

Factoring in Electrification: Designs for a Renewable Energy Grid

Bronwyn Barry, RA, CPHD

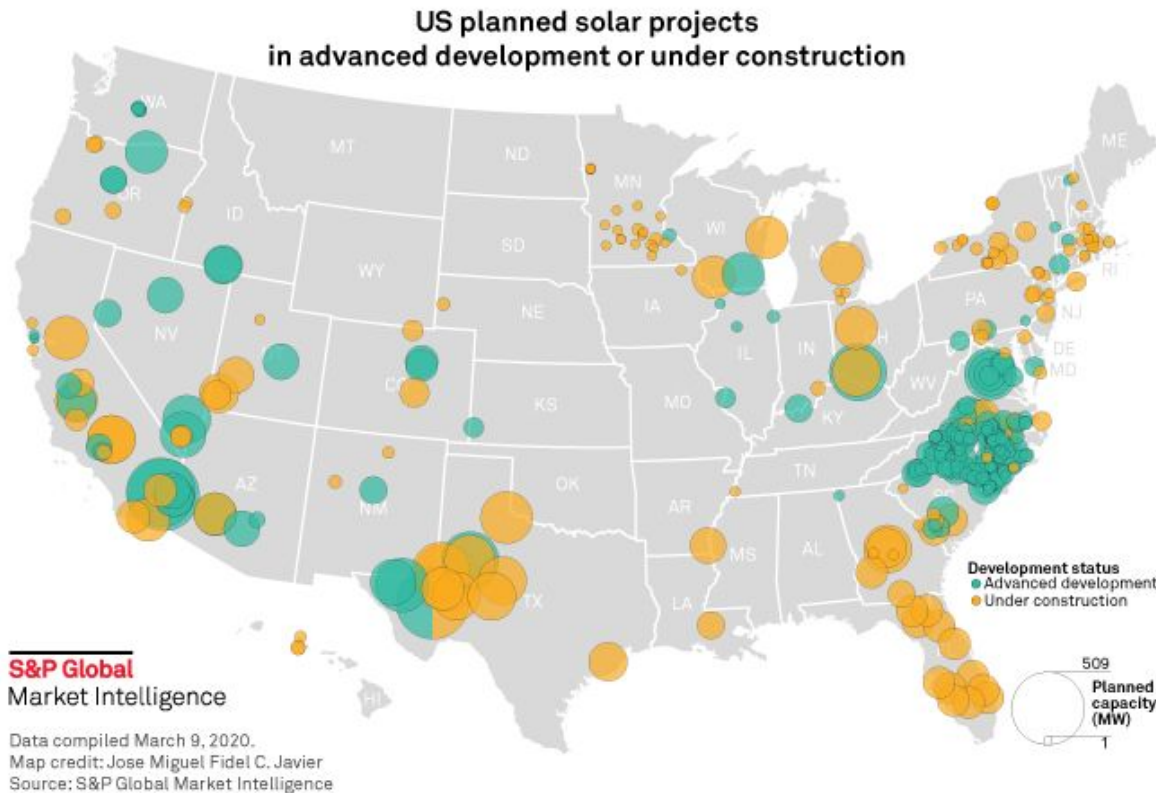
Dylan Martello, SWA

Dec. 2021

OVERVIEW



The Passive House Network



1. What are Primary Energy Factors?
2. An intro to Primary Energy Renewables (PER)
3. What do these look like in YOUR Region?
4. How this works on real projects
5. Discussion and Q&A

DEFINING THE DESTINATION



The Passive House Network

**We must rapidly transition
from this..**

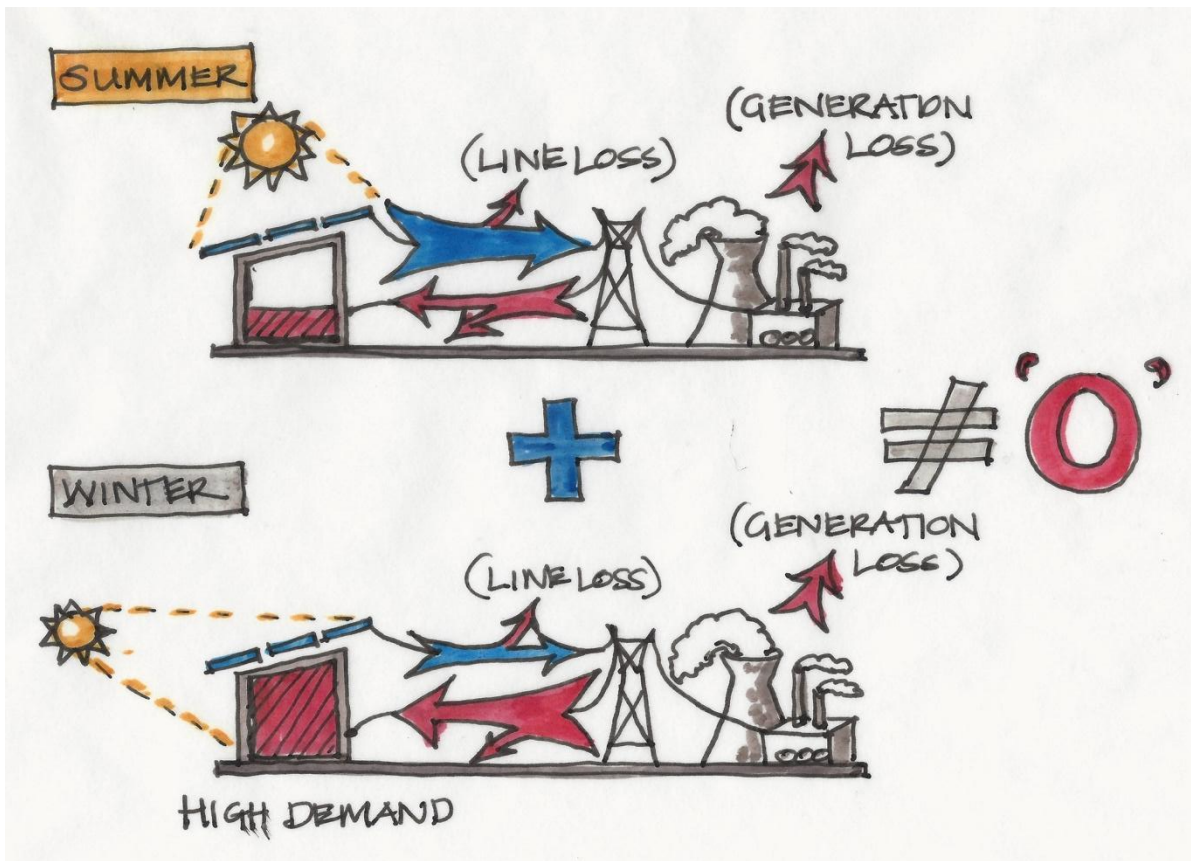


to this!



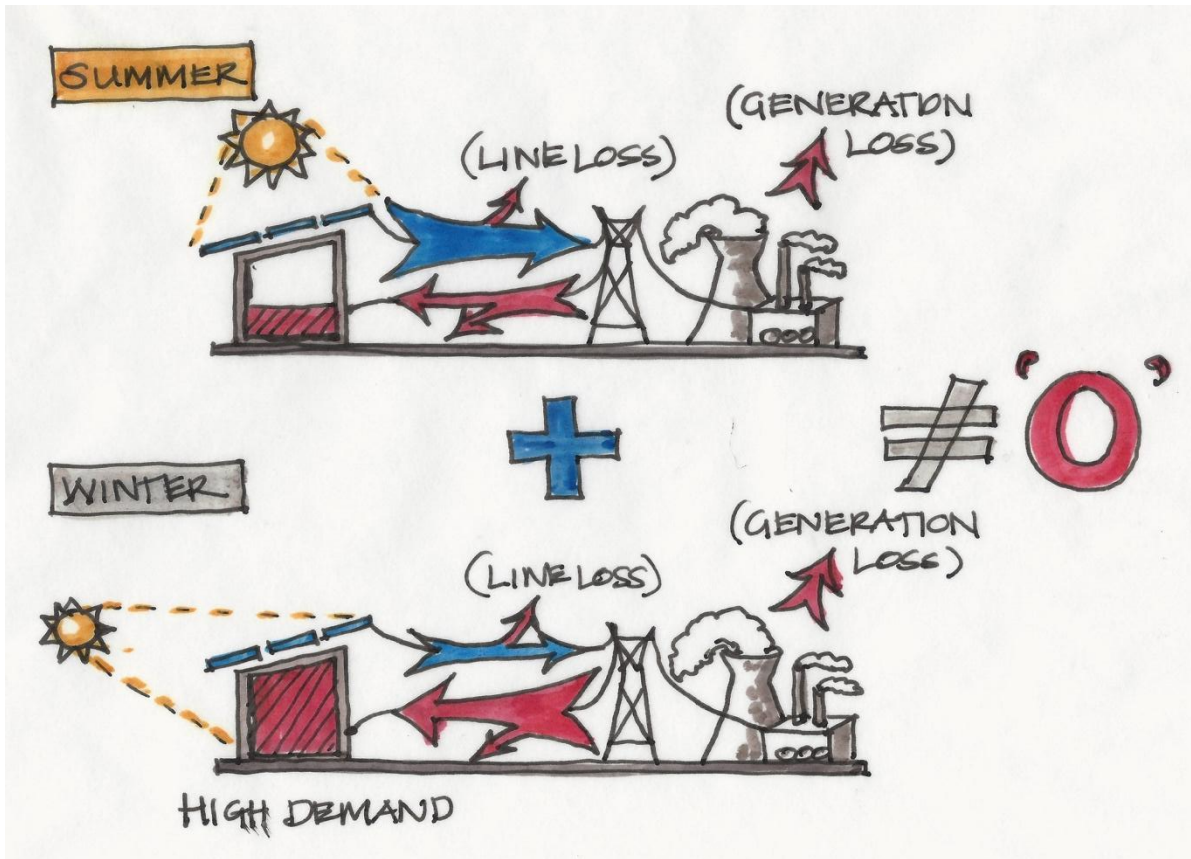
Image Credit: Copyright NAPHN 2019, based on illustrations by B.Barry

'SOURCE' vs 'SITE' ENERGY



SOURCE: Illustration from 'California's All Renewable Energy Future' by Bronwyn Barry

'SOURCE' vs 'SITE' ENERGY



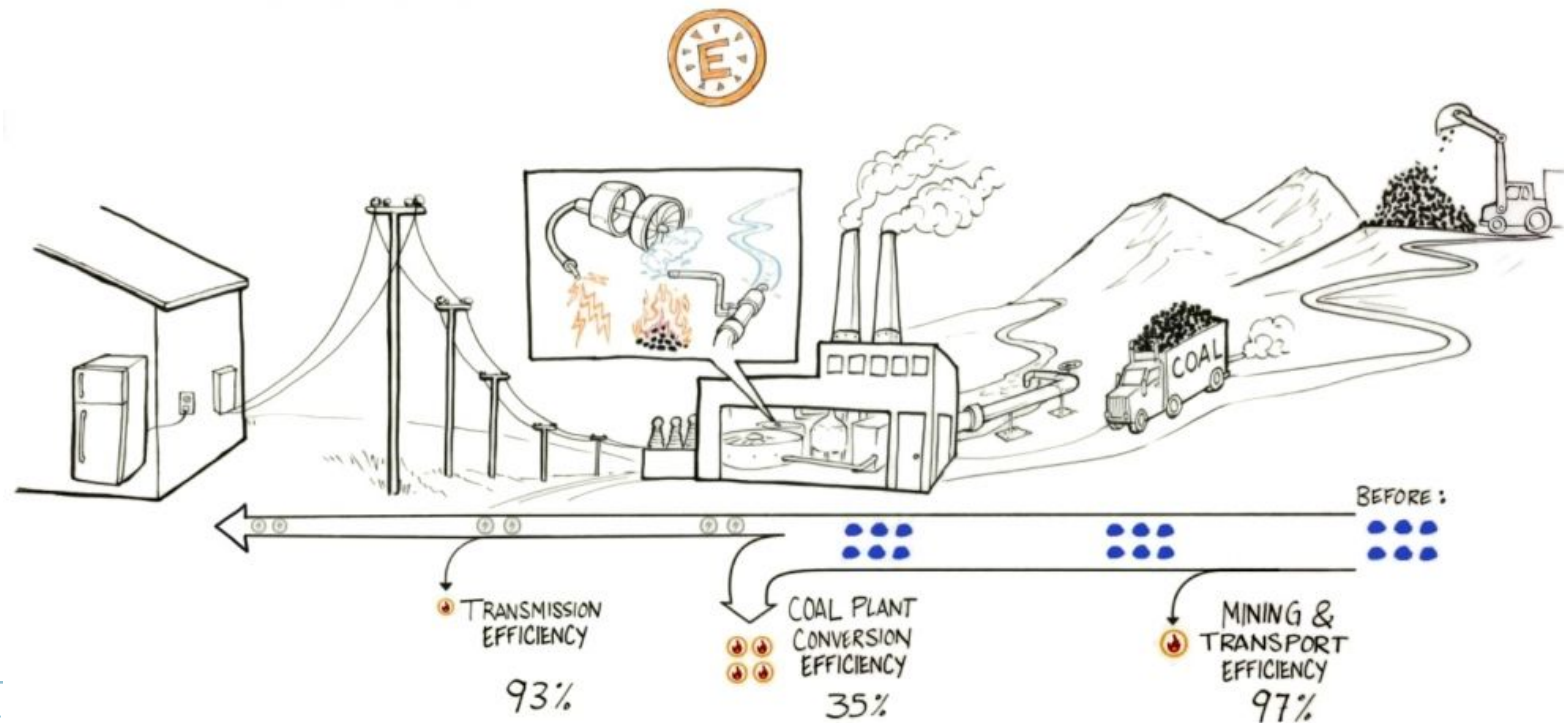
SOURCE: Illustration from 'California's All Renewable Energy Future' by Bronwyn Barry

'SITE NET ZERO' IS FUZZY MATH!

