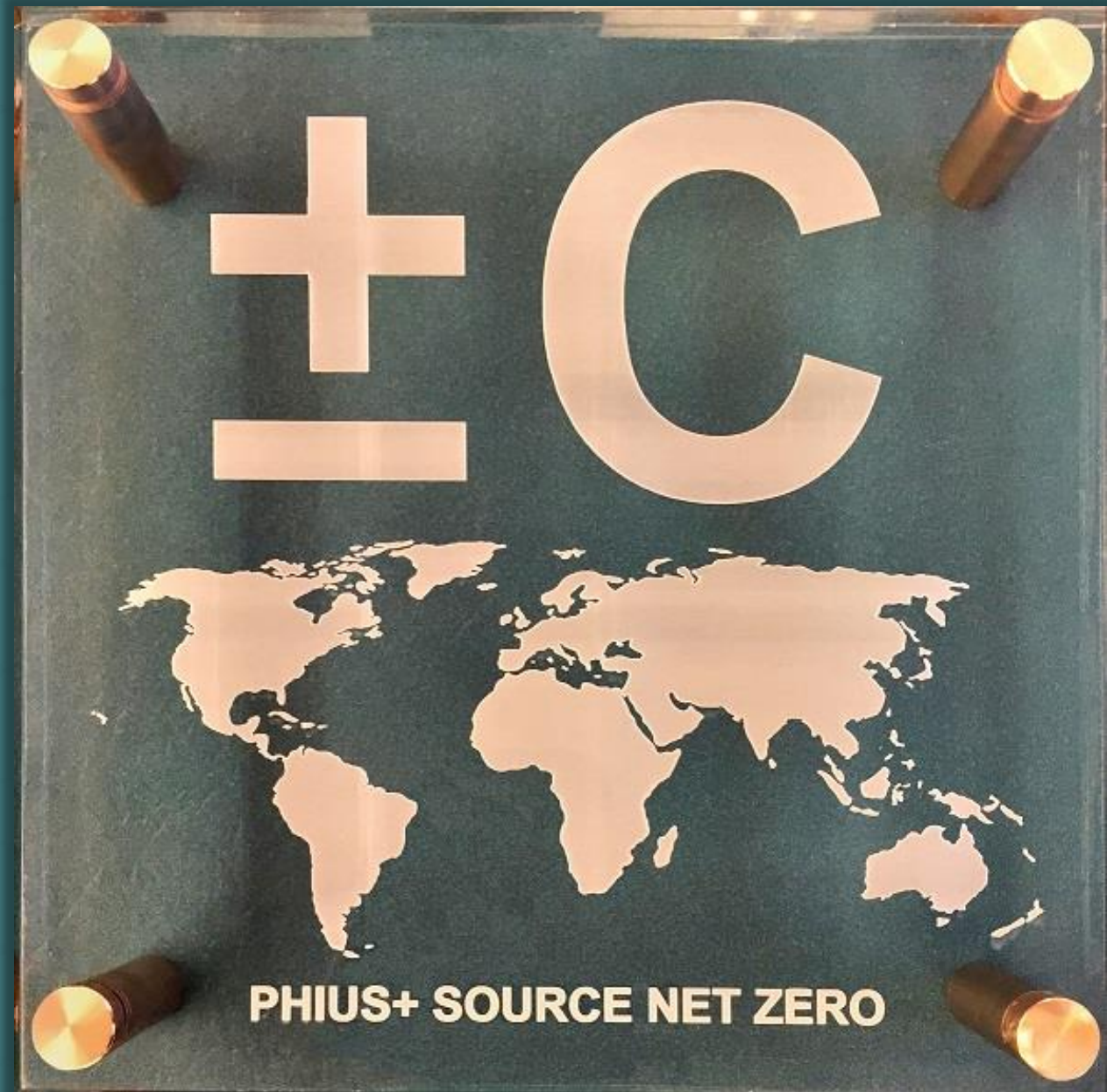
## PV to offset Primary Energy

PV onsite utilization, Zone 5A



PV Output/ TOTAL Site	LIVE UTILIZATION
0.09	1
0.19	0.96
0.25	0.83
0.53	0.52
0.85	0.38
1.28	0.29
1.95	0.20

***PHIUS+***  
***Source***  
***Zero***





# AGENDA:

What is it?

