DESIGNING COMMUNITIES TO BE RESILIENT

HOLISTIC, POSITIVE-IMPACT DESIGN

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Brennan + Company Architects

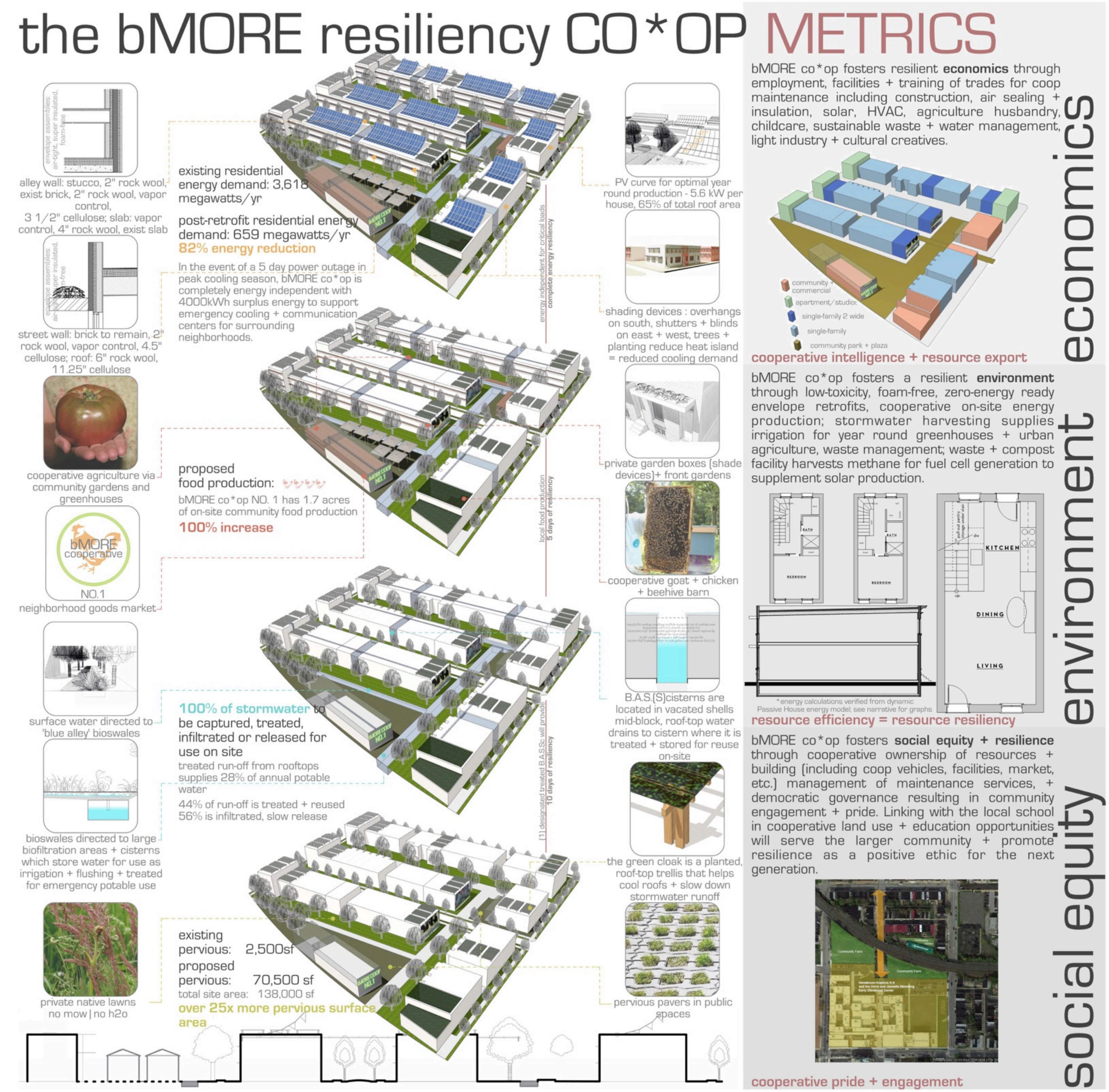
Michael Hindle CPHC, CPHB
Passive to Positive Consulting

brennan + company ARCHITECTS

Passive to **POSITIVE**

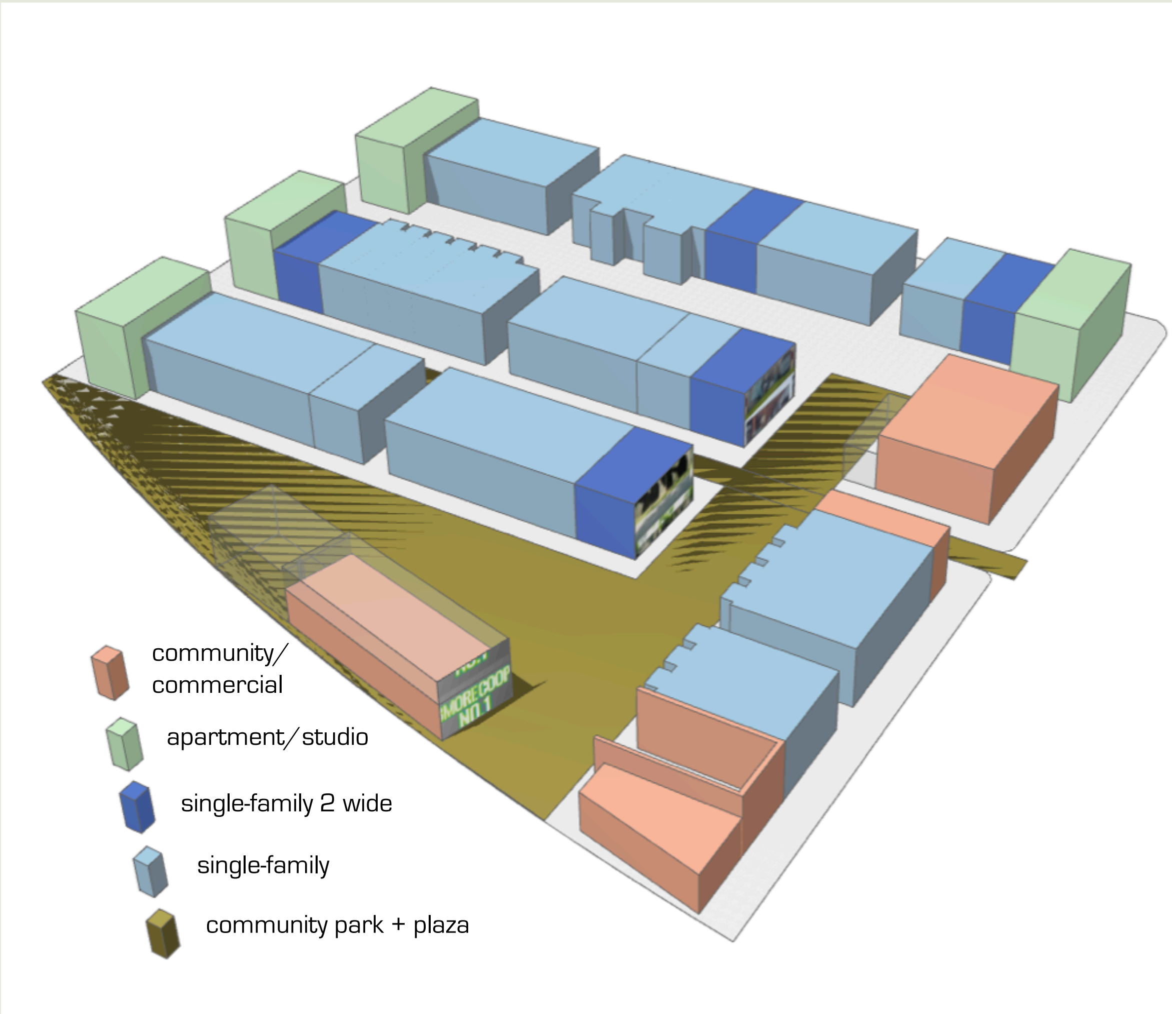
Most Resilient Concept, bMORE Resilient CO*OP

Michael Hindle, Adam Ganser, Peter May, Katelin Posthuma, Carri Beer, Jack Sullivan



bMORE Resilient CO*OP Metrics

economics * environment * social equity



bMORE co*op **= resilient economics**

- Avoids getrification
- Provides employment,
- facilities + training
    - construction,
    - air sealing + insulation, solar,
    - HVAC,
    - agriculture husbandry,
    - childcare,
    - sustainable waste + water management,
- light industry + cultural creatives.

bMORE co*op **= a resilient environment**

- low-toxicity, foam-free,
- zero-energy ready envelope retrofits,
- cooperative on-site energy production;
- stormwater harvesting irrigation
    - year round greenhouses
    - urban agriculture,
- waste management;
    - waste + compost facility

bMORE co*op **= social equity + resiliency**

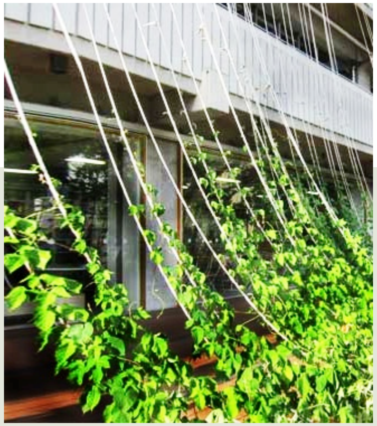
- cooperative ownership of resources
- Democratic
- Linkage with the local school in cooperative land use + education opportunities.

green infrastructure

existing pervious: 2,500sf

proposed pervious:70,500sf

over 25x more pervious surface area



green cloaks, native lawns and pervious reduce the heat island effect
contribute to building efficiency,
slow storm-water runoff,
creating wildlife habitat.

Increase tree canopy to sequester carbon, reduce the heat island effect, create cooling summer shade

water infrastructure

100% of storm-water to be captured, treated, infiltrated or released for use on site

treated run-off from rooftops supplies 28% of annual potable water

44% of run-off is treated + reused
56% is infiltrated, slow release

Stormwater runoff control and capture through bio-filtration and cistern storage for gray water irrigation and toilet flushing.

One designated 10,500 gallon B.A.S.Scistern will be treated with reverse osmosis and UV disinfection to provide the entire neighborhood with 10 days of water

10 days of resiliency

agriculture infrastructure

bMORE co*op NO. 1 has 1.7 acres of on-site community food production

100% increase

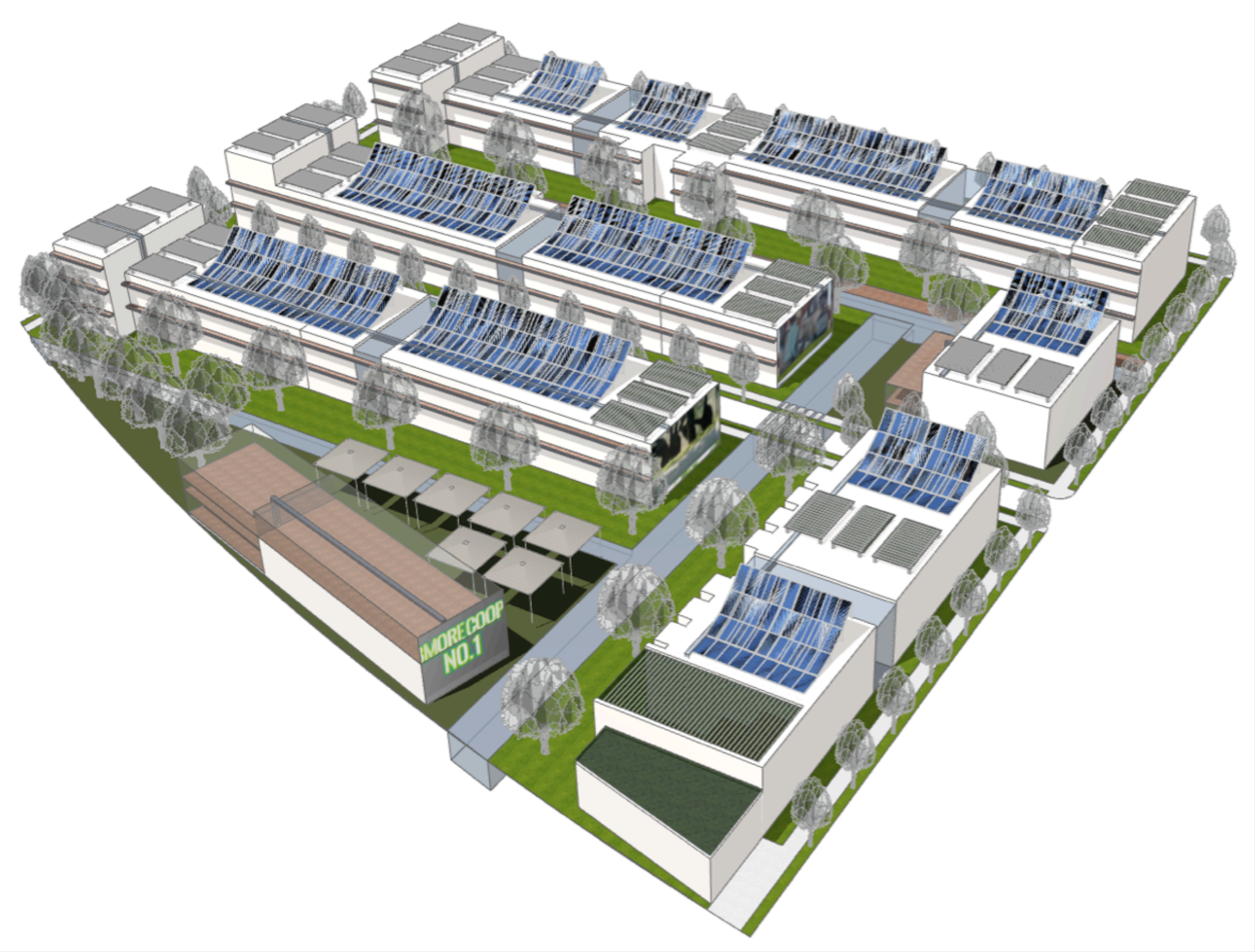
neighborhood goods market

cooperative agriculture via community gardens + greenhouses

private garden boxes (shade devices) + front gardens

cooperative goat + chicken + beehive barn

energy infrastructure – *begins with the envelope*



Highly insulated, **foam-free** and tightly sealed, healthy envelopes

Methods are cash-flow positive when considering energy bills.

Passive House casement or tilt-turn windows.

PV - 5.6 kW per house, 65% of total roof area AND 34.4 KW on 13 unit multi-family

energy independent for critical loads

complete energy resiliency

OUR BEGINNING ASSUMPTION

RETROFIT THIS!!

NOT YOUR AVERAGE PASSIVE HOUSE

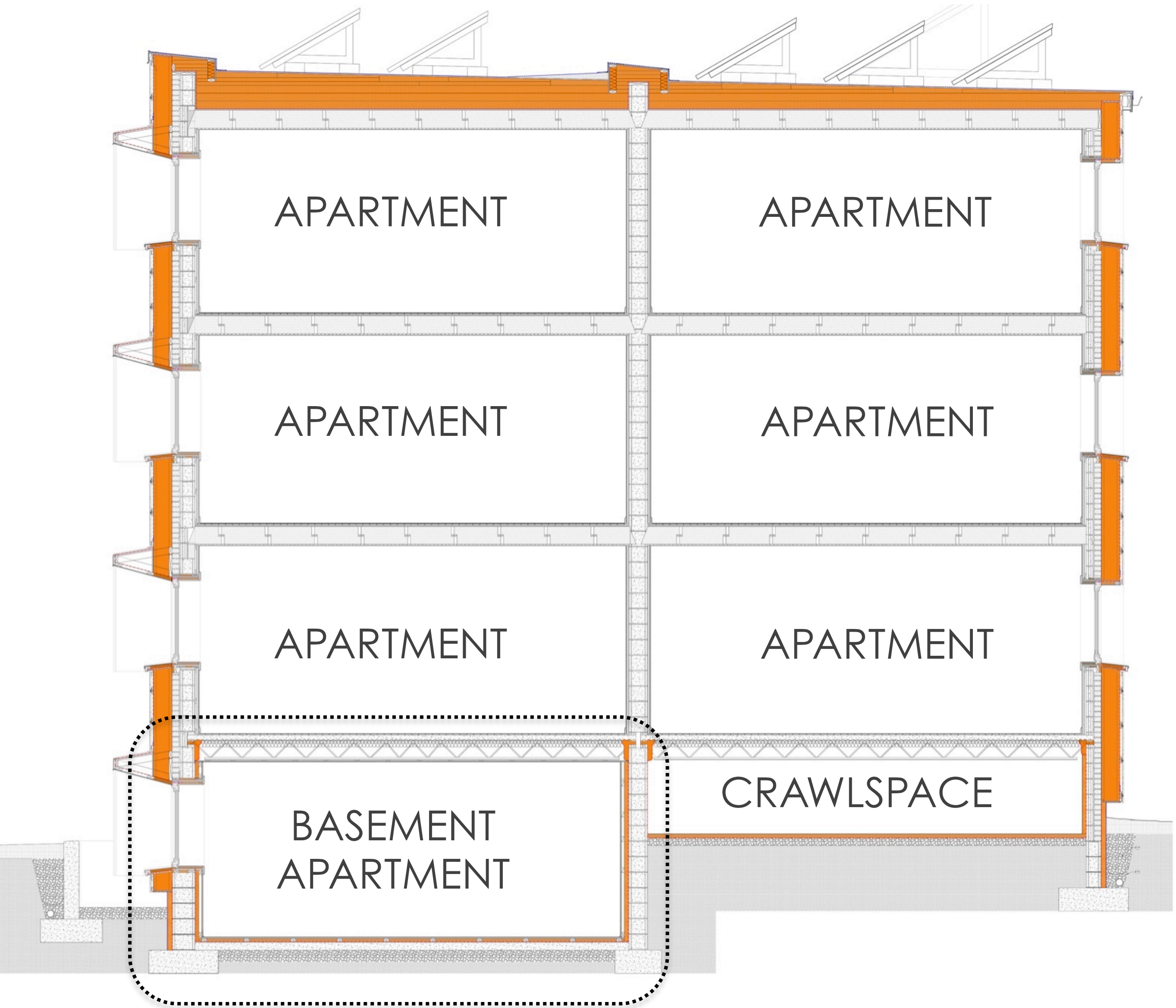
RETROFIT THIS!!

NOT YOUR AVERAGE PASSIVE HOUSE

OUR CANVAS: FROM VACANT TO HIGH PERFORMANCE ENVELOPE

OUR CANVAS: FROM VACANT TO HIGH PERFORMANCE ENVELOPE

OUR CANVAS: FROM RUST BUCKETS TO HIGH PERFORMANCE SYSTEMS



EXTERNAL BLANKET: NON-HISTORIC

OUR CANVAS: FROM VACANT TO HIGH PERFORMANCE ENVELOPE

INTERNAL INTERVENTIONS: HISTORIC

HIGH PERFORMANCE ENVELOPE

MATERIALS AND METHODS

Existing frame wall retrofit detail

Basement and masonry interior retrofit details

APPROPRIATELY LOCATED AND DURABLE CONTROL LAYERS

Basement and masonry interior retrofit detail

WHEN TO STOP?