WHAT IS A SOURCE ENERGY FACTOR?



The Passive House Network

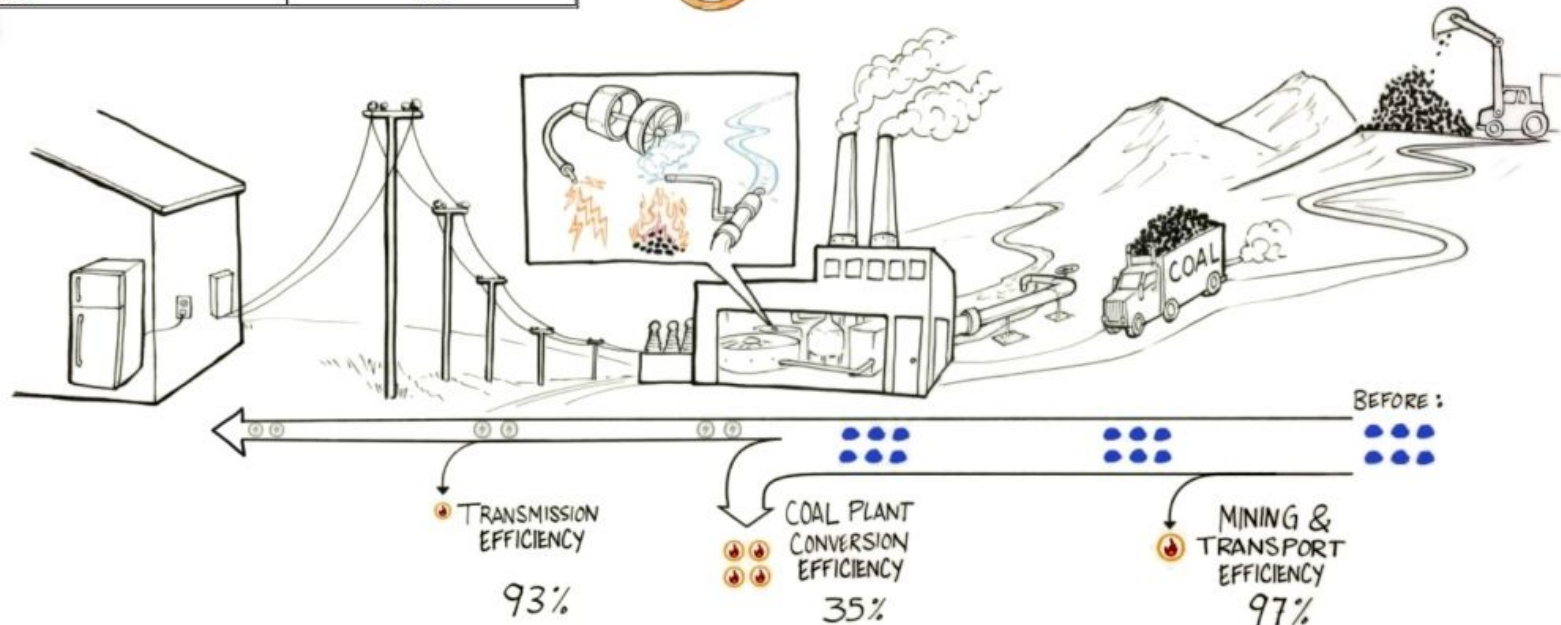


WHAT IS A SOURCE ENERGY FACTOR?



The Passive House Network

Table 1 Source-Site Ratios for all Portfolio Manager Fuels	
Fuel Type	Source-Site Ratio
Electricity (Grid Purchase)	3.34
Electricity (on-Site Solar or Wind Installation)	1.0
Natural Gas	1.047
Fuel Oil (1,2,4,5,6,Diesel, Kerosene)	1.01
Propane & Liquid Propane	1.01
Steam	1.21
Hot Water	1.28
Chilled Water	1.05
Wood	1.0
Coal/Coke	1.0
Other	1.0



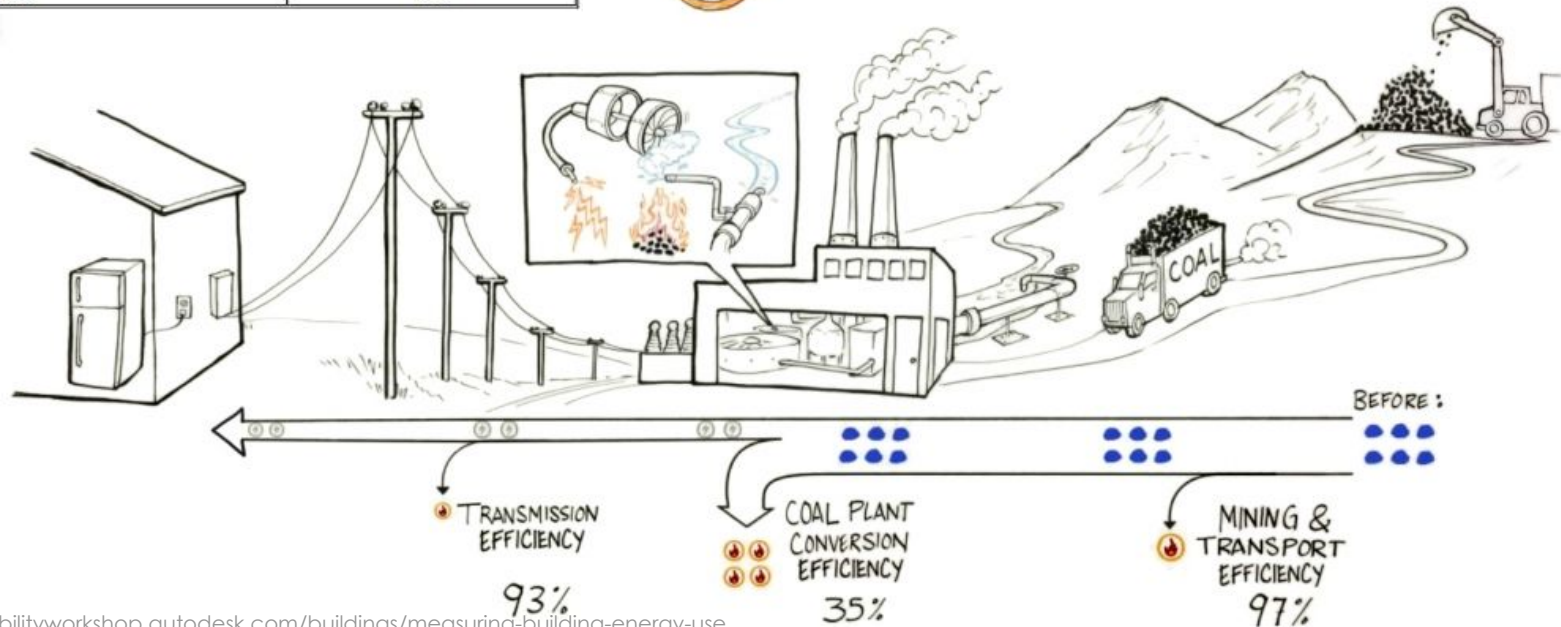
WHAT IS A SOURCE ENERGY FACTOR?



The Passive House Network

Table 1
Source-Site Ratios for all Portfolio Manager Fuels

Fuel Type	Source-Site Ratio
Electricity (Grid Purchase)	3.34
Electricity (on-Site Solar or Wind Installation)	1.0
Natural Gas	1.047
Fuel Oil (1,2,4,5,6,Diesel, Kerosene)	1.01
Propane & Liquid Propane	1.01
Steam	1.21
Hot Water	1.28
Chilled Water	1.05
Wood	1.0
Coal/Coke	1.0
Other	1.0



REGIONAL ELECTRIC SOURCE ENERGY FACTORS

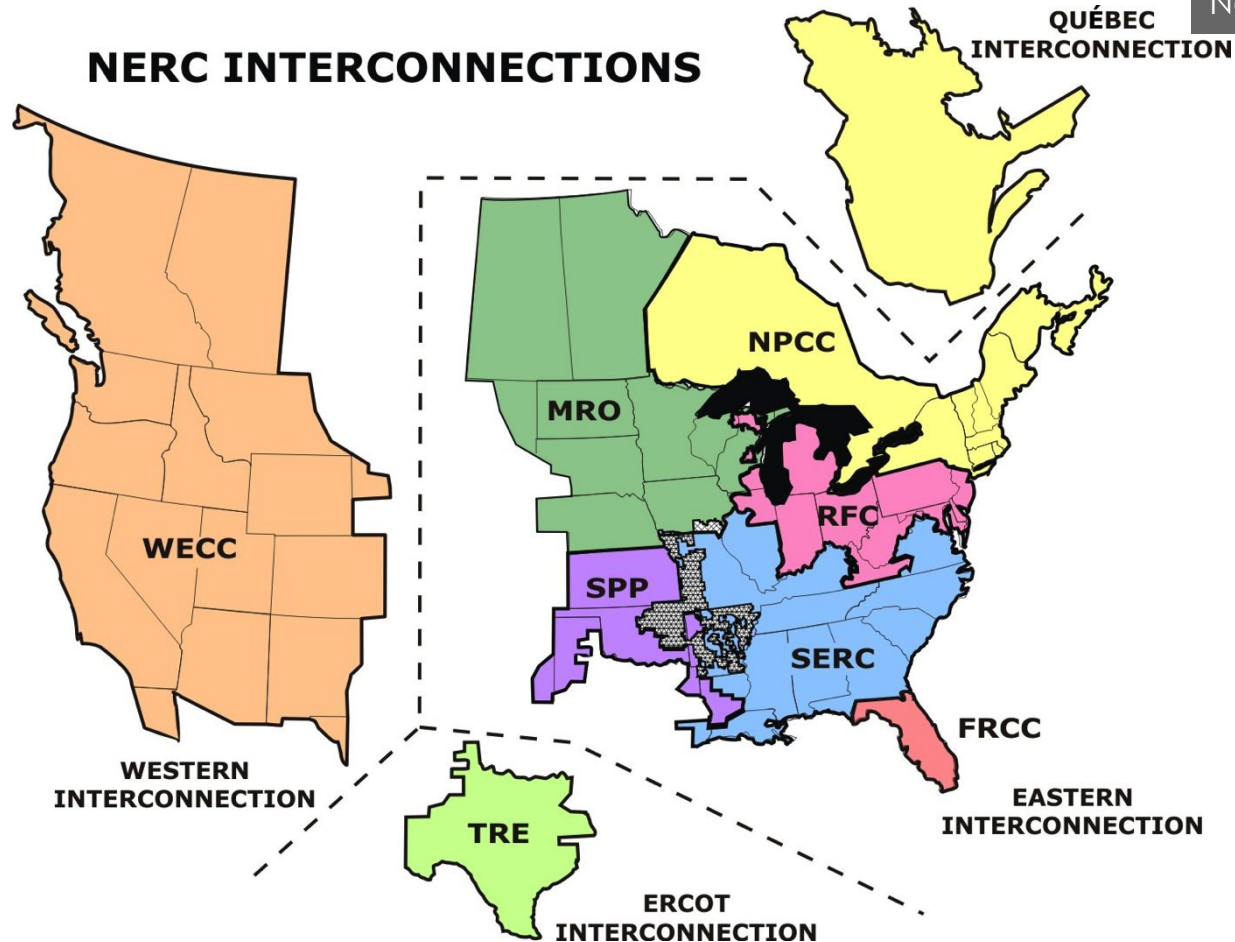


The Passive House Network

kWh of Source Energy per kWh of delivered electricity (2004)

National: ~~3.315~~

National: 2.8



SOURCE: Image - <http://www.theenergycollective.com/aqailbert/2322195/us-electricity-system-15-maps>, Data: Passive House Academy

REGIONAL ELECTRIC SOURCE ENERGY FACTORS



The Passive House Network

kWh of Source Energy per kWh of delivered electricity (2004)