Development and Resulting Requirements

**PHIUS+ 2015 Certification Process & Stats**

# CERTIFICATION REQUIREMENTS

## SUMMARY TABLE

	Heating Demand/Load*	Cooling Demand/Load*	AIR-TIGHTNESS (cfm50/sf envelope)	Source Energy Demand	Renewable Generation for Source Zero
SINGLE FAMILY	1 - 16.8	1 - 23.4	0.05	6200 kWh/person.yr	>6200 kWh/person.yr
COMMERCIAL	kBTU/ft2.yr 0 - 7.6 BTU/hr.ft2	kBTU/ft2.yr 1.3 - 9.5 BTU/hr.ft2		38 kBTU/ft2.yr	>38 kBTU/ft2.yr
MULTIFAMILY			0.08**		
RETROFIT	As above, + allowance for existing thermal bridges	As above, + allowance for existing thermal bridges	0.05	6200 kWh/person.yr / 38 kBTU/ft2.yr	>6200 kWh/person.yr / >38 kBTU/ft2.yr

\*Based on climate specific targets for each individual project

\*\*Buildings with 5 stories+, non-combustible construction

## OTHER REQUIREMENTS

1. Moisture design criteria for assemblies and details
2. Quality-related prescriptive design elements
3. Field quality assurance inspections
4. Contractor declaration

# Process

## Design Review & On-Site Inspection



PHIUS+ FEEDBACK - V3.0		Date:	Submitter Name:	CPHC Name:	CPHC Number:
SECTION 0: WUFI PASSIVE		WUFI Checklist - Branches	Response	Certifier Comments	Response
Project	General				
	Data				
	Picture				
Localization/Climate	Localization				
	Climate				
	Primary Energy/CO <sub>2</sub> Factor				
PH Case	General				
	Additional Data				
	Foundation Interface				
Zone 1					
Visualized Components	General				
Roof Components	Assembly				
	Surface				
Wall Components	General				
	Assembly				
	Surface				



1. Complying energy model must match drawings/plans/specs (pre-cert)
2. Building must match modeled drawings & pass inspections (final cert)

PHIUS+ On-site Quality Control - Building Envelope section. Includes items like 'Take pictures of each building elevation during final construction inspection for documentation', 'Take pictures of eave/soffit details on all sides of building', 'Take representative pictures of insulated eave', etc.

PHIUS+ On-site Quality Control - Ventilation section. Includes items like 'High-Performance Fan-coil or Heat Recovery Ventilator (HRV) system', 'Whole-house Mechanical System Installation', 'Mechanical System Commissioning', etc.

PHIUS+ On-site Quality Control - Heating + Cooling section. Includes items like 'HVAC System Description', 'Heating/Cooling Loads + Equipment Selection', 'Heating/Cooling System Installation', etc.

PHIUS+ On-site Quality Control - Domestic Hot Water (DHW) section. Includes items like 'Project team insulation pip and install', 'DHW tank or tankless water heater', 'DHW system', etc.

PHIUS+ On-site Quality Control - Indoor airPLUS section. Includes items like 'Indoor airPLUS Version 1 (Rev. 01) Verification Checklist', 'ENERGY STAR 3.0', etc.

PHIUS+ On-site Quality Control - Water Management section. Includes items like 'ENERGY STAR Certified Homes, Version 3 (Rev. 07) Water Management System Builder Checklist', 'Water Management System Builder Checklist', etc.

PHIUS+ On-site Quality Control - Volume of tank section. Includes a table for 'Volume of tank' with columns for 'Nominal Size', 'Copper', 'M', 'L', and 'Conversion: 1.0 gallon/3.785 L'.

PHIUS+ On-site Quality Control - Details section. Includes a table for 'Details' with columns for 'Internal', 'External', and 'Roof'.

PHIUS+ On-site Quality Control - Materials section. Includes a table for 'Materials' with columns for 'Material', 'Quantity', and 'Notes'.

PHIUS+ On-site Quality Control - Final section. Includes a table for 'Final' with columns for 'Final', 'Quantity', and 'Notes'.



Passive House Institute U.S. has developed the various checklist requirements that are on energy efficient.

Both PHIUS+ and DOE Challenge Home building, but also a durable, comfortable, and healthy building environment.

PHIUS+ and DOE Challenge Home building is typically certified through Challenge Home, Energy Star, etc. (U.S. Green Building Council).

