Implementing Equitable Capacity Management Strategies for All-Electric Multifamily Housing

Who’s with us?

Let us know what City/Municipality and Department you are from!

Speakers:

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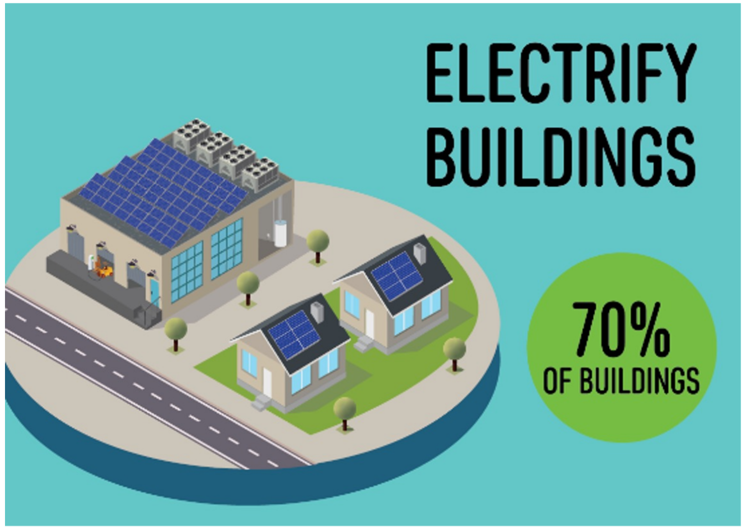
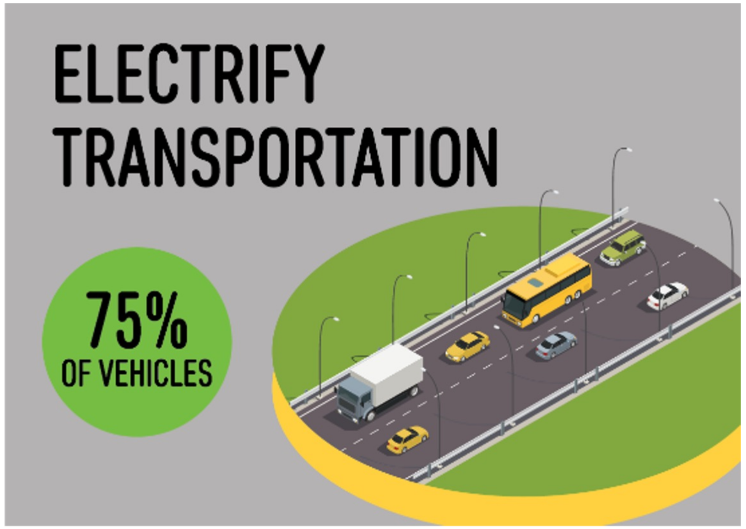
BERKELEY LAB

California 2045 Decarbonization Goals:





Grid Impacts:

Electrifying buildings in California is estimated to increase overall demand by 80-100% by 2045.

The rapid adoption of EV's in California is projected to add about 60 TWh of new energy demand to the grid by 2045, and account for about 1/3 of total energy use in California.

Local grid conditions already limit service options and will cost billions to upgrade.

New generation sources (PV, battery and wind) will shift grid infrastructure needs.

National Electric Code - Evolution Over Time

- 1947-1959 National Electrical Code (NEC) required **60A Service to houses, but not apartments.**
- 1962 update to the NEC required **100A Service to houses**, but no minimum for apartments.
- 2016 (houses) and 2022 (apartments) California Energy Code now **requires pre-wiring for full electrification**, with 200A minimum for houses, but *still* no minimum for apartments.

Multifamily Housing in California

Housing Unit Type	LMI Households	Non-LMI Households	All Households
Single family detached	2,697,041	5,109,241	7,806,282
Single family attached	458,553	554,691	1,013,244
Buildings with 2-4 units	617,529	395,899	1,013,428
Buildings with 5+ units	1,953,673	1,181,009	3,134,682
Mobile home/other	319,916	141,519	461,435

30% of CA housing is multifamily

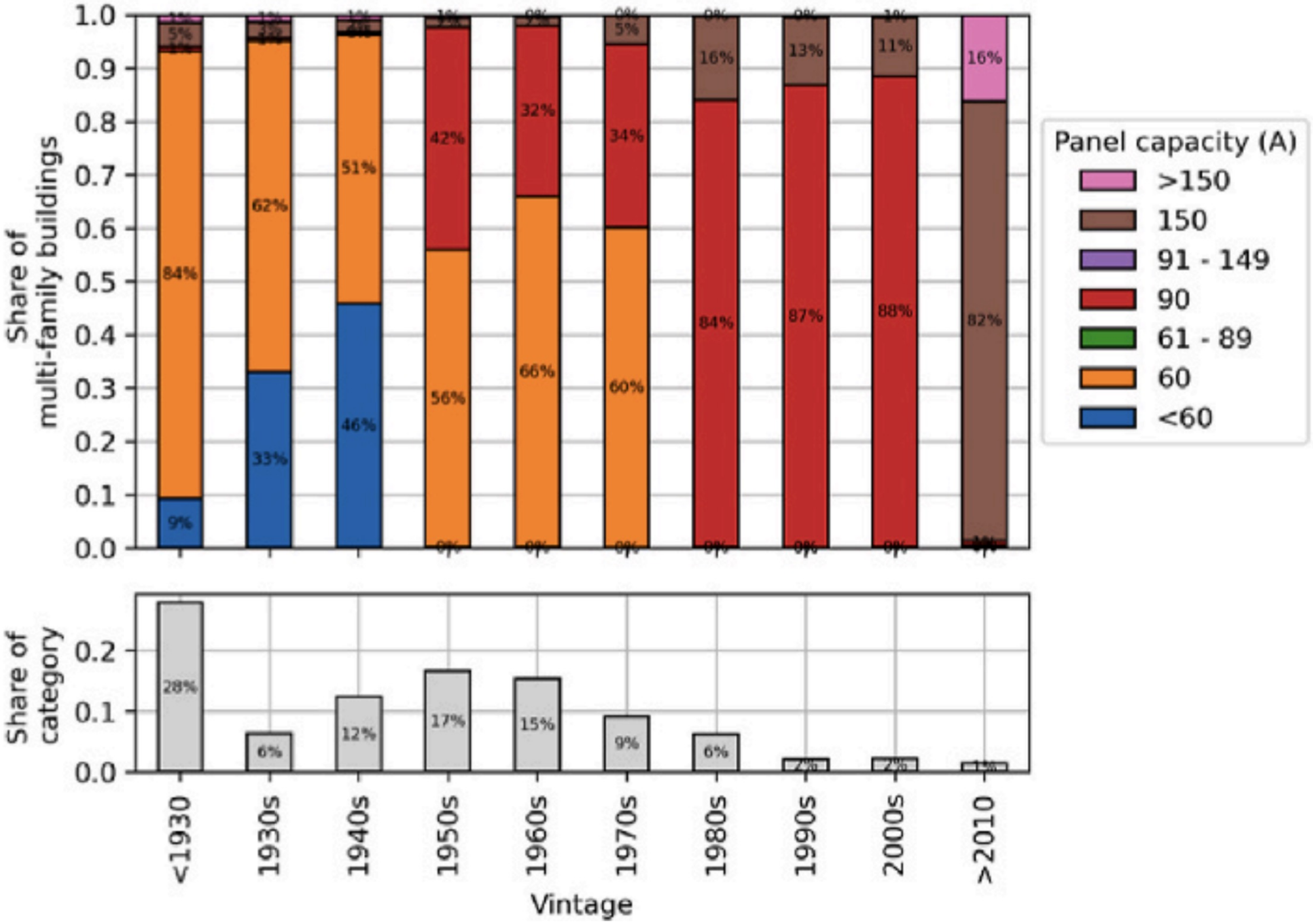
Half the multifamily housing is LMI*

Source: 2021 ACS PUMS *Low to moderate income

Service Panel Capacity in California Multifamily Housing

- Until the 1980s, CA multifamily got mostly 30A to 60A service panels.