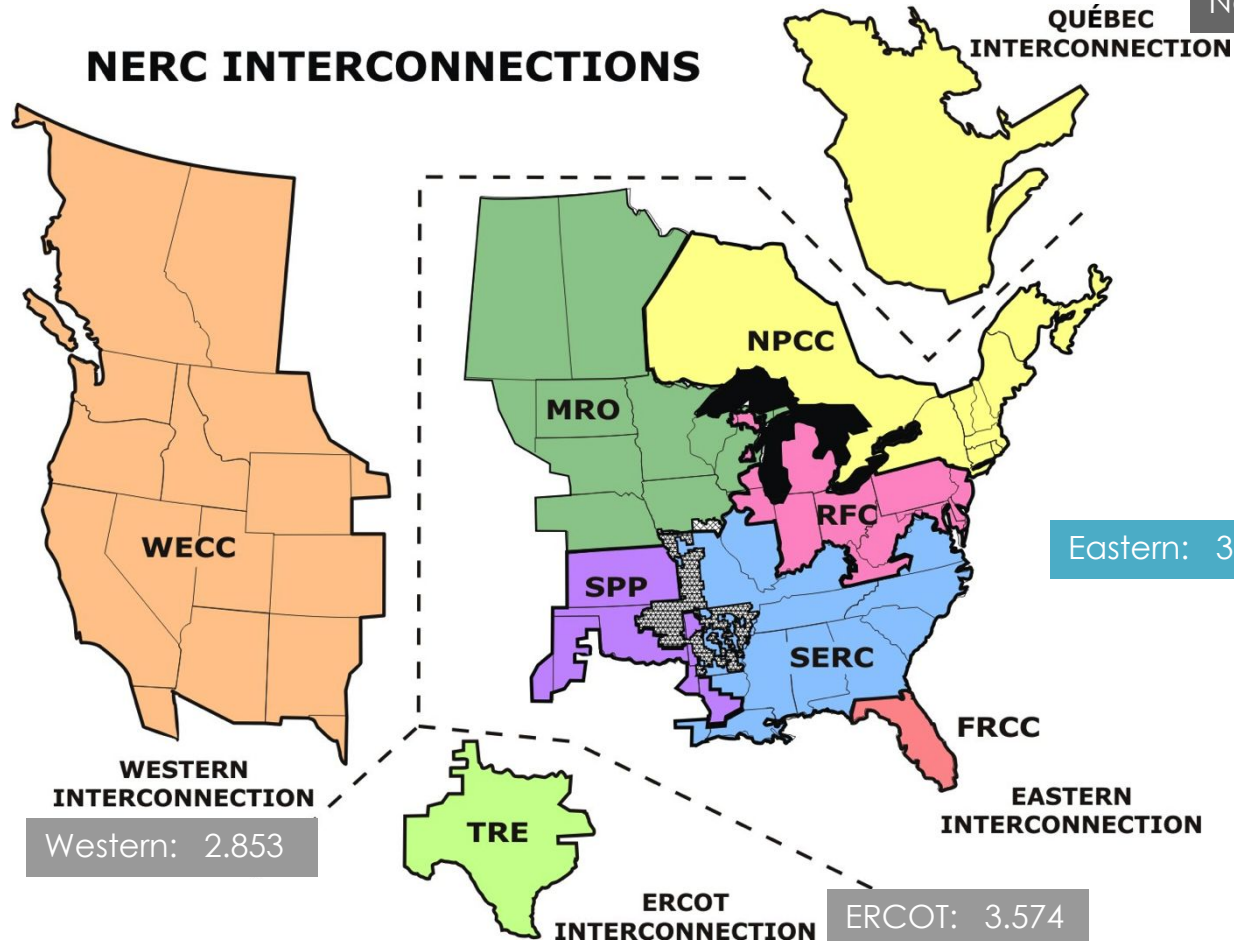
National: ~~3.315~~

National: 2.8

NERC INTERCONNECTIONS

Alaska: 3.568

Hawaii: 3.1917



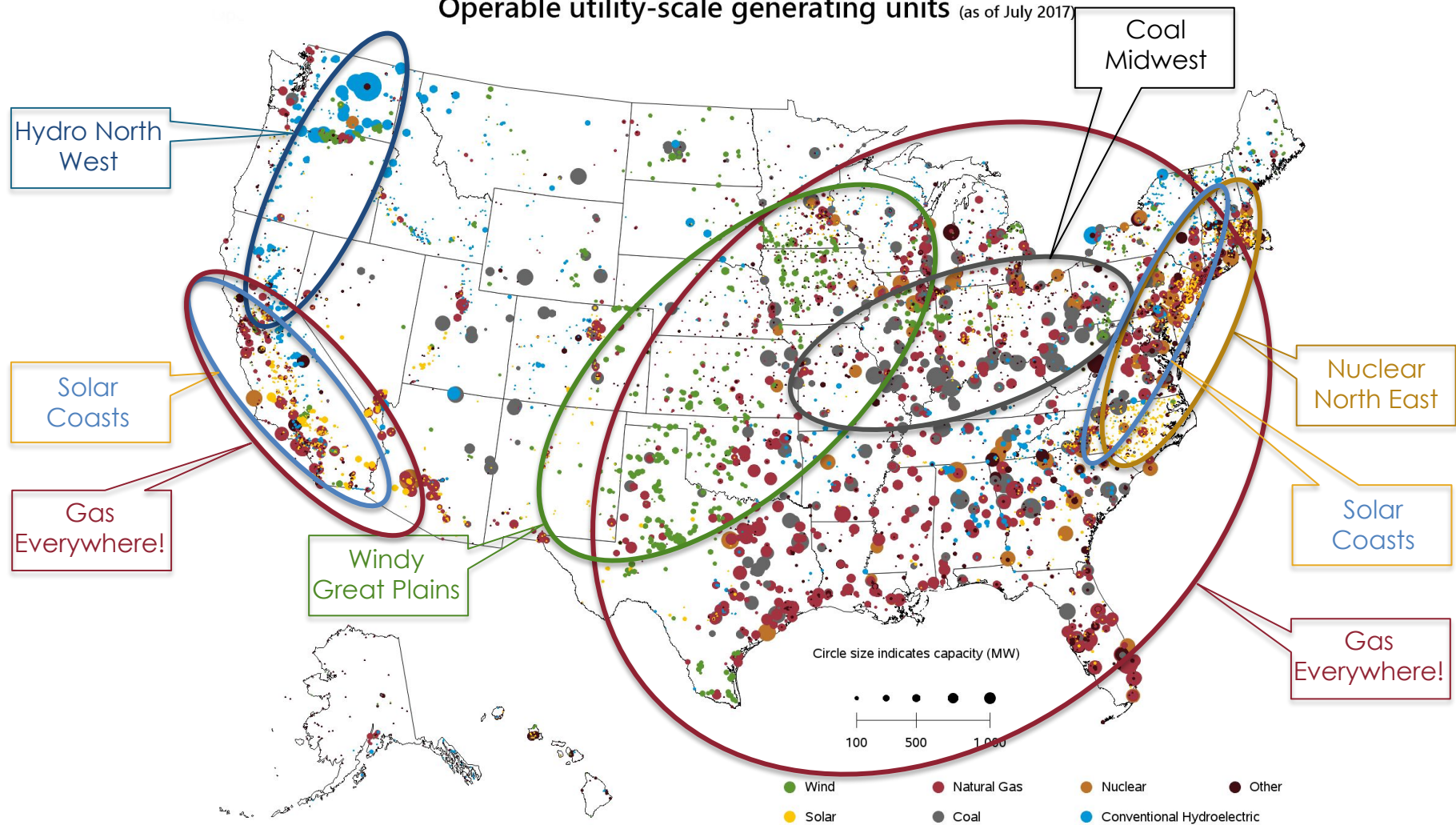
SOURCE: Image - <http://www.theenergycollective.com/aqailbert/2322195/us-electricity-system-15-maps>, Data: Passive House Academy

WHAT'S FED INTO YOUR GRID?



The Passive House Network

Operable utility-scale generating units (as of July 2017)

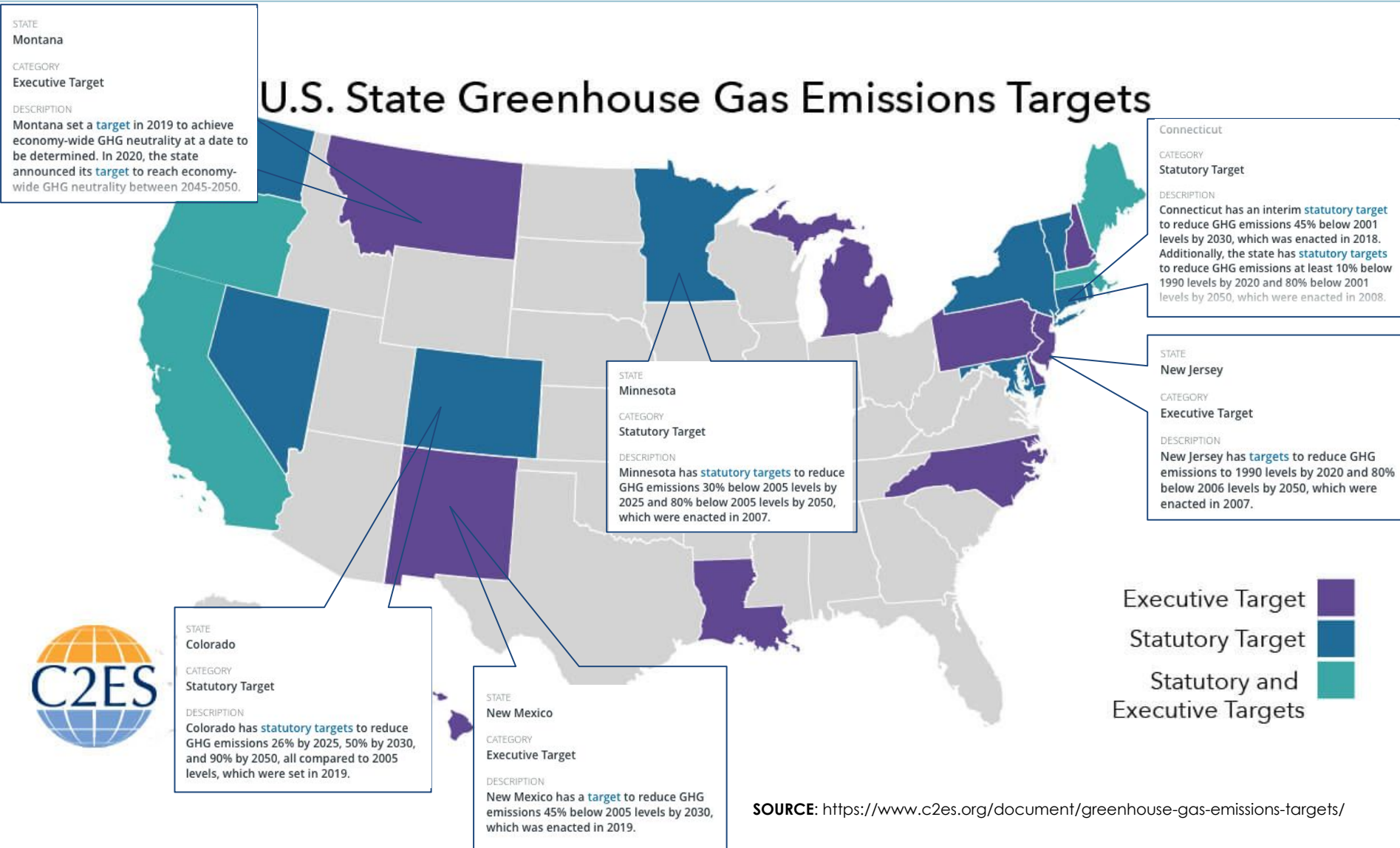


Sources: U.S. Energy Information Administration, Form EIA-860, 'Annual Electric Generator Report' and Form EIA-860M, 'Monthly Update to the Annual Electric Generator Report.'

GHG REDUCTION TARGETS (~80% by 2050)



The Passive House Network

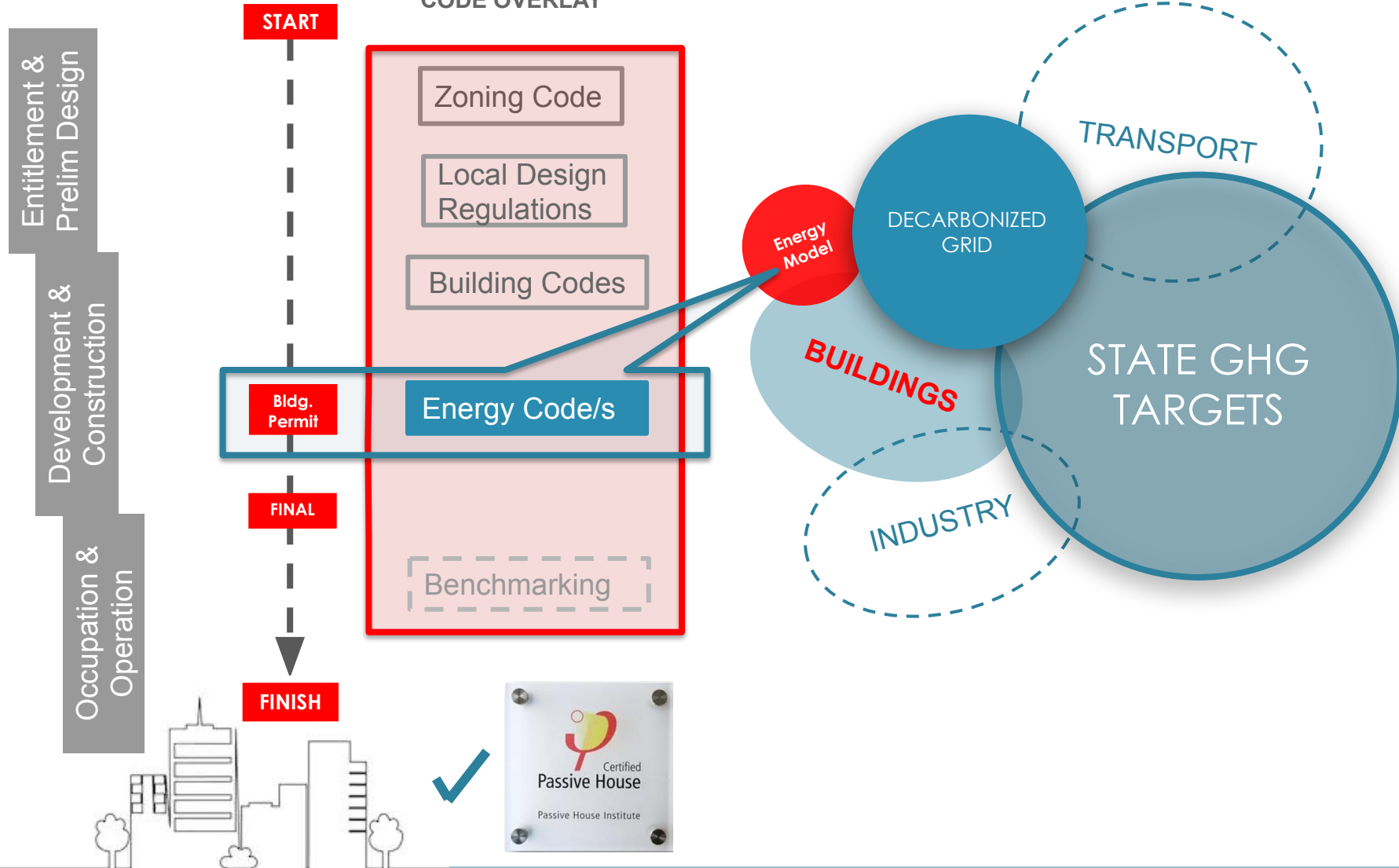


Connect your Code to your Grid!