This workbook includes checklist for Energy Star, Energy Star, etc. (U.S. Green Building Council).

There are seven checklists to complete Energy Star, etc. (U.S. Green Building Council).

PHIUS+ On-site Quality Control - Domestic Hot Water (DHW) section.

PHIUS+ On-site Quality Control - Indoor airPLUS section.

PHIUS+ On-site Quality Control - Water Management section.

PHIUS+ On-site Quality Control - Volume of tank section.

PHIUS+ On-site Quality Control - Details section.

PHIUS+ On-site Quality Control - Materials section.

PHIUS+ On-site Quality Control - Final section.

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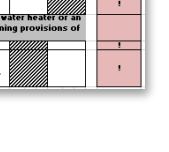
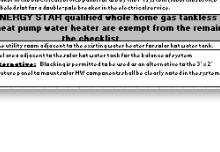
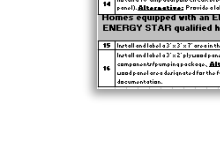
PHIUS+ On-site Quality Control - Final section.

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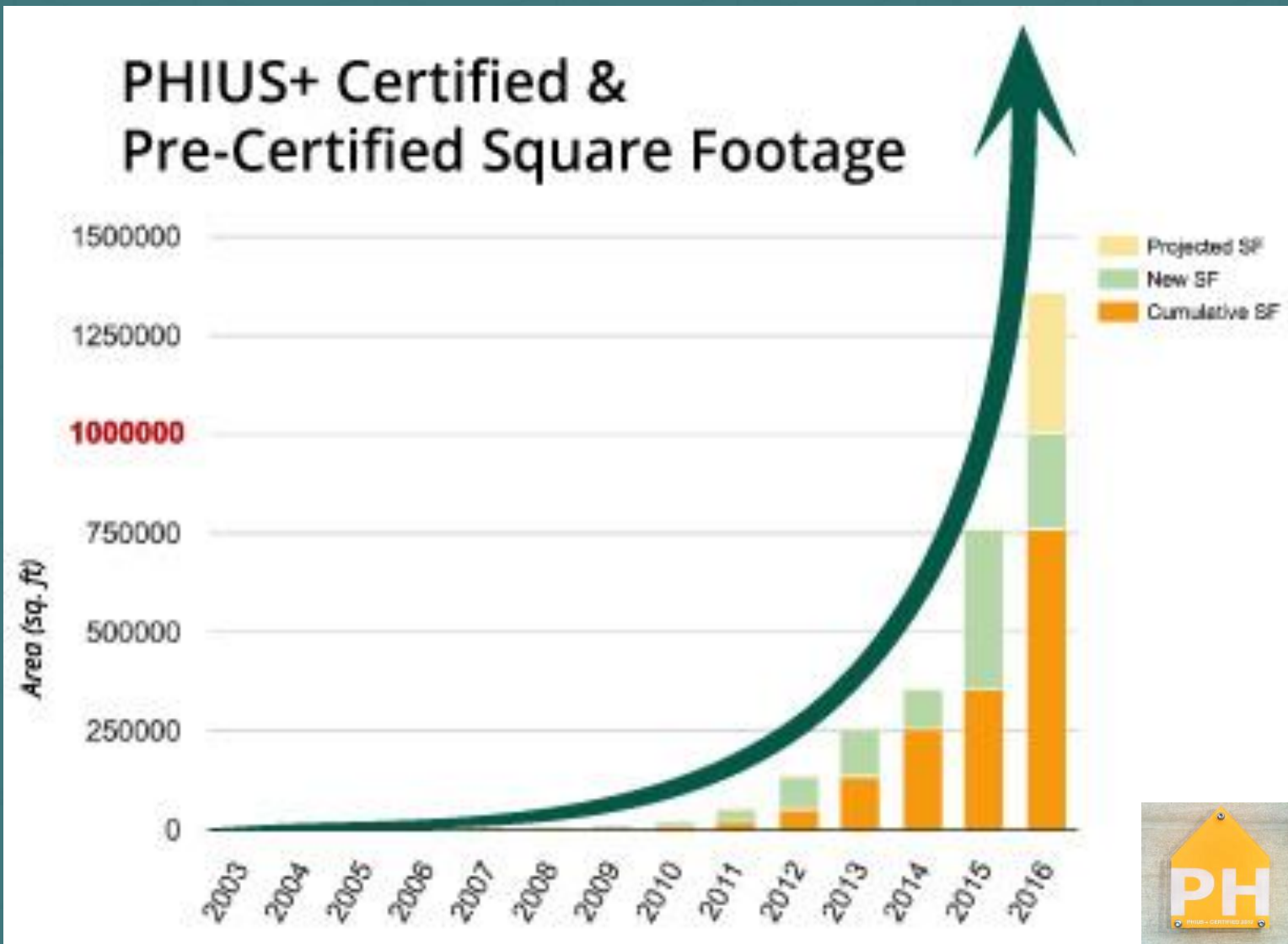
PHIUS+ On-site Quality Control - Final section.