DEFINE YOUR GOALS!!

A STANDARD?
LOW ANNUAL ENERGY?
RESILIENCE?


DESIGNING COMMUNITIES TO BE RESILIENT
STARTS WITH PASSIVE SURVIVABILITY
DEAD END
D.U.M.B.O

energy infrastructure – *begins with the envelope BUT DOES NOT PRECLUDE RENEWABLES*

Highly insulated, **foam-free** and tightly sealed, healthy envelopes

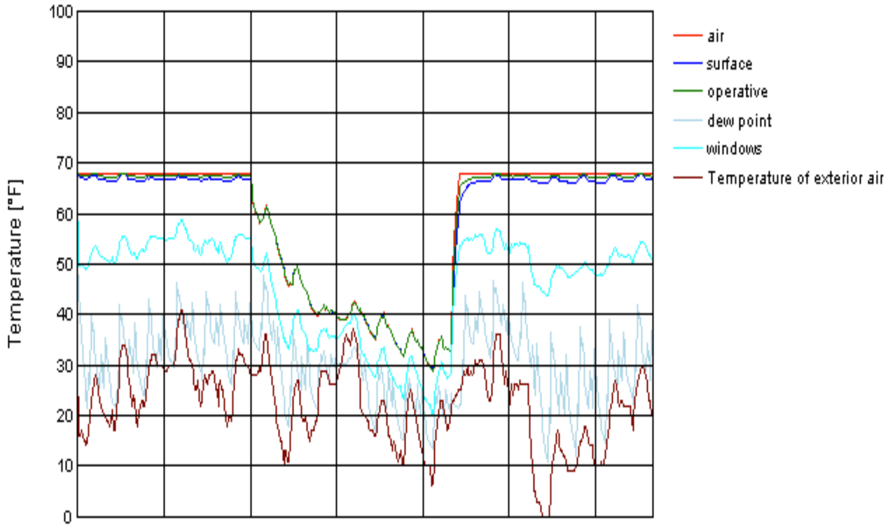
Passive House casement or tilt-turn windows.

Etc.

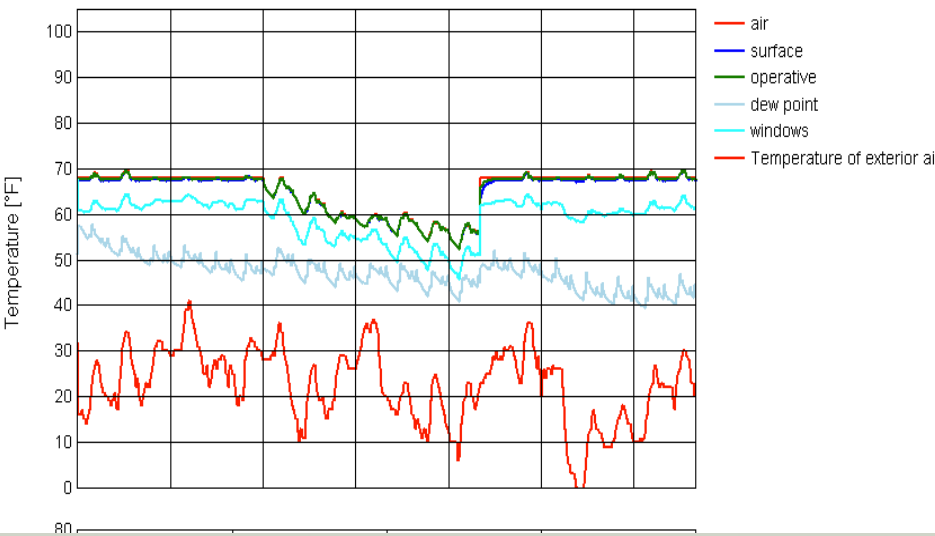
energy independent for critical loads

complete energy resiliency

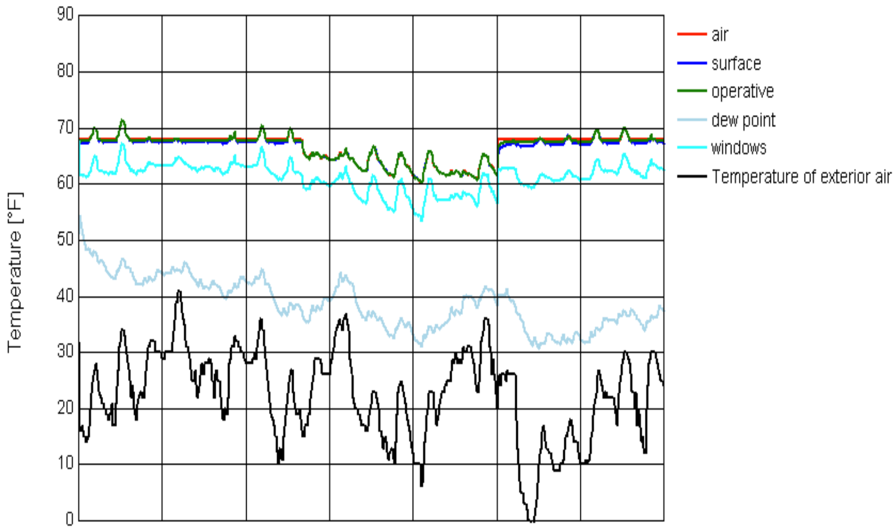

REVITALIZING MASONRY MULTIFAMI
WEINBERG COMMON
5086



Single family 2 BR – typical row-home



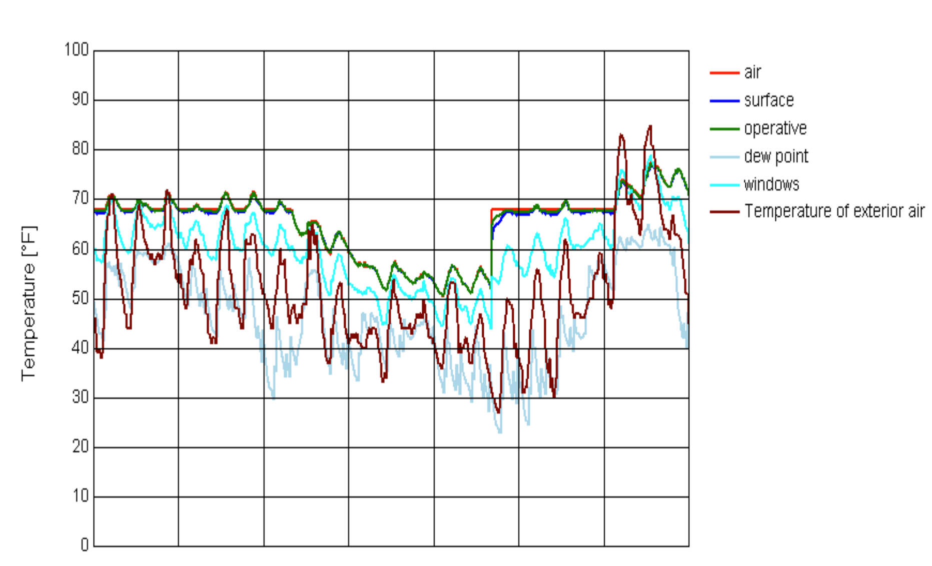
Single family 2 BR – row-home retrofit



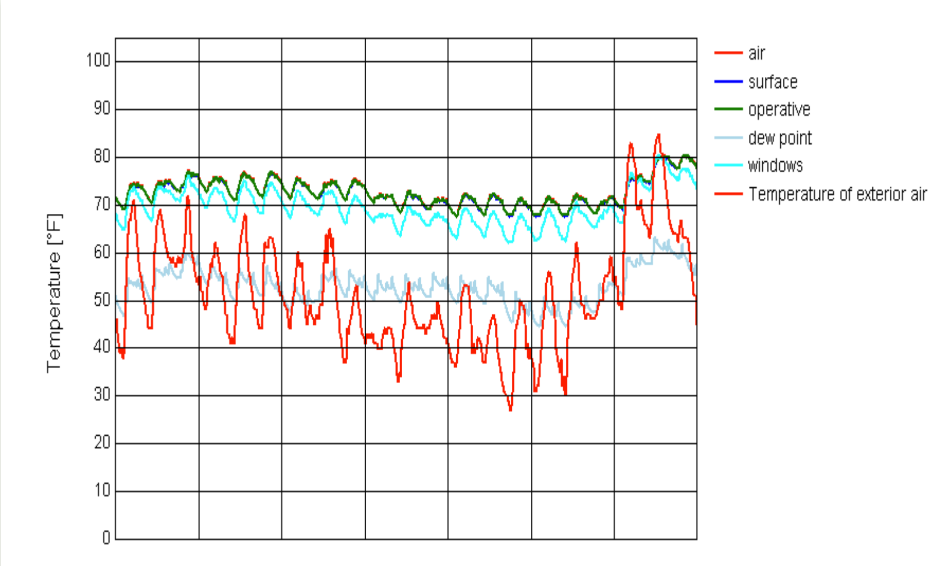
Multi-family– retrofit

ONE WEEK POWER OUTAGE IN JANUARY:

HIGH PERFORMANCE ENVELOPE MAINTAINS COMFORT AND SAFETY



Single family 2 BR – typical row-home



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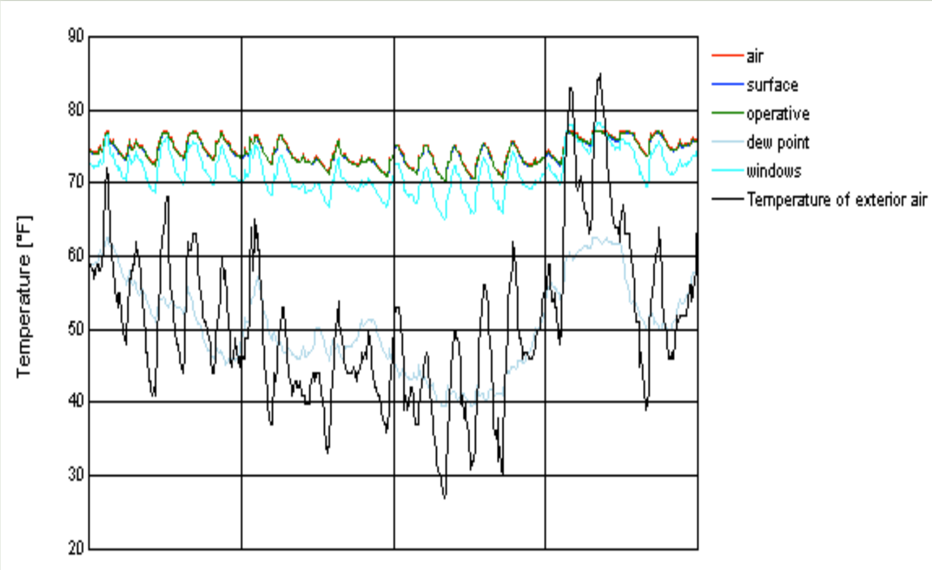
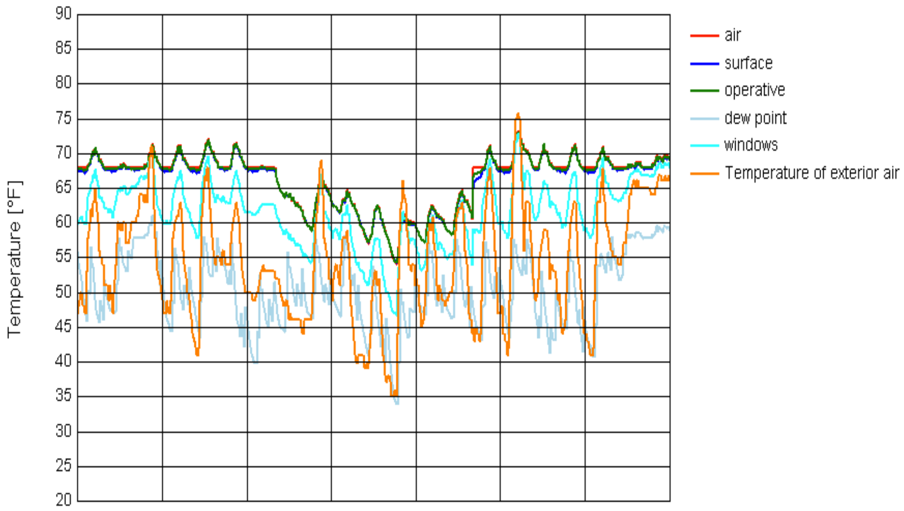


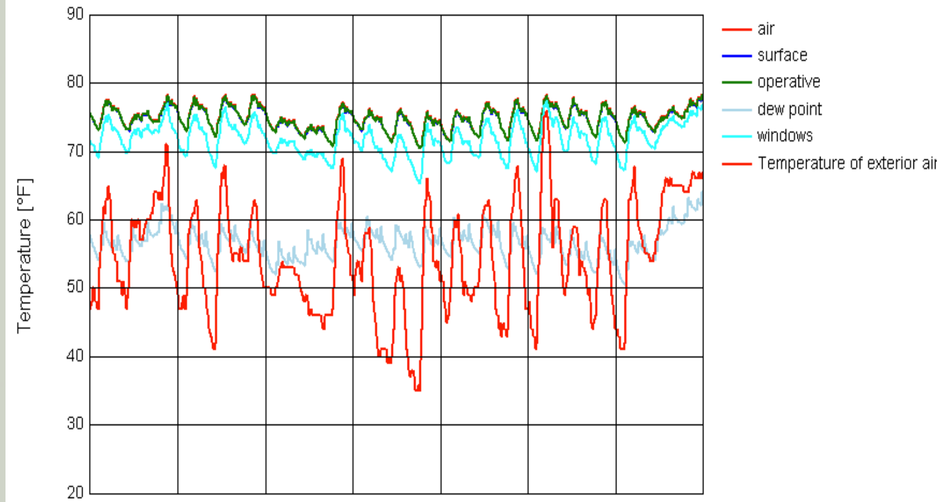
Multi-family– retrofit

ONE WEEK POWER OUTAGE IN MARCH:

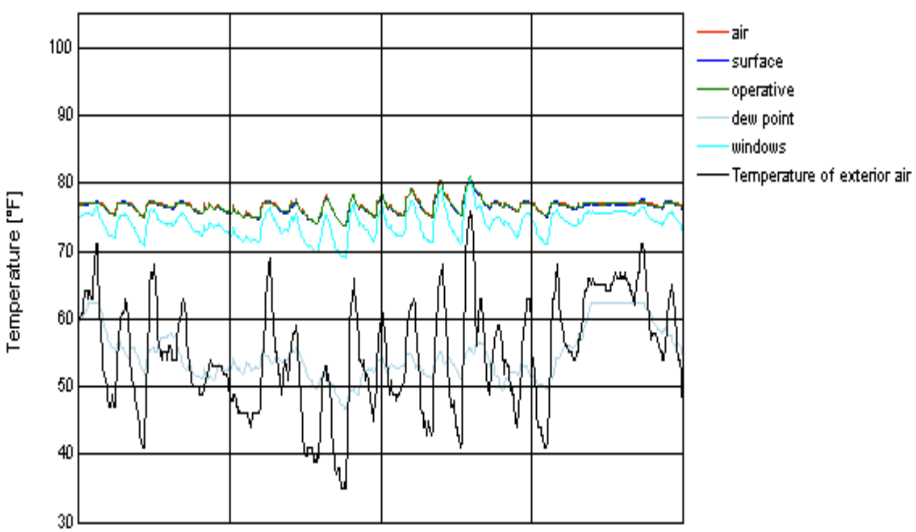
HIGH PERFORMANCE ENVELOPE MAINTAINS COMFORT AND SAFETY



Single family 2 BR – typical row-home



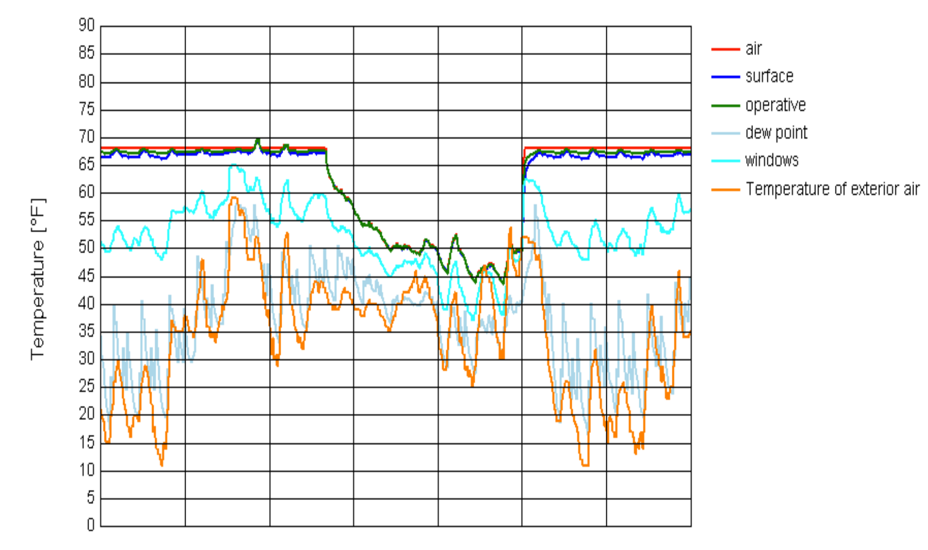
Single family 2 BR – row-home retrofit



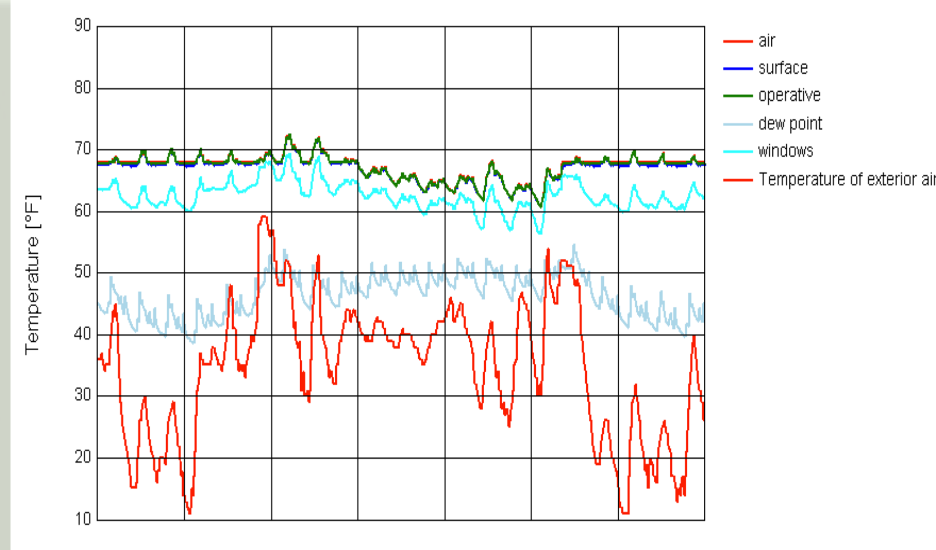
Multi-family– retrofit

ONE WEEK POWER OUTAGE IN OCTOBER:

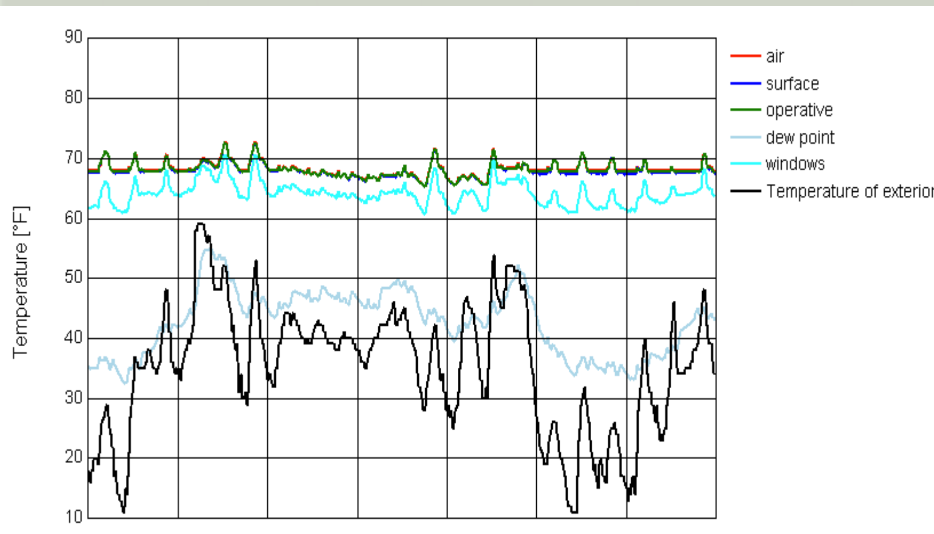
HIGH PERFORMANCE ENVELOPE MAINTAINS COMFORT AND SAFETY



Single family 2 BR – typical row-home



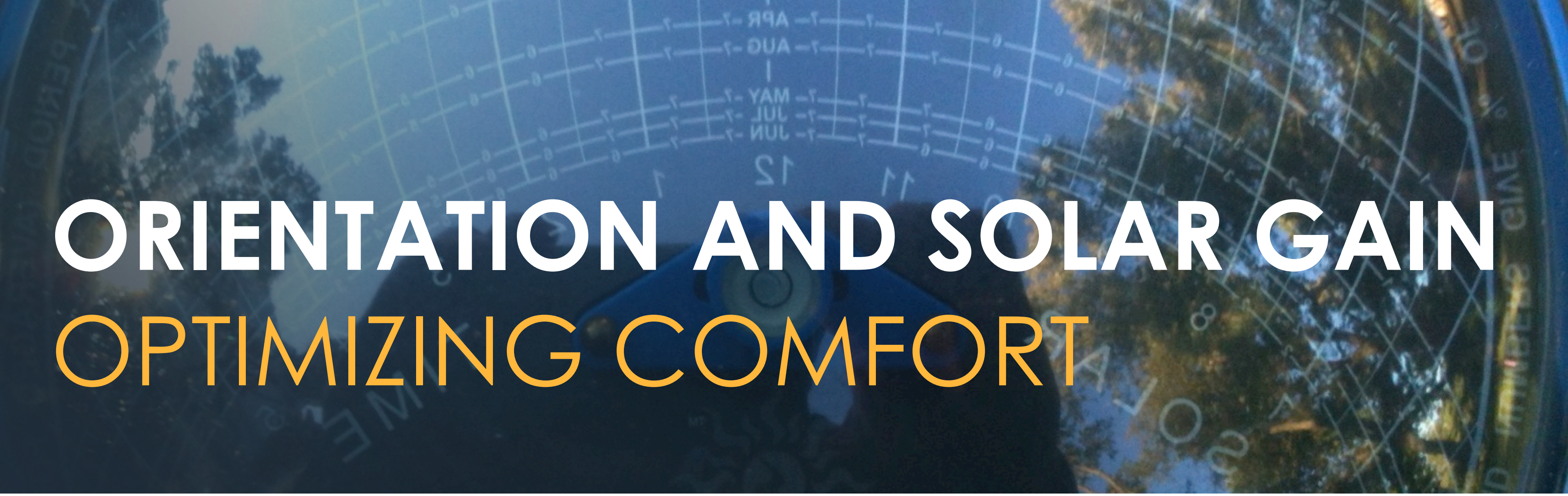
Single family 2 BR – row-home retrofit



Multi-family– retrofit

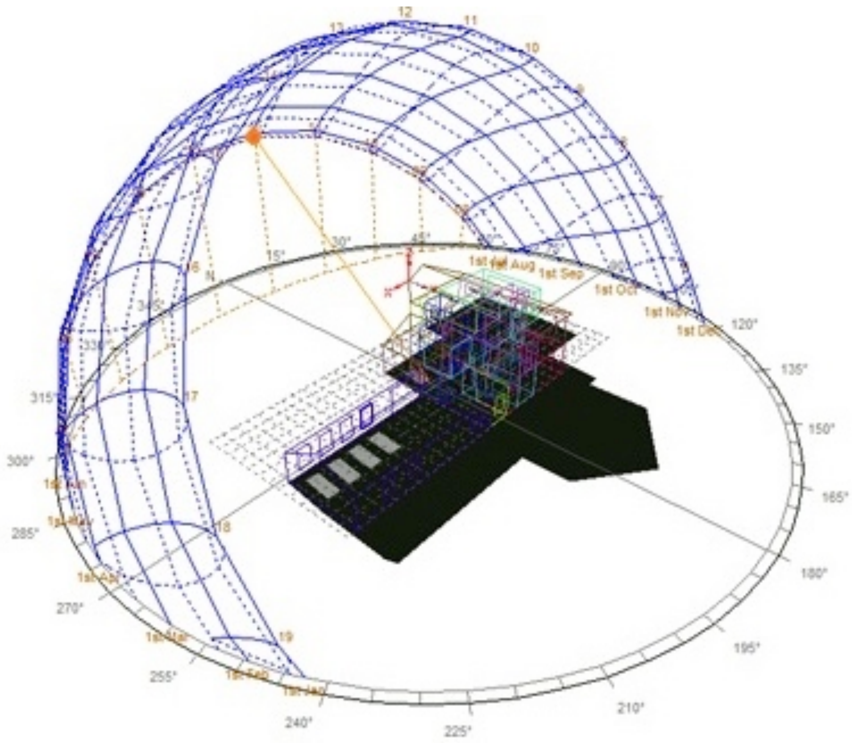
ONE WEEK POWER OUT IN DECEMBER:

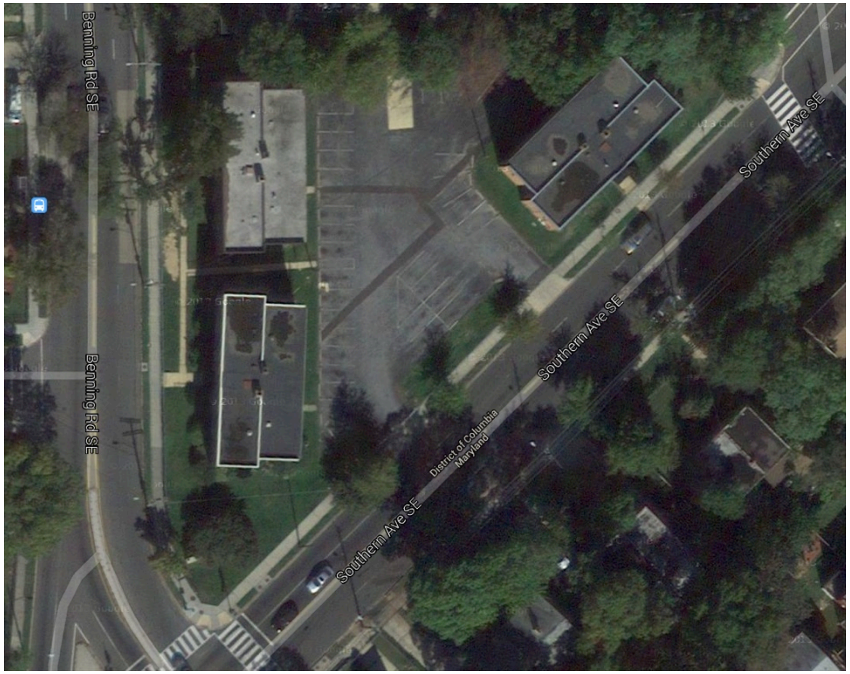
HIGH PERFORMANCE ENVELOPE MAINTAINS COMFORT AND SAFETY

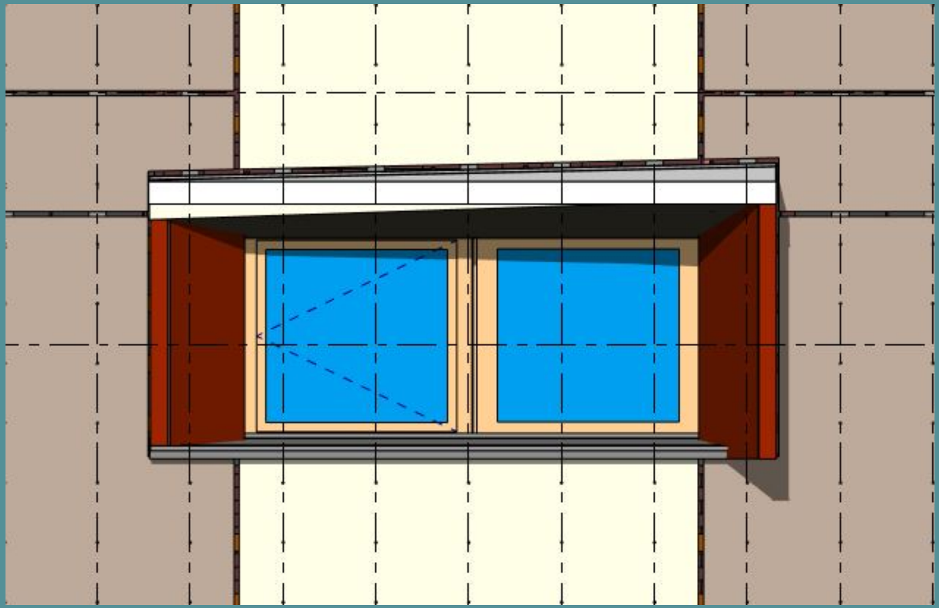


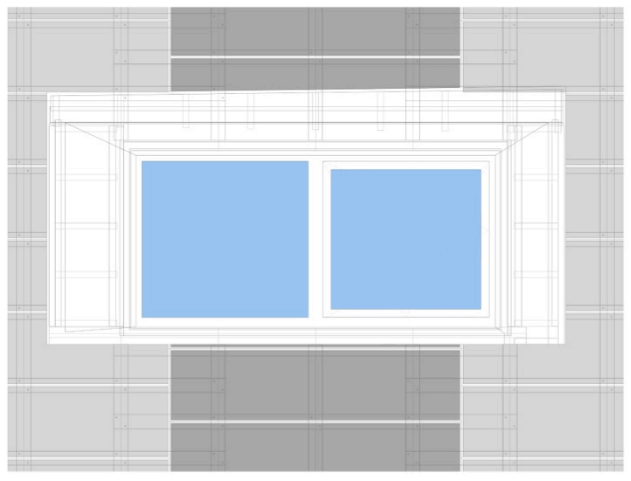
ORIENTATION AND SOLAR GAIN

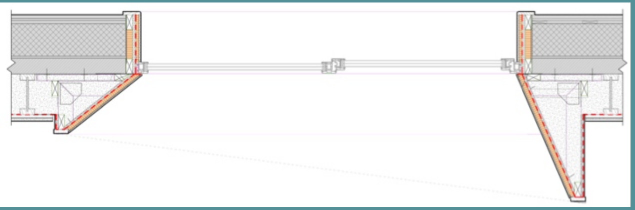
OPTIMIZING COMFORT

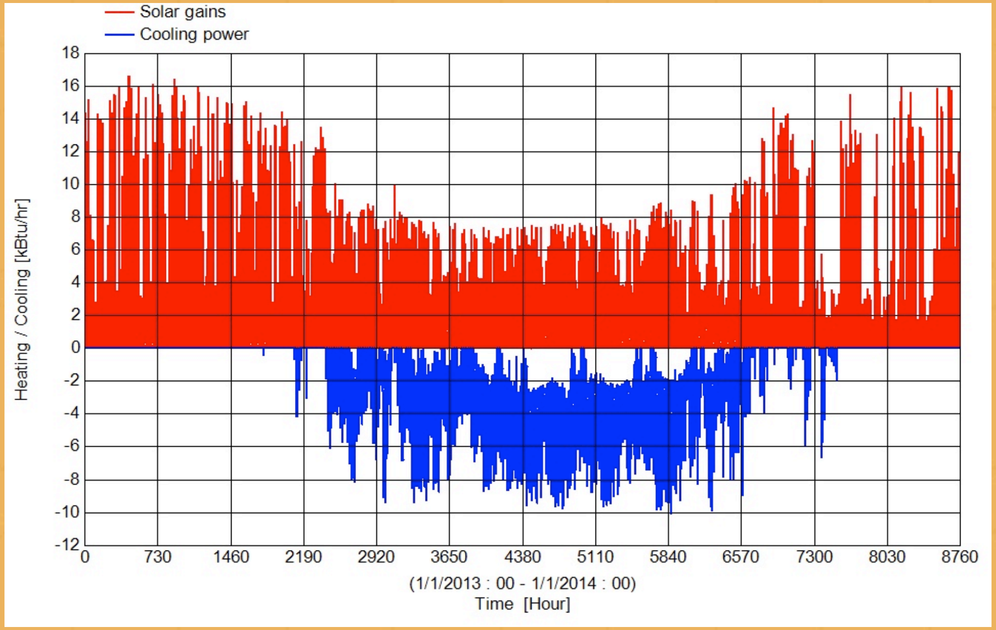




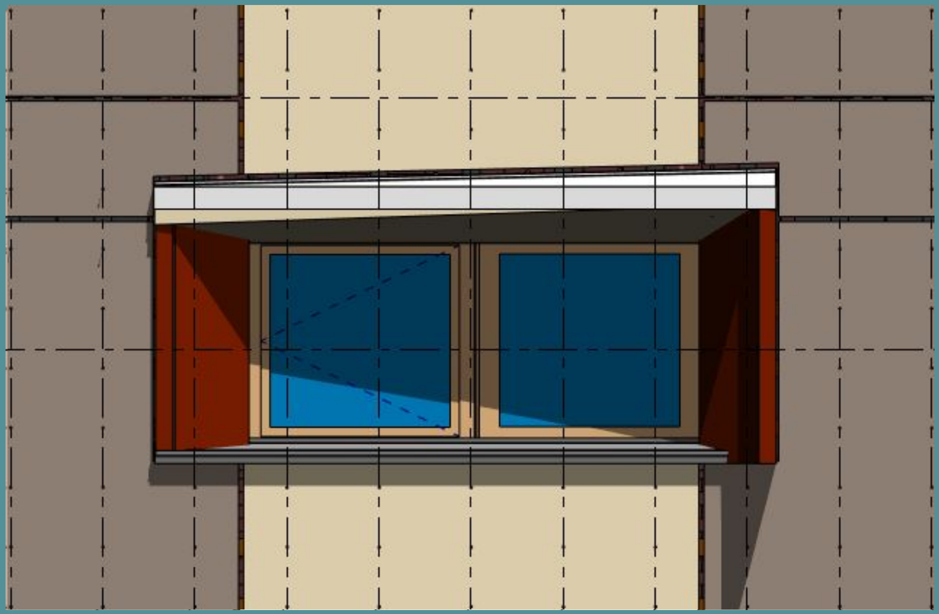


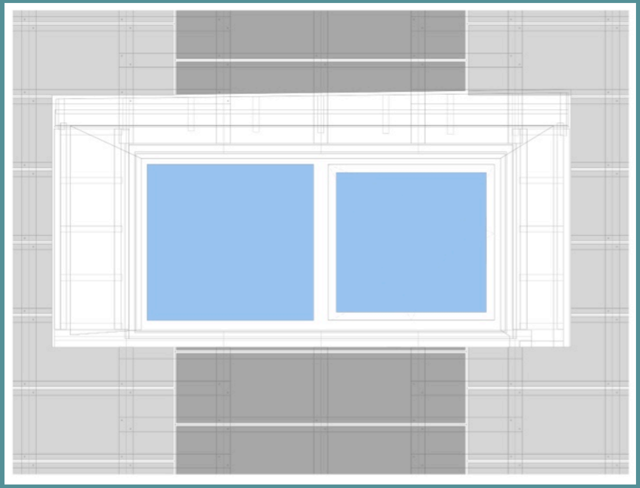


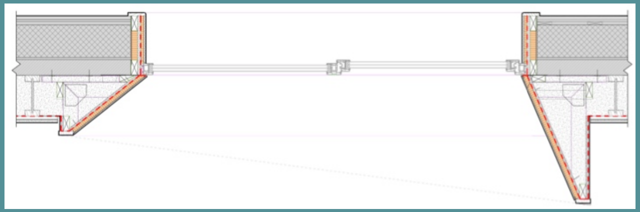


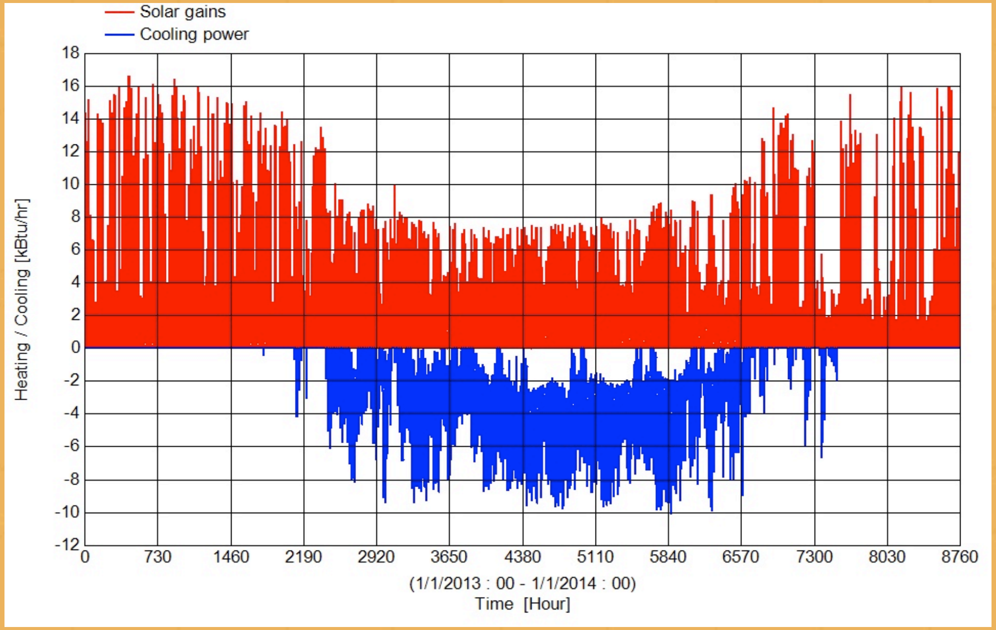


SOLAR GAIN WHEN YOU WANT IT



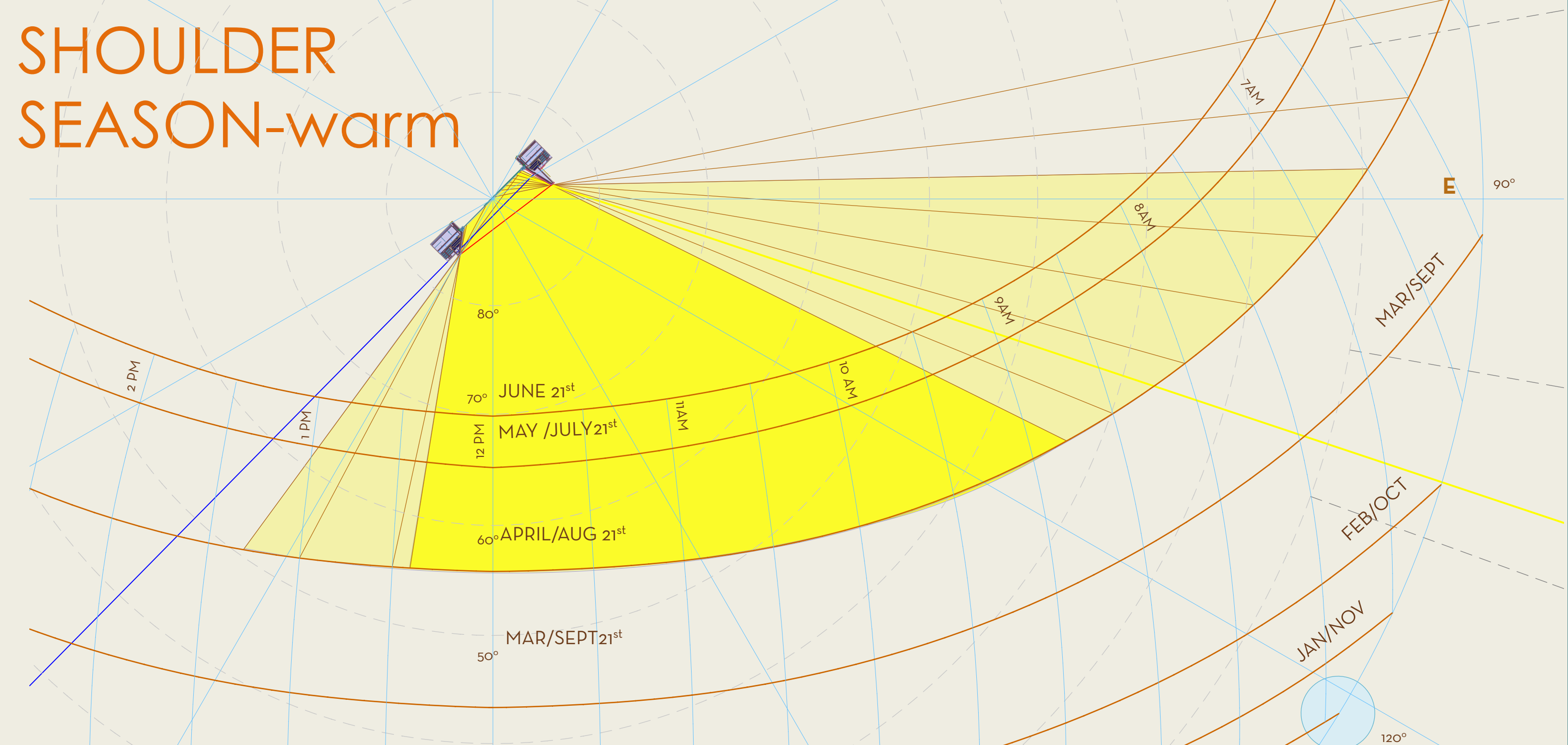




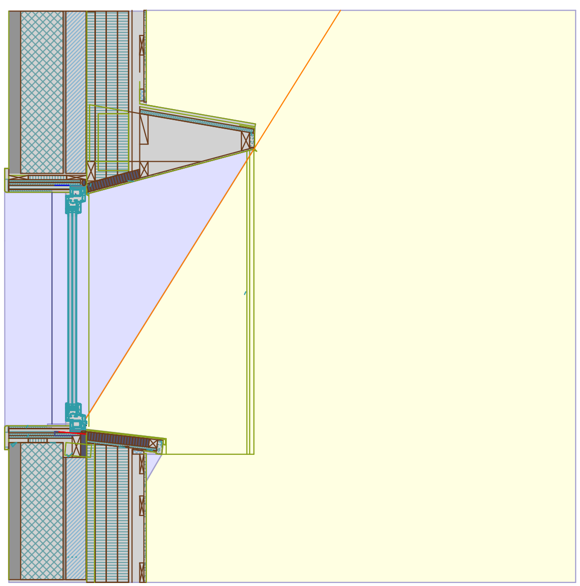


SHADING WHEN YOU DON'T

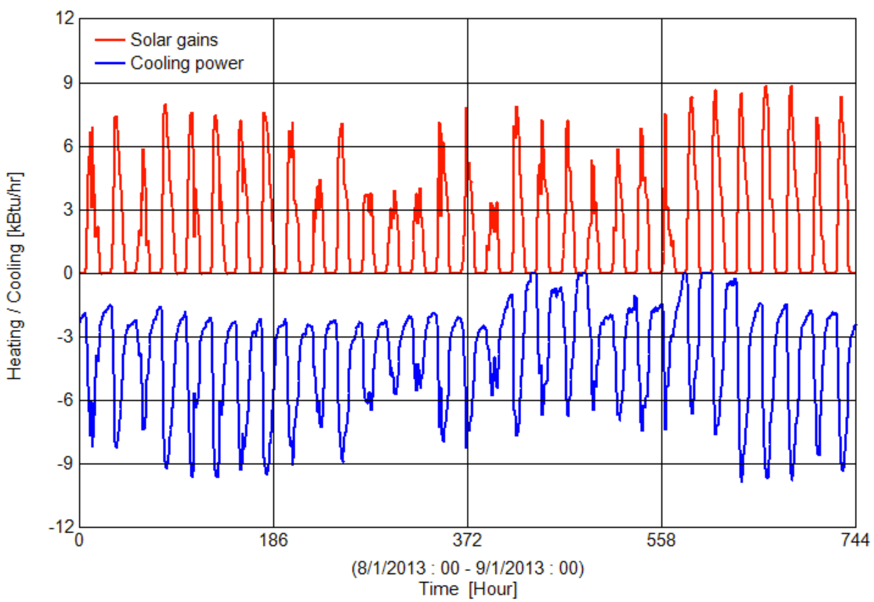

SHOULDER SEASON-warm

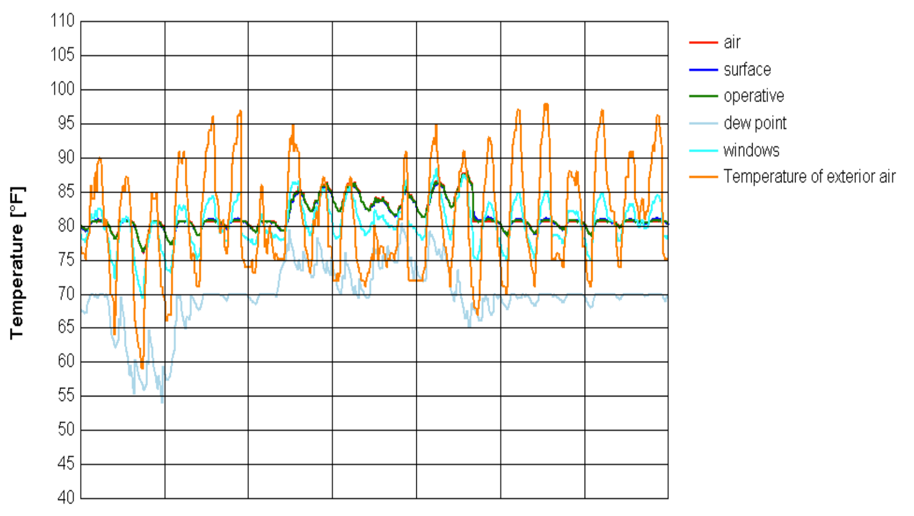


April / August



Solar Gain / cooling August





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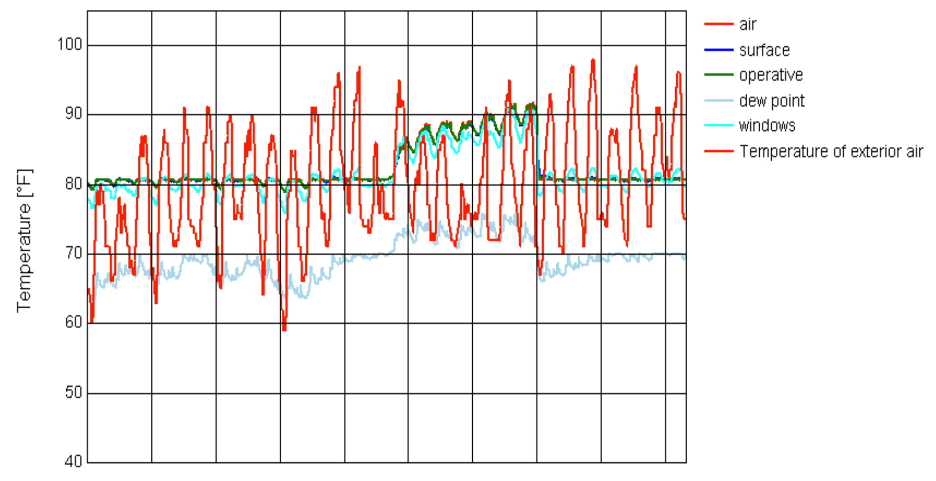
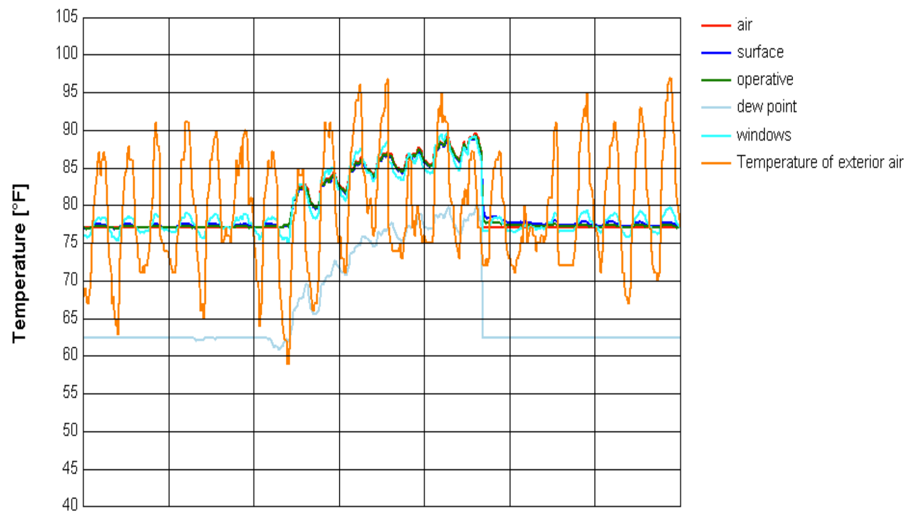


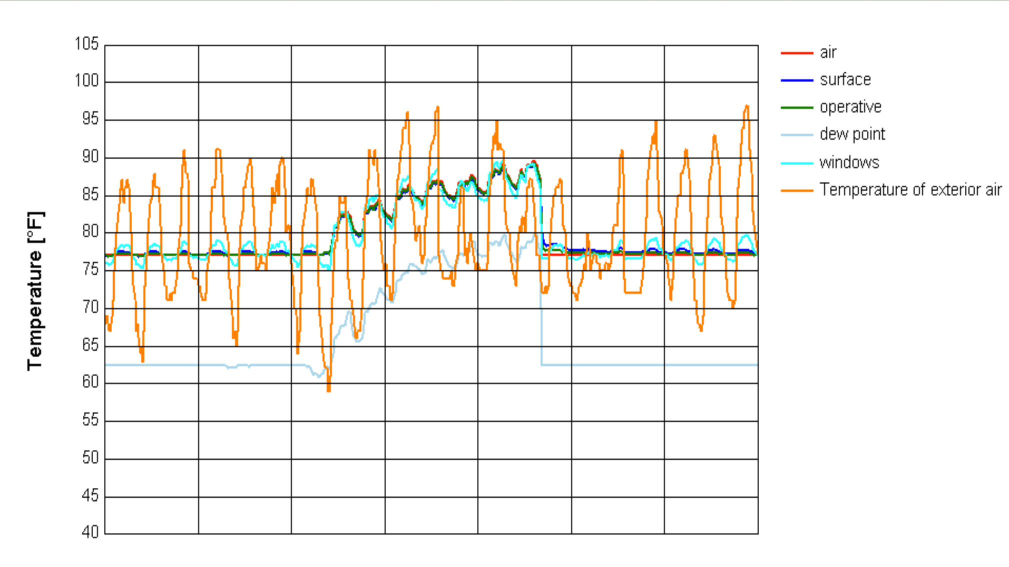
Single family 2 BR – row-home retrofit

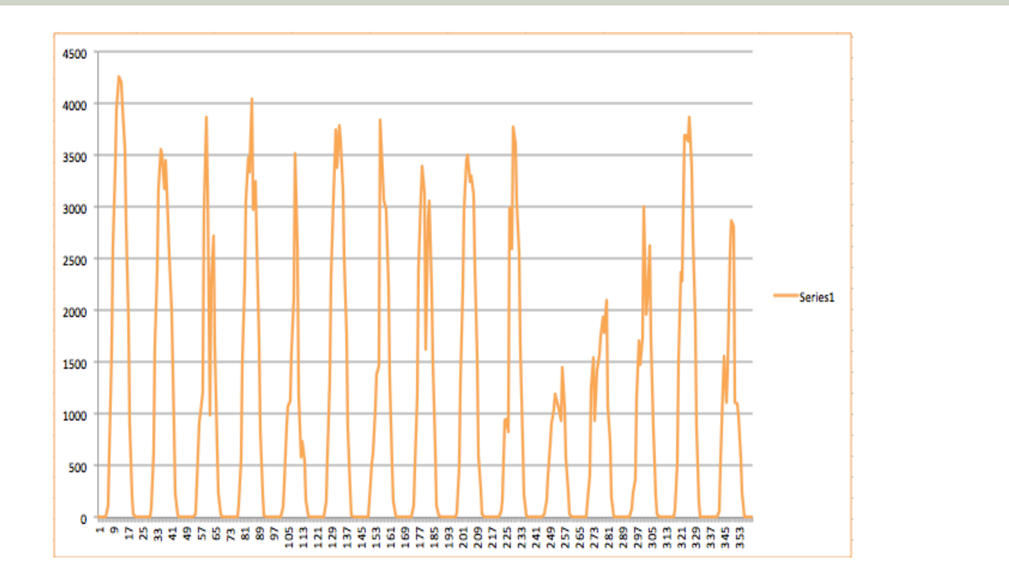


Multi-family– retrofit

ONE WEEK POWER OUTAGE IN JULY:

INTERNAL HEAT GAINS AND SOLAR GAIN DRIVE INCREASE IN TEMPERATURES



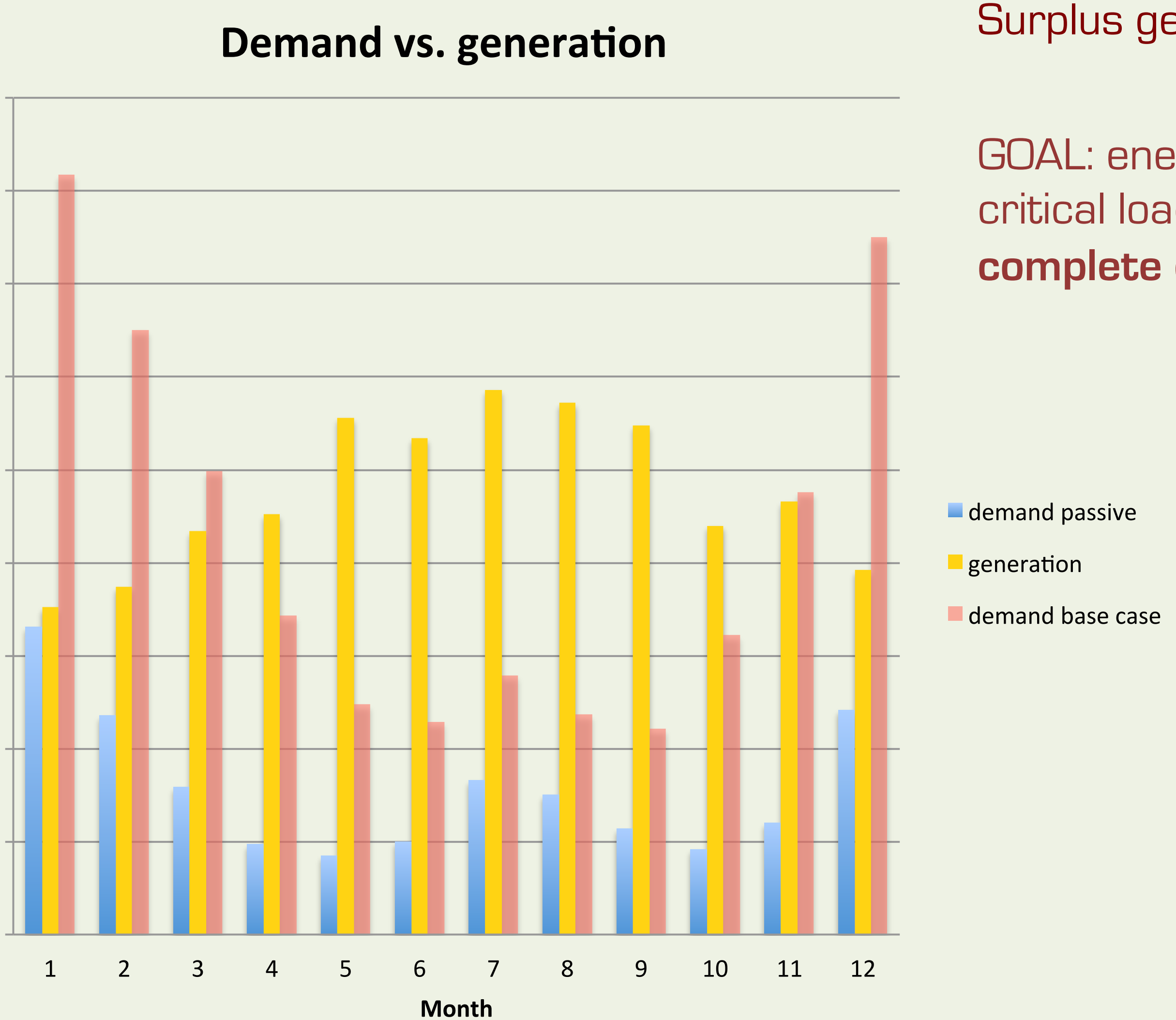


ONE WEEK POWER OUTAGE IN JULY:

BUT . . .