The Passive House Network

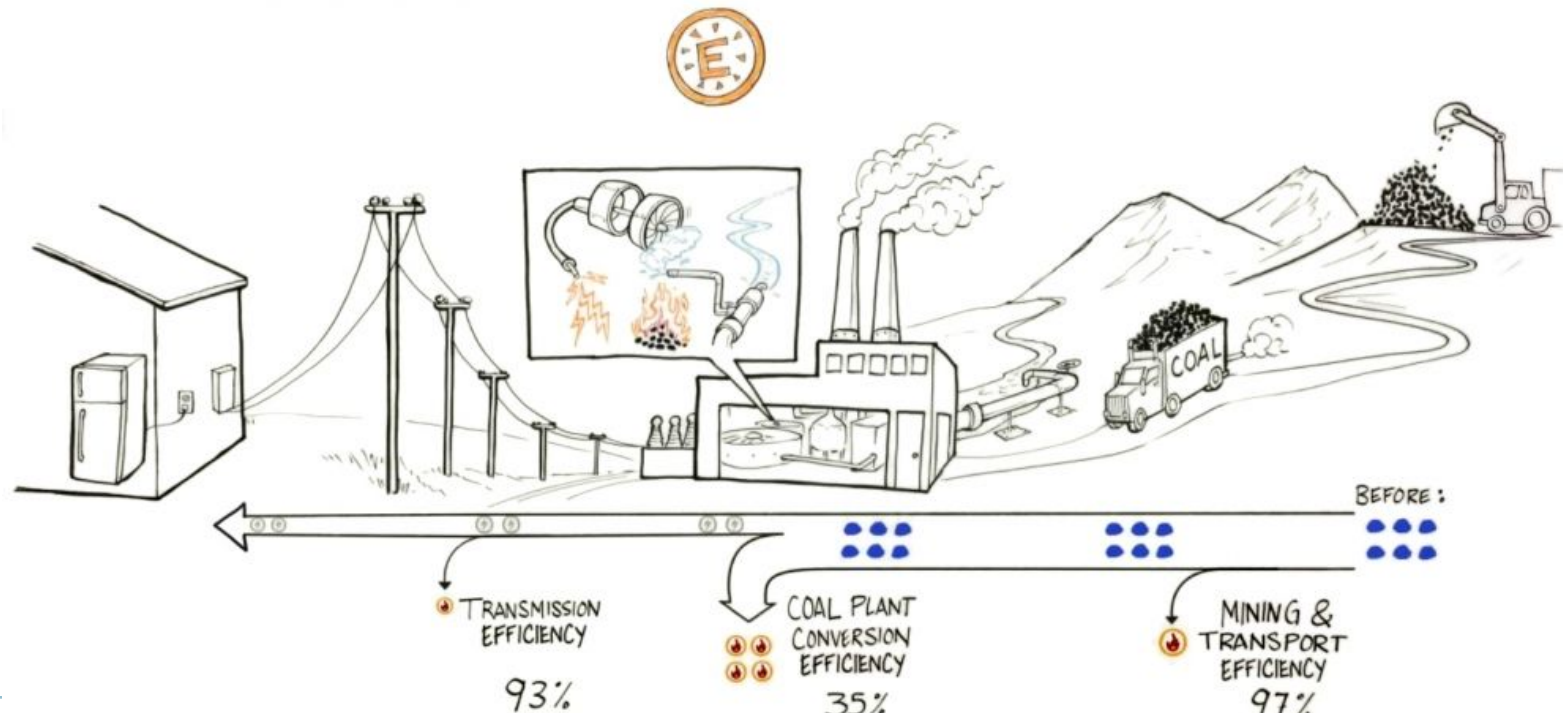
Project Development Timeline:



SHIFTING INCENTIVES TO FAVOR RENEWABLES



The Passive House Network



SOURCE: <https://sustainabilityworkshop.autodesk.com/buildings/measuring-building-energy-use>

SHIFTING INCENTIVES TO FAVOR RENEWABLES



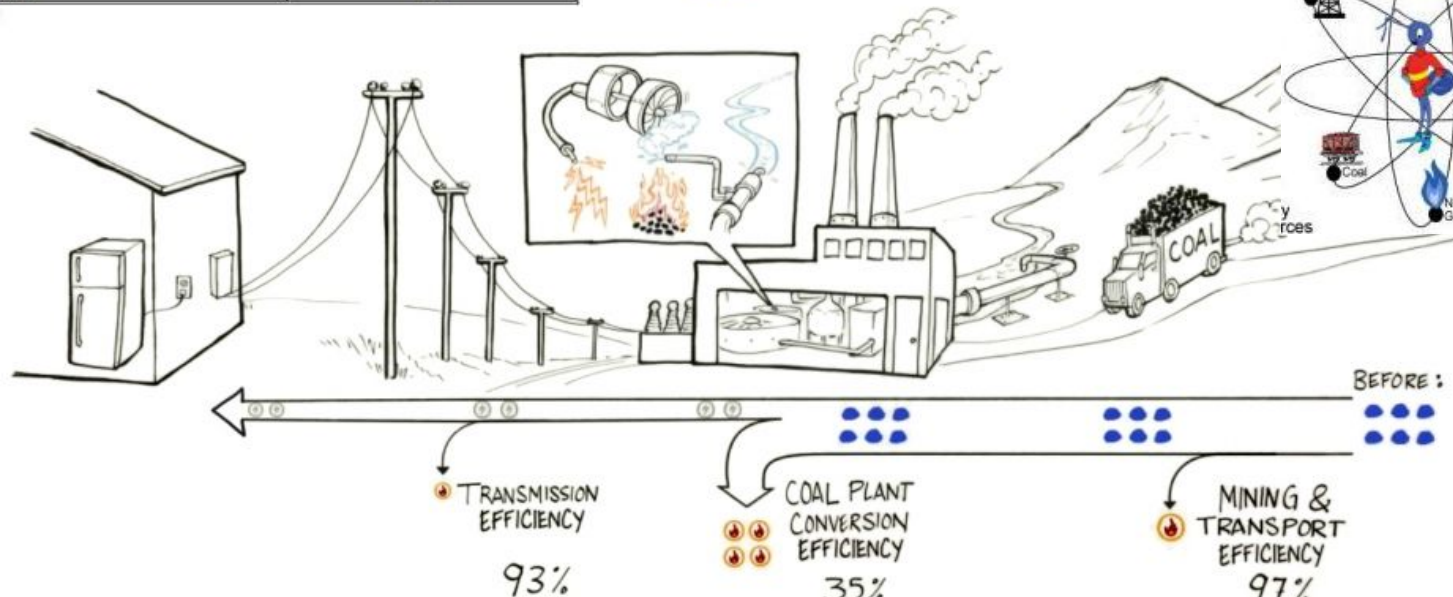
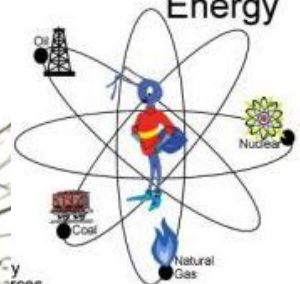
The Passive House Network

Fuel Type	Source-Site Ratio
Electricity (Grid Purchase)	3.34
Electricity (on-Site Solar or Wind Installation)	1.0
Natural Gas	1.047
Fuel Oil (1,2,4,5,6,Diesel, Kerosene)	1.01
Propane & Liquid Propane	1.01
Steam	1.21
Hot Water	1.28
Chilled Water	1.05
Wood	1.0
Coal/Coke	1.0
Other	1.0

Renewables 3x
better site utilization



Non-Renewable Energy



SHIFTING INCENTIVES TO FAVOR RENEWABLES



The Passive House Network

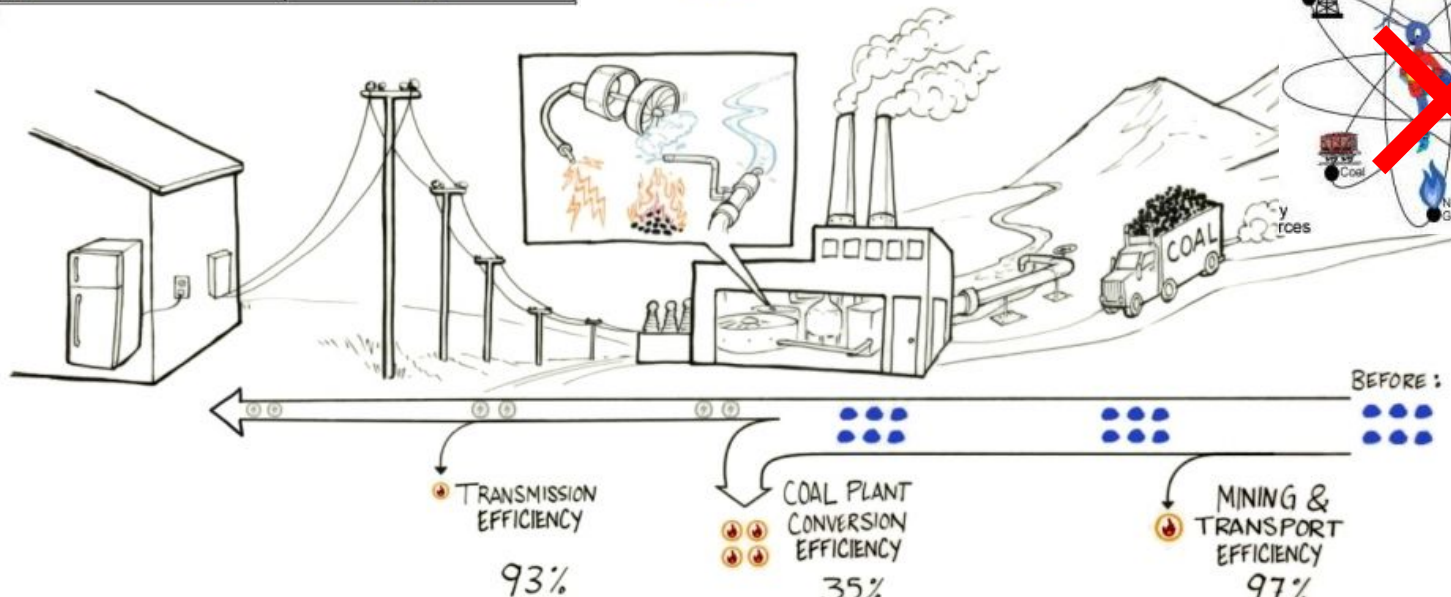
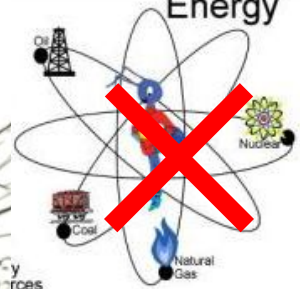
Fuel Type	Source-Site Ratio
Electricity (Grid Purchase)	3.34
Electricity (on-Site Solar or Wind Installation)	1.0
Natural Gas	1.047
Fuel Oil (1,2,4,5,6,Diesel, Kerosene)	1.01
Propane & Liquid Propane	1.01
Steam	1.21
Hot Water	1.28
Chilled Water	1.05
Wood	1.0
Coal/Coke	1.0
Other	1.0

