



NET ZERO ENERGY & PASSIVE HOUSE

ZACK SEMKE, HAMMER & HAND



FOUNDED 1995, 80 EMPLOYEES.
SERVING CLIENTS AND ARCHITECTS
IN SEATTLE AND PORTLAND.

“INCITING EVOLUTION IN BUILDING
THROUGH SERVICE, CRAFT, AND SCIENCE”



WE BUILD



WE CONSULT



Blue Ridge Passive House

Designed by:
Whitney Architecture



Maple Leaf Passive House

Designed by:
Whitney Architecture



Central Seattle Passive House

Designed by:
William Zimmerman Architects



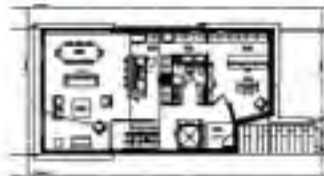
Palatine Passive House

Designed by:
Tiffany Bowie, CPHC
Malboeuf Bowie Architecture



Issaquah Passive House

Designed by:
Whitney Architecture



Wallingford Passive House

Designed by:
Whitney Architecture



Madrona Passive House

Designed by:
SHED Architecture & Design



Seaglass Development

Designed by:
Ripple Design Studio Inc.

PHIUS+ RATING

CH2 - Accessory Dwelling Unit

Designed by: PDX Living, LLC

Kiln* - Apartments

Designed by: GBD Architects

O2 Haus - Duplex

Designed by: PDX Living, LLC

Skidmore - Accessory Dwelling Unit

Designed by: In Situ Architecture

Stellar* - Apartments

Designed by: Bergund DeLaney Architecture & Planning

* All PHUS+ ratings are based on the current PHUS+ certification process.

WE MAKE PASSIVE HOUSE DOORS



“WHEN WE BUILD, LET US THINK THAT WE
BUILD FOREVER. LET IT NOT BE FOR PRESENT
DELIGHT NOR FOR PRESENT USE ALONE. LET IT
BE SUCH WORK AS OUR DESCENDANTS WILL
THANK US FOR.”

- JOHN RUSKIN

PASSIVE HOUSE & NET ZERO ENERGY



SOURCE: <https://www.flickr.com/photos/greensmps/9180614416>



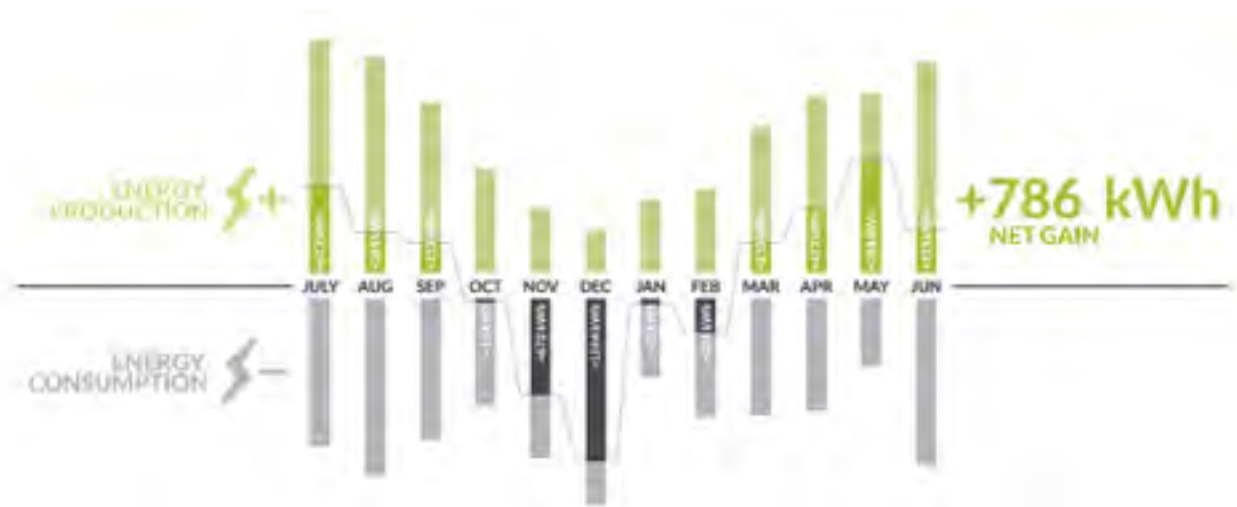
THE TARGET AND THE MEANS

NET ZERO ENERGY = **THE “WHAT”**

PASSIVE HOUSE = **THE “HOW”**

“NET ZERO” MEANS:

- CONNECTED TO GRID.
- FEEDS “GREEN ELECTRONS” TO GRID IN SUMMER.
- DRAWS ELECTRONS FROM GRID IN WINTER.
- BALANCE IS ZERO OR BETTER.



KARUNA HOUSE, JULY 2014 - JUNE 2015

SOURCE: MONITORING DATA

STRENGTH #1 - SIMPLE MESSAGE IS POWERFUL:



STRENGTHS OF NET ZERO ENERGY

STRENGTH #2 - ENCOURAGES AGGRESSIVE ENERGY BUDGETS:

WHEREVER ACCESS TO SUNLIGHT OR SPACE FOR PANELS IS LIMITED, THE NET ZERO TARGET DEMANDS AGGRESSIVE CONSERVATION.



STRENGTHS OF NET ZERO ENERGY

STRENGTH #3 - MARKET MOJO:

LOCAL: BUILT GREEN (SEATTLE) & EARTH ADVANTAGE (PORTLAND)

NATIONAL: DOE ZERO ENERGY READY HOME (PHIUS+)

ILFI ZERO ENERGY BUILDING CERTIFICATION (LIVING BUILDING)



WEAKNESSES OF NET ZERO ENERGY, REAL AND PERCEIVED

WEAKNESS #1 - NET ZERO IS EASIER ON LARGE SUBURBAN LOTS:

CAN ACCOMMODATE REALLY BIG ARRAYS.

BUT IS A BIG, CAR-DEPENDENT, LEAKY HOUSE WITH PV “GREEN”?



+



=

?

WEAKNESSES OF NET ZERO ENERGY, REAL AND PERCEIVED

WEAKNESS #2 - EASIER TO ACHIEVE AT LOW-RISE SCALE:

FAVORABLE RATIO BETWEEN ROOF AREA AND BUILDING VOLUME.

IS A NET ZERO SFH “GREENER” THAN A PH APARTMENT BUILDING?



SOURCE: Fast Company

V

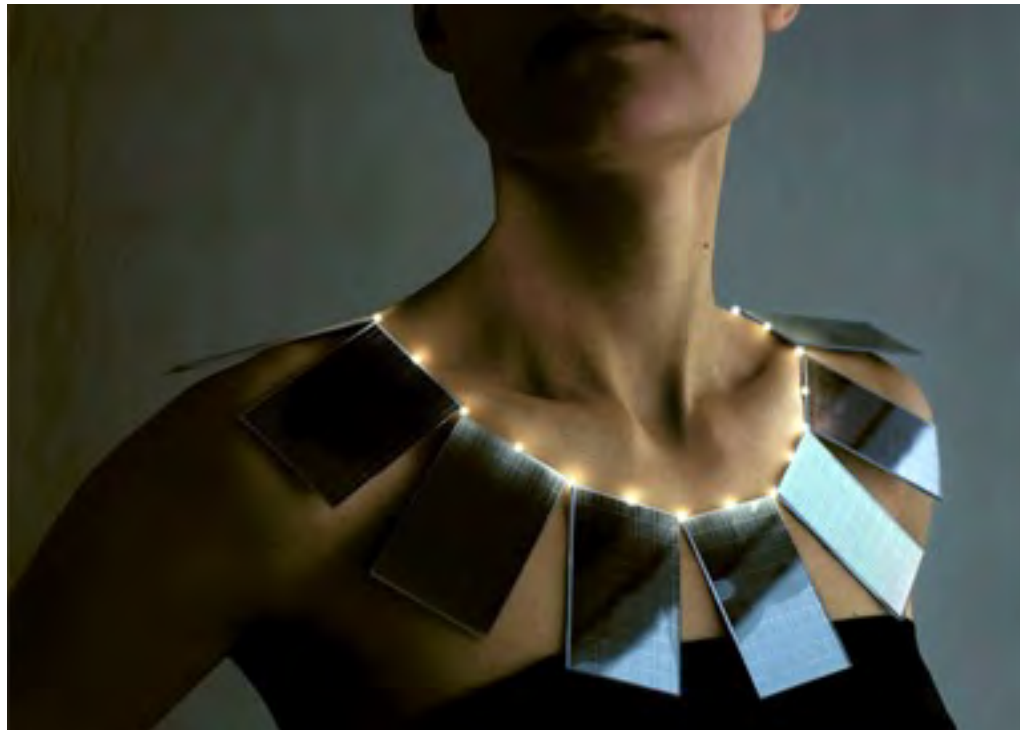


SOURCE: REACH CDC

“WEAKNESS” #3 - RELIES ON SOLAR PV, WHICH IS “ECO-BLING”:

TOO EXPENSIVE.

FLASHY DISTRACTION FROM IMPORTANT INVESTMENTS IN
ENVELOPE PERFORMANCE.



“WEAKNESS” #4 - SOLAR POWER COMES WHEN WE DON'T NEED IT:

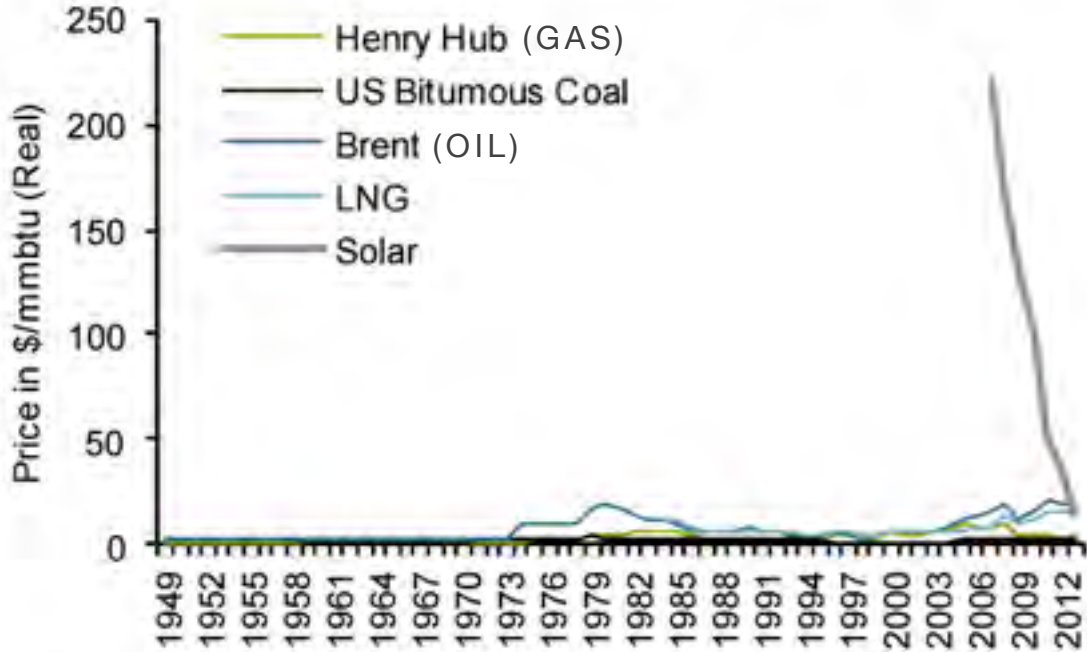
THE SUMMER.