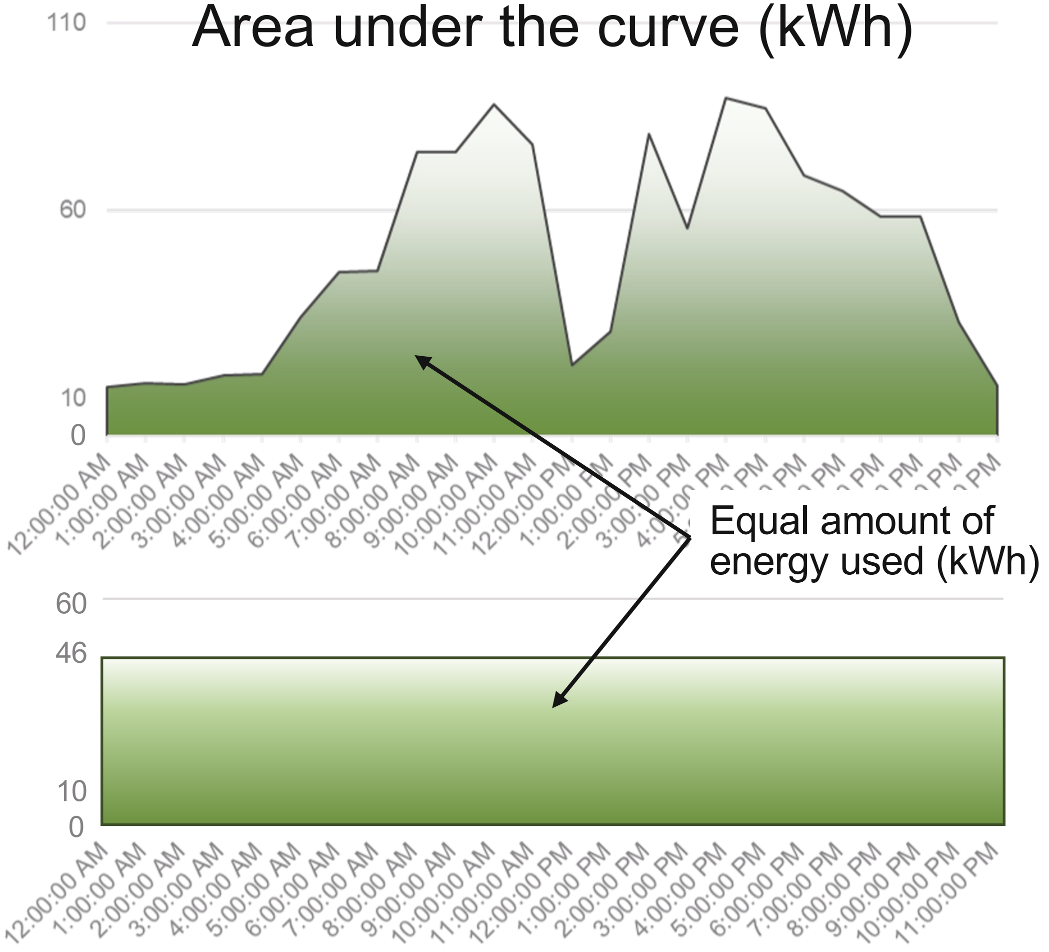
- **68% of all multifamily housing in California has panels 60A or less.**



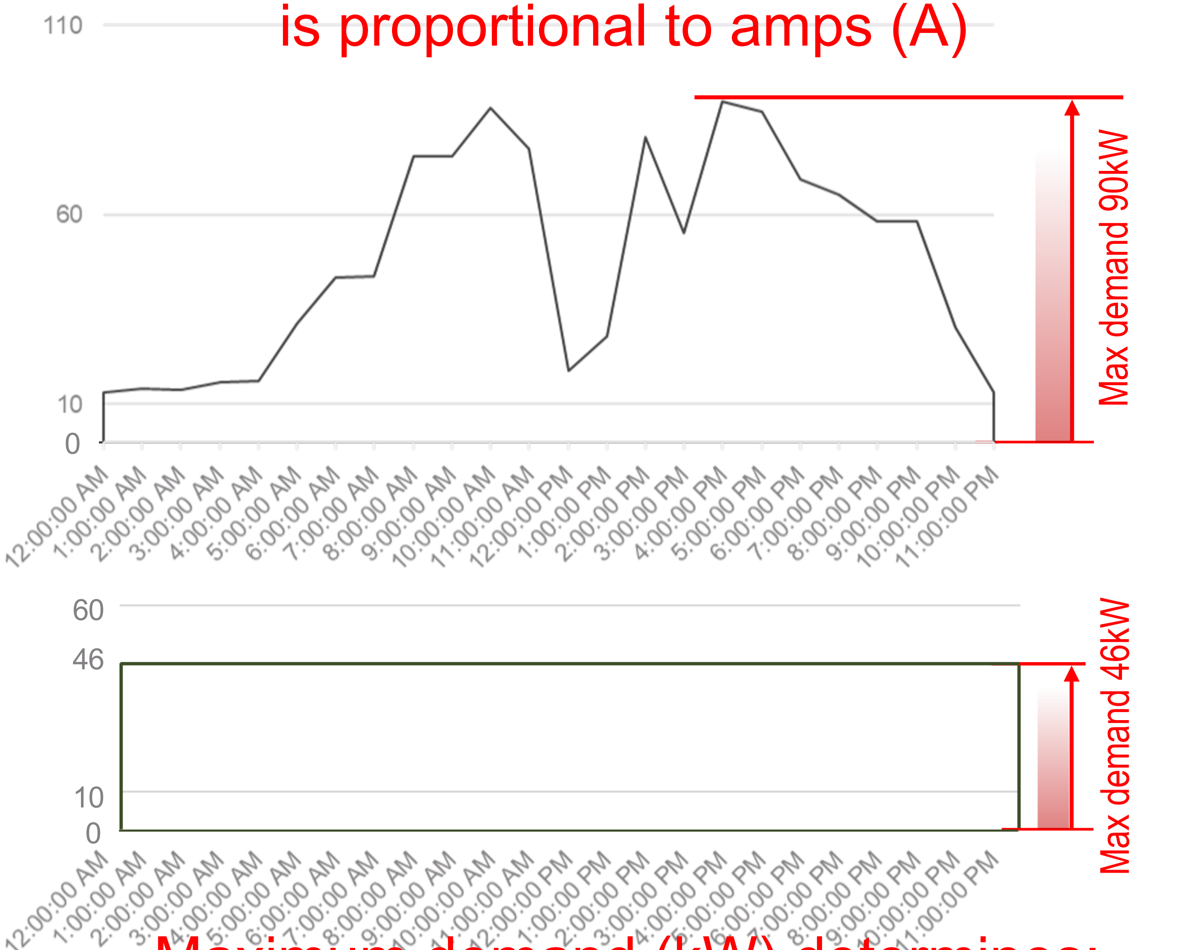
Source: Fournier, E. D., Cudd, R., Smithies, S., & Pincetl, S. (2024). Quantifying the electric service panel capacities of California's residential buildings. Energy Policy, 192, 114238. https://doi.org/10.1016/j.enpol.2024.114238

Controlling Demand (not energy)

Amount of energy needed =
Area under the curve (kWh)