Renewables 3x
better site utilization

But non-Renewables
look equally good



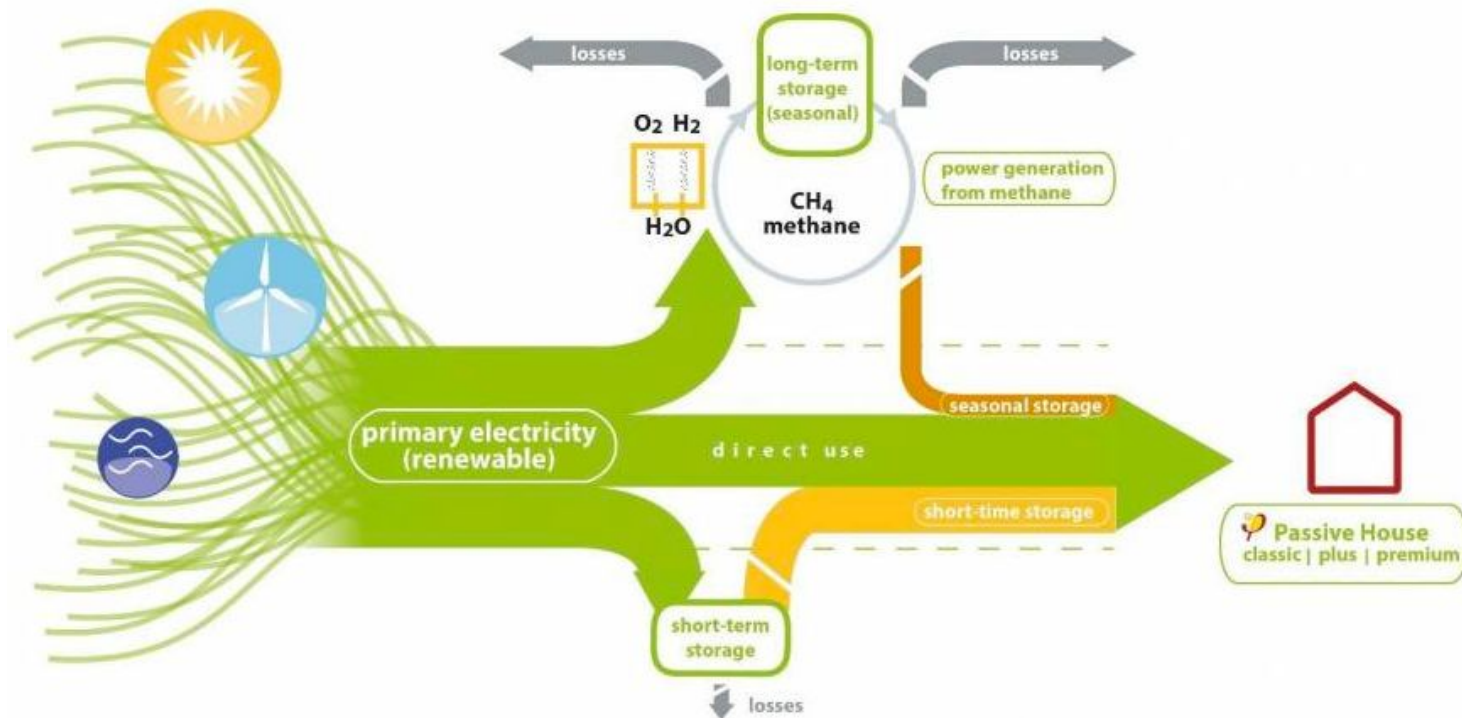
Non-Renewable
Energy



INCENTIVIZING DESIGN FOR RENEWABLES



The Passive House Network

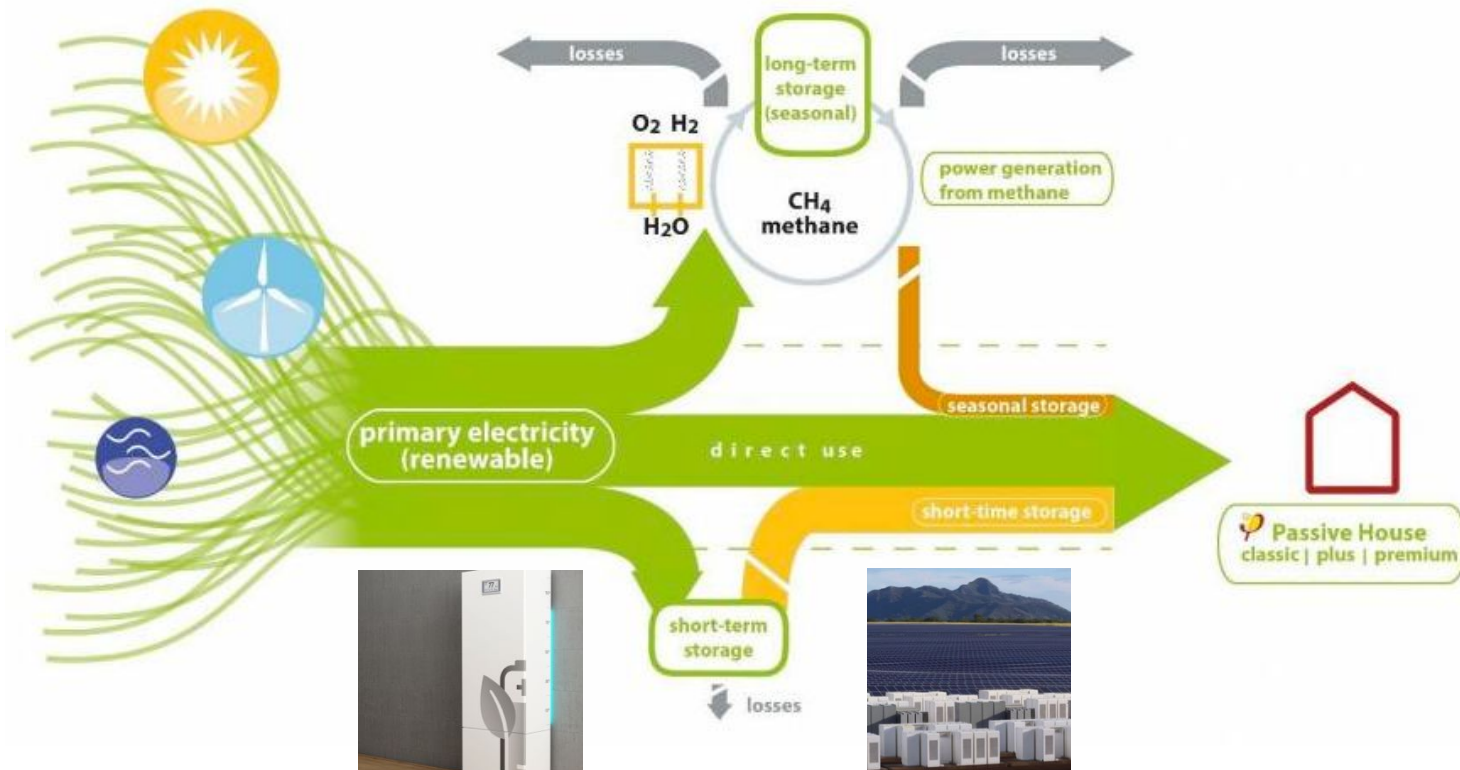


SOURCE: https://passipedia.org/certification/passive_house_categories/per#the_per_sustainability_assessment

INCENTIVIZING DESIGN FOR RENEWABLES



The Passive House Network



SOURCE: https://passipedia.org/certification/passive_house_categories/per#the_per_sustainability_assessment

INCENTIVIZING DESIGN FOR RENEWABLES

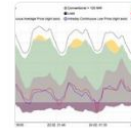


The Passive House Network



Following

'Power to gas' is a critical part of world decarbonisation. My article at bit.ly/2mL40sa.



Power-to-gas: the remaining critical ingredient in the energy..
A windy week in Germany produced the expected result. Wholesale electricity prices from 19th to 26th February 2017 dipped below zero four times and much of the weekend saw f...
carboncommentary.com



SOURCE: https://passipedia.org/certification/passive_house_categories/per#the_per_sustainability_assessment

INCENTIVIZING DESIGN FOR RENEWABLES

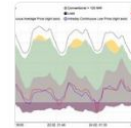


The Passive House Network

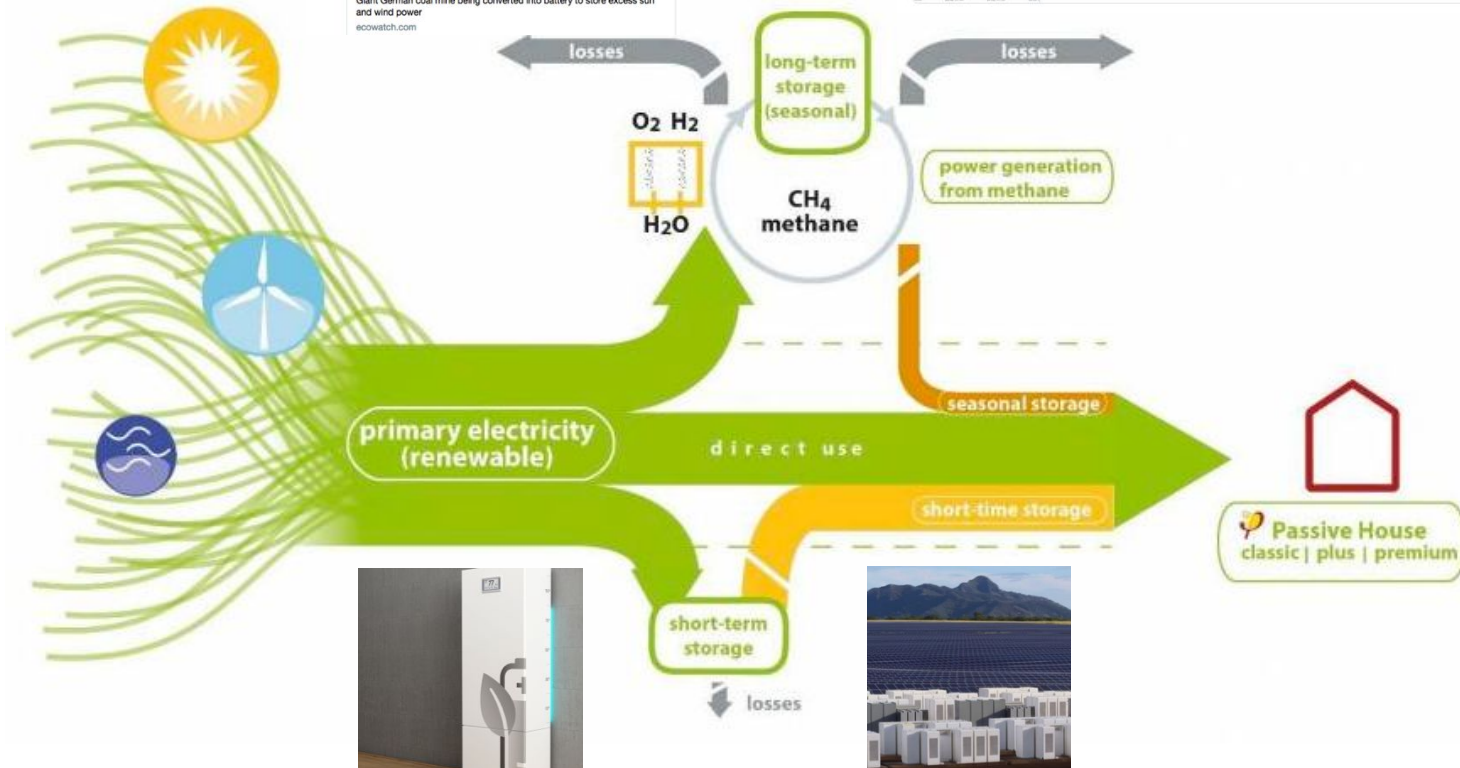


Following

'Power to gas' is a critical part of world decarbonisation. My article at bit.ly/2mL40sa.



Power-to-gas: the remaining critical ingredient in the energy..
A windy week in Germany produced the expected result. Wholesale electricity prices from 19th to 26th February 2017 dipped below zero four times and much of the weekend saw f...
carboncommentary.com

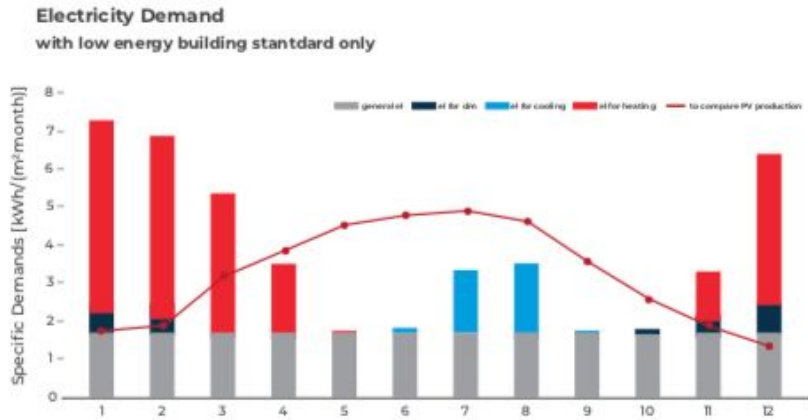


SOURCE: https://passipedia.org/certification/passive_house_categories/per#the_per_sustainability_assessment

WITH RENEWABLES, TIMING IS EVERYTHING...



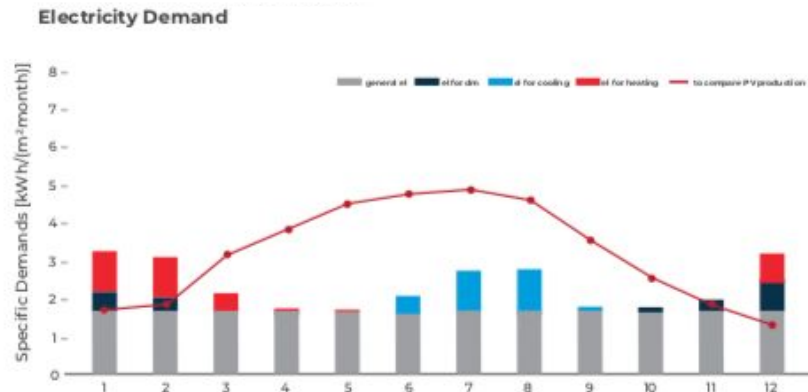
The Passive House Network



NET ZERO



Passive House's focus on **peak load reduction** aligns & supports renewables



PASSIVE HOUSE



REVISIONING PRIMARY (SOURCE) ENERGY



The Passive House Network

Heating/Cooling
Demand:

OR

Peak Heat Load:

15 kWh/m²yr
or 4.75 kBTU/hr.ft²

10 W/m²
or 3.2 BTU/hr.ft²

Air-tightness:

$n_{50} < 0.6$ ACH



Total Primary Energy:

Primary Energy
Renewables (PER)
Factors 3 Certification Levels

Cooling Limits
adjusted for
Humid Climates:

City	kBTU/ft ² .yr
Madrid	4.75
Melbourne	4.75
New York	5.38
Beijing	6.02
Seoul	6.02
Austin	6.97
Shanghai	7.6
Miami	16.5