AT NOON.



SOLAR AIN'T "ECO-BLING" ANYMORE

“WELCOME TO THE TERRORDOME”... \$/MMBTU BY ENERGY TYPE:



SOURCE: EIA, CIA, World Bank, Bernstein analysis



SOLAR AIN'T “ECO-BLING” ANYMORE

MOORE’S LAW:

PRICE OF **CHIP** FALLS AS THE NUMBER OF TRANSISTORS ON A CHIP DOUBLES EVERY 2 YEARS.

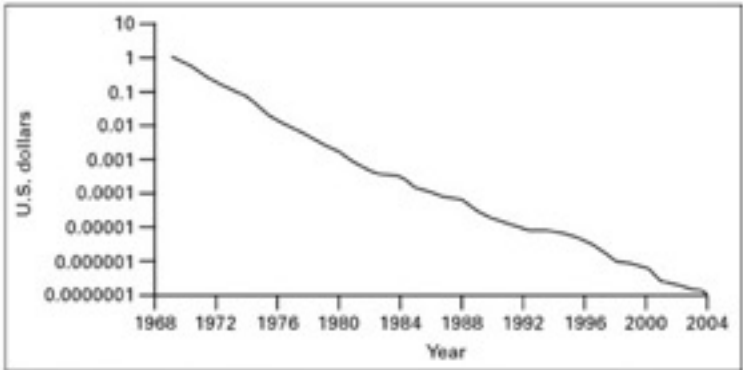
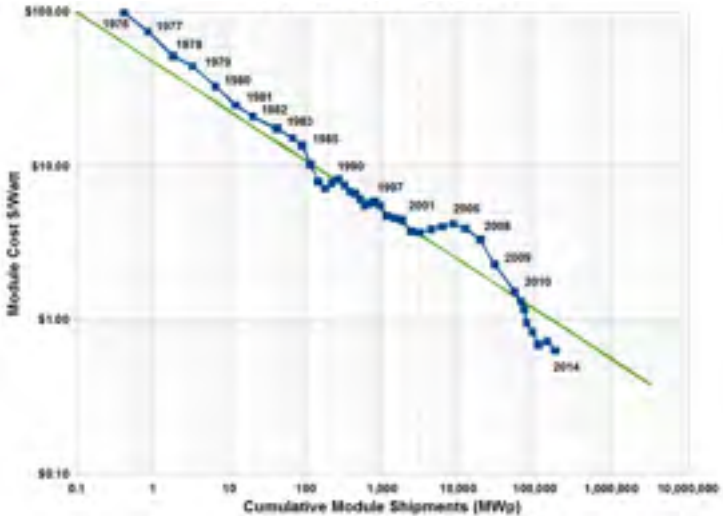


Figure 3. Average price of a transistor (1968–2004). Source: Intel/WSTS, May 2005.

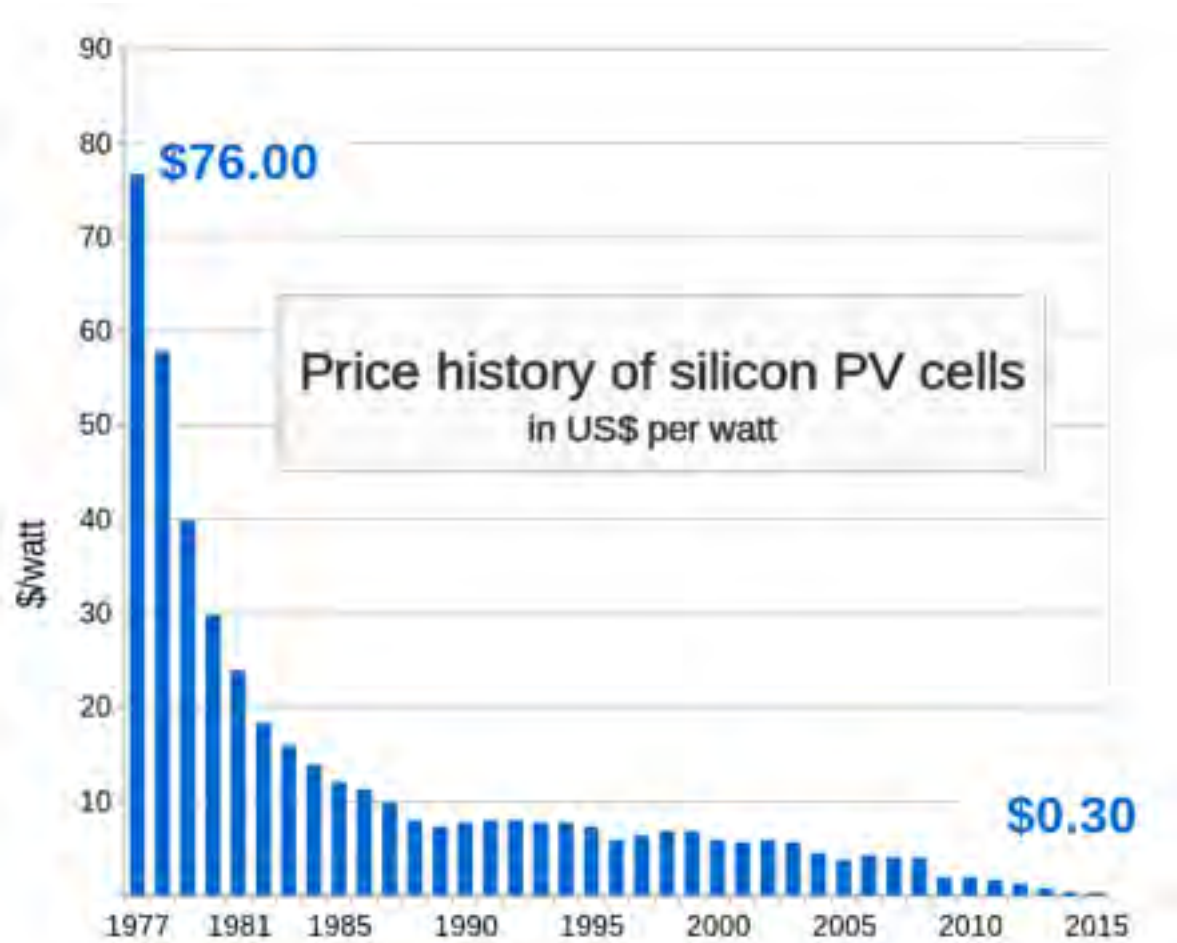
SWANSON’S LAW:

PRICE OF **PV MODULE** FALLS BY 20% WITH EVERY DOUBLING OF GLOBAL PRODUCTION



SOLAR AIN'T "ECO-BLING" ANYMORE

1977-2015: 99.6% REDUCTION IN PRICE

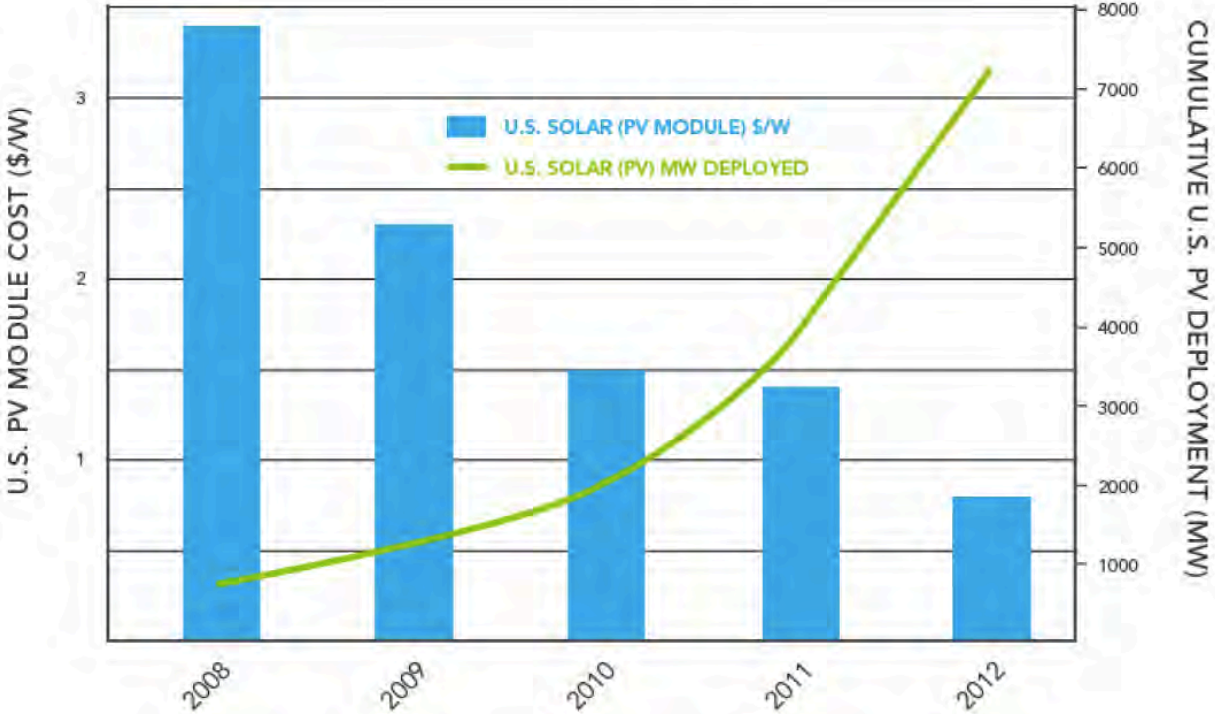


SOURCE: Bloomberg News



REDUCTIONS IN PRICE ARE NOT SLOWING

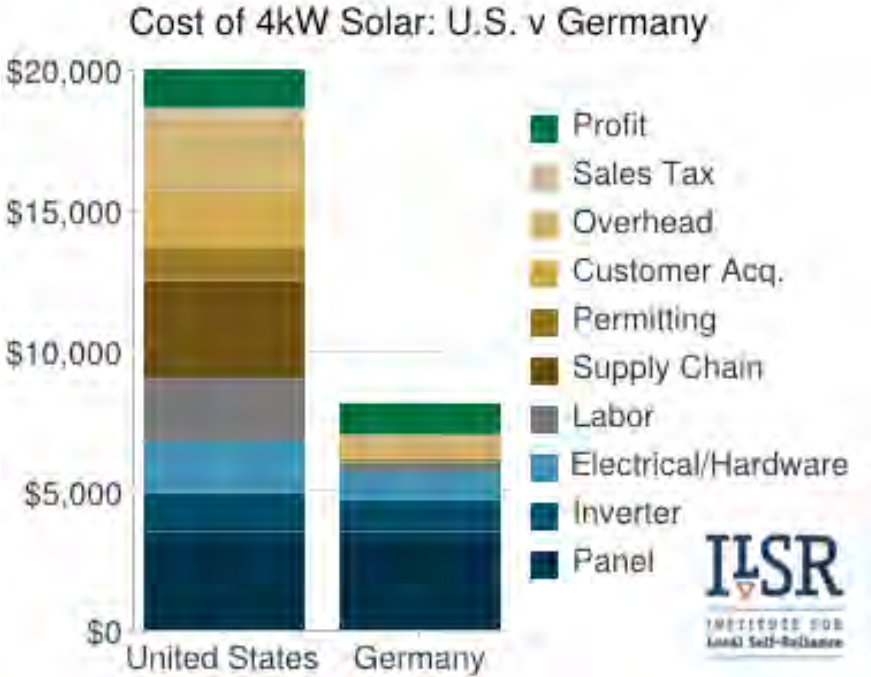
U.S. Deployment and Cost for Solar PV Modules
2008-2012



SOURCE: US DOE



SOFT COSTS CAN STILL GO WAY DOWN.
US DOE EXPECTS GRID PARITY BY 2020.