THAT IS WHEN WE HAVE SOLAR AVAILABLE

energy infrastructure – DEMAND vs. GENERATION



Demand vs. generation - Single occupancy units – code and passive

Meeting critical demands under peak winter conditions

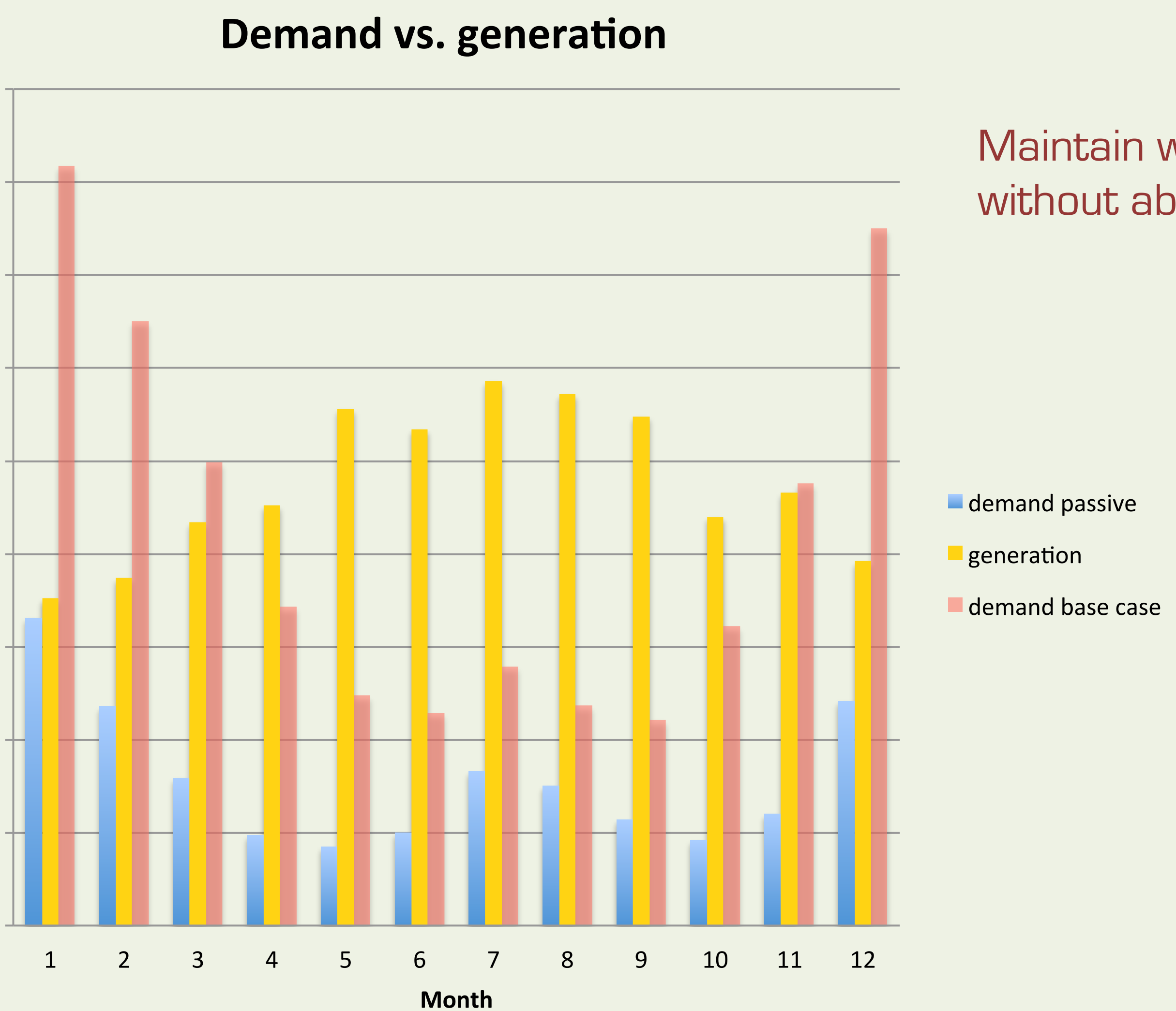
Surplus generation in summer

GOAL: energy independent for critical loads =
complete energy resiliency

BIG QUESTION!

HOW MUCH IS ENOUGH?

Maintain winter survivability with without absurd over-expenditure



Demand vs. generation - Single occupancy units – code and passive

CAVEATS

ASSUMPTIONS AND CAPABILITIES

WORK IN PROGRESS !!!

INITIAL FINDINGS BASED ON "BUILDING TYPE" MODELING AND STATIC MODELS

SUBSEQUENT MODELING WAS BASED ON MY UNDERSANDING OF INTERNAL DEMAND PROFILES FROM VARIOUS SOURCES

I DEFINE CRITICAL LOADS – YOU MAY NOT AGREE

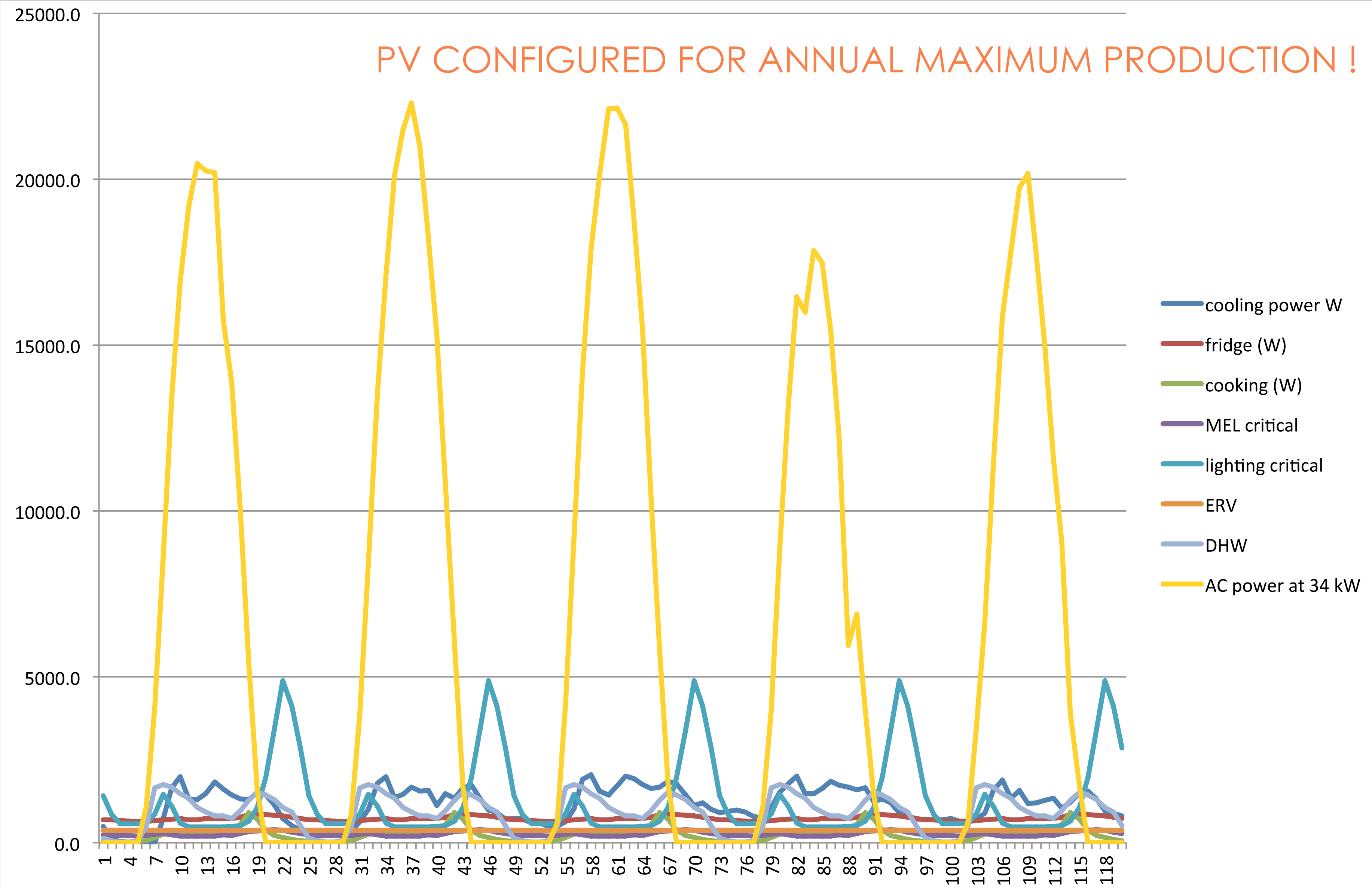
I COULD BE DEAD WRONG

PROCESS

MODELING "PROTOCOLS" (?)

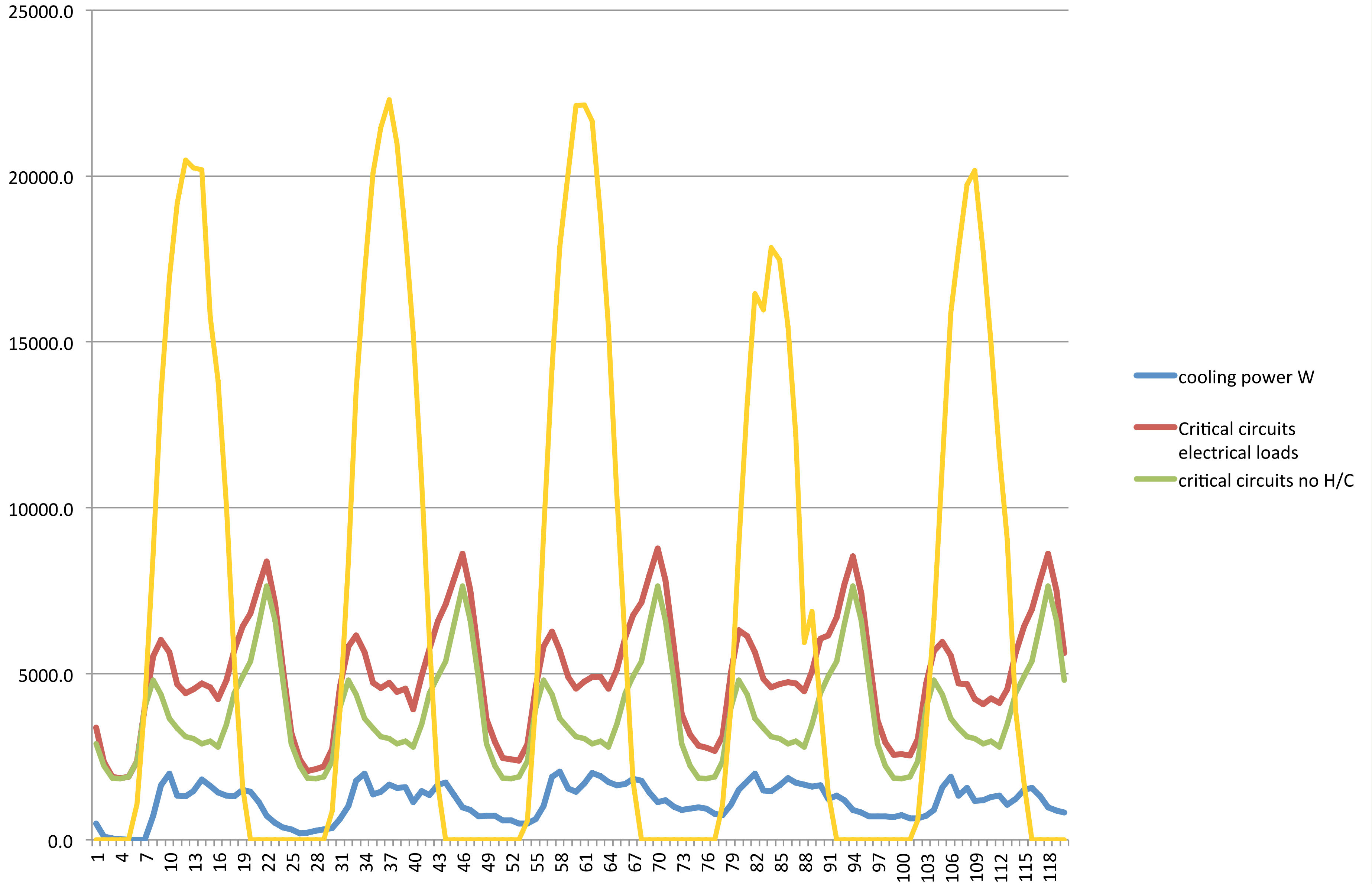
INTERNAL LOAD ASSUMPTIONS BASED ON A COMBINATION OF

- BUILDING AMERICA NCTH MODELING PROTOCOL (BASED ON OBSERVED DATA)
- PHIUS+2015 CALCULATOR
- MY OWN DEFINITION OF CTITICAL SURVIVABILITY
- HOURLY MODELING BASED ON **WUFI PASSIVE DYNAMIC** AND MONTHLY FACTORS AND HOURLY FACTORS FROM **BUILDING AMERICA NCTH** PROTOCOLS



POWER OUTAGE IN JULY:

GENERATION PLOTTED AGAINSTCITICAL LOAD DEMAND CURVES



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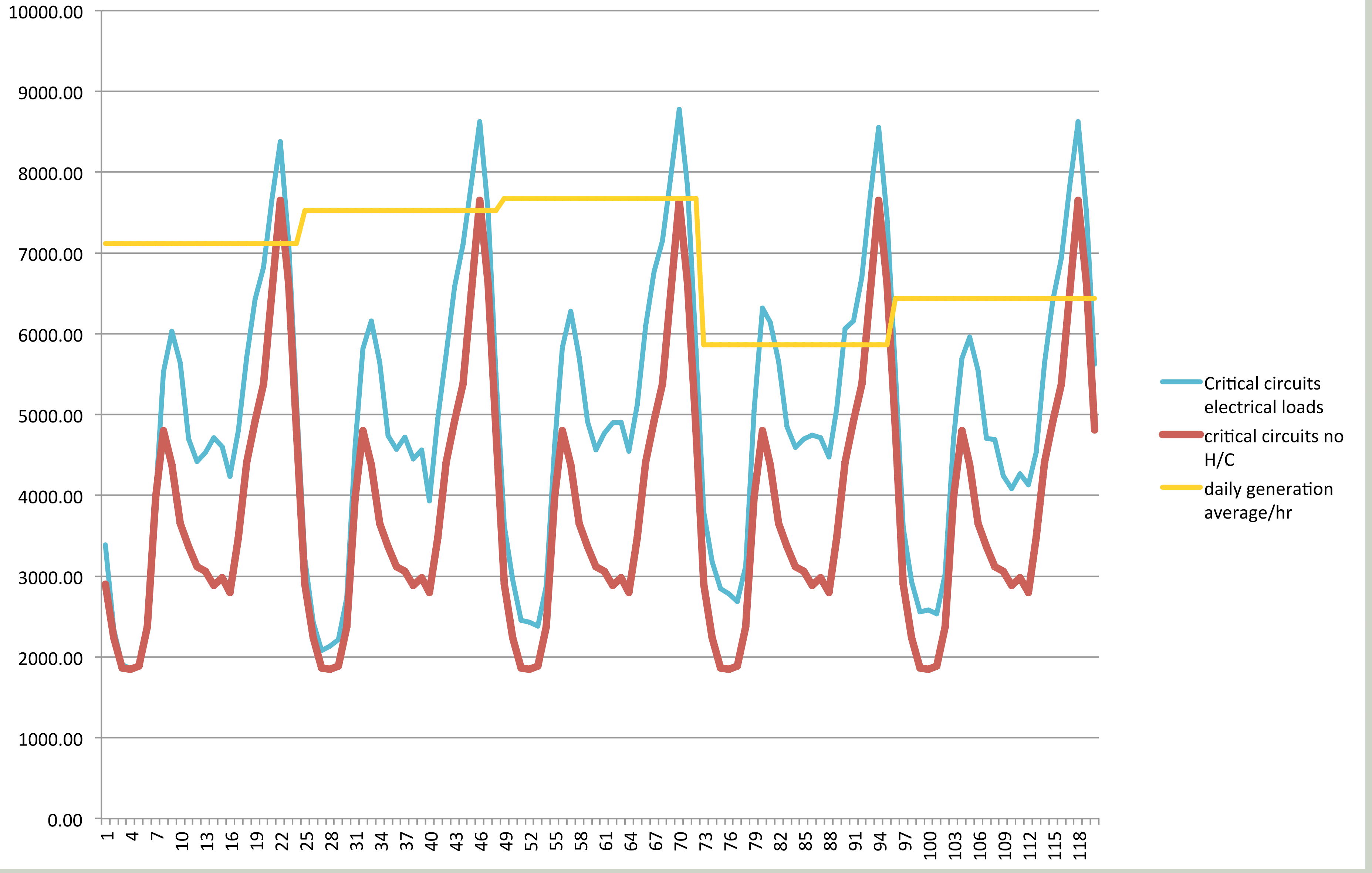
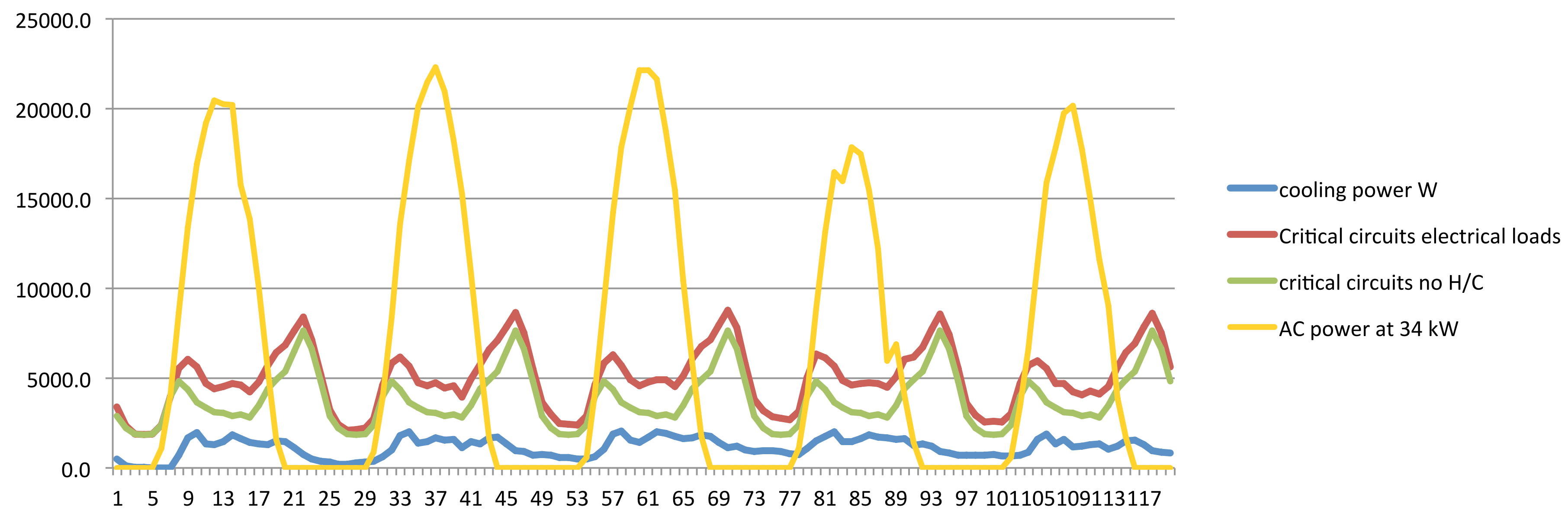
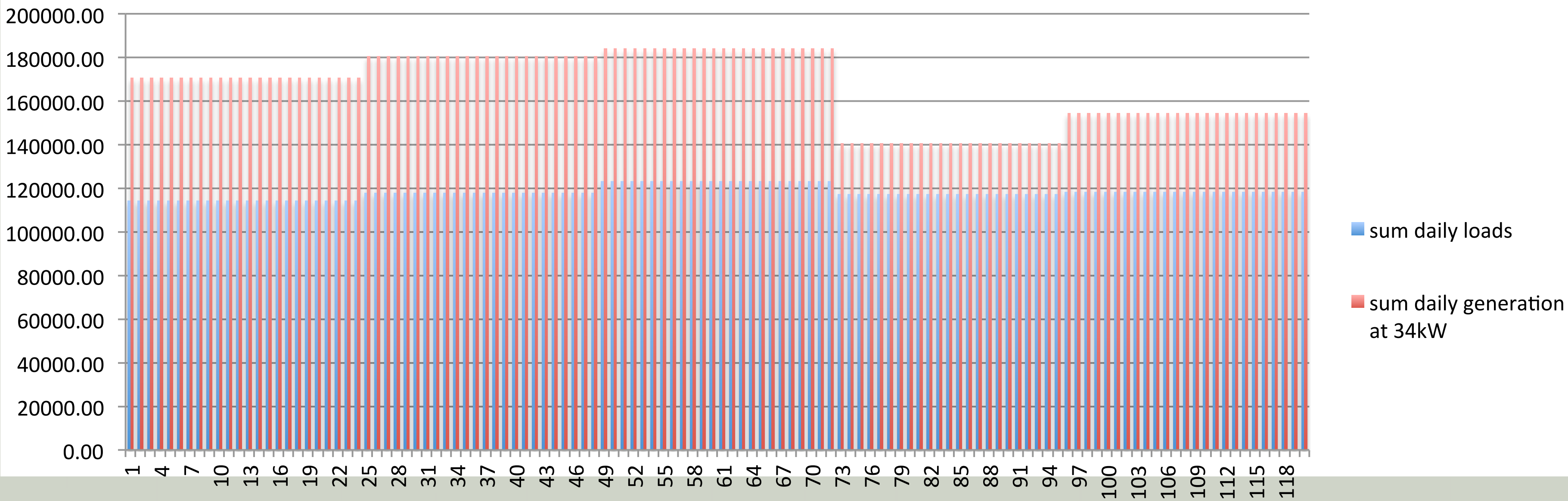