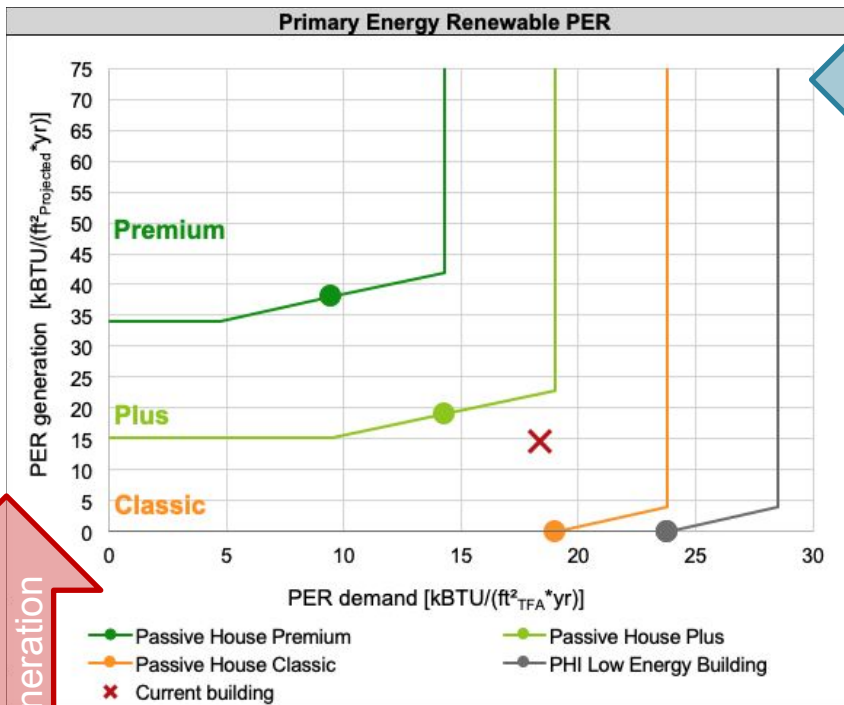
Creates a **CARBON**
EMISSIONS focus

Incentivizes **RENEWABLE ENERGY** sources

THREE CERTIFICATION PATHWAYS

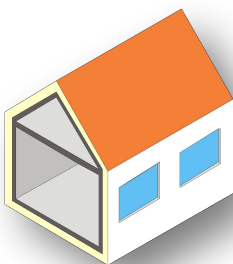
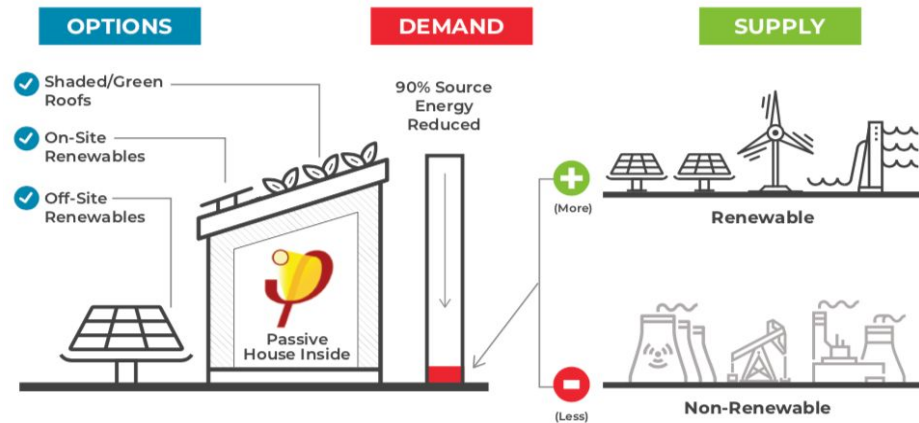


The Passive House Network

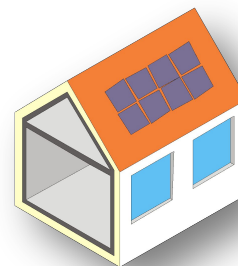


Reduce Demand

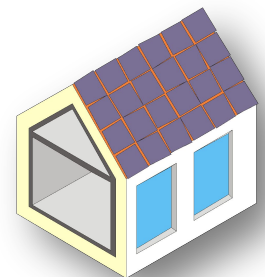
(Heavily favors electric buildings & penalizes gas)



CLASSIC



PLUS



PREMIUM

PER: HOW THE NUMBERS ARE DERIVED



The Passive House Network

1. Total Demand Reduction

Considers:

- Building size vs roof area
- Supply vs Demand balance



3. Building Site & Size

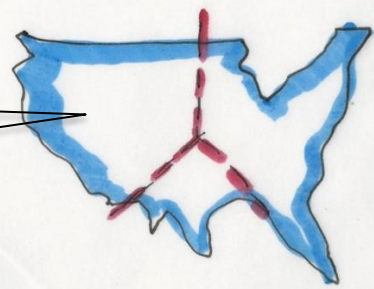
5. Regional Peak Load

Considers local:

- Demand Type
- Daily Peak Use
- Seasonal Peak

Incentivizes fuel switching

7. Appliance Energy Source



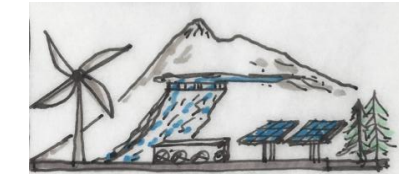
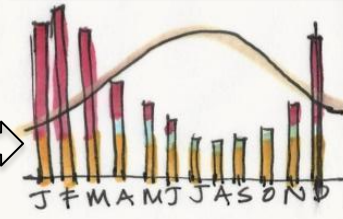
Calculated kWh of:

- Short-term &
- Long-term energy

2. Seasonal Energy Demand

Classified by end use:

- Electricity
- Hot Water
- Heating
- Cooling
- Dehumidification



4. Regional Grid Renewable Supply

Looks at available:

- Wind
- Solar PV & HW
- Hydro
- (+ Biomass & District Heat)

6. Renewable Storage

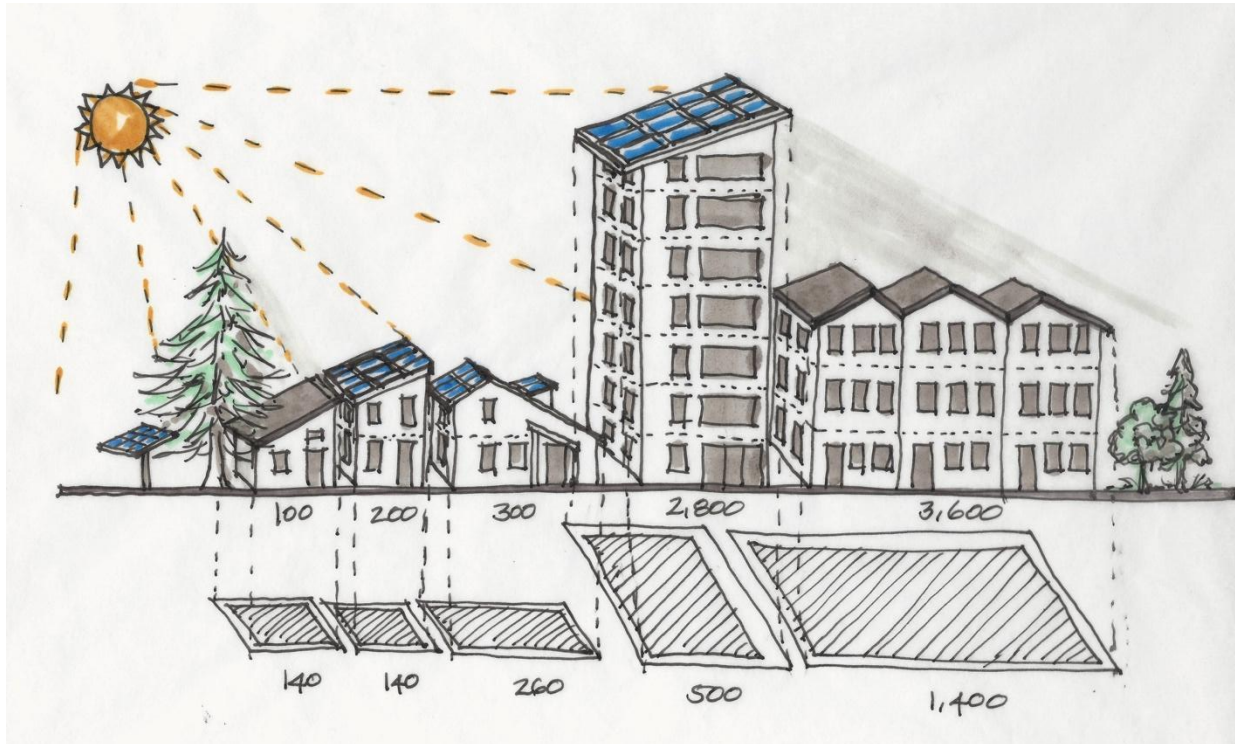


SOURCE: Illustrations by Bronwyn Barry, info: https://passipedia.org/certification/passive_house_categories/per#the_per_sustainability_assessment

EQUITY: HOW IS THIS FACTORED?



The Passive House Network



RENEWABLE CREDITS ALLOCATED BY

Projected Building
Footprint

Incentivizes large-scale
and micro-grid
renewable supply.
Off-site generation
allowed for Premium Tier.

Does not penalize commercial,
tall, shaded or urban infill projects
with no site generation capacity.

PER FOR YOUR CONNECTICUT



The Passive House Network



CONNECTICUT PASSIVE HOUSE

HARTFORD &
NEW HAVEN, CT

Energy demand Reference: Treated floor area	Effectiveness Calculation	Manual value	Contribution (useful energy)	Final energy demand kBTU/(ft²·yr)	PER factor kBTU/kBTU	PER Effective PER factor (including biomass) kBTU/kBTU	PER specific value kBTU/(ft²·yr)
	-	-					
							27.3
			Hint: own effectiveness(es) chosen				
Heating			100%			1.27	5.0
Electricity (HP compact unit)					1.50		
Electricity (heat pump)	1.57	2.30	100%	2.4	1.50	1.11	2.6
District heating: 1-None					2.8 4.5 3.3		
Wood and other biomass					1.10		
Natural gas / RE gas					1.75		
Heating oil / RE methanol					2.30		
Solar thermal system							
Electricity (direct)					1.50		
Aux. electricity (heating, wintertime ventilation)				1.6	1.50	1.50	2.3
Cooling and dehumidification					1.56		3.9
Electricity cooling (heat pump)	4.40			0.9	1.50		1.3
Auxiliary electricity cooling, ventilation summer				1.2	1.50		1.8
Electricity dehumidification (heat pump)	2.00			0.5	1.85		0.8
Auxiliary electricity (dehumidification)					1.85		
DHW generation			100%			1.15	5.1
Electricity (HP compact unit)					1.15		
Electricity (heat pump)	2.49	2.50	100%	4.3	1.15	1.15	5.0
District heating: 1-None					2.8 4.5 3.3		
Wood and other biomass					1.10		
Natural gas / RE gas					1.75		
Heating oil / Methanol					2.30		
Solar thermal system							
Electricity (direct)					1.15		
Aux. electricity (DHW + solar DHW)				0.2	1.15	1.15	0.2
Household electricity				11.1		1.20	13.3
Electricity (household or non-residential lighting, etc.)				10.2	1.20	1.20	12.3
Auxiliary electricity (other)				0.8	1.20	1.20	1.0
Gas / RE gas dry/cook				0.0	1.75		0.0

PER FOR YOUR TRI-STATE



The Passive House Network



CONNECTICUT PASSIVE HOUSE



PER Assessment for Tri-State Region						
City, State	Pittsburgh, PA	Washington, DC	Philadelphia, PA	New York, NY	Buffalo, NY	Rochester, NY
Energy demand	Primary Energy Renewables (PER) factor					
Reference: Treated floor area	kBTU/kBTU					
Heating						
Electricity (HP compact unit)	1.6	1.55	1.55	1.5	1.55	1.55
Electricity (heat pump)	1.6	1.55	1.55	1.5	1.55	1.55
District heating: 1-None	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3
Wood and other biomass	1.1	1.1	1.1	1.1	1.1	1.1
Natural gas / RE gas	1.75	1.75	1.75	1.75	1.75	1.75
Heating oil / RE methanol	2.3	2.3	2.3	2.3	2.3	2.3
Solar thermal system						
Electricity (direct)	1.6	1.55	1.55	1.5	1.55	1.55
Aux. electricity (heating, wintertime ventilation)	1.6	1.55	1.55	1.5	1.55	1.55
Cooling and dehumidification						
Electricity cooling (heat pump)	1.5	1.6	1.55	1.55	1.4	1.4
Auxiliary electricity cooling, ventilation summer	1.5	1.6	1.55	1.55	1.4	1.4
Electricity dehumidification (heat pump)	1.95	1.95	1.95	1.9	1.8	1.75
Auxiliary electricity (dehumidification)	1.95	1.95	1.95	1.9	1.8	1.75
DHW generation						
Electricity (HP compact unit)	1.2	1.2	1.2	1.15	1.15	1.15
Electricity (heat pump)	1.2	1.2	1.2	1.15	1.15	1.15
District heating: 1-None	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3
Wood and other biomass	1.1	1.1	1.1	1.1	1.1	1.1
Natural gas / RE gas	1.75	1.75	1.75	1.75	1.75	1.75
Heating oil / Methanol	2.3	2.3	2.3	2.3	2.3	2.3
Solar thermal system						
Electricity (direct)	1.2	1.2	1.2	1.15	1.15	1.15
Aux. electricity (DHW + solar DHW)	1.2	1.2	1.2	1.15	1.15	1.15
Household electricity						
Electricity (household or non-residential lighting)	1.2	1.2	1.2	1.2	1.2	1.2
Auxiliary electricity (other)	1.2	1.2	1.2	1.2	1.2	1.2
Gas / RE gas dry/cook	1.75	1.75	1.75	1.75	1.75	1.75