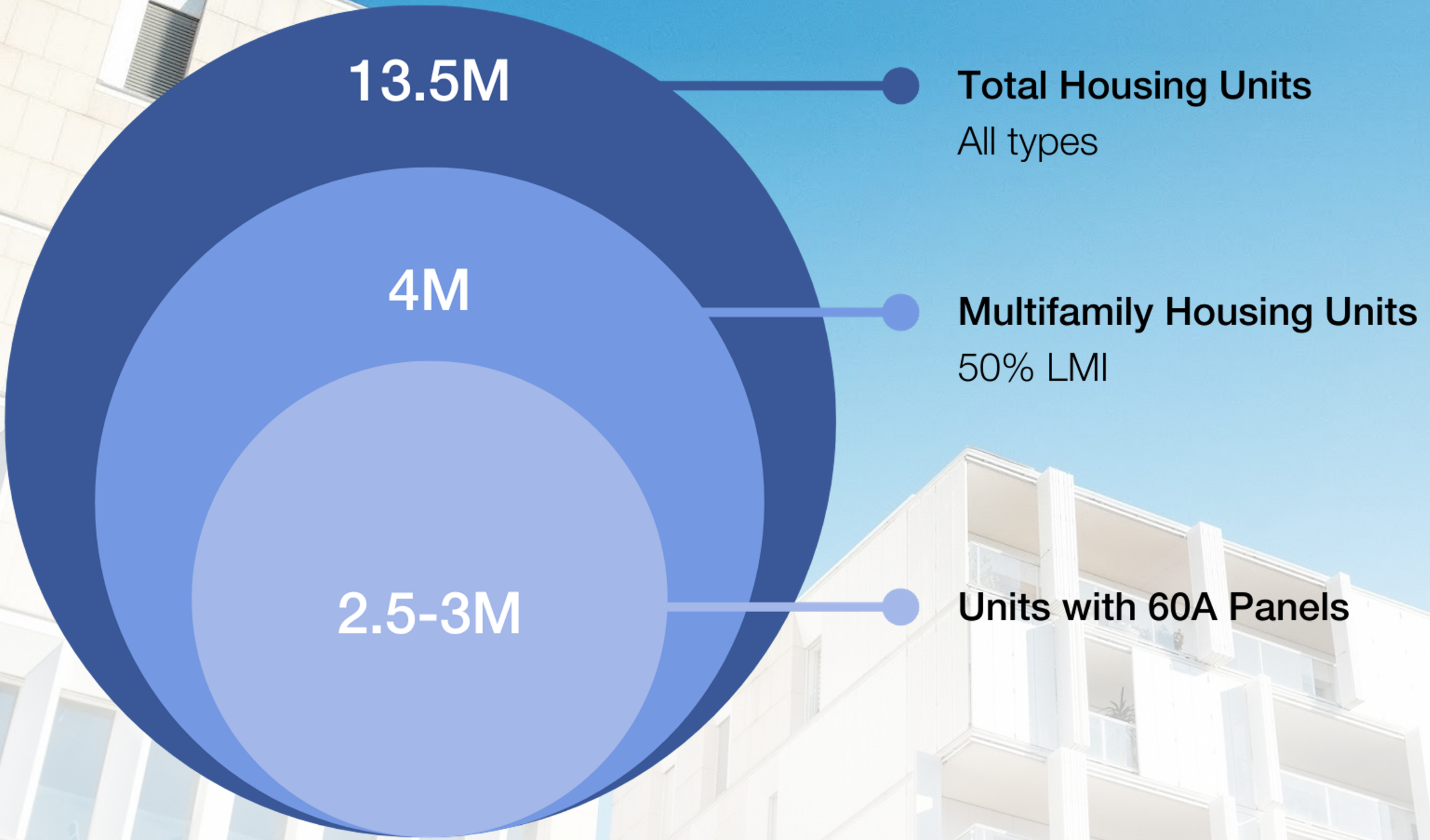


Maximum demand =
The height of the curve (kW)
is proportional to amps (A)



Maximum demand (kW) determines:
Transformer, service, panel and wire sizes

The California Existing Housing Picture



Electrical Service Calc for converting from gas to electric

Typical additional 240V electric loads:

- HP AC/Heating – 24A
- HP Water Heater – 19A
- Electric Clothes Dryer – 23A
- Electric Stovetop - 33A
- Electric Oven – 20A

Calc exceeds **100A rating** of the electrical service

(from 2021)

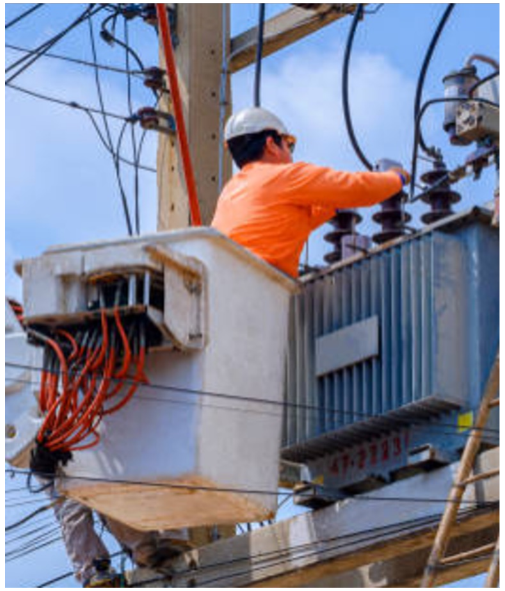
PANELBOARD
Typical Unit

VOLTAGE: 208/120 V
PHASE/WIRE: 1 PH 2W
MAIN AMPS: 100 A
BUS AMPS: 100 A
AIC RATING 22000 A
MOUNTING: SURFACE

PHASE A:	14330 VA	119.4 A
PHASE B:	14330 VA	119.4 A
EXISTING MEASURED LOAD:	4686 VA	19.5 A
CONNECTED:	28660 VA	137.8 A
DEMAND:	33351 VA	160.3 A

NOTES	LOAD DESCRIPTION	φ	VA		BKR	CKT	CKT	BKR	VA		φ	LOAD DESCRIPTION	NOTES
	(E) Kitchen Receptacles	A			20/1	1	2	15/1			A	(E) Lights and Receptacles	
	(E) Kitchen Receptacles	B			20/1	3	4	15/1			B	(E) Lights and Receptacles	
	(E) Microwave	A			20/1	5	6	15/1			A	(E) Lights and Receptacles	
	(E) Heater	B			20/1	7	8	15/2			B	(E) Dishwasher	
	(E) Washing machine	A			20/1	9	10				A	(E) Disposal	
	(E) Dryer	B			20/2	11	12	30/2	WH	2250	B	Heat Pump Water Heater	
		A				13	14		WH	2250	A		
	Induction Cooktop	B	4000	K	40/2	15	16	30/2	C	2880	B	Heat Pump	
		A	4000	K		17	18		C	2880	A		
	Electric Oven	B	2400	K	30/2	19	20	30/2	H	2800	B	Dryer	
		A	2400	K		21	22		H	2800	A		
		B				23	24				B	Space	