SOURCE: Institute for Local Self-Reliance



WHAT IS OUR GRID?

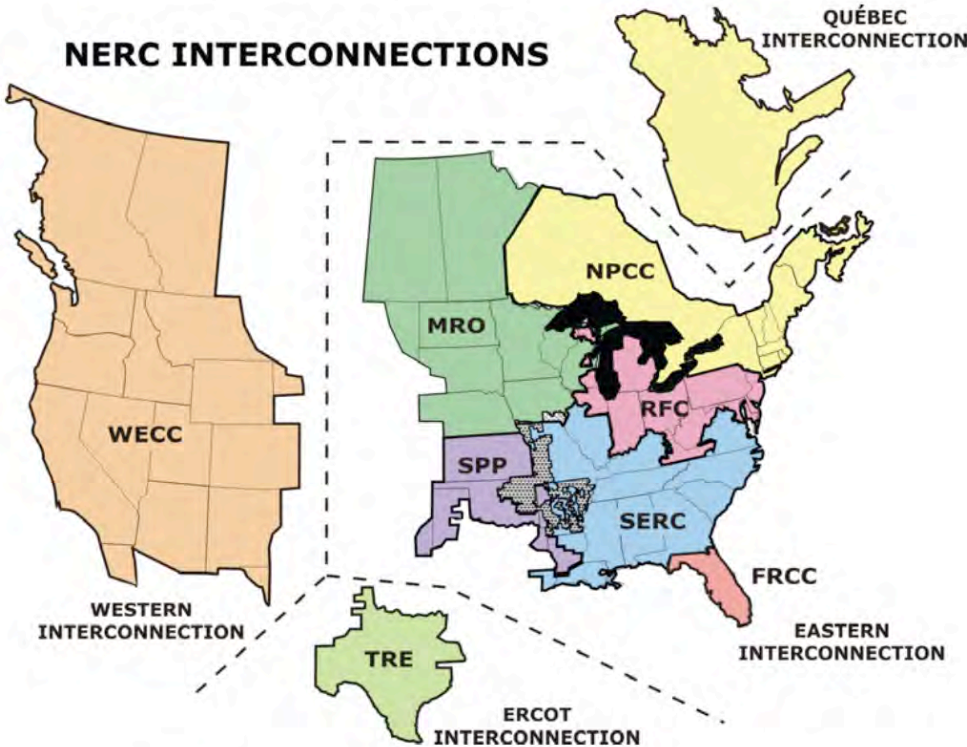


Figure 3: North American electrical grid interconnections, including the 10 NERC regional reliability councils (NERC 2007) (via Deru and Torcellini 2007)

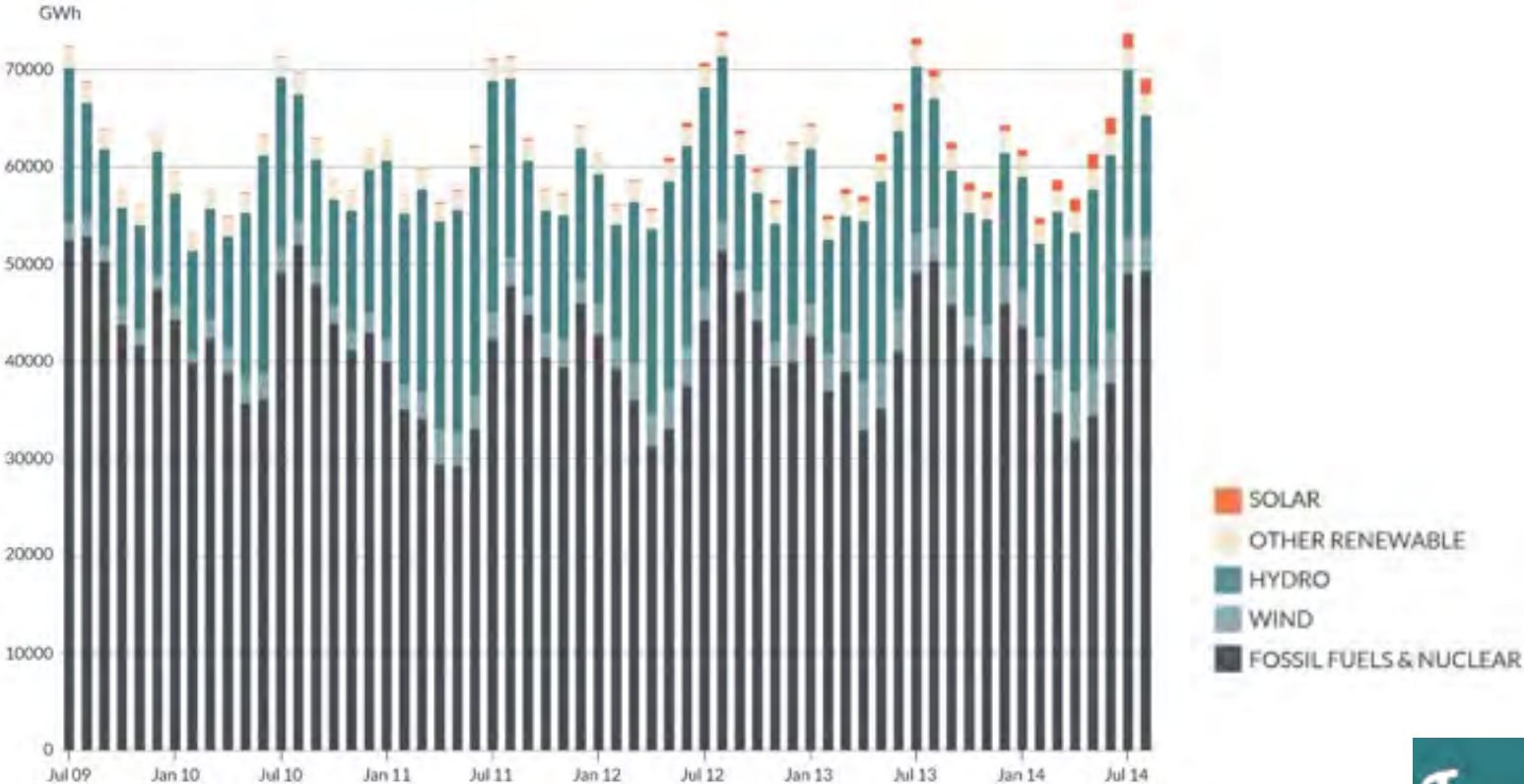
VIA: Building Science Corp.



SOLAR DELIVERS ENERGY WHEN WE NEED IT - THE SUMMER

“DIRTY” GENERATION SPIKES EVERY SUMMER.

ELECTRICITY GENERATION BY SOURCE
GRID: WESTERN INTERCONNECTION (US PORTION)