GRID FACTORS FOR PA and NJ



The Passive House Network

LOCAL SOURCE ENERGY FACTORS:

- ❑ Seasonal Energy Demand
- ❑ Fuel type
- ❑ Renewable grid supply
- ❑ Appliance type
- ❑ Storage requirements



PER Assessment for Tri-State Region						
City, State	Pittsburgh, PA	Washington, DC	Philadelphia, PA	Newark, NJ	Buffalo, NY	Rochester, NY
Energy demand	Primary Energy Renewables (PER) factor					
Reference: Treated floor area	kBTU/kBTU					
Heating						
Electricity (HP compact unit)	1.6	1.55	1.55	1.5	1.55	1.55
Electricity (heat pump)	1.6	1.55	1.55	1.5	1.55	1.55
District heating: 1-None	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3
Wood and other biomass	1.1	1.1	1.1	1.1	1.1	1.1
Natural gas / RE gas	1.75	1.75	1.75	1.75	1.75	1.75
Heating oil / RE methanol	2.3	2.3	2.3	2.3	2.3	2.3
Solar thermal system						
Electricity (direct)	1.6	1.55	1.55	1.5	1.55	1.55
Aux. electricity (heating, wintertime ventilation)	1.6	1.55	1.55	1.5	1.55	1.55
Cooling and dehumidification						
Electricity cooling (heat pump)	1.5	1.6	1.55	1.55	1.4	1.4
Auxiliary electricity cooling, ventilation summer	1.5	1.6	1.55	1.55	1.4	1.4
Electricity dehumidification (heat pump)	1.95	1.95	1.95	1.9	1.8	1.75
Auxiliary electricity (dehumidification)	1.95	1.95	1.95	1.9	1.8	1.75
DHW generation						
Electricity (HP compact unit)	1.2	1.2	1.2	1.15	1.15	1.15
Electricity (heat pump)	1.2	1.2	1.2	1.15	1.15	1.15
District heating: 1-None	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3
Wood and other biomass	1.1	1.1	1.1	1.1	1.1	1.1
Natural gas / RE gas	1.75	1.75	1.75	1.75	1.75	1.75
Heating oil / Methanol	2.3	2.3	2.3	2.3	2.3	2.3
Solar thermal system						
Electricity (direct)	1.2	1.2	1.2	1.15	1.15	1.15
Aux. electricity (DHW + solar DHW)	1.2	1.2	1.2	1.15	1.15	1.15
Household electricity						
Electricity (household or non-residential lighting)	1.2	1.2	1.2	1.2	1.2	1.2
Auxiliary electricity (other)	1.2	1.2	1.2	1.2	1.2	1.2
Gas / RE gas dry/cook	1.75	1.75	1.75	1.75	1.75	1.75

MINNESOTA AND ROCKY MOUNTAINS



The Passive House Network



State	Colorado				New Mexico		Minnesota	
City	Aspen, CO	Colorado Springs	Denver	Gunnison	Albuquerque	Rosewell	Minneapolis	Duluth
Energy Demand Reference: TFA	Primary Energy Renewables (PER) factor				kBTU/kBTU			
Heating								
Electricity (HP compact unit)	1.95	1.95	1.95	1.95	1.8	1.7	1.7	1.7
Electricity (heat pump)	1.95	1.95	1.95	1.95	1.8	1.7	1.7	1.7
	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3
	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Natural gas / RE gas	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75
Heating oil / RE methanol	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Solar thermal system								
Electricity (direct)	1.95	1.95	1.95	1.95	1.8	1.7	1.7	1.7
Aux. electricity (heating, wintertime ventilation)	1.95	1.95	1.95	1.95	1.8	1.7	1.7	1.7
Cooling and dehumidification	1.3	1.35	1.35	1.3	1.35	1.45	1.25	1.1
Electricity cooling (heat pump)	1.3	1.35	1.35	1.3	1.35	1.45	1.25	1.1
Auxiliary electricity cooling, ventilation summer	1.3	1.35	1.35	1.3	1.35	1.45	1.25	1.1
Electricity dehumidification (heat pump)	1.05	1.15	1.05	1.05	1.35	1.65	1.5	1.3
Auxiliary electricity (dehumidification)	1.05	1.15	1.05	1.05	1.35	1.65	1.5	1.3
DHW generation								
Electricity (HP compact unit)	1.2	1.2	1.2	1.2	1.2	1.15	1.2	1.15
Electricity (heat pump)	1.2	1.2	1.2	1.2	1.2	1.15	1.2	1.15
	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3	2.8 4.5 3.3
	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Natural gas / RE gas	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75
Heating oil / Methanol	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Solar thermal system								
Electricity (direct)	1.2	1.2	1.2	1.2	1.2	1.15	1.2	1.15
Aux. electricity (DHW + solar DHW)	1.2	1.2	1.2	1.2	1.2	1.15	1.2	1.15
Household electricity								
Electricity (household or non-residential lighting, etc)	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Auxiliary electricity (other)	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Gas / RE gas dry/cook	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75

PER FOR CALIFORNIA'S CITIES



The Passive House Network



PER Assessment for California's Largest Cities						
Utility	PG&E			SMUD	LADWP	SDG&E
City	San Francisco	San Jose	Fresno	Sacramento	Los Angeles	San Diego
Energy demand	Primary Energy Renewables (PER) factor					
Reference: Treated floor area	kBTU/kBTU					
Heating						
Electricity	1.70	1.70	1.75	1.80	1.50	1.30
District heating: 20-Gas CGS	0.85 1.32	0.85 1.32	0.85 1.36	0.85 1.39	0.85 1.16	0.85 1.01
70% PHC	0.97	0.97	0.97	0.97	0.93	0.93
Wood and other biomass	1.10	1.10	1.10	1.10	1.10	1.10
Natural gas / RE gas	1.75	1.75	1.75	1.75	1.75	1.75
Oil, Coal, Methanol / RE methanol	2.30	2.30	2.30	2.30	2.30	2.30
Cooling and dehumidification						
Electricity cooling	1.00	1.00	1.05	1.00	1.15	1.25
Electricity dehumidification	1.05	1.10	1.15	1.00	1.40	1.55
DHW generation						
Electricity (heat pump)	1.25	1.25	1.25	1.25	1.20	1.20
District heating: 20-Gas CGS	0.85 1.32	0.85 1.32	0.85 1.36	0.85 1.39	0.85 1.16	0.85 1.01
70% PHC	0.97	0.97	0.97	0.97	0.93	0.93
Wood and other biomass	1.10	1.10	1.10	1.10	1.10	1.10
Natural gas / RE gas	1.75	1.75	1.75	1.75	1.75	1.75
Heating oil / Methanol	2.30	2.30	2.30	2.30	2.30	2.30
Solar thermal system	0.27	0.28	0.29	0.28	0.30	0.30
Other building energy uses						
Electricity lighting, etc.)	1.25	1.25	1.25	1.25	1.20	1.20
Auxiliary electricity (other)	1.25	1.25	1.25	1.25	1.20	1.20
Gas / RE gas dry/cook	1.75	1.75	1.75	1.75	1.75	1.75
Energy generation	PER					
Reference: Projected Footprint Area	PER factor					
	kBTU/kBTU					
PV electricity	1.00	1.00	1.00	1.00	1.00	1.00
Solar thermal system	0.27	0.28	0.29	0.28	0.30	0.30
User determined energy carrier	0.00	0.00	0.00	0.00	0.00	0.00

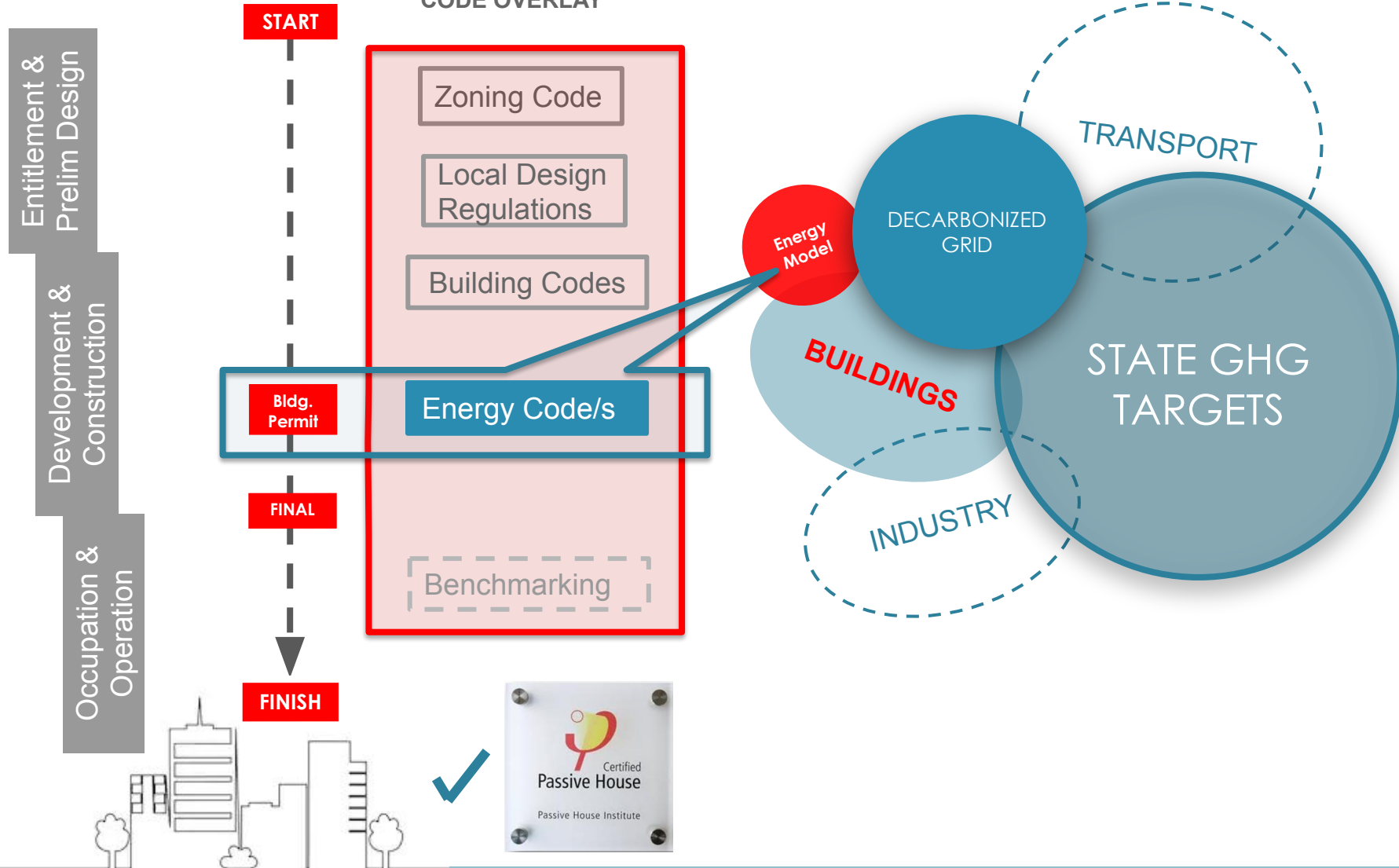
Source: PHPPv.9

Connect your Code to your Grid!



The Passive House Network

Project Development Timeline:



Passive House, PER, and Electrification



A project can certify to either...

- **Primary Energy (PE) - source energy under "today's" grid**
 - Fixed threshold typically between 38 and 45 kBtu/sf.yr
 - Electricity site to source factor = 2.6
 - Natural gas site to source factor = 1.1

OR

- **Primary Energy Renewables (PER) - source energy w/ "green grid"**
 - Threshold on a curve relating building's energy demand and onsite renewable energy production (see graph to right).
Must be within orange shaded region.
 - Electricity site to source factor = 1.1 - 1.3 (depends on end use)
 - Natural gas site to source factor = 1.75

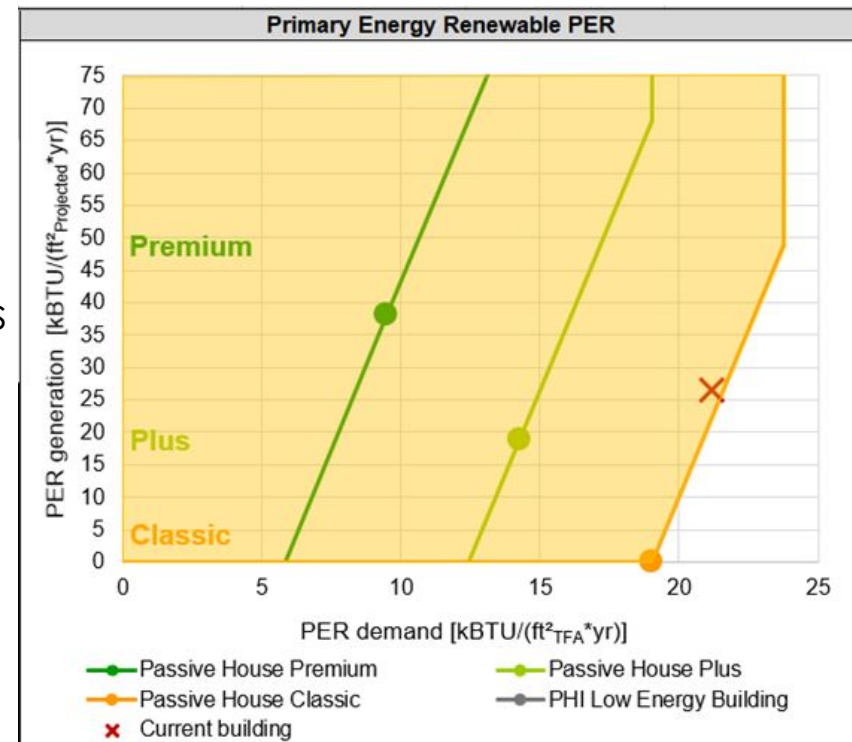
Passive House, PER, and Electrification

A project can certify to either...