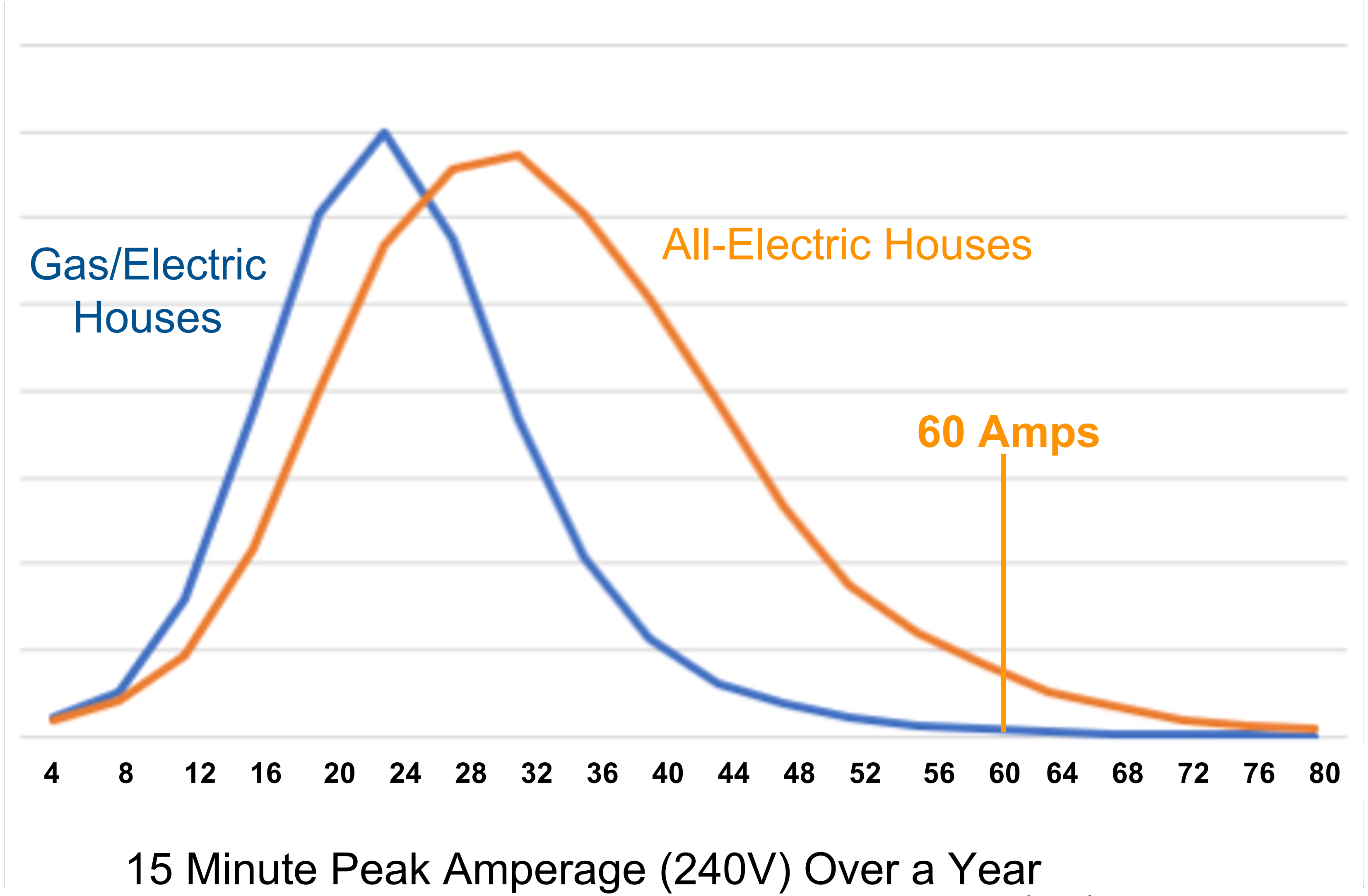
Typical Solutions for Adding New Load...



- **New Service**:
  - New electrical service panels for each apartment
  - Rewire feeder to each apartment
  - New service and transformer to the building
  - Possible new service and new transformers to the entire site (like a campus)
  - $$$$

- **Power Sharing Devices**:
  - Circuit splitters. $$

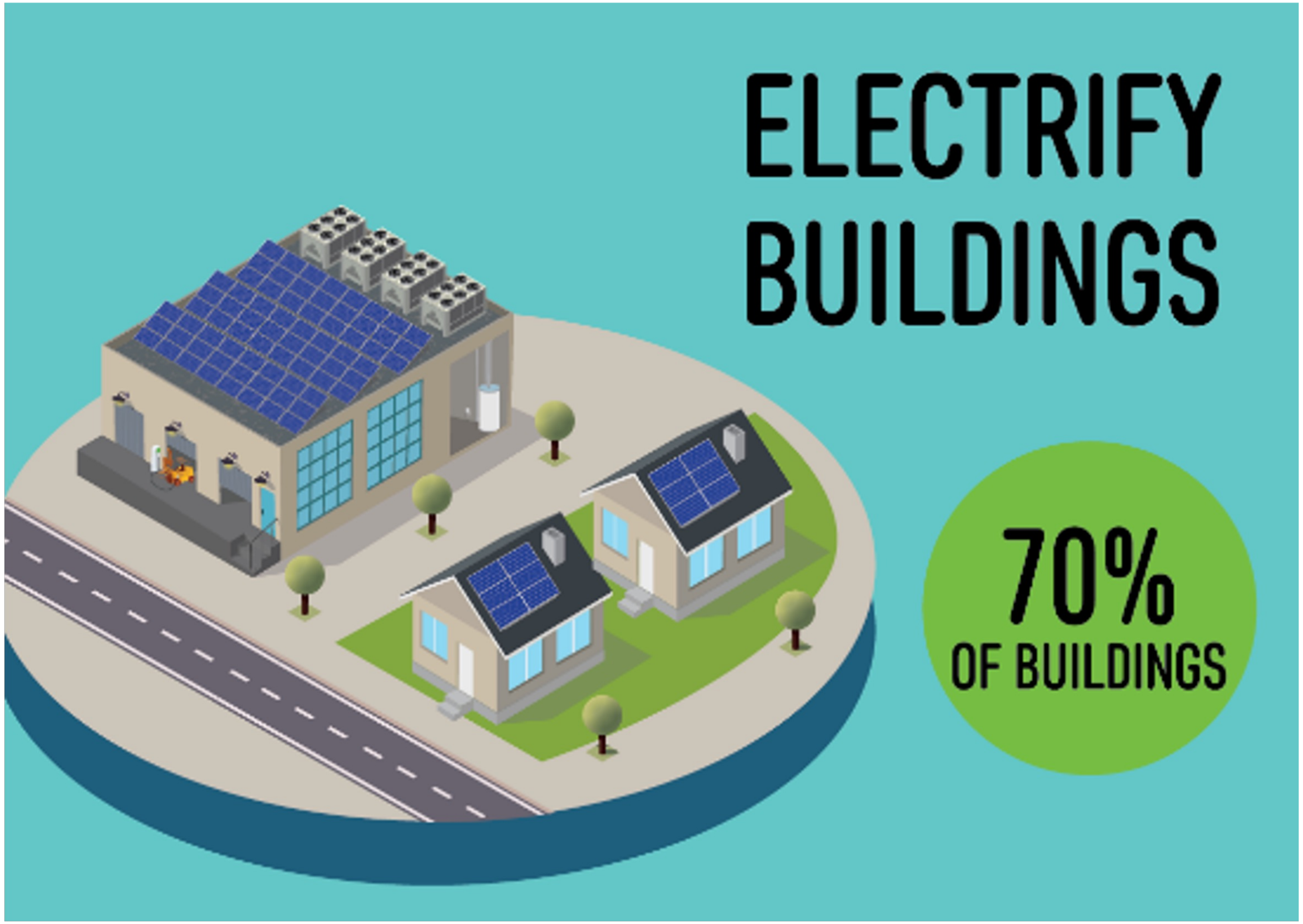
Maximum Demand in Households (Sacramento, CA)



Courtesy: Redwood Energy

Word Cloud: What are your biggest difficulties in decarbonizing multi-family housing? (2 words)

California 2045 Decarbonization Goals:



MultiFamily Challenges:

Existing subpanel capacity is low, constrains new load options

New 120V appliances can help with capacity issues, but can cost a lot more

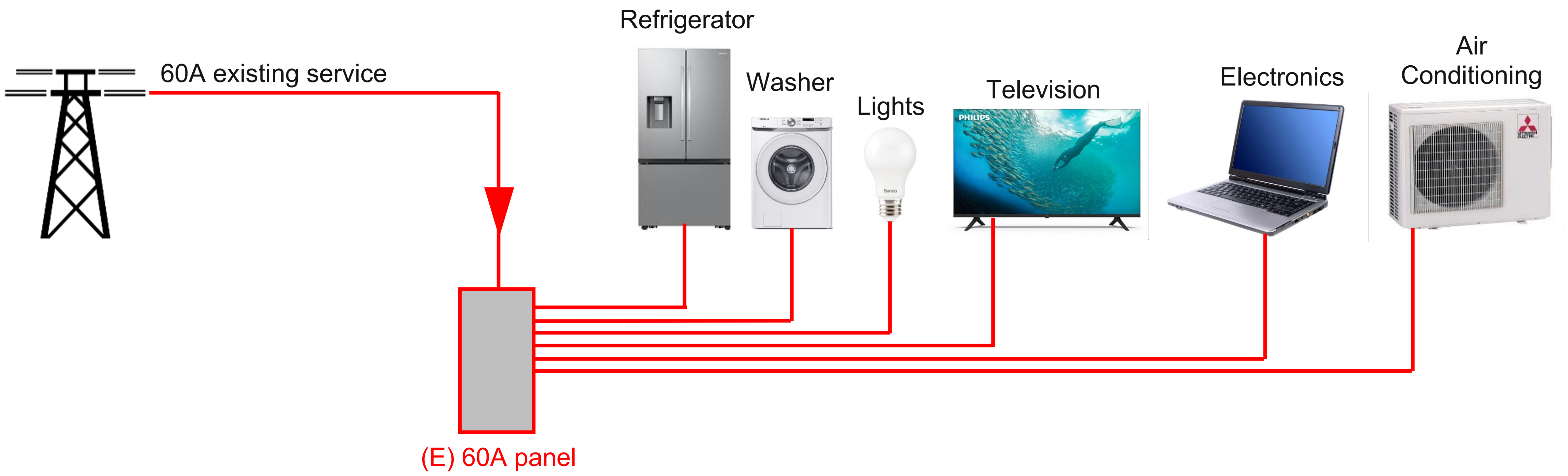
Service upgrades are costly both to the project and to the grid