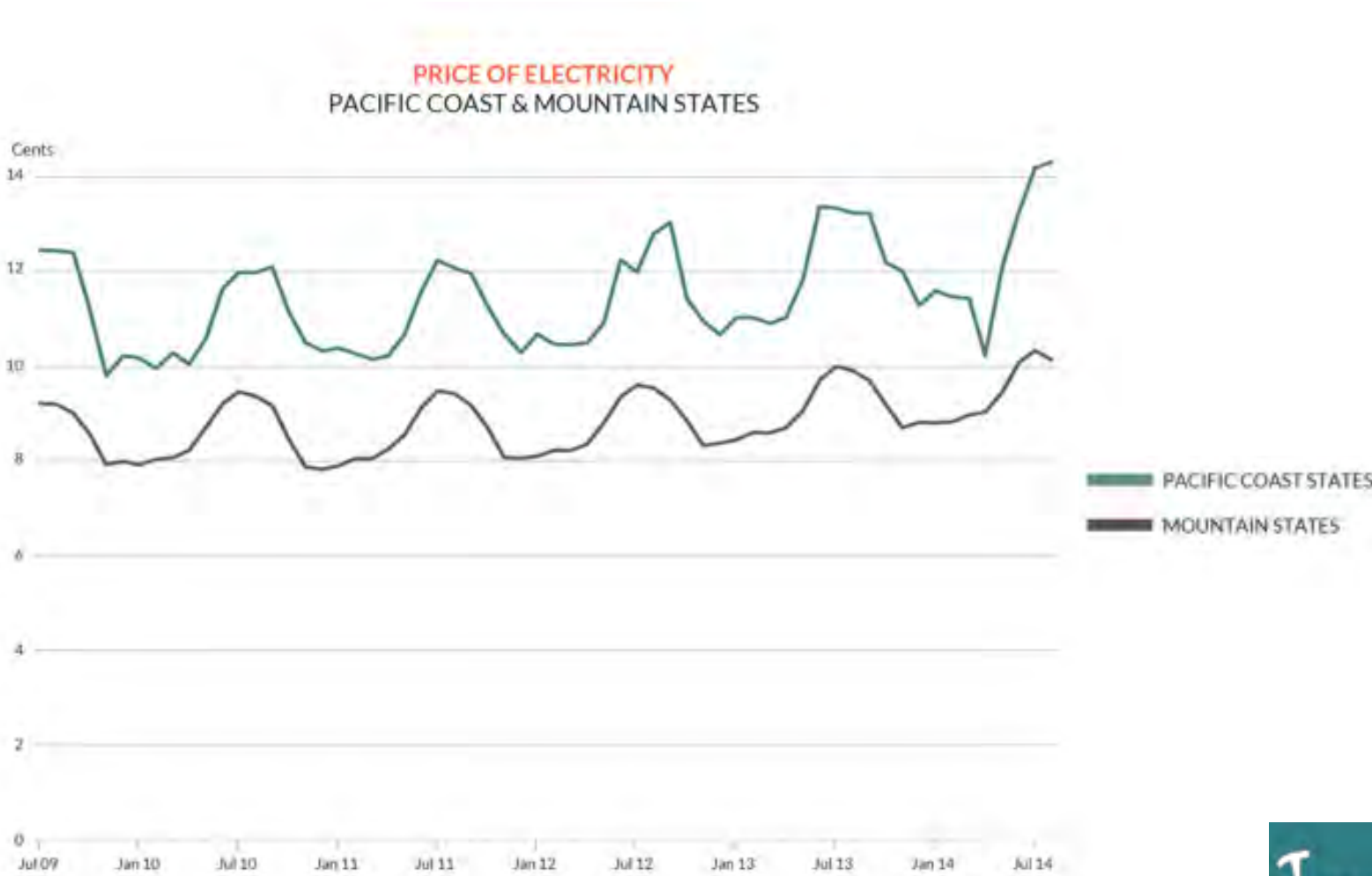


DATA SOURCE: US Energy Information Administration



SOLAR DELIVERS ENERGY WHEN WE NEED IT - THE SUMMER

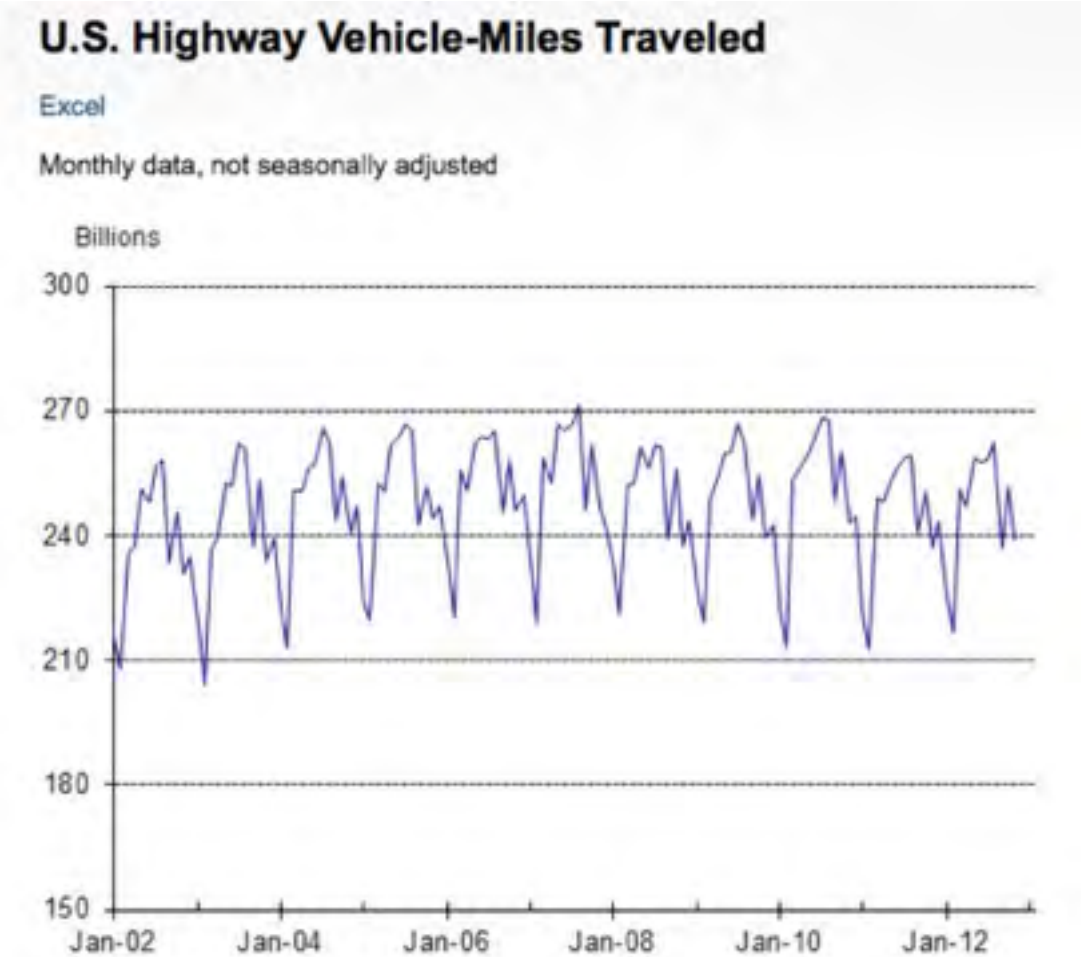
PRICE SPIKES REFLECT INCREASED SUMMER DEMAND.



DATA SOURCE: US Energy Information Administration



VEHICLE MILES TRAVELED SPIKE EVERY SUMMER.



DATA SOURCE: US Department of Transportation



WHAT ABOUT SEASONAL INTERMITTENCY?

FIVE WAYS TO MITIGATE INTERMITTENCY:

1. CONNECT GEOGRAPHICALLY-DISPERSE ENERGY SOURCES (WIND, SOLAR, WAVE, TIDAL).
2. USE A RELIABLE SOURCE, LIKE HYDRO, TO SMOOTH OUT SUPPLY OR MATCH DEMAND.
3. USE SMART METERS TO PROVIDE ELECTRIC POWER TO VEHICLES TO SMOOTH SUPPLY.
4. STORE ELECTRIC POWER FOR LATER USE
5. FORECAST WEATHER.

SOURCE: Prof. Mark Z. Jacobson, Stanford University, in Energy & Environmental Science, December 1, 2008



WHAT ABOUT SEASONAL INTERMITTENCY?

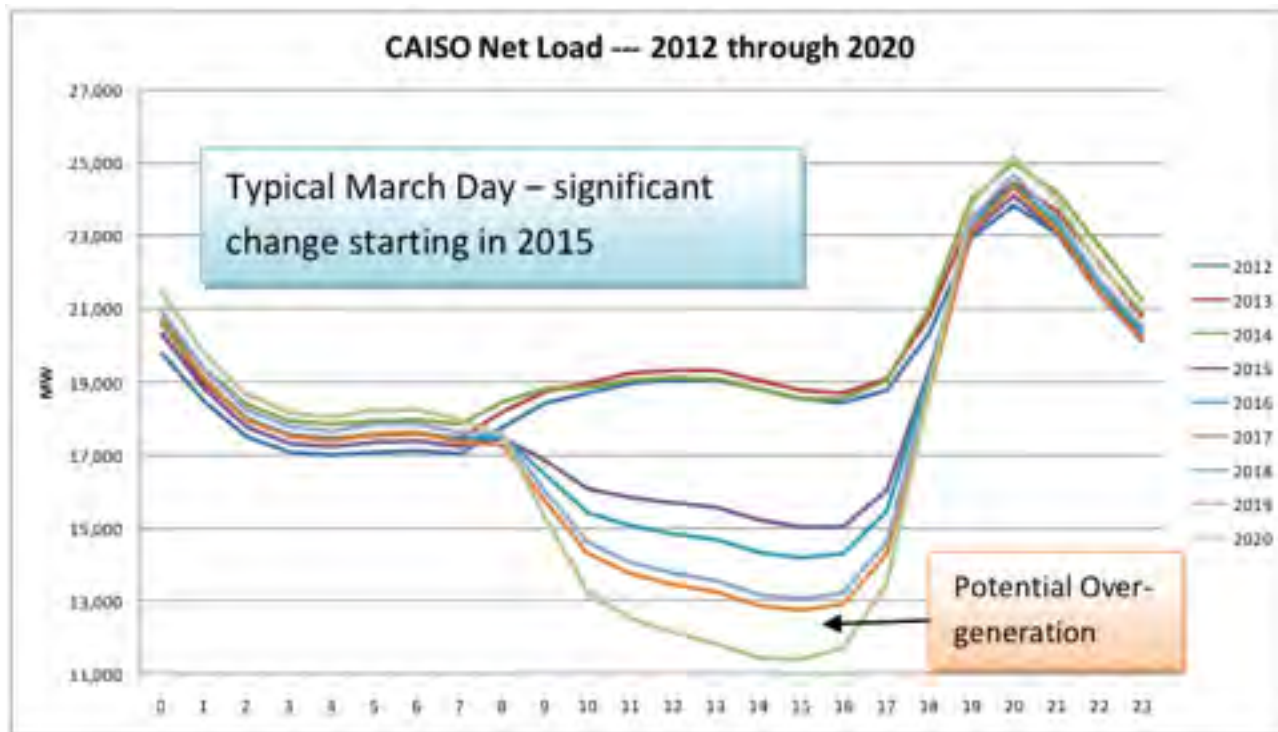
WE ALREADY COPE WITH OUTAGES FROM COAL-CCS & NUCLEAR:

1. AVERAGE COAL PLANT IN US DOWN 6.5% OF YEAR FOR UNSCHEDULED MAINTENANCE AND 6% FOR SCHEDULED MAINTENANCE.
2. NUKES HAVE UNSCHEDULED OUTAGES DURING HEAT WAVES.
3. ONSHORE WIND IS DOWN 0-2% OF YEAR.
4. OFFSHORE WIND IS DOWN 0-5% OF YEAR.
5. SOLAR PV IS DOWN 0-2% OF YEAR.

SOURCE: Prof. Mark Z. Jacobson, Stanford University, in Energy & Environmental Science, December 1, 2008



WHAT ABOUT DAILY INTERMITTENCY?



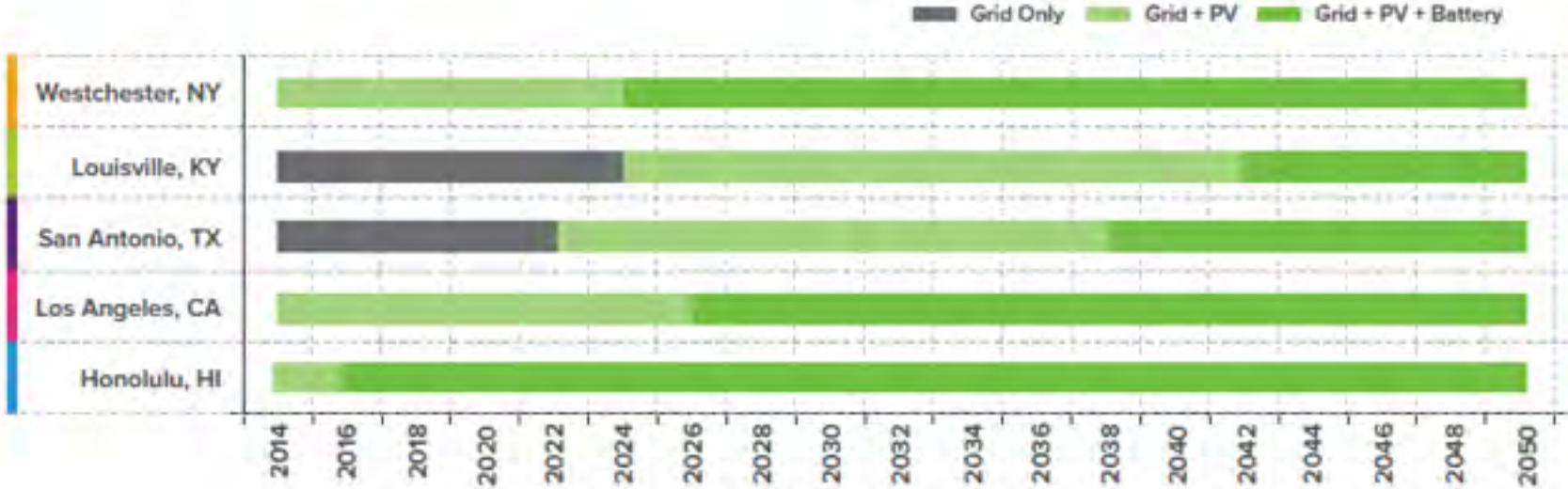
SOURCE: CAISO

TAMING THE DUCK:

1. IMPORT/EXPORT
2. DEMAND RESPONSE
3. TIME OF USE (TOU) PRICING
4. PASSIVE HOUSE AS STORAGE
5. BATTERIES

WHAT ABOUT DAILY INTERMITTENCY?