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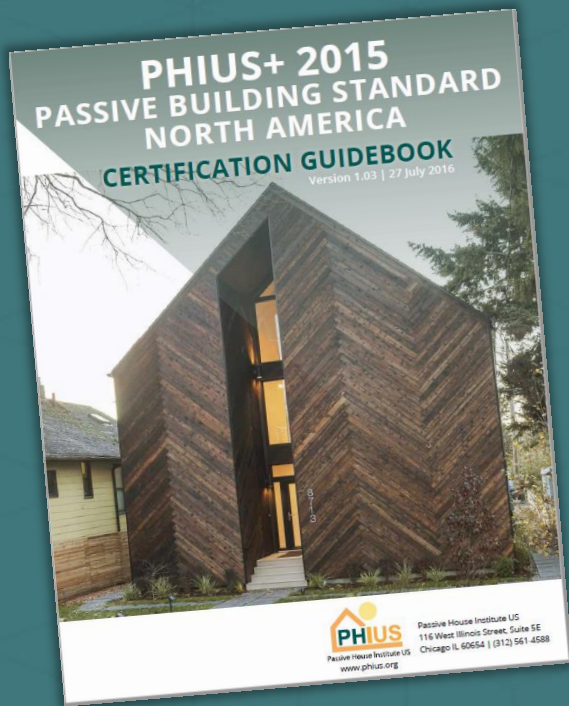
PHIUS+ On-site Quality Control - Final section.



# PASSIVE HOUSE US DATABASE

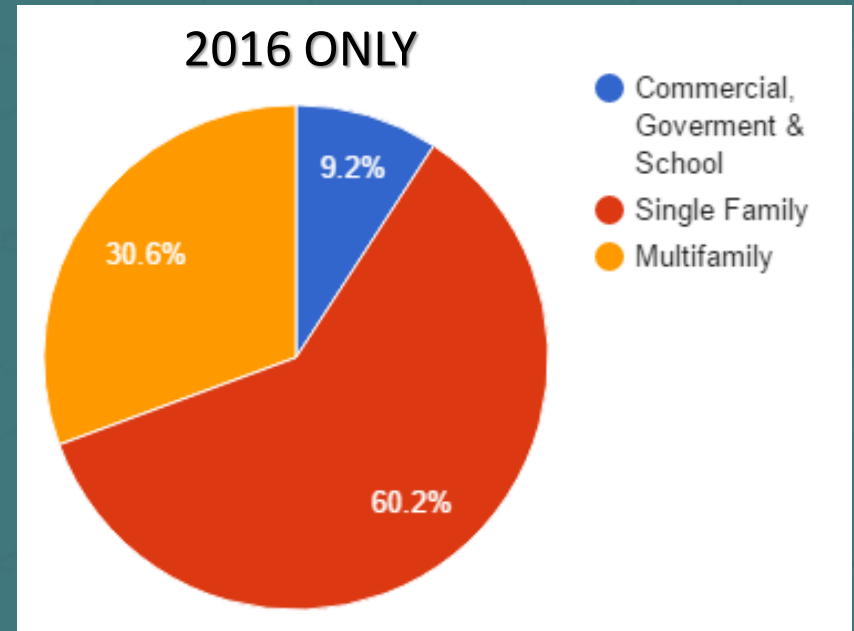
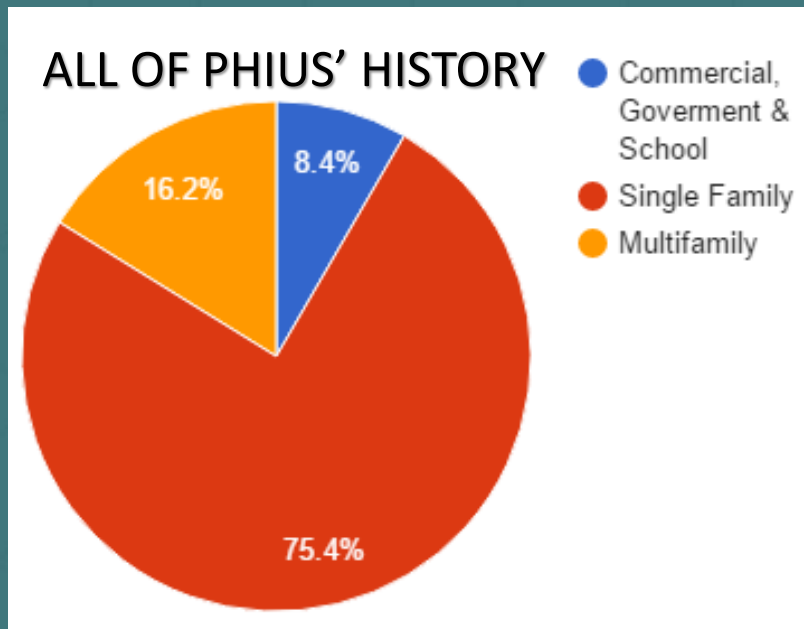