- **Primary Energy (PE) - source energy under "today's" grid**
 - Fixed threshold typically between 38 and 45 kBtu/sf.yr
 - Electricity site to source factor = 2.6
 - Natural gas site to source factor = 1.1

OR

- **Primary Energy Renewables (PER) - source energy w/ "green grid"**
 - Threshold on a curve relating building's energy demand and onsite renewable energy production (see graph to right). Must be within orange shaded region.
 - Electricity site to source factor = 1.1 - 1.3 (depends on end use)
 - Natural gas site to source factor = 1.75



Passive House, PER, and Electrification

A project can certify to either...

- **Primary Energy (PE) - source energy under "today's" grid**

- Fixed threshold typically between 38 and 45 kBtu/sf.yr
- Electricity site to source factor = 2.6
- Natural gas site to source factor = 1.1

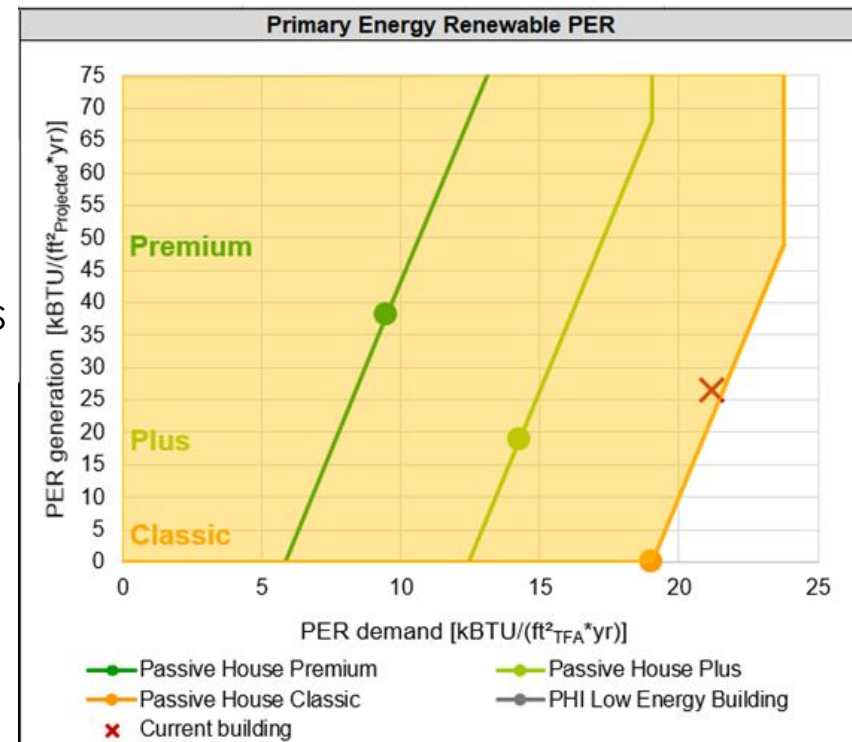
Effectively penalizes all electric buildings

OR

- **Primary Energy Renewables (PER) - source energy w/ "green grid"**

- Threshold on a curve relating building's energy demand and onsite renewable energy production (see graph to right). Must be within orange shaded region.
- Electricity site to source factor = 1.1 - 1.3 (depends on end use)
- Natural gas site to source factor = 1.75

Effectively penalizes fossil fuel use

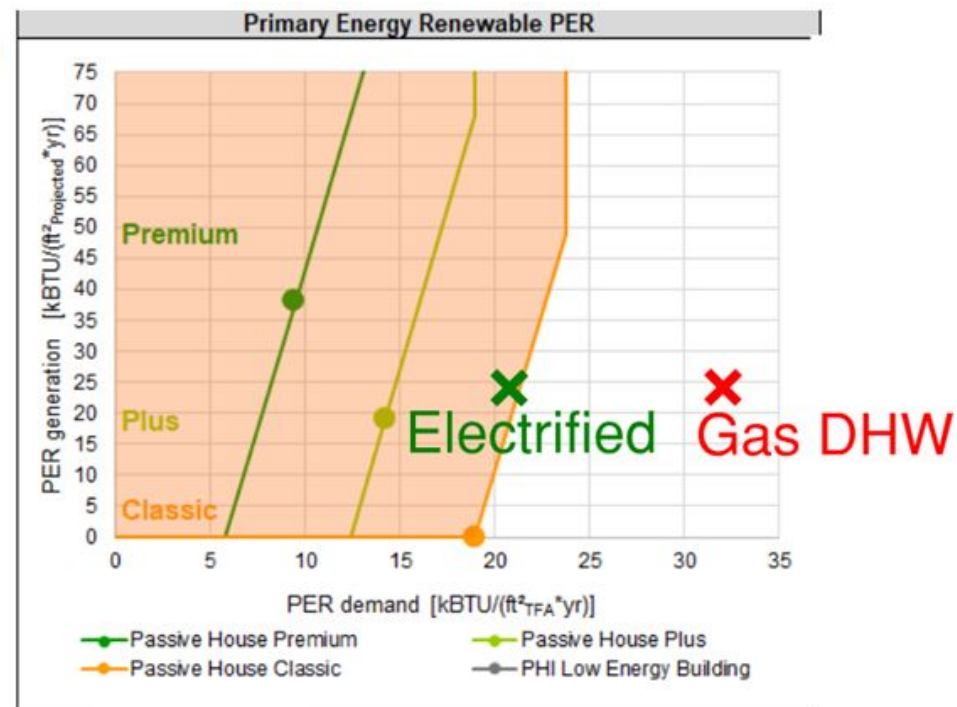
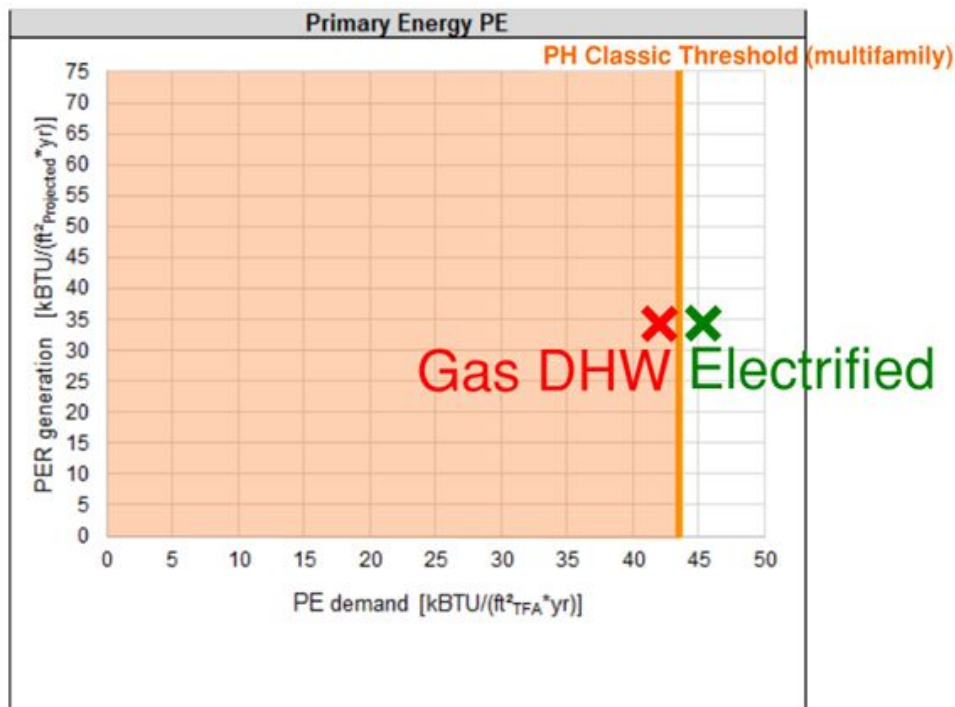


Passive House, PER, and Electrification

Example Project in NYC

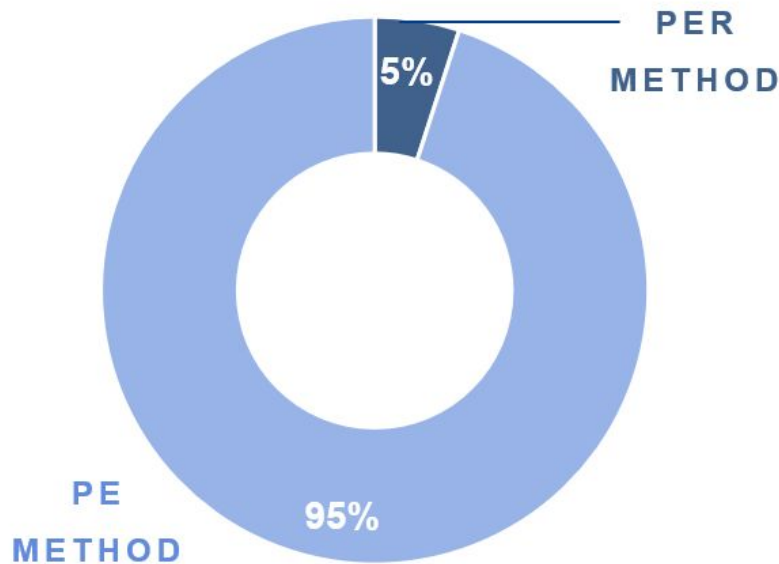
- 18-story, 290,000 gsf, 311-unit affordable multifamily
- 135 kW PV system
- All-Electric Scenario (heat pumps for heating/cooling/DHW) - Better under PER path**
- Gas Boiler DHW Scenario (heat pumps for heating/cooling) - Better under PE path**

**Assuming DHW heat pump COP = 2.0 and
DHW boiler efficiency = 95%*



Passive House, PER, and Electrification

SWA Project Certification Breakdown

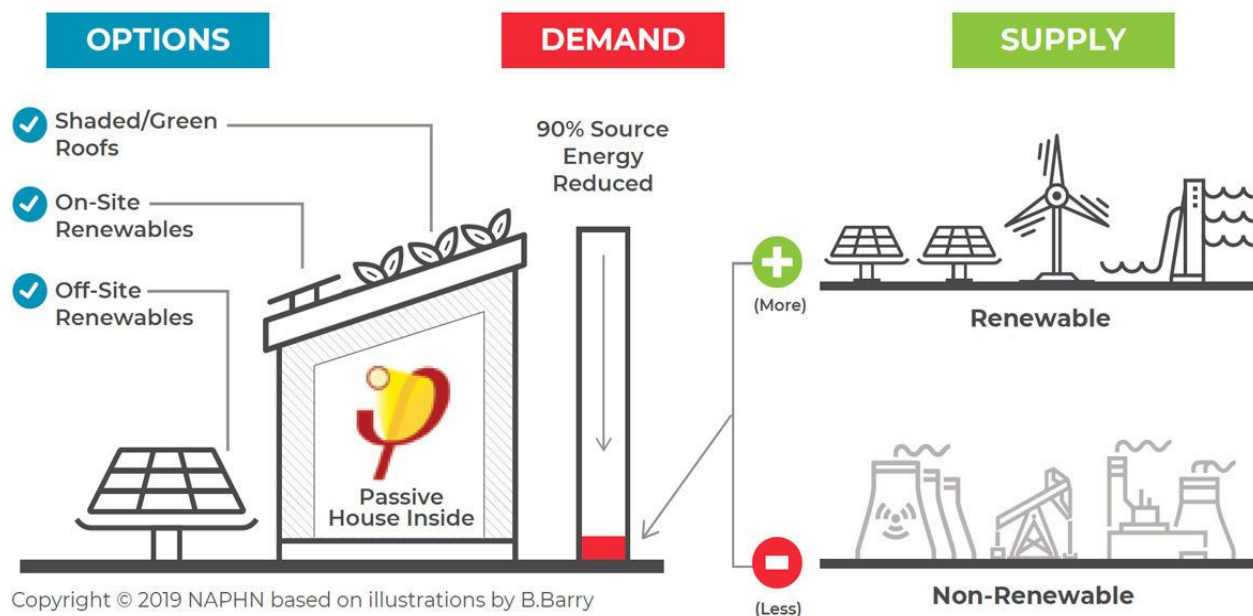


- Anticipated shift in certification method
- Incentive program (i.e., NYSERDA programs) future accommodation of PER method



Courtesy of
<https://climatechange.ita.org>

SUMMARY & DISCUSSION



PRIORITIZES DEMAND REDUCTION

Renewable sources given beneficial 'Primary Energy Renewable' factors

Credits given to:

- ☐ On-site generation
- ☐ Off-site generation
- ☐ Green Roofs

Factors in YOUR Regional Grid.

And did you know, PER factors can be CUSTOMIZED?
(Take a look at the PHPP 'data' sheet.)

THANKS AND CREDITS



SOURCE MATERIAL:

- Passive House Institute, passivehouse.com
- 'The PER Sustainability Assessment,' Passipedia.org
- Bronwyn Barry, 'California's All-Renewable Energy Future'



RECOMMENDED READING:

https://passipedia.org/certification/passive_house_categories/per#the_per_sustainability_assessment

https://passipedia.org/basics/passive_house_-_assuring_a_sustainable_energy_supply/passive_house_the_next_decade

Dylan Martello, CPHD

Email: dmartello@swinter.com

Website: <https://www.swinter.com/>

Bronwyn Barry, RA, CPHD

Email: bronwyn@naphnetwork.org

Website: <http://naphnetwork.org/>