POWER OUTAGE IN JULY:

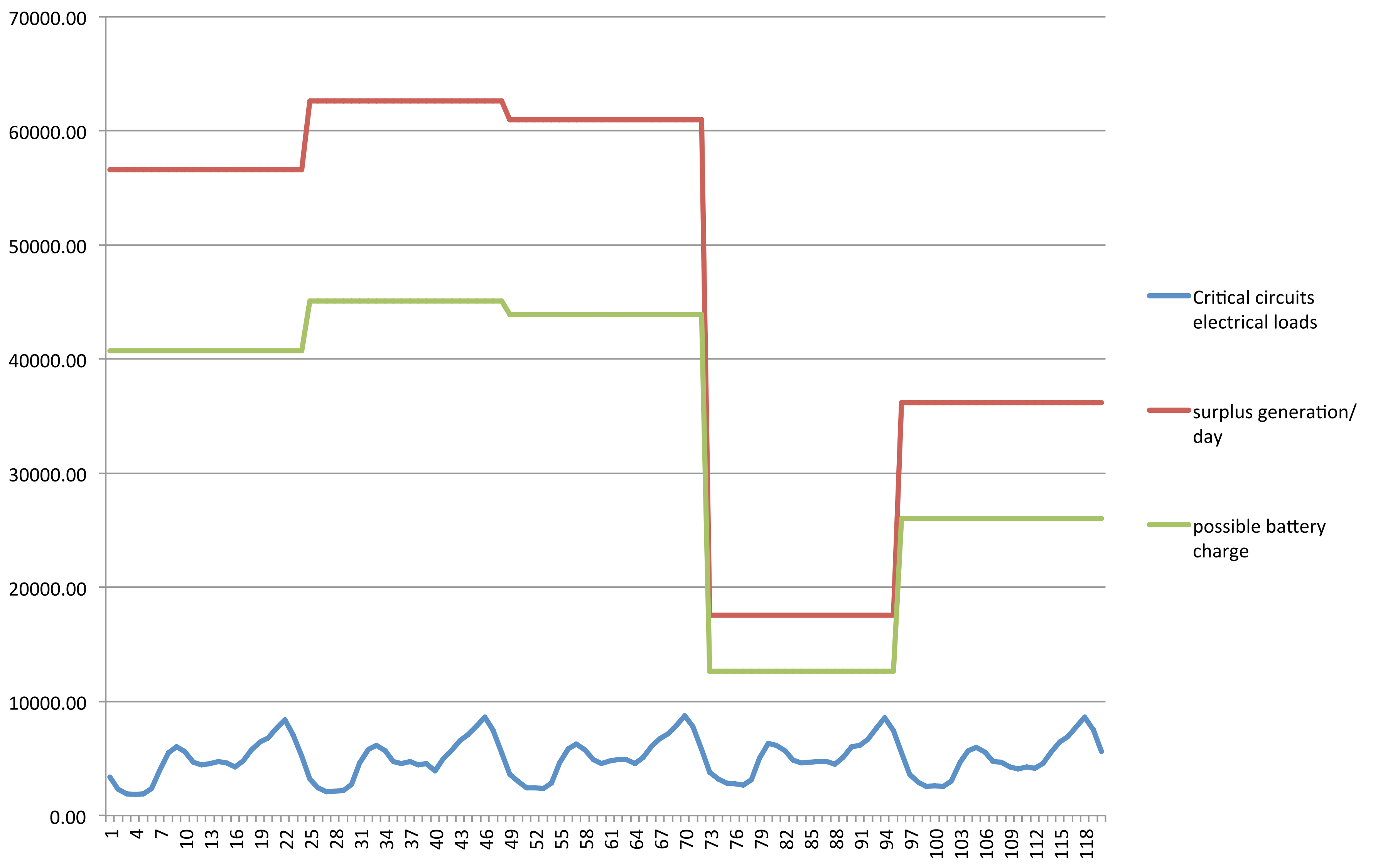
GENERATION AVERAGE VS. DEMAND





POWER OUTAGE IN JULY:

GENERATION EXCEEDS DEMAND



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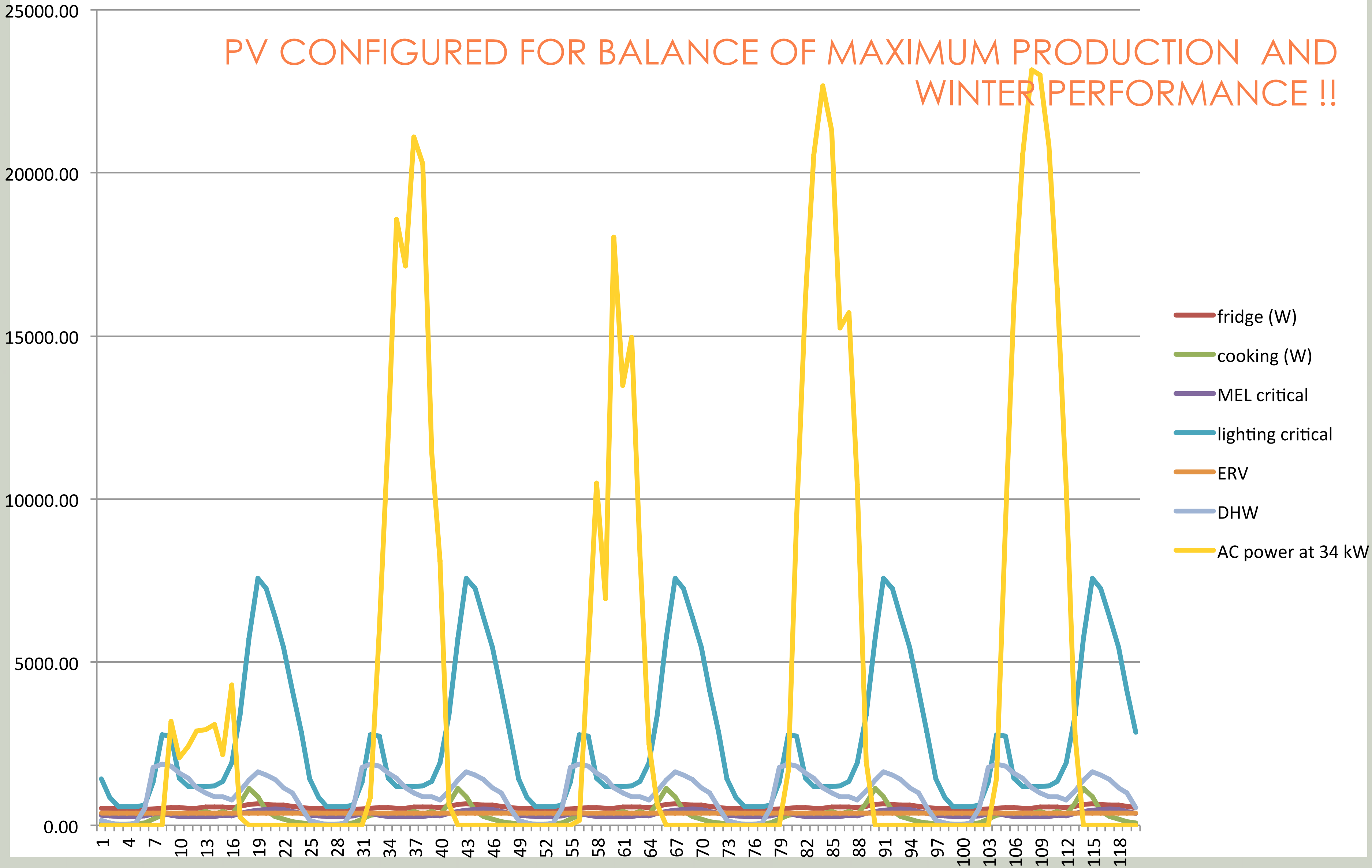
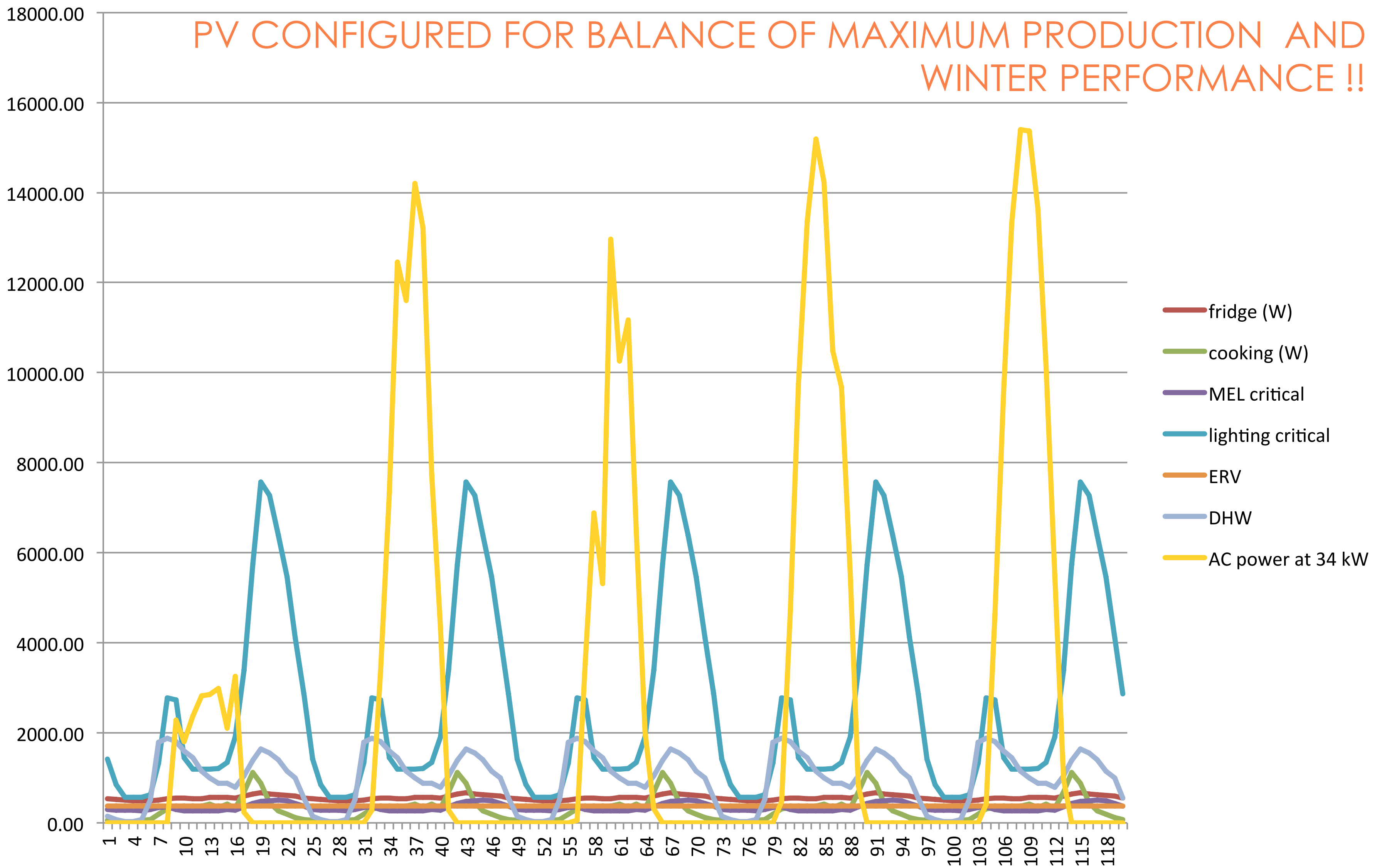


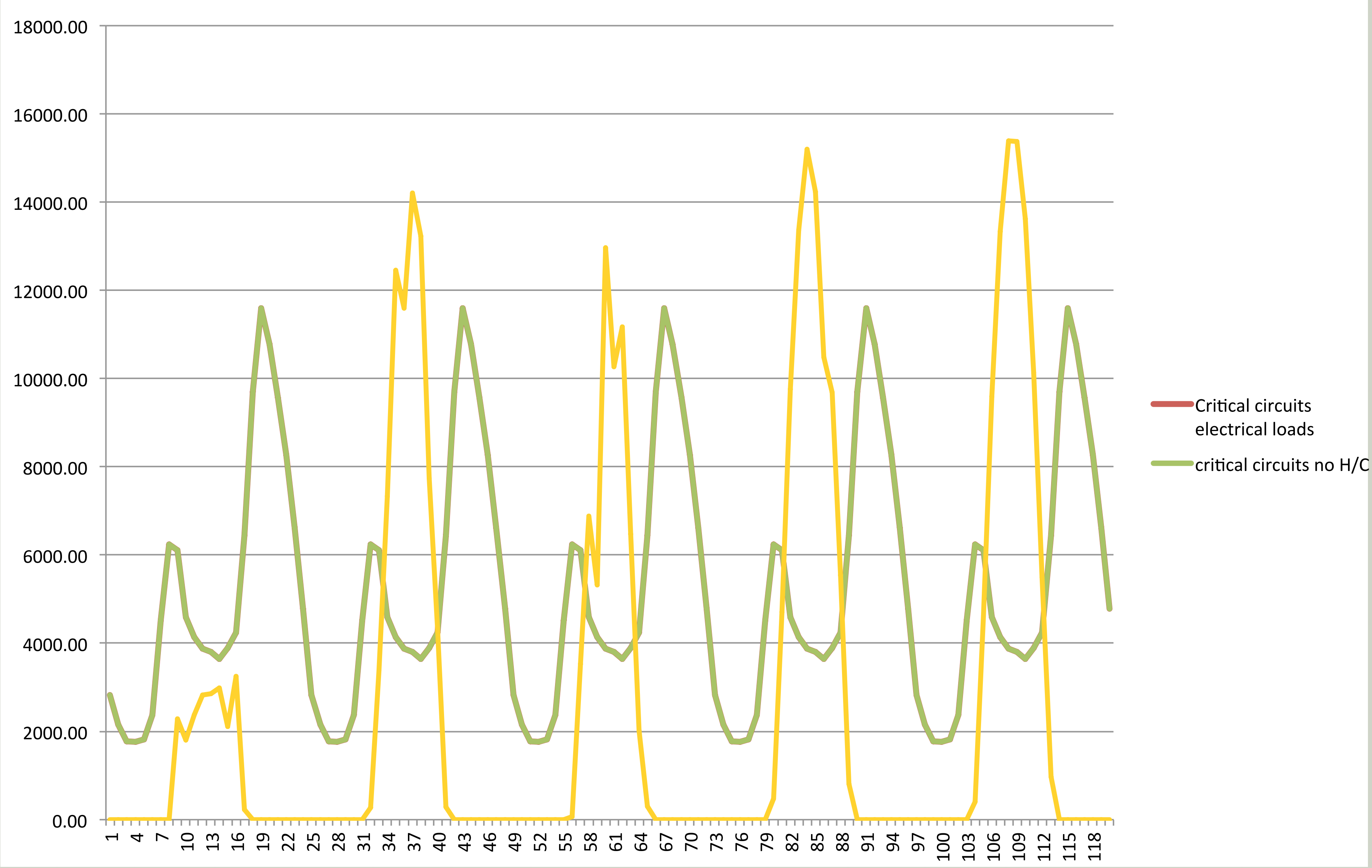
POWER OUTAGE IN DECEMBER:

GENERATION VS. DEMAND AT 30DEGRE TILT



POWER OUTAGE IN DECEMBER:

GENERATION VS. DEMAND



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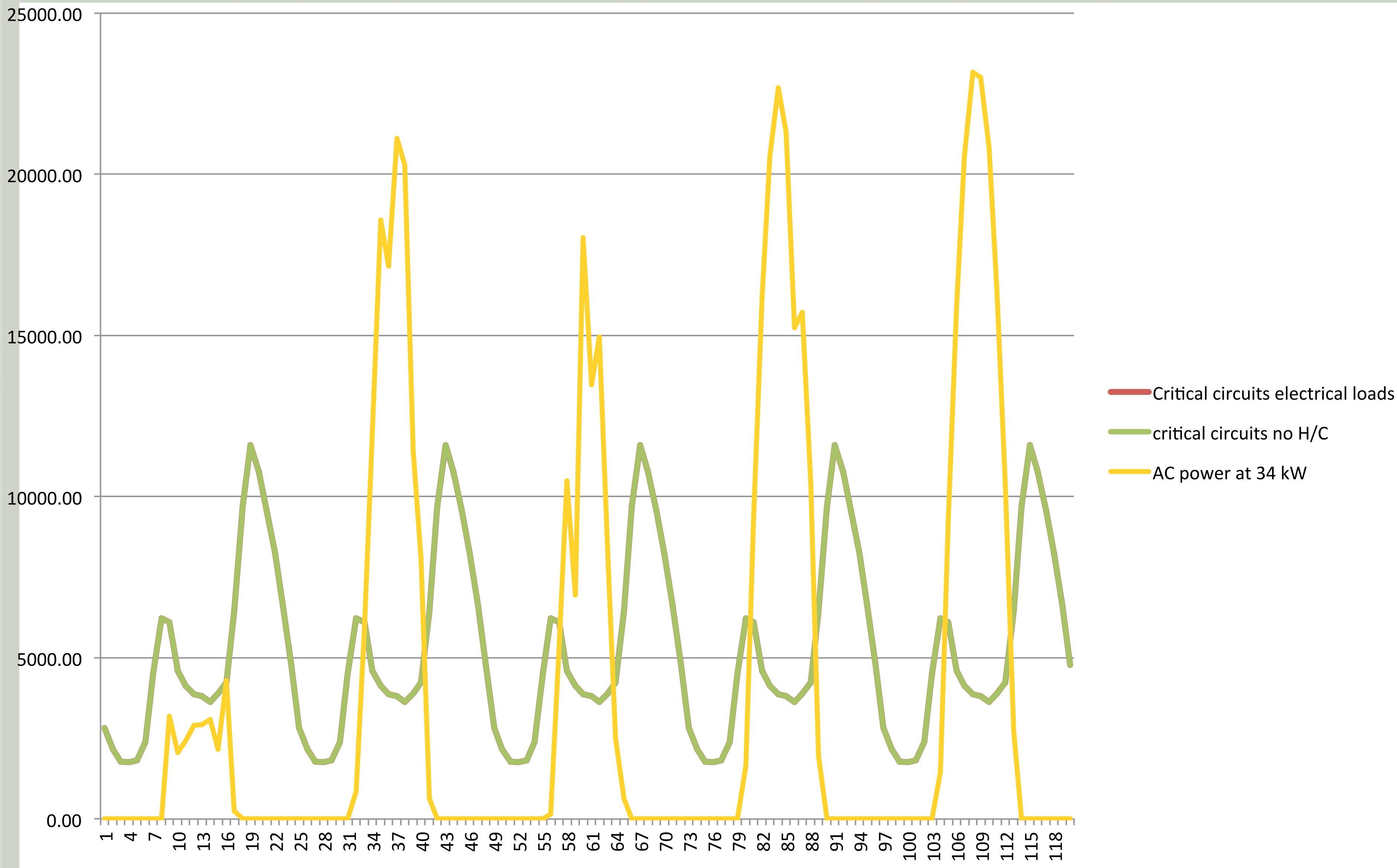

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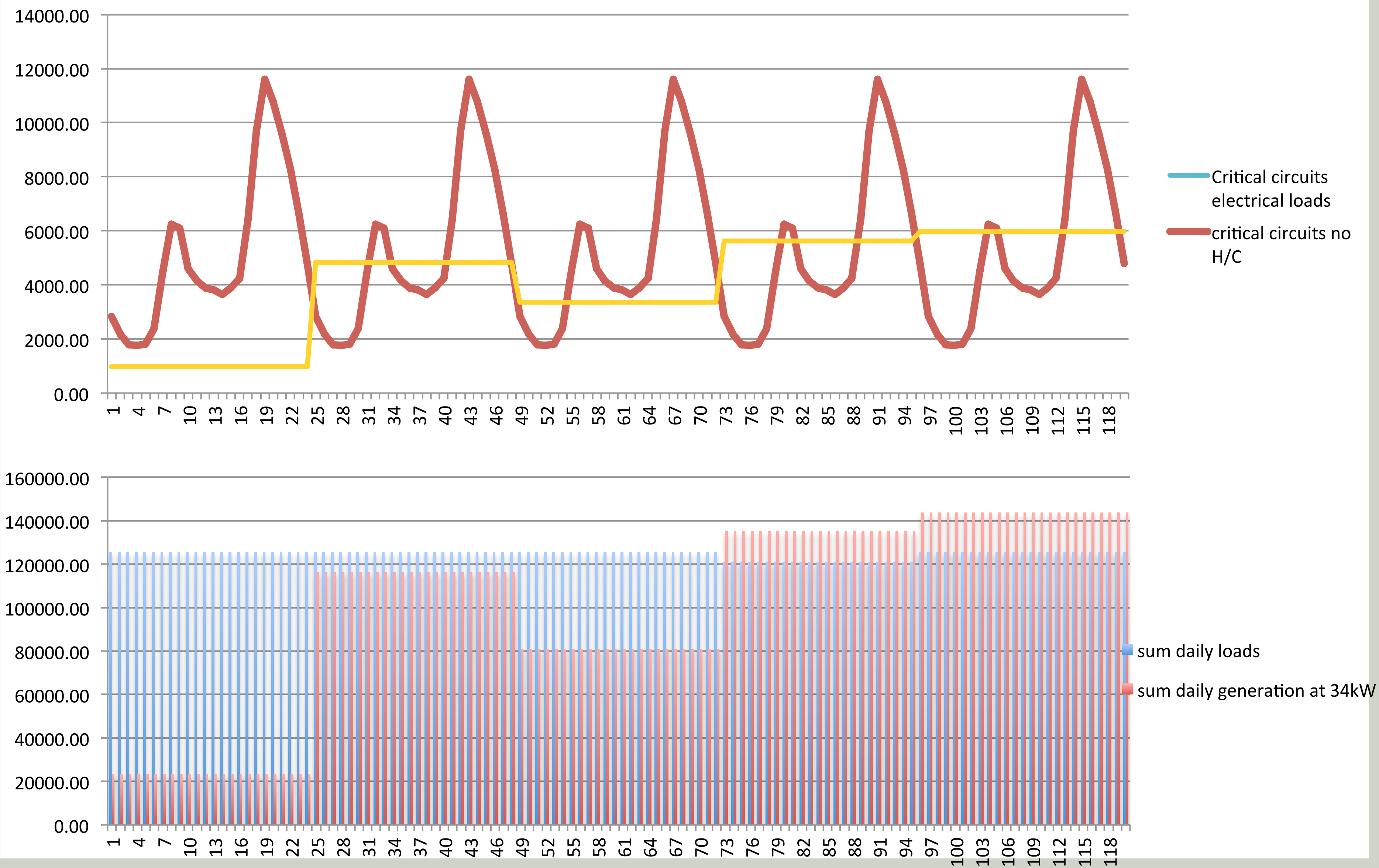
GENERATION VS. DEMAND AT 30DEGRE TILT



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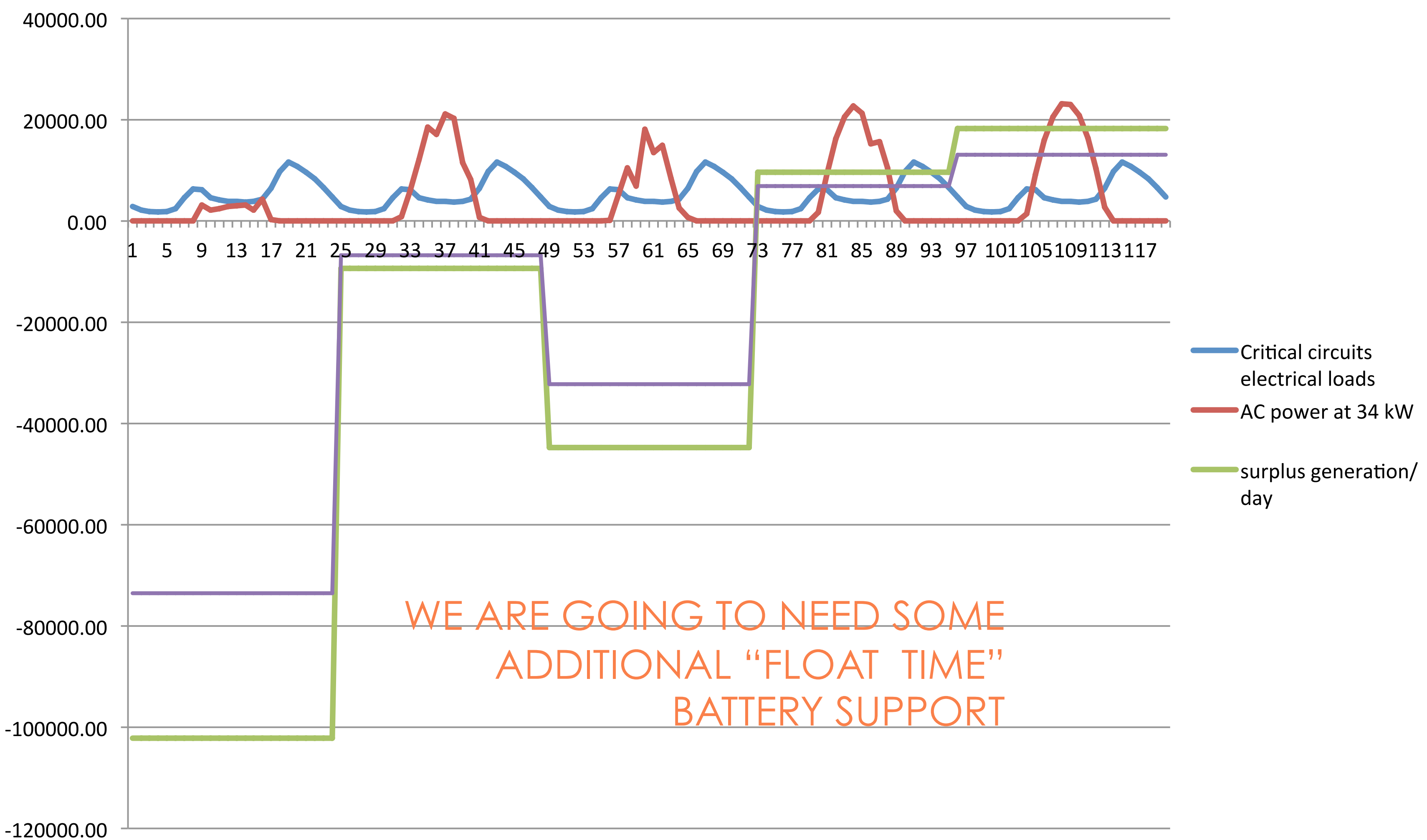
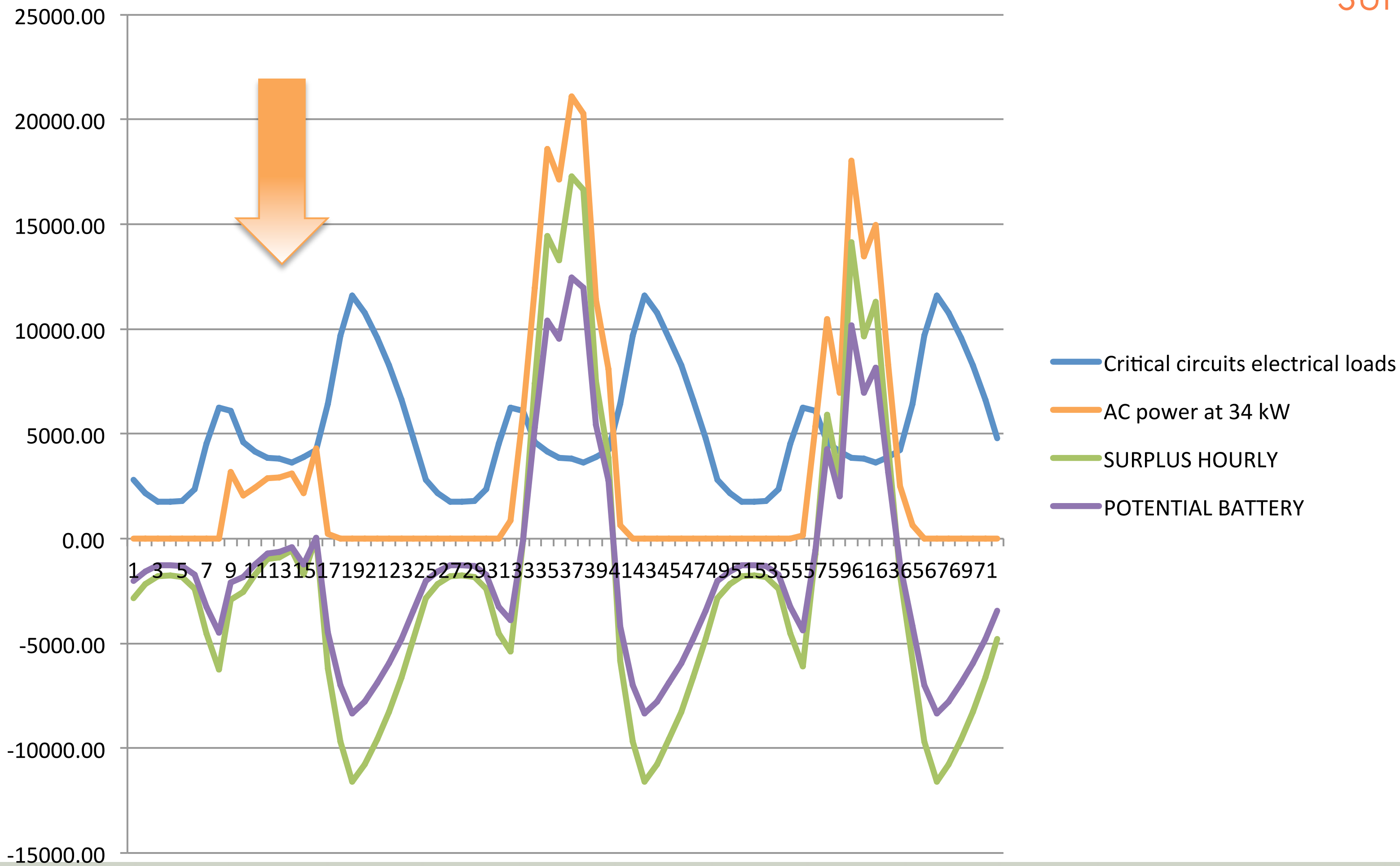
GENERATION VS. DEMAND AT 30DEGRE TILT



POWER OUTAGE IN DECEMBER:

GENERATION VS. DEMAND AT 30DEGRE TILT

WE ARE GOING TO NEED SOME ADDITIONAL "FLOAT TIME" BATTERY SUPPORT



POWER OUTAGE IN DECEMBER:

GENERATION VS. DEMAND AT 30DEGRE TILT

COST EFFECTIVENESS

OPTIMIZE FOR ANNUAL GENERATION

DON'T SPEND ANY MORE THAN YOU HAVE TO AND STAY WITHIN LOCAL NET METERING RULES

SURVIVABILITY

OPTIMIZE FOR WINTER OUTAGE

LEAN TOWARDS PV OPTIMIZATION FOR WINTER GAIN (?)

DEFINE AND GOVERN CRITICAL LOADS

LOSE THE SURPLUS ASSET (?)

MICRO-GRID AND STORAGE

(STILL A SURPLUS PROBLEM ABSENT SEASONAL STORAGE)

COST EFFECTIVENESS

OPTIMIZE FOR ANNUAL GENERATION

SURVIVABILITY

OPTIMIZE FOR WINTER OUTAGE

WHAT IF WE COULD USE OUR ENERGY ASSETS YEAR ROUND TO PAY FOR RESILIENCY FOR WINTER??