FIGURE ES1:
ECONOMICALLY OPTIMAL SYSTEM CONFIGURATION
RESIDENTIAL

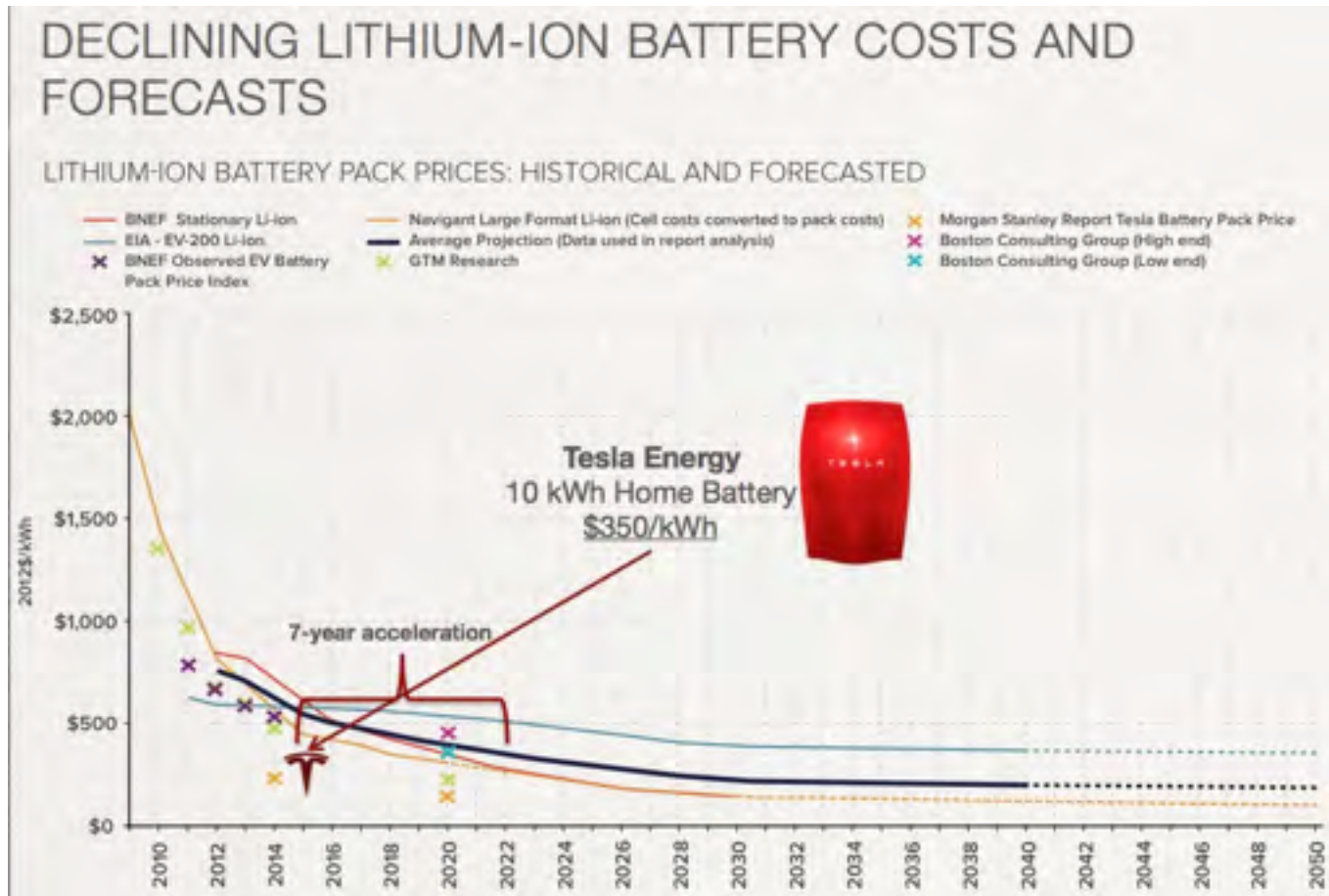


SOURCE: Rocky Mountain Institute

CONSERVATIVE; ASSUMES NO COMPENSATION FOR
“EXPORT” OF SOLAR ENERGY.

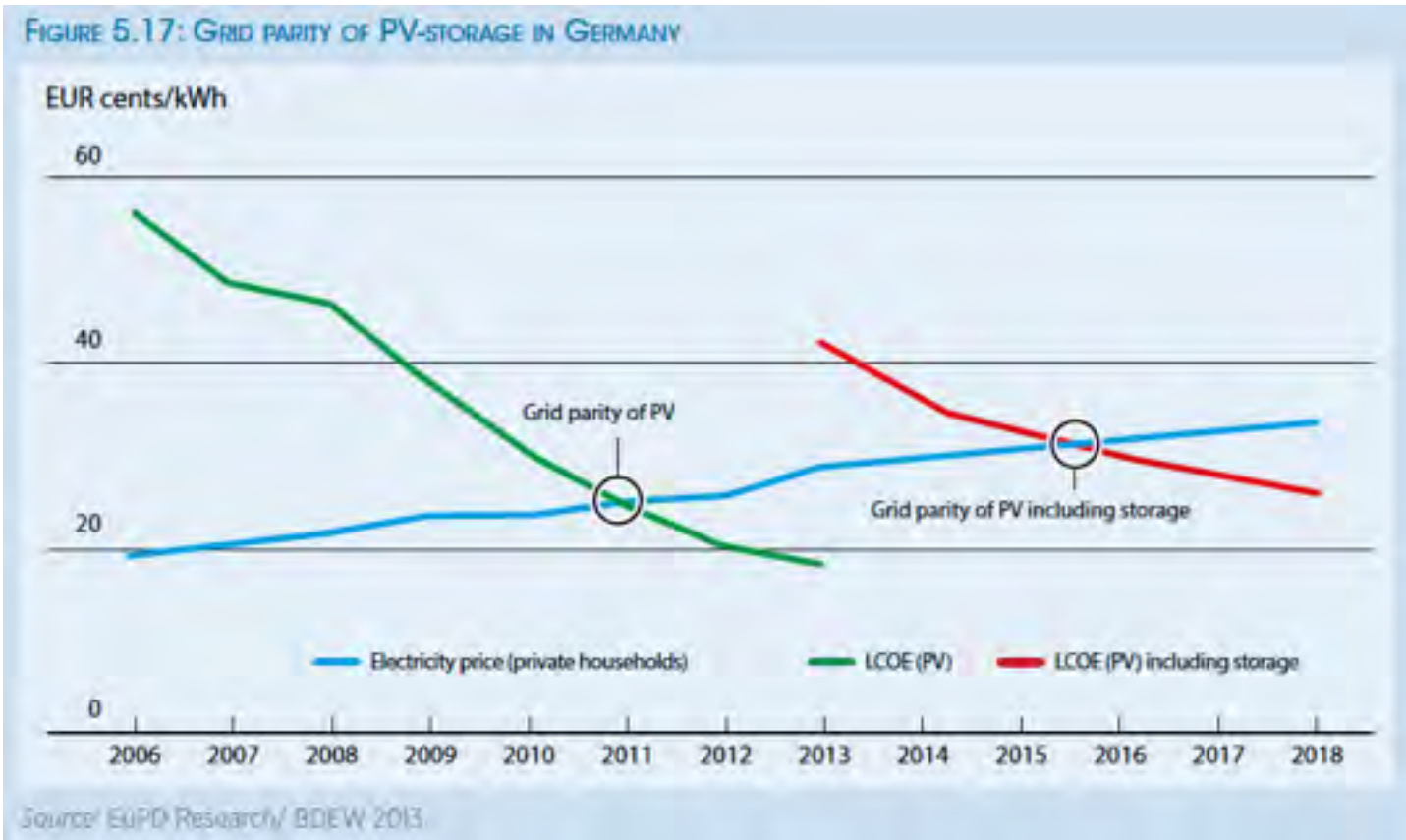


WHAT ABOUT DAILY INTERMITTENCY?



SOURCE: Rocky Mountain Institute

WHAT ABOUT DAILY INTERMITTENCY?



SOURCE: IRENA

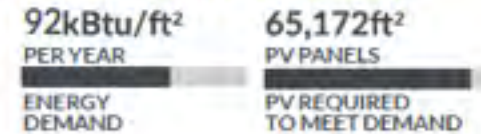
CONSERVATION FIRST, *THEN* PRODUCTION.

THE ENVELOPE STILL MATTERS, A LOT.

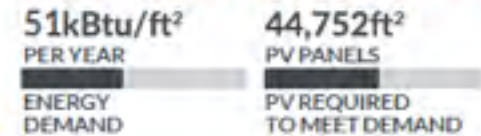
THE BULLITT CENTER: PERFORMANCE VS. ARRAY SIZE

Rooftop array size necessary to reach Net Positive Energy:

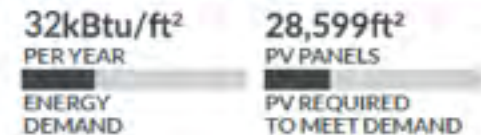
If built as a typical building.



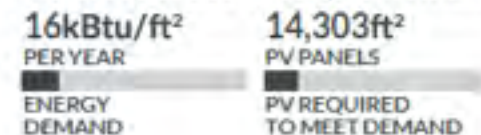
If built to meet the Seattle Energy Code.



If built to meet LEED Platinum.