PROJECT COUNT (TOTAL): 358  
 CERTIFIED & PRE-CERTIFIED: 196  
 SUBMITTED: 162

UNITS (TOTAL): 1835  
 CERTIFIED & PRE-CERTIFIED: 930  
 SUBMITTED: 905

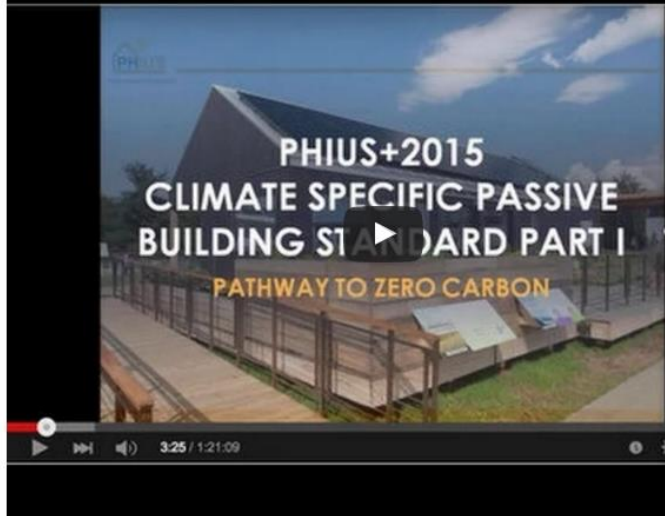


## PHIUS+ 2015: Webinar Series

PHIUS+ 2015: The New Climate Specific Passive Building Standard (Part 1) -- presented by Katrin Klingenberg, PHIUS Executive Director.

Originally aired April 20, 2015 at 6pm ET.

Part 1: PHIUS+2015: New Climate Specific Passive Building Stand...



PHIUS+ 2015: The New Climate Specific Passive Building Standard (Part 2) -- presented by Graham S. Wright, PHIUS Senior Scientist.

Originally aired May 4, 2015 at 6pm ET.

Part 2: PHIUS+ 2015: The New Climate Specific Passive Building S...  
Source Energy

- Motivation: the Intergovernmental Panel on Climate Change says we can emit about another 800 Gigatons.
  - For 60% chance of <math>2^{\circ}\text{C}</math> temperature rise.
  - And there's about 8 Gigapeople.
  - Atmosphere is the ultimate commons.
    - So, about 100 tons/person share.
  - Current US rate ~17 tons/person.yr LOL
- We found no great justification for relaxation.

© 2015 PHIUS

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# Resources:

Graham Wright & Katrin Klingenberg. (2015) *Climate-Specific Passive Building Standards*. <http://www.nrel.gov/docs/fy15osti/64278.pdf>

PHIUS. *PHIUS+ 2015 Webinar Series*. (2016). <http://www.phius.org/phius-certification-for-buildings-and-products/phius-2015-webinar-series>





THANKS!  
QUESTIONS?

**PASSIVE BUILDING**

PART OF THE SOLUTION

Lisa White, PHIUS Certification Manager, [lisa@passivehouse.us](mailto:lisa@passivehouse.us)