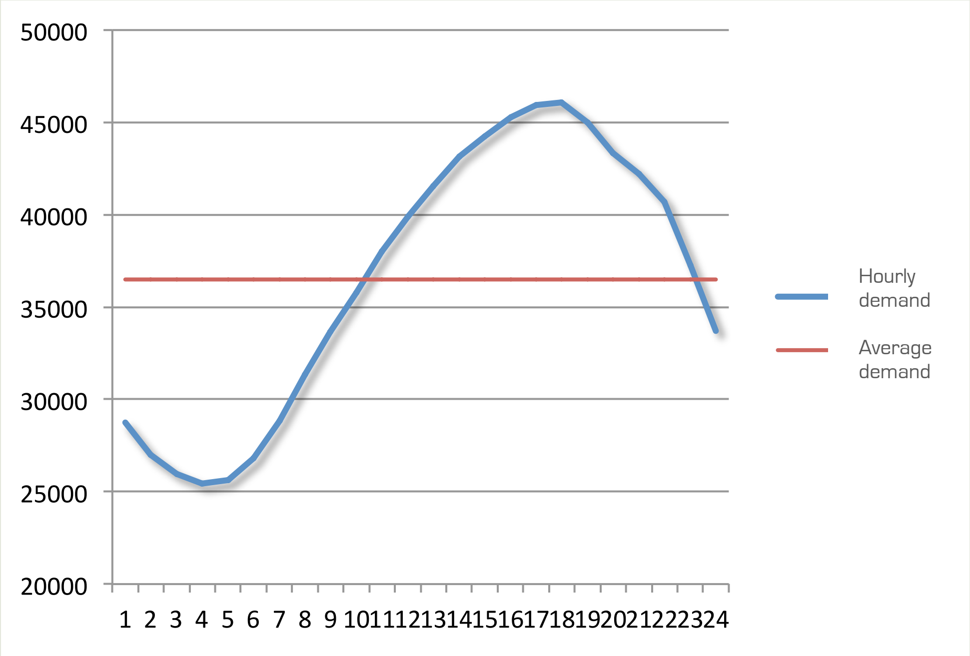
PEAK DEMAND

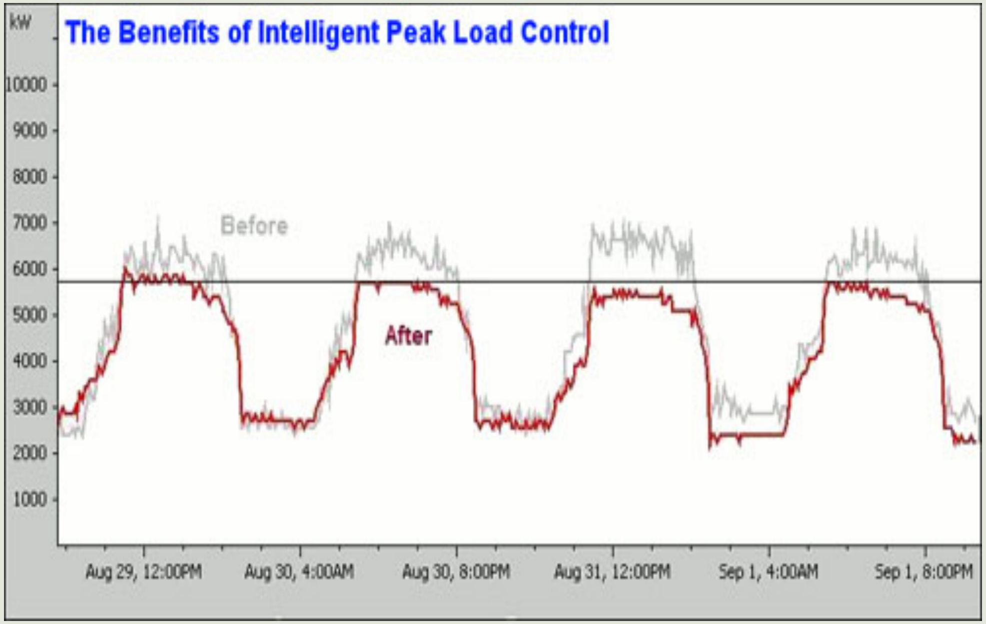
IS THIS THE BEST WE CAN DO?

INCREMENTALISM WILL SAVE THE UTILITIES PEAK DEMAND COST . . .

BUT WILL DO NOTHING FOR CLIMATE CHANGE!

THERE IS SERIOUS VALUE HERE FOR THE ULTILITIES

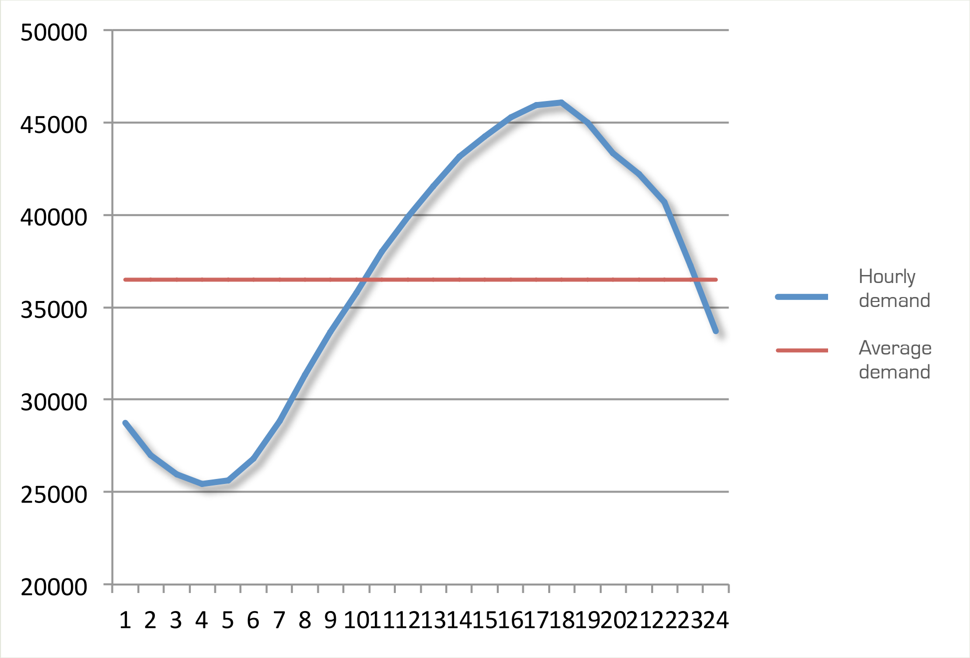


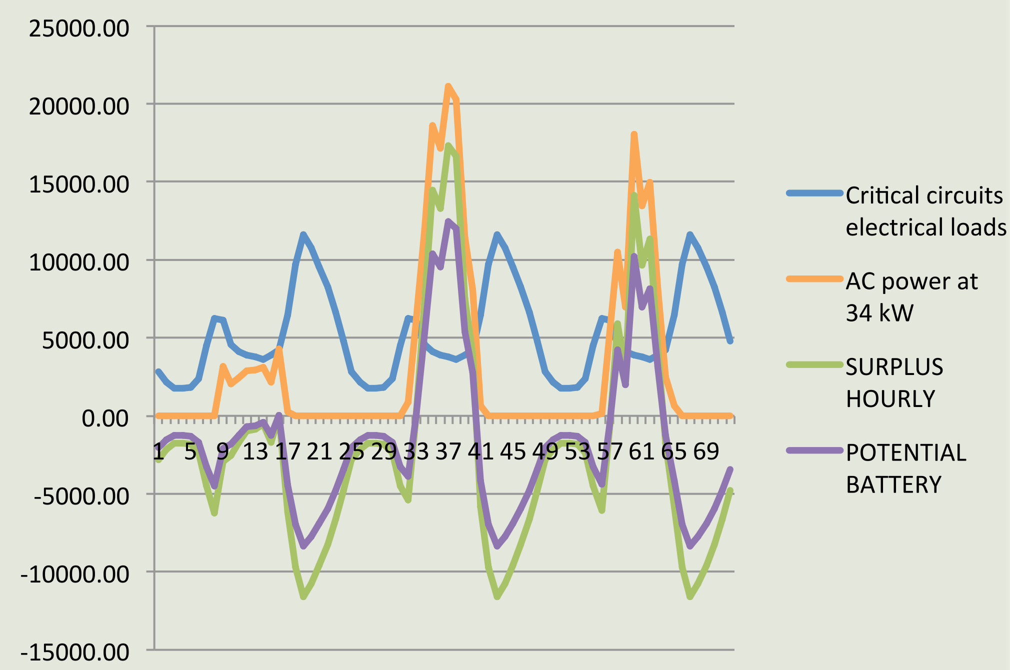


PEAK DEMAND

SHAVING AND SHIFTING WITH PASSIVE DESIGN

Good for everyone!!

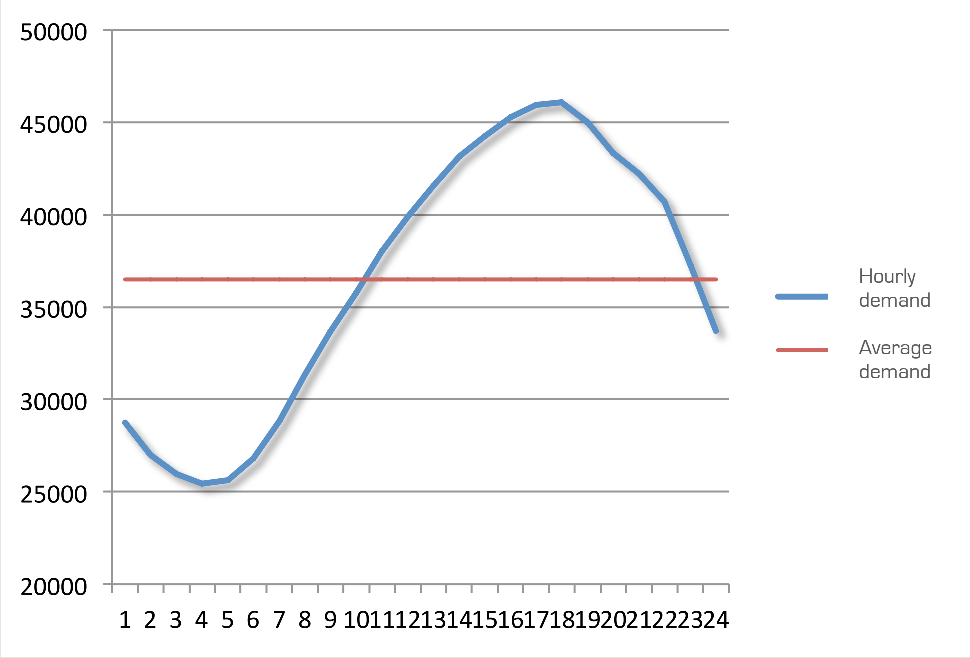


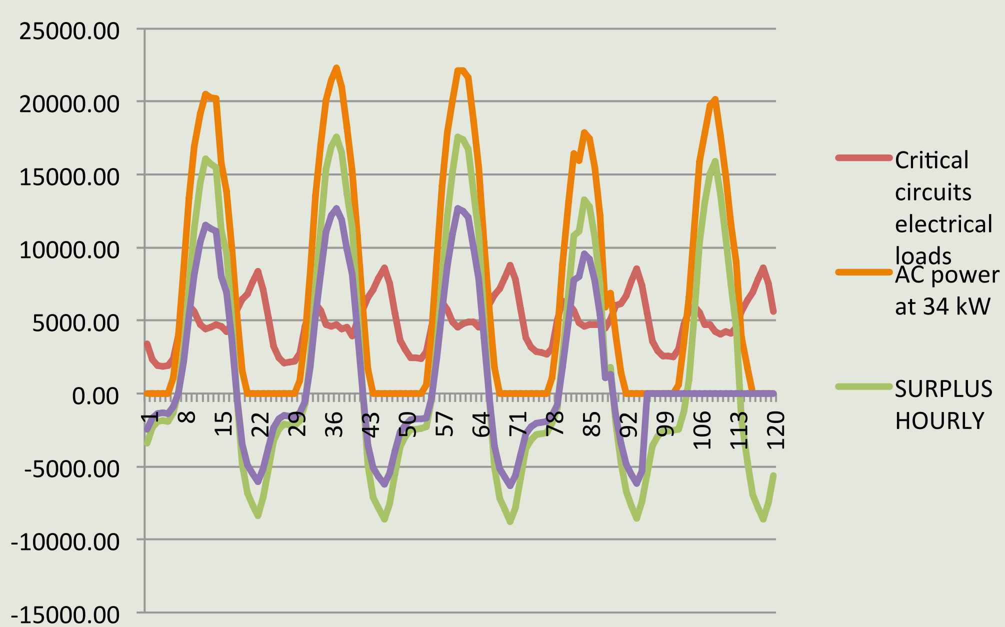


PEAK DEMAND

SHAVING AND SHIFTING WITH PASSIVE DESIGN

Good for everyone!!

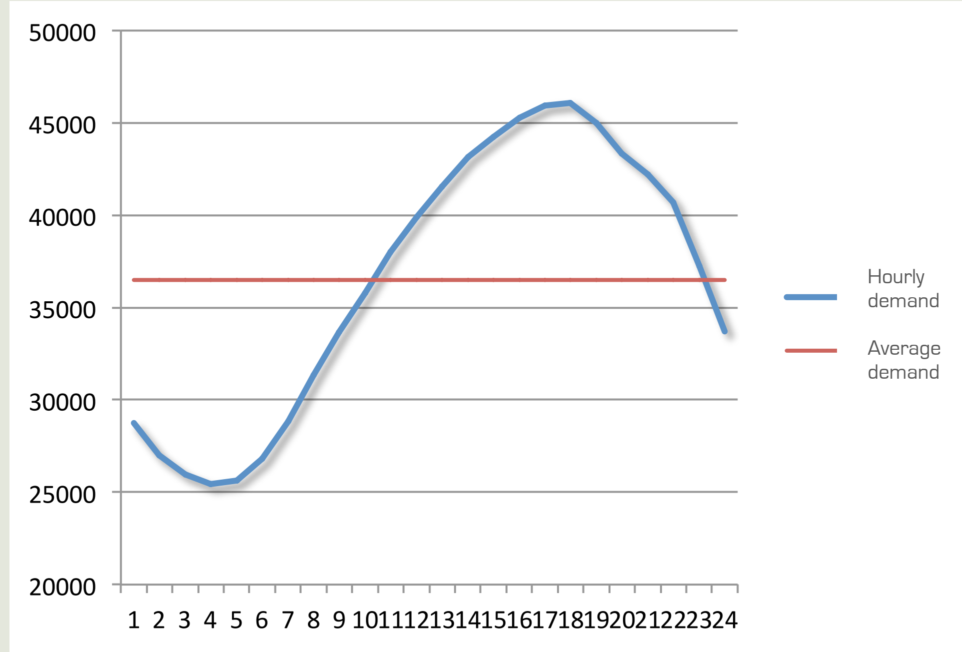




PEAK DEMAND

SHAVING AND SHIFTING WITH PASSIVE DESIGN

GETTING CREATIVE WITH GENERATION, THERMAL STORAGE, BATTERY STORAGE . . . ETC.



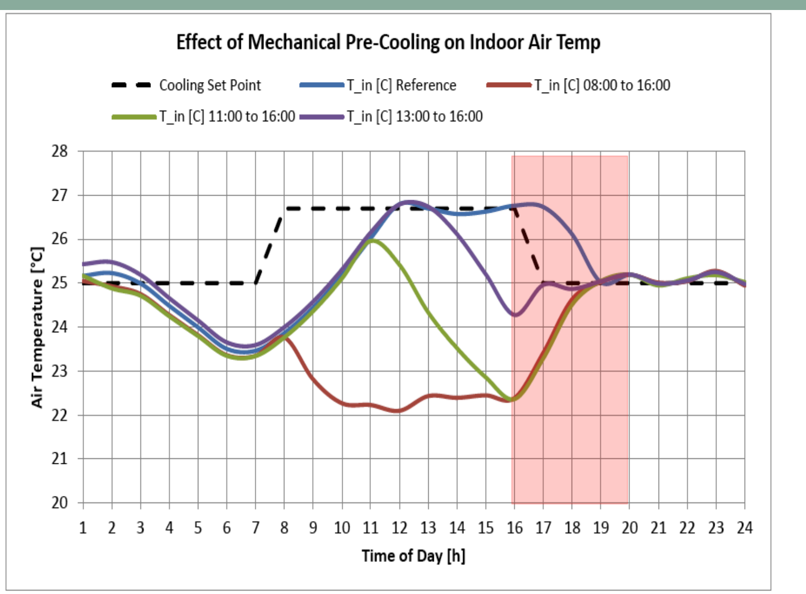
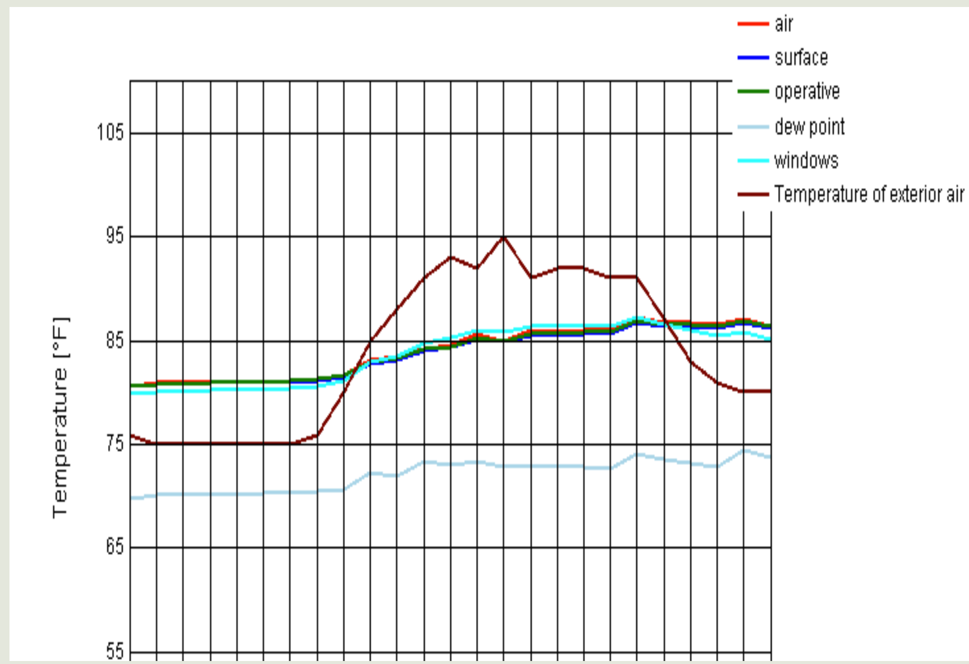


Figure 3: Effect on indoor air temperature of changing the cooling set points at different times to produce pre-cooling. 22.2°C or 72°F set point used, climate zone 3B – El Paso, TX. The dashed line shows the standard (no pre-cooling) cooling set point temperatures throughout the day. The red box indicates the peak period.



CONCLUSIONS

GETTING WARMER

PASSIVE HOUSE IS FOUNDATIONAL TO RESILIENCE, BUT SHOULD NOT DEFINE OUR LIMITS

INTERNAL GAIN AND LOADS MUST BE QUANTIFIED BETTER

RELYING ON INCENTIVES MAY LEAD US TO NEGLECT THE MARKET FORCES

PH, PV AND THE UTILITIES SHOULD BE ON THE SAME TEAM

STATIC MODELS WITH PHIUS+ CALCULATORS IS NOT SUFICIENT

I SUCK AT EXCEL

QUESTIONS

WHAT IS THE BALANCE?

HOW CAN WE IMPROVE WUFI PASSIVE AND PHIUS+2015 INTERNAL LOADS CALCULATORS AND PROTOCOLS?

WHAT ARE THE SOCIAL, LEGAL AND REGULATORY FRAMEWORKS WE NEED TO MASTER

ARE FREQUNCY REGULATED MARKETS COUPLED WITH PH, PV MICRO-GRID AND STORAGE A SOLUTION?

CAN I GO TO BED NOW?

energy infrastructure – DEMAND vs. GENERATION

Plotting hourly demand against generation

post-retrofit residential energy demand: 659 megawatts/yr

82% demand reduction

Renewable Generation

- 34.4kW array on 13 unit multi-family
- 5.6 kW PV per 2 BR house
  (Only 65% of total roof area)
  - Saves roof area for water treatment and urban agriculture

during power outage in peak cooling season

- completely energy independent
- 4000kWh surplus energy to
- support emergency cooling + communication centers for surrounding neighborhoods.

energy independent for critical loads

complete energy resiliency

Passive to **POSITIVE**

PASSIVE HOUSE AND LOW IMPACT DESIGN

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