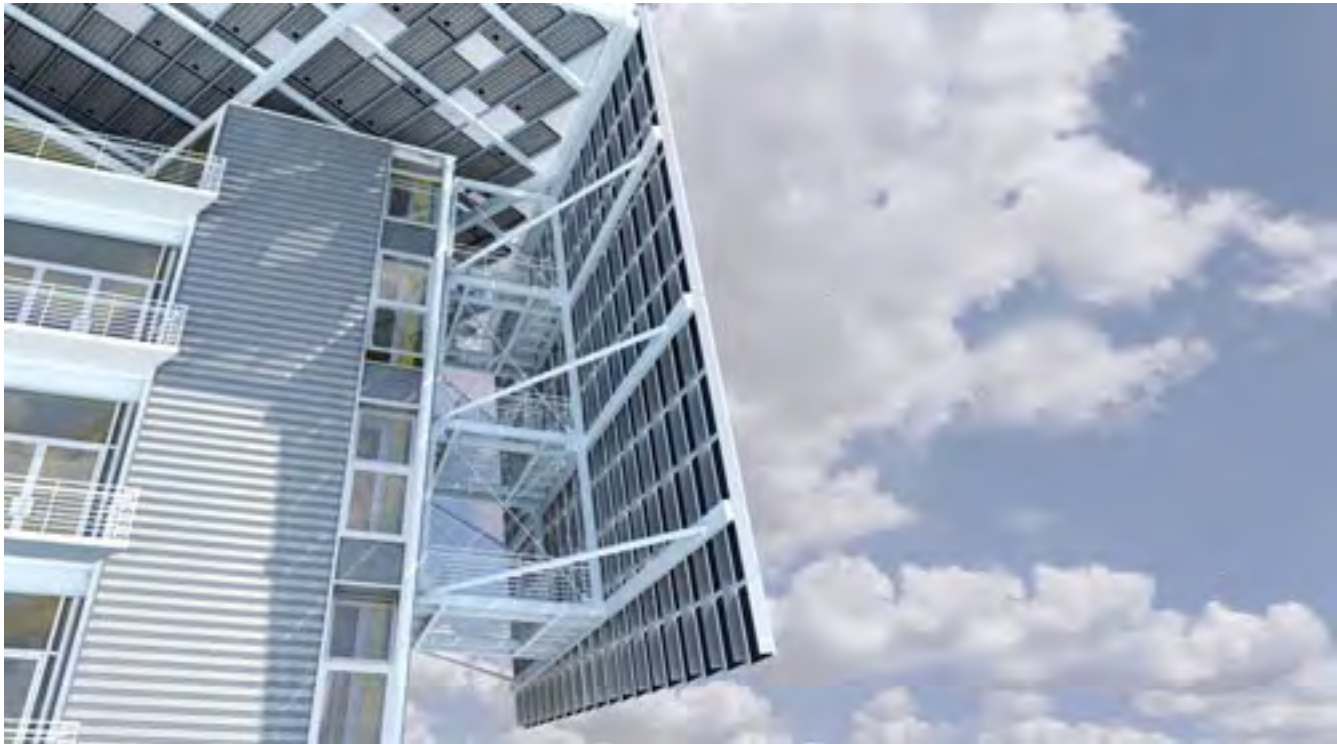
As built: a Living Building with Passive House-level performance.



HOW BIG A ROOF AT THE BULLITT CENTER?

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WHAT COULD'VE BEEN AT THE BULLITT CENTER



Source: The Miller Hull Partnership

WHAT COULD'VE BEEN AT THE BULLITT CENTER



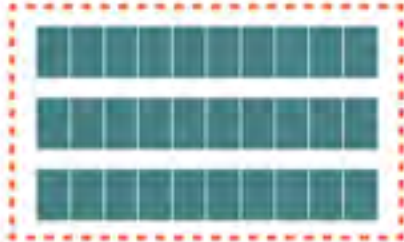
Source: The Miller Hull Partnership

WHAT IS AT THE BULLITT CENTER

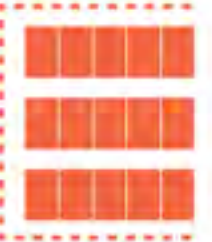
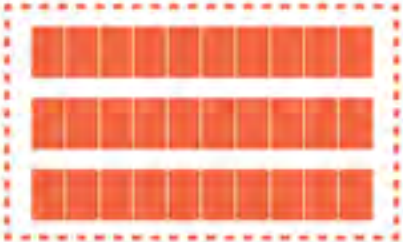
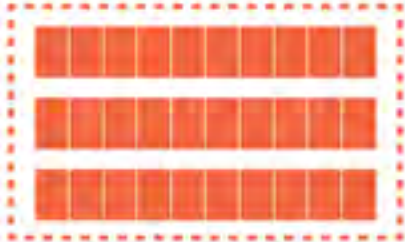


Source: The Miller Hull Partnership

WHAT COULD'VE BEEN AT KARUNA HOUSE



CURRENT 10kW PV ARRAY



ADDITIONAL 25kW+ PV ARRAY

WHAT IS AT KARUNA HOUSE



THE TYPICAL PORTLAND OR SEATTLE HOUSE IS NO DIFFERENT



Bullitt Center
Lot/Roof



Karuna House
Certifications



Typical Seattle House
Lot/Roof

ENERGY USE OF A TYPICAL HOUSE



LIMITED SPACE DRIVES DEMAND FOR PERFORMANCE

MAX ARRAY SIZE FOR TYPICAL SFH ROOF IN SEA/PDX IS **6.6KW**
THAT ARRAY WILL GENERATE **5,800KWH/YR**

USEIA: AVERAGE 2000SF HOUSE CONSUMES **22,509KWH/YR**

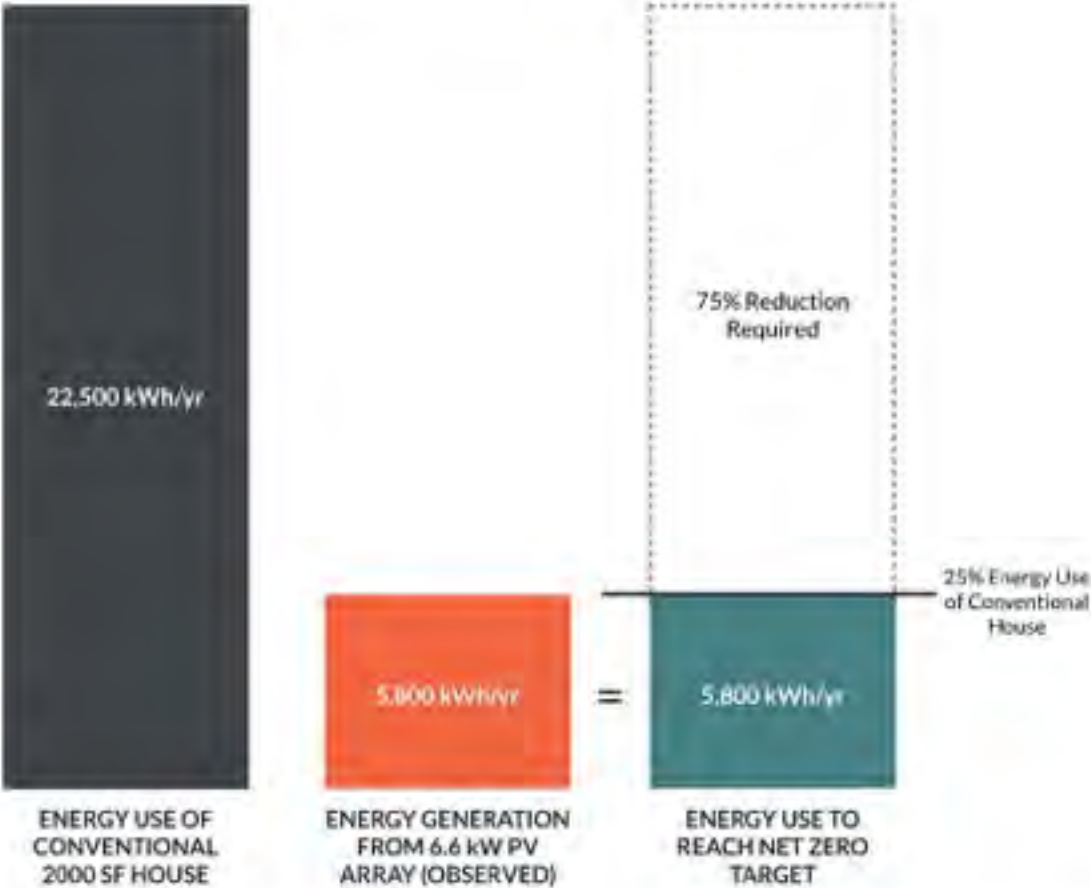
SO!

TO REACH NET ZERO ENERGY IN SEA/PDX, OUR HOUSES WILL
NEED TO USE **75%** LESS ENERGY.



ENERGY USE OF A TYPICAL HOUSE

REACHING NET ZERO - PERFORMANCE IS KEY
75% REDUCTION IN ENERGY USE TO REACH NET ZERO

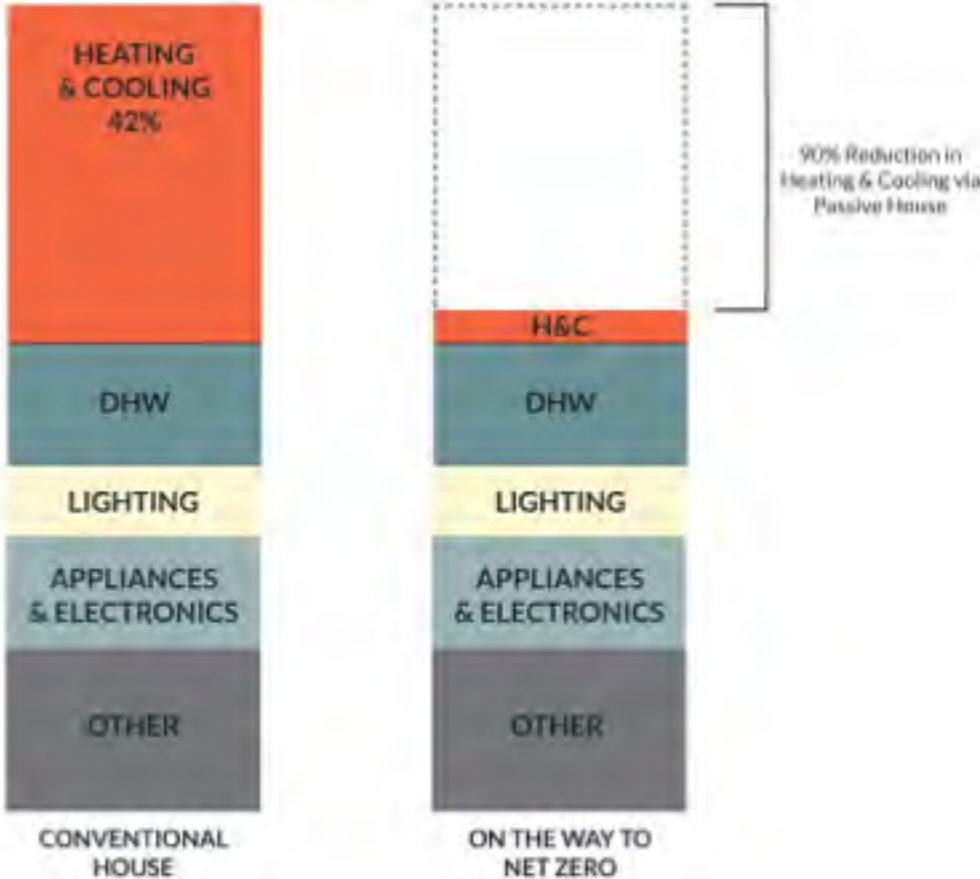


THE PASSIVE HOUSE APPROACH TO BUILDING IS THE ONLY STRATEGY WE KNOW THAT CAN REDUCE BUILDING ENERGY USE BY **75%**.