Assets like energy storage are increasingly attractive, but untested in MFH units

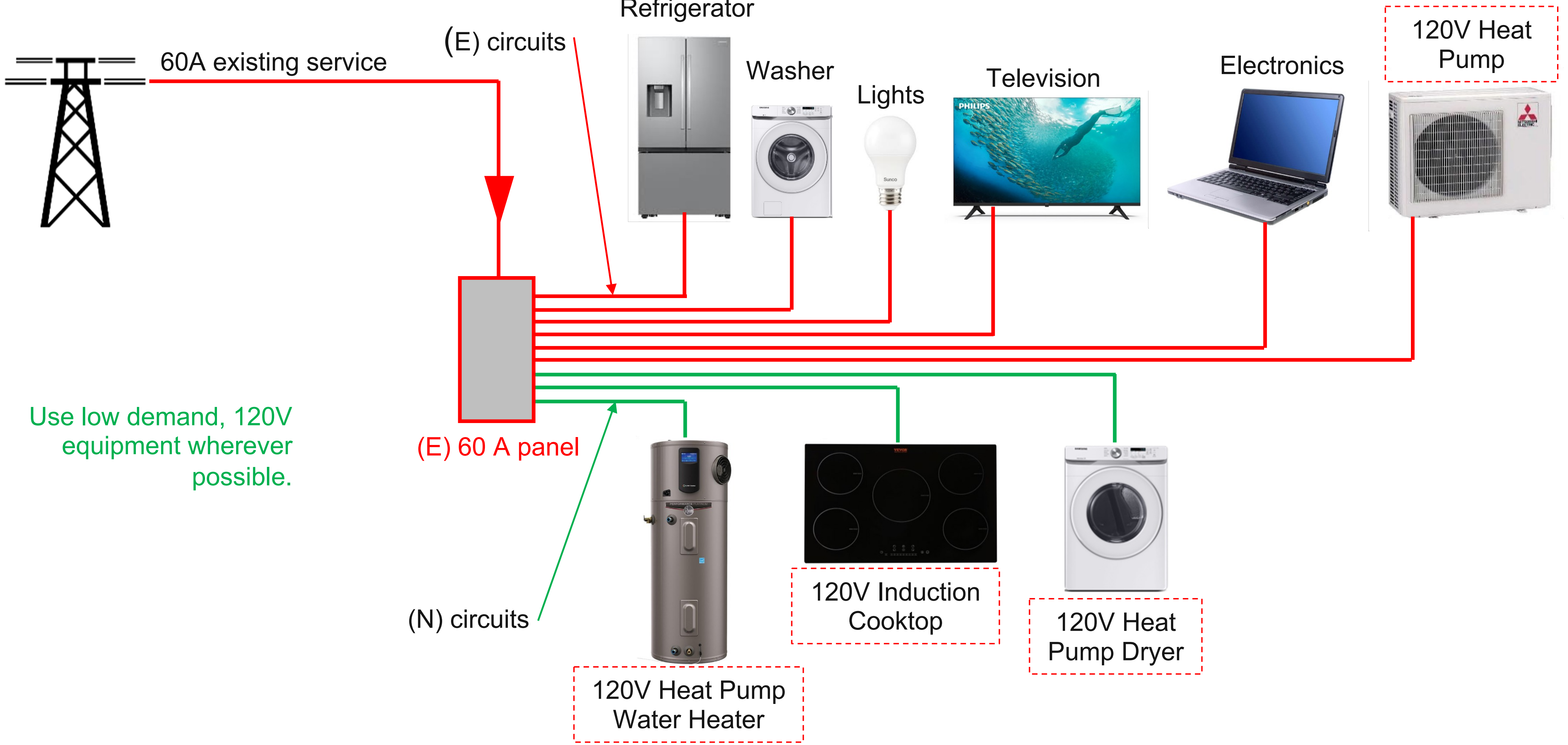
But what if we could...

- Add capacity without a service upgrade?
- Manage apartment circuits to prevent overloading and limit costs to the renter?
- Automate demand response across the housing community, and manage impacts to the grid?
- Provide backup power that lets people stay in their homes longer if power goes out?

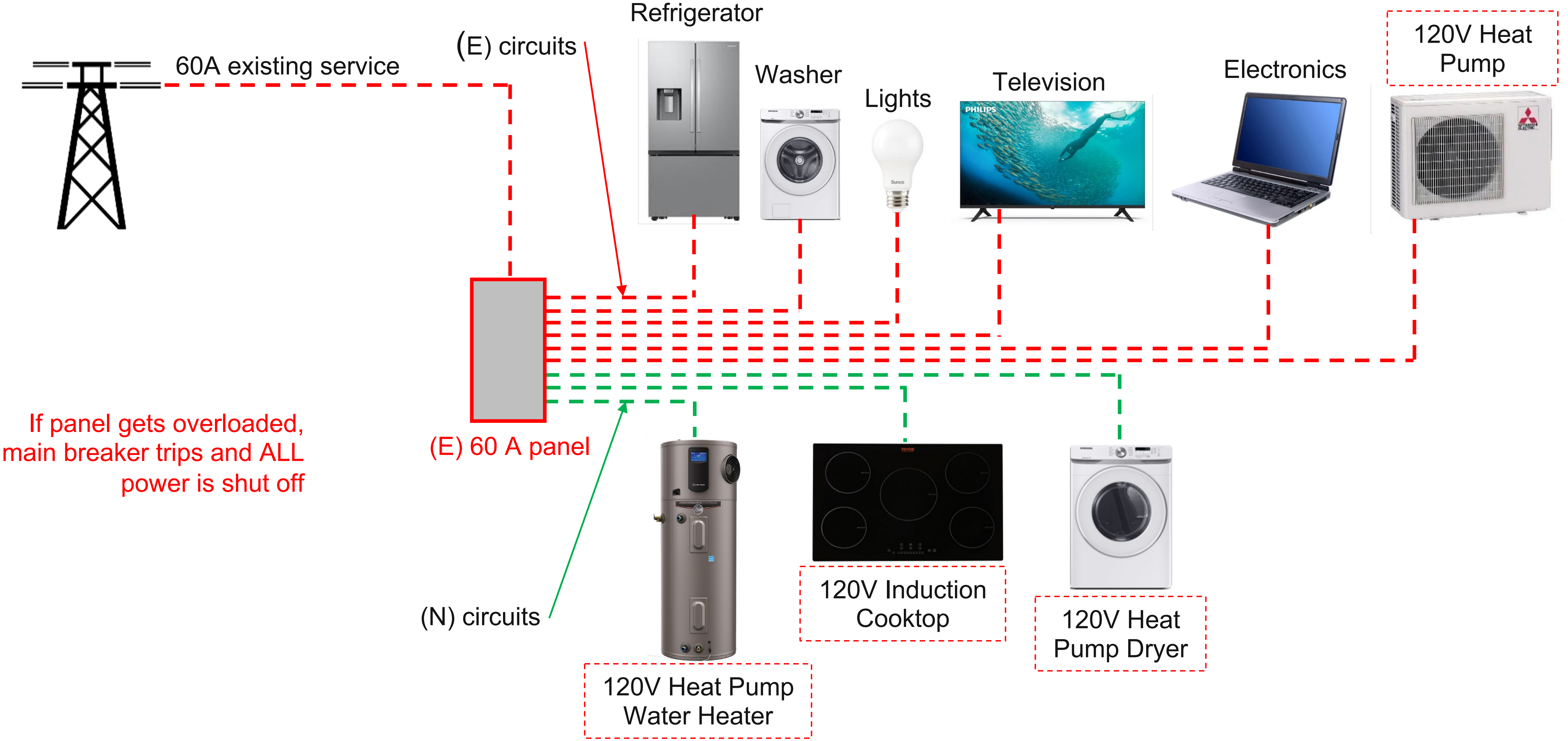
Example Existing Residence



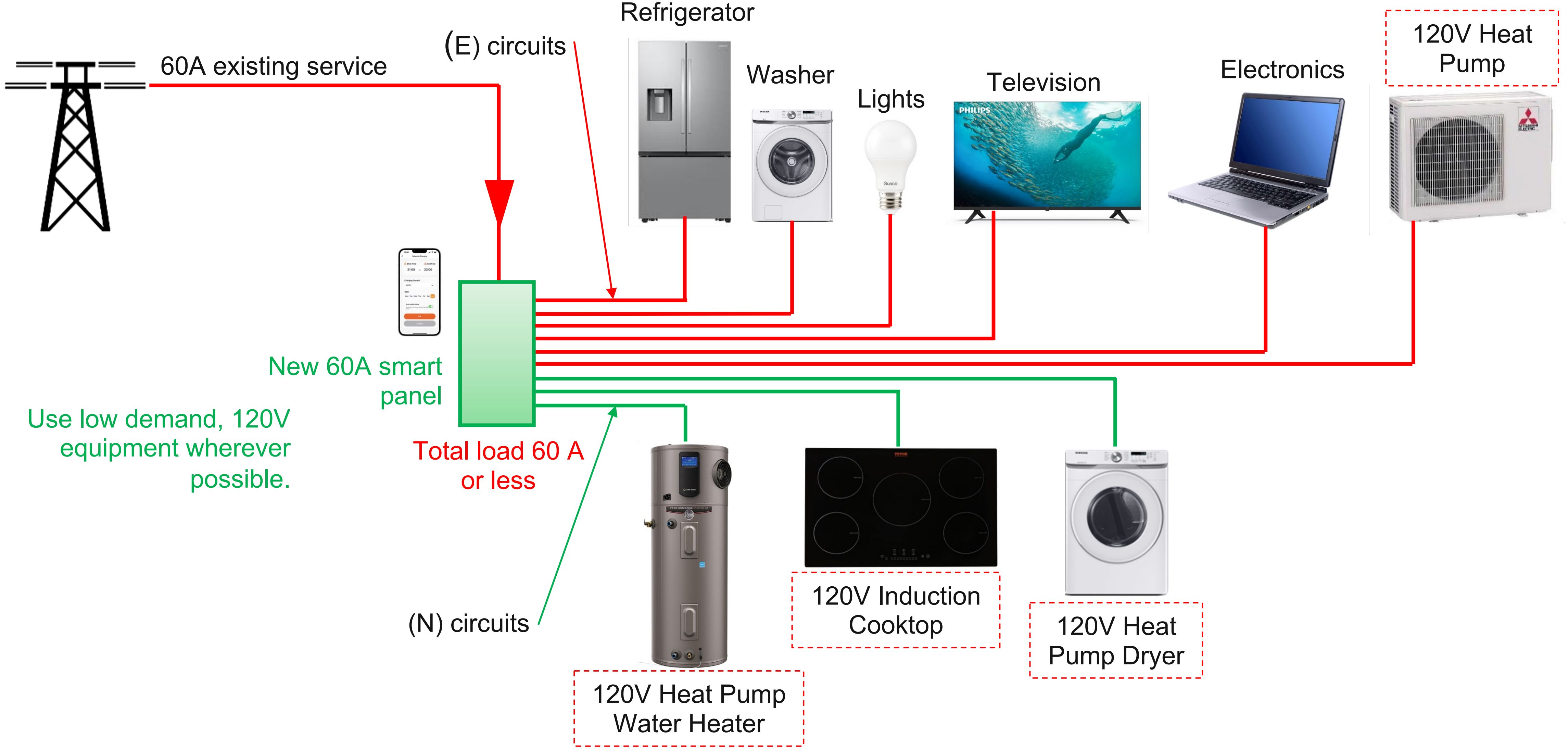
Option 1 - Electrify (and cross your fingers!) 🤞



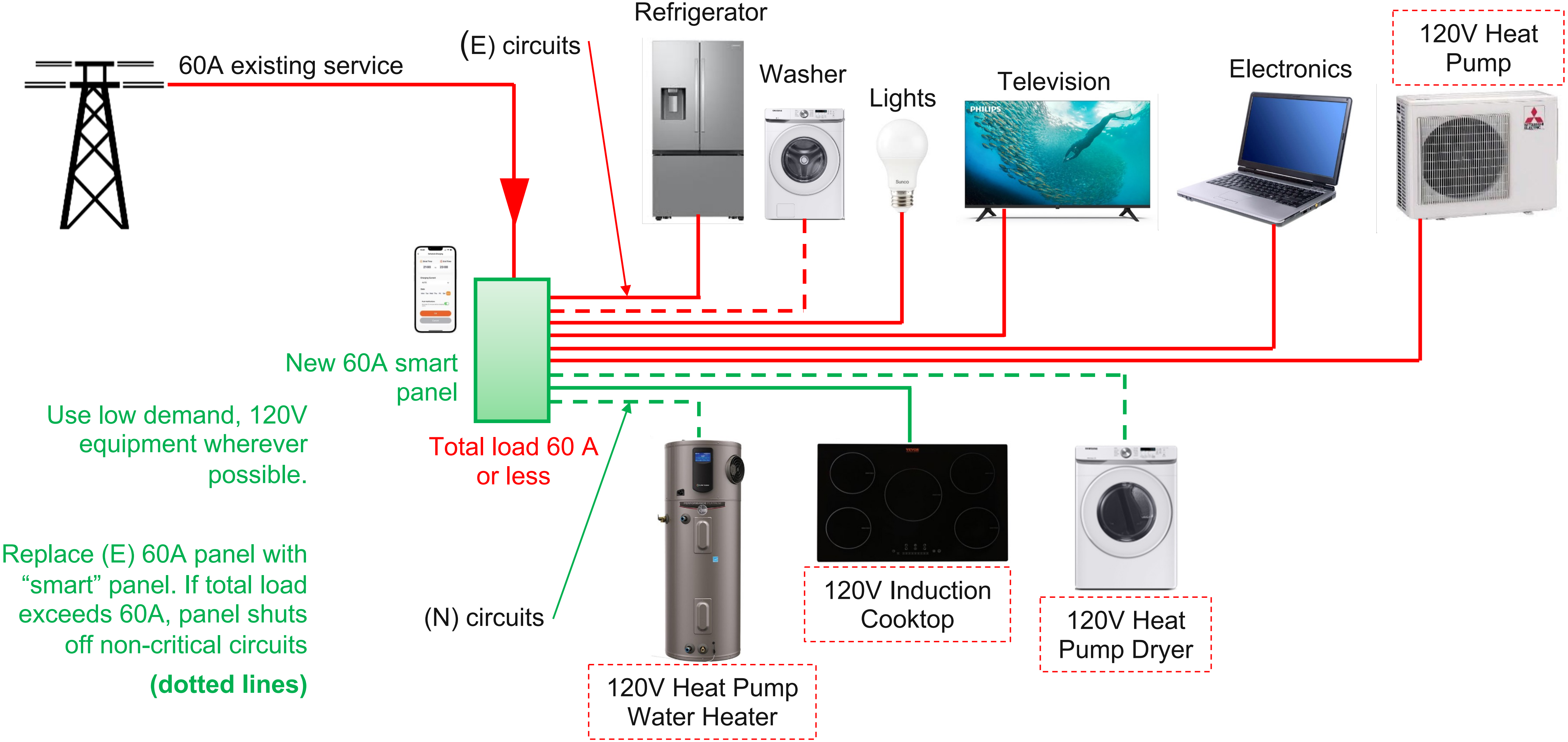
Option 1 - Electrify



Option 2 - Smart Panel/Low Load Equipment



Option 2 - Smart Panel/Low Load Equipment (Load Shed)

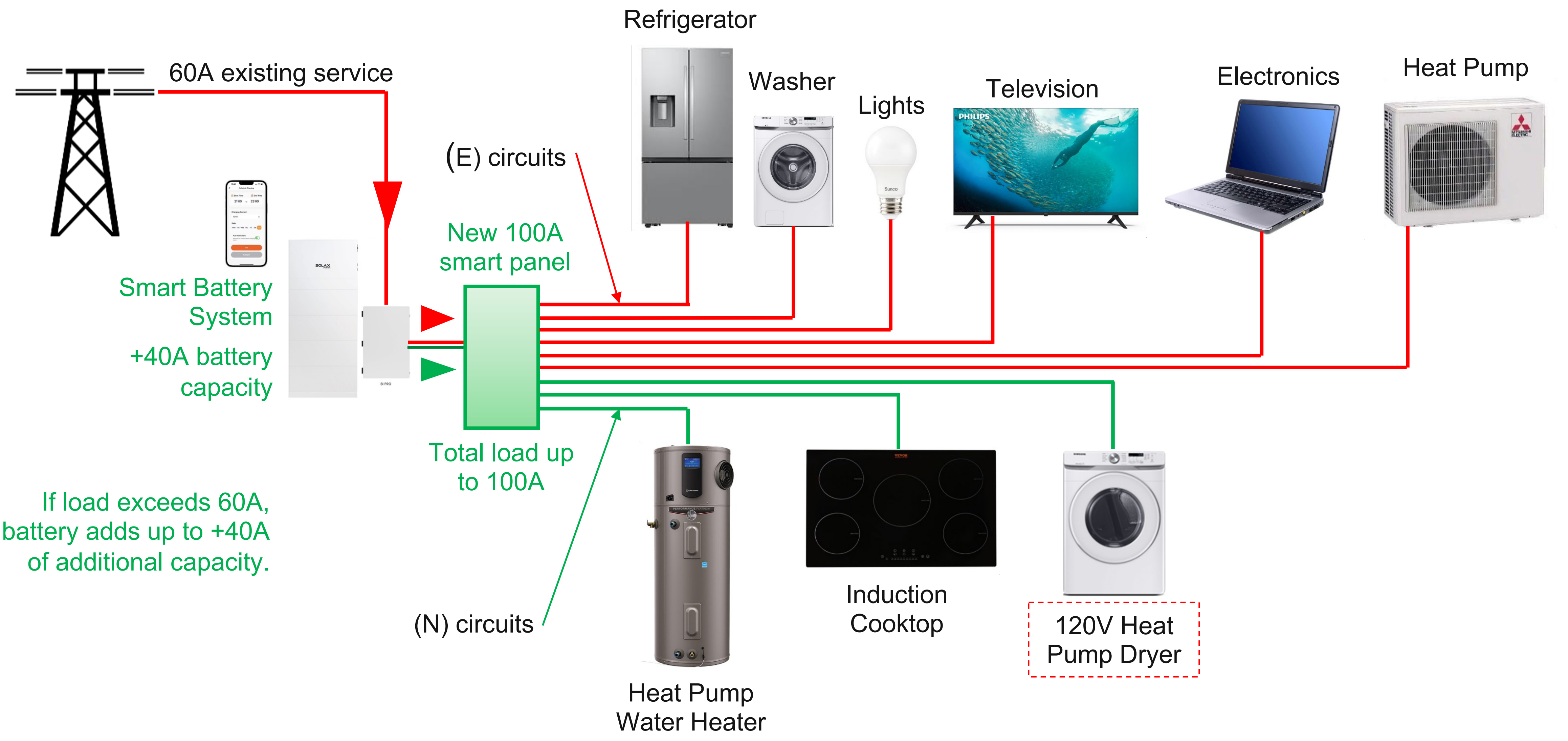


Use low demand, 120V equipment wherever possible.

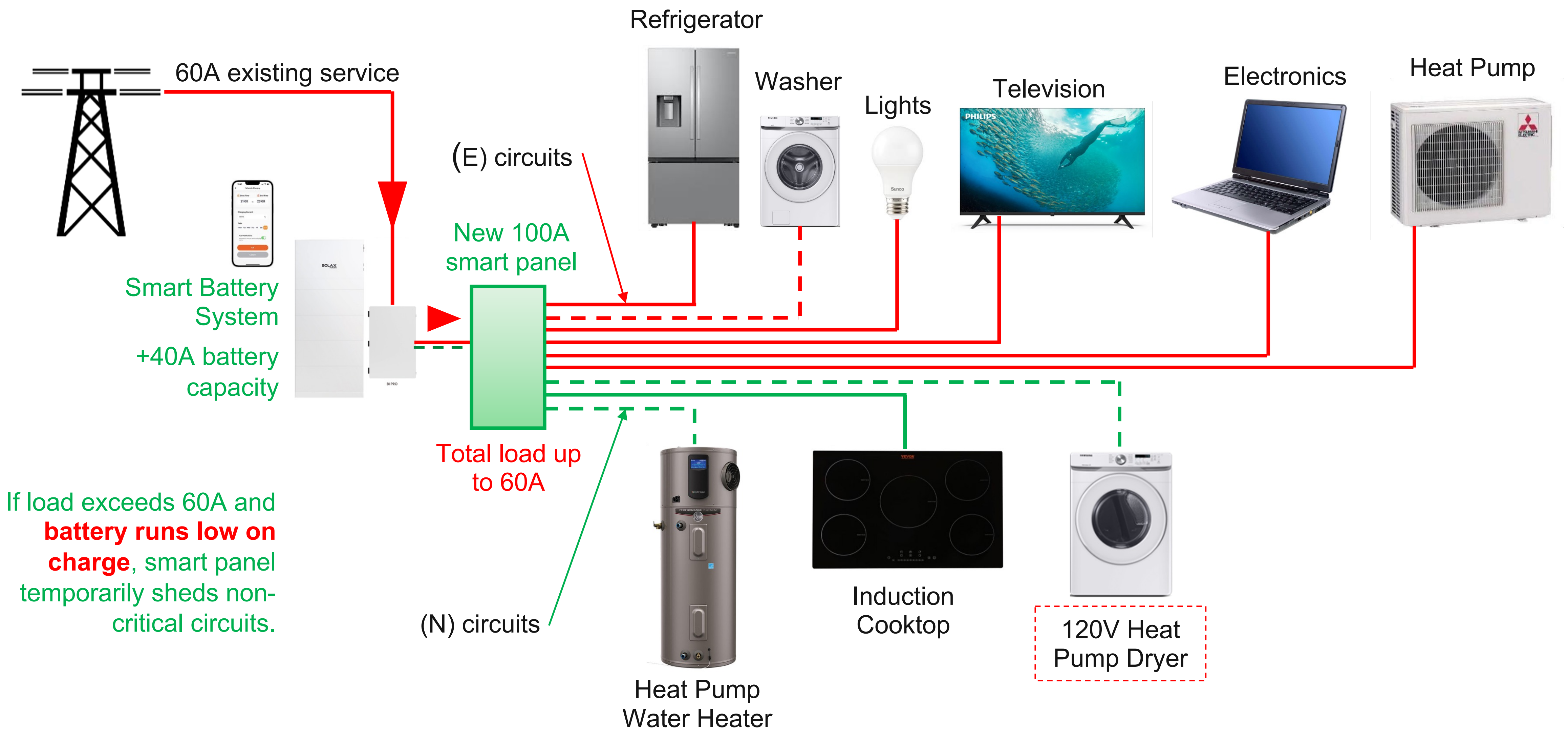
Replace (E) 60A panel with "smart" panel. If total load exceeds 60A, panel shuts off non-critical circuits

(dotted lines)

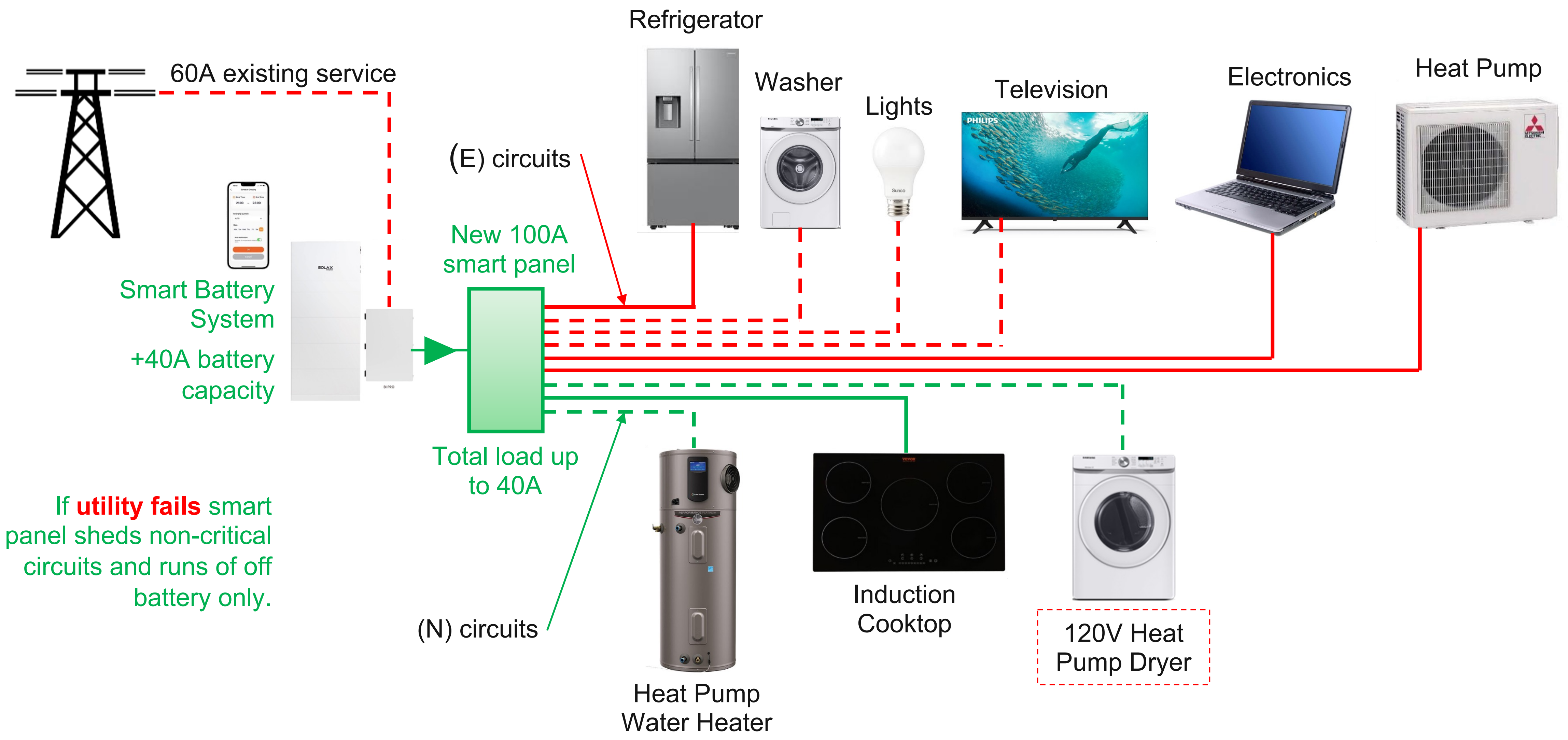
Option 3 – Service + Battery



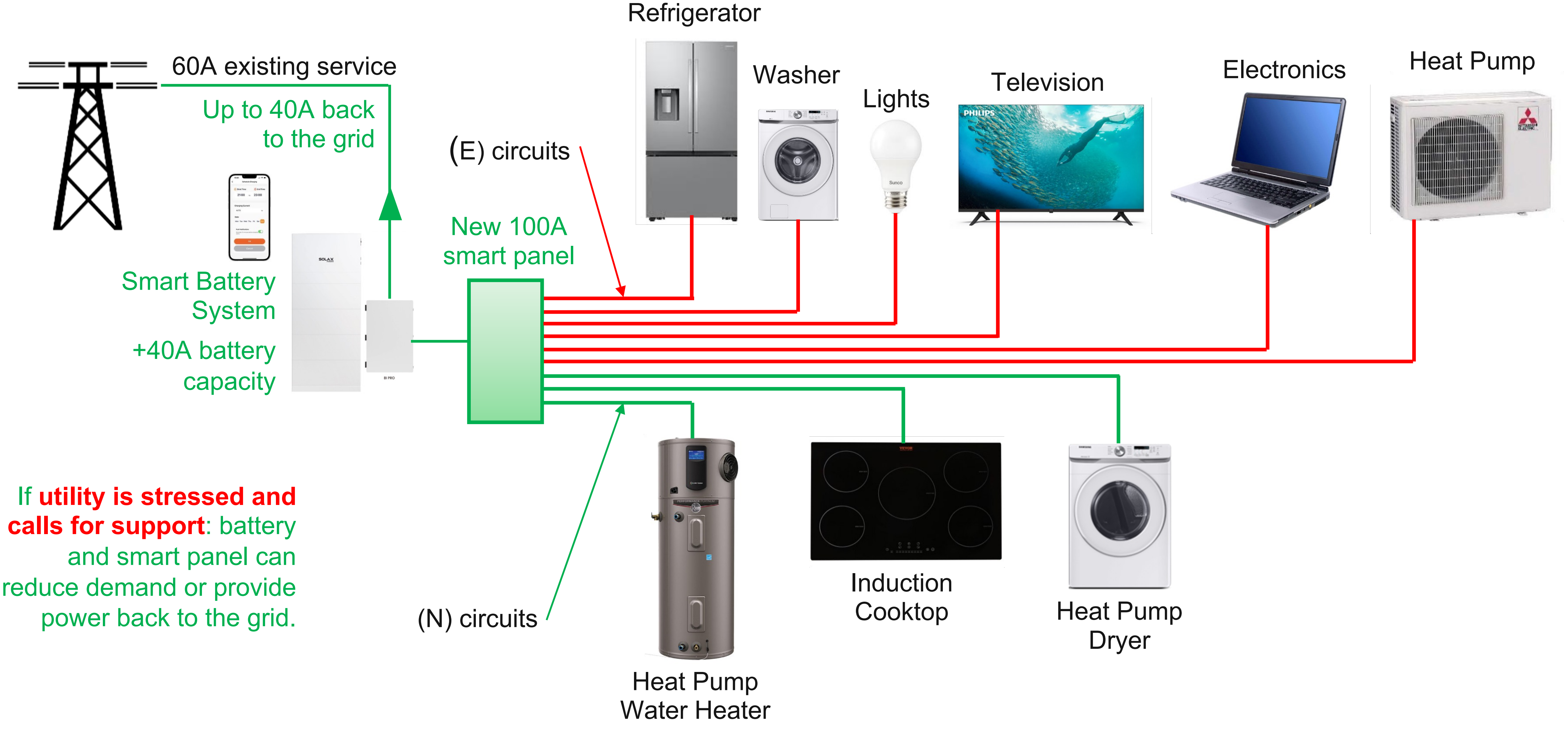
Option 3a – Battery (Low Battery/Load Shed)



Option 3b – Resilience (Utility Power Outage)



Option 3d – Virtual Power Plant



If **utility is stressed and calls for support**: battery and smart panel can reduce demand or provide power back to the grid.

Project Locations

Santa Rosa, CA

Funded by the CEC EPIC Program

ProspectSV IDeAsC DANCO BURBANK HOUSING Sonoma Clean Power

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Power Management Pilot - Our Objectives