ENERGY USE OF A TYPICAL HOUSE

REACHING NET ZERO - START WITH PASSIVE HOUSE
REDUCE HEATING & COOLING DEMAND BY 90%



SOURCE: Ecotope Inc. and NEEA

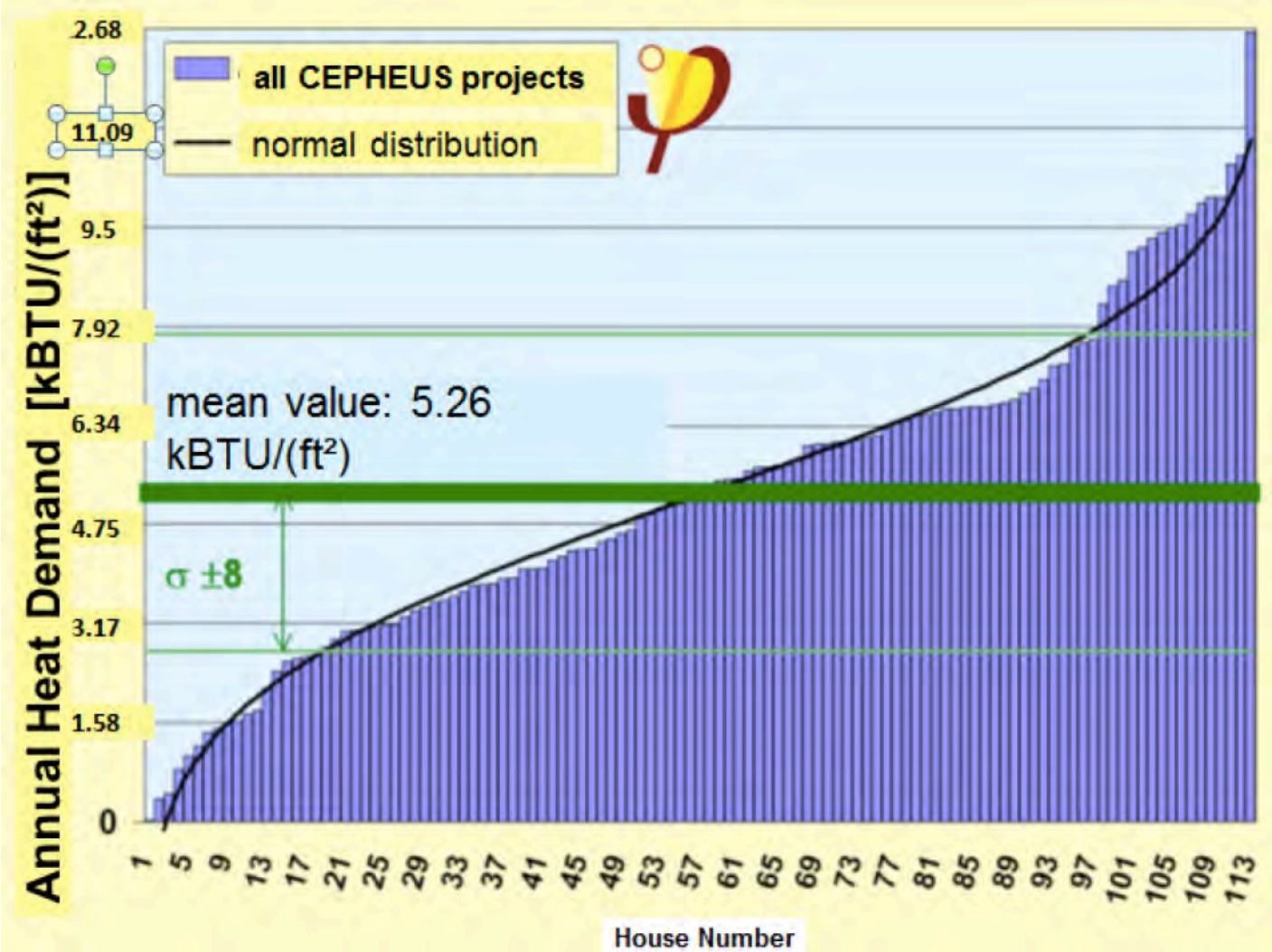


SO WE'RE HALFWAY TO **75%**. HOW DO WE GET ALL THE WAY?

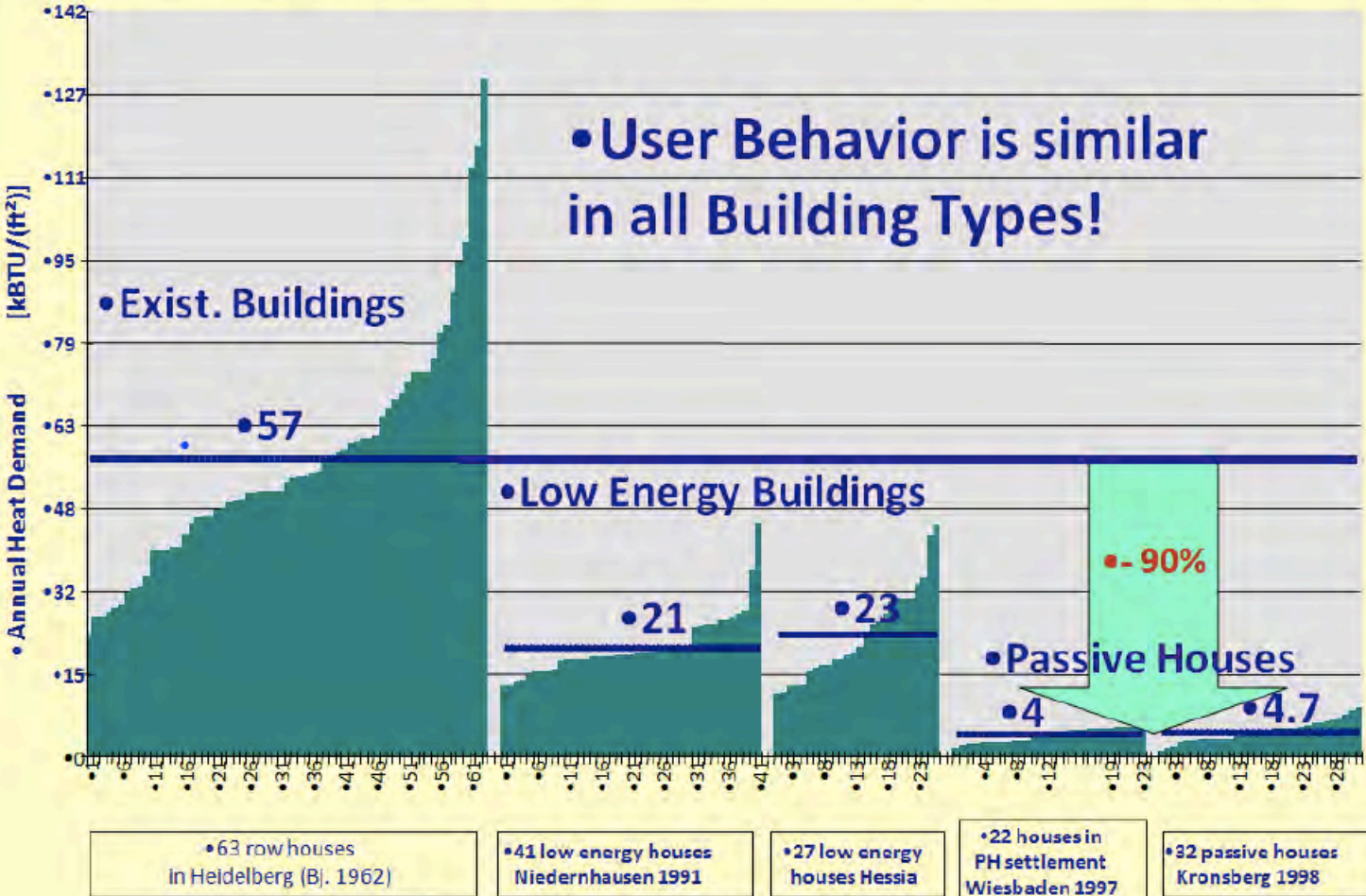
- USER BEHAVIOR
- IMPROVED DOMESTIC HOT WATER SYSTEMS
- BETTER LIGHTING STRATEGIES
- SUPER-EFFICIENT APPLIANCES

IMPACT OF USER BEHAVIOR

“COST EFFICIENT PASSIVE HOUSES AS EUROPEAN STANDARDS” STUDY, 2001



Statistics Show importance of mean measured values



• 63 row houses in Heidelberg (Bj. 1962)

• 41 low energy houses Niederrhein 1991

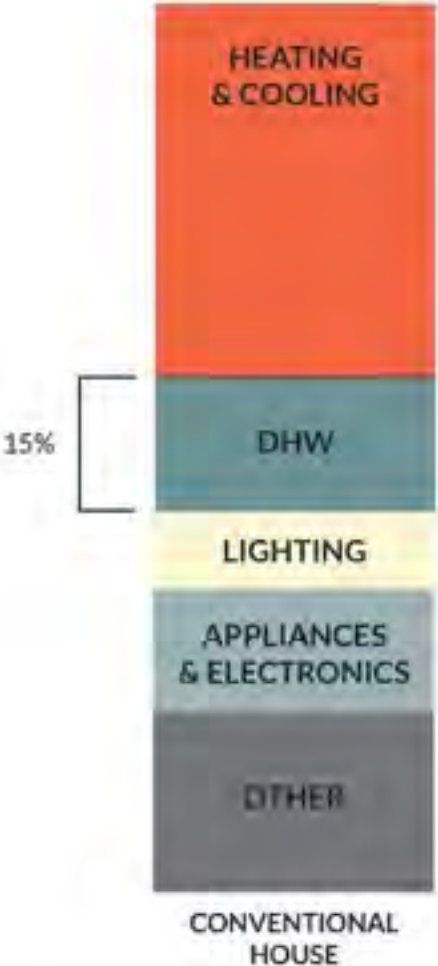
• 27 low energy houses Hessia

• 22 houses in PH settlement Wiesbaden 1997

• 32 passive houses Kronsberg 1998

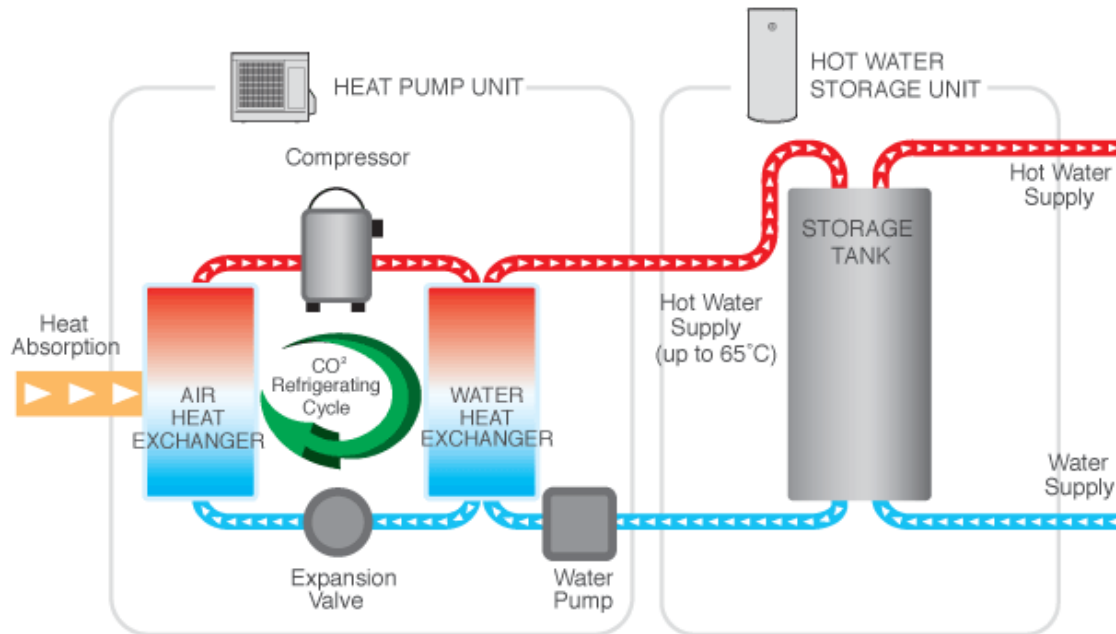


IMPROVED DHW



SOURCE: Ecotope Inc. and NEEA





1. Efficient production: e.g. Sanden heat pump hot water heater

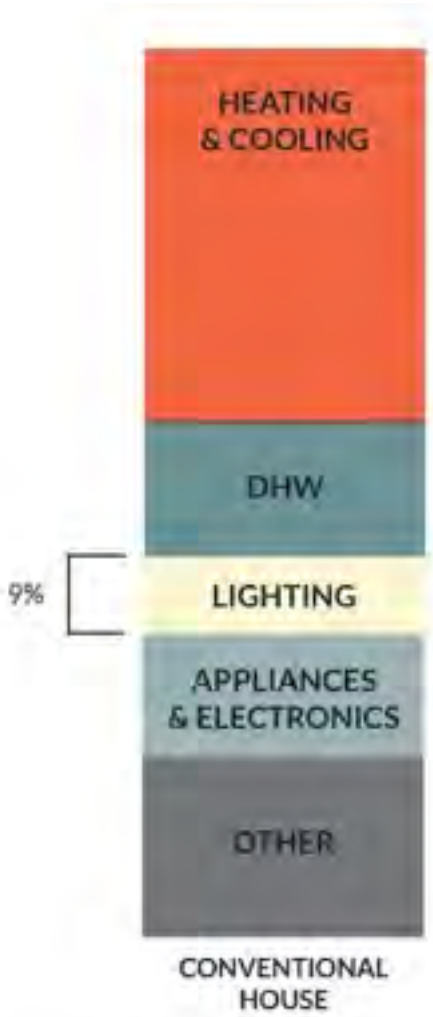
<http://www.ecobuilding.org/code-innovations/case-studies/sanden-co2-refrigerant-heat-pump-water-heater-in-seattle-passive-house>

2. Efficient distribution: On-demand circulating hot water

http://www.epa.gov/watersense/docs/hw_distribution_guide.pdf

http://www.allianceforwaterefficiency.org/Residential_Hot_Water_Distribution_System_Introduction.aspx

IMPROVED LIGHTING



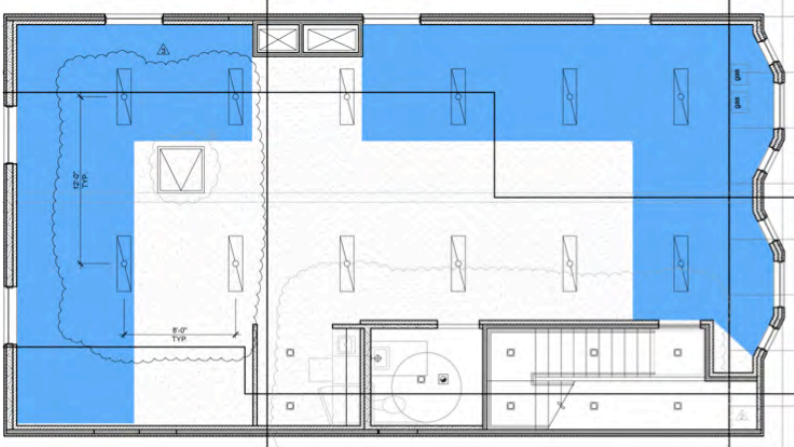
SOURCE: Ecotope Inc. and NEEA



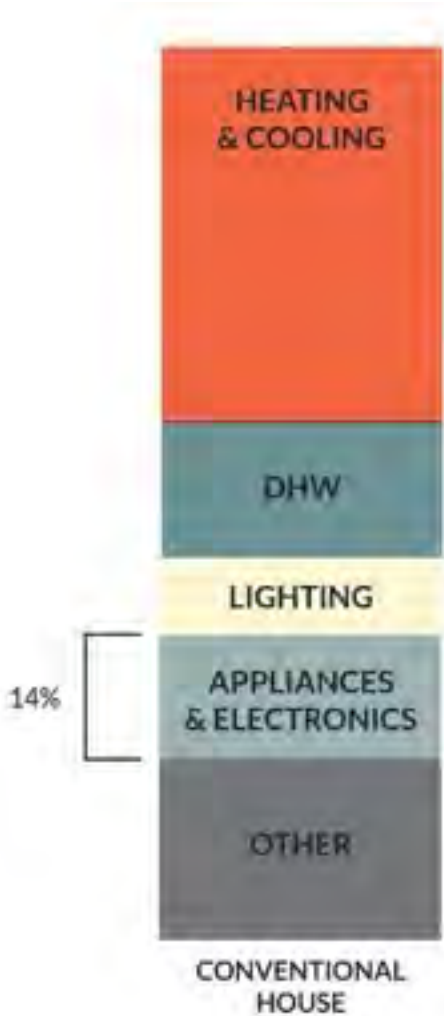
1. LEDs



2. Daylighting



SUPER-EFFICIENT APPLIANCES

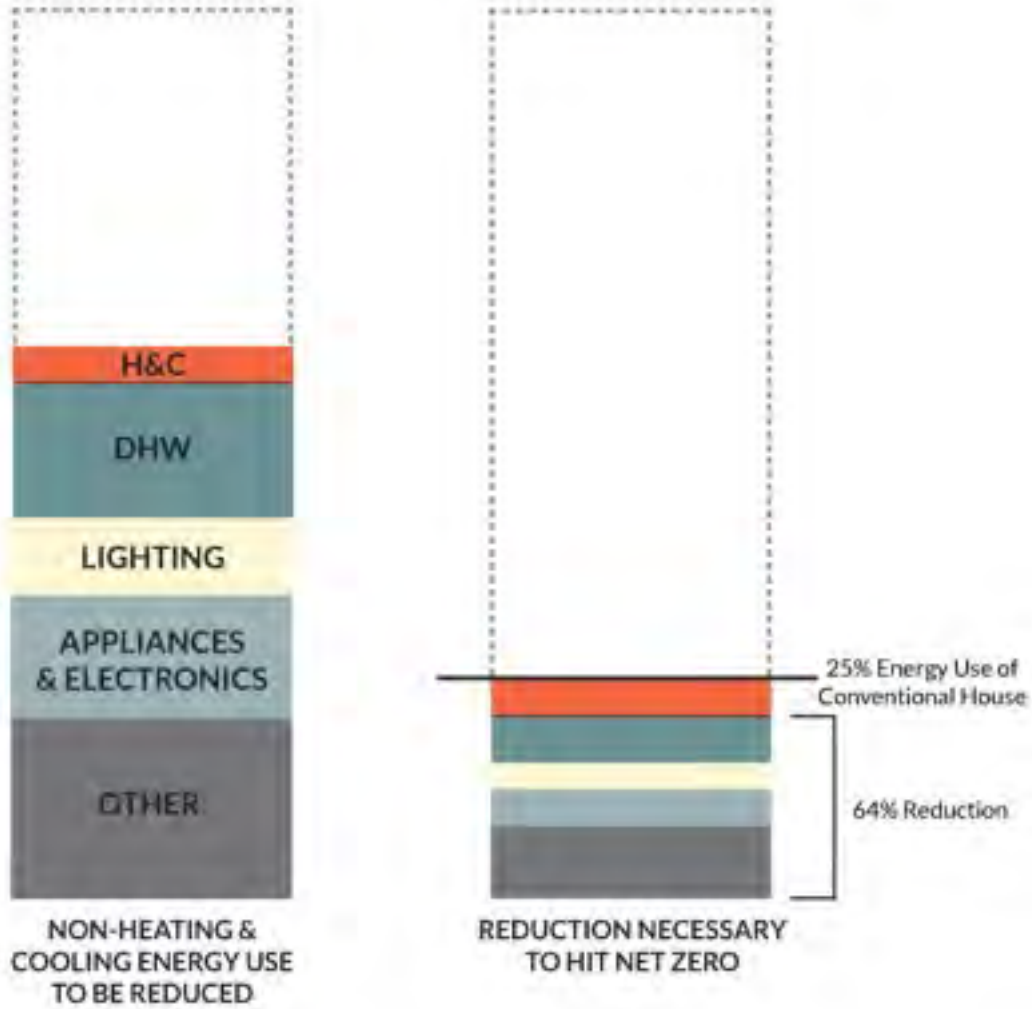


SOURCE: Ecotope Inc. and NEEA



SO...PASSIVE HOUSE CAN GET US THERE

REACHING NET ZERO - DIAL-IN OCCUPANT BEHAVIOR & EFFICIENCY REDUCE NON-HEATING & COOLING ENERGY USE TO HIT TARGET



ANECDOTAL EVIDENCE OF THE “MAGIC” OF THE TARGET



ANECDOTAL EVIDENCE OF THE “MAGIC” OF THE TARGET



ANECDOTAL EVIDENCE OF THE “MAGIC” OF THE TARGET



“PRO-SUMERS” OF ENERGY:

PASSIVE HOUSE + PV + BATTERIES

OPTIMIZE MIX OF CONSERVATION, STORAGE, AND
GENERATION, TIMED TO THE MARKET.



THANK YOU

ZACK@HAMMERANDHAND.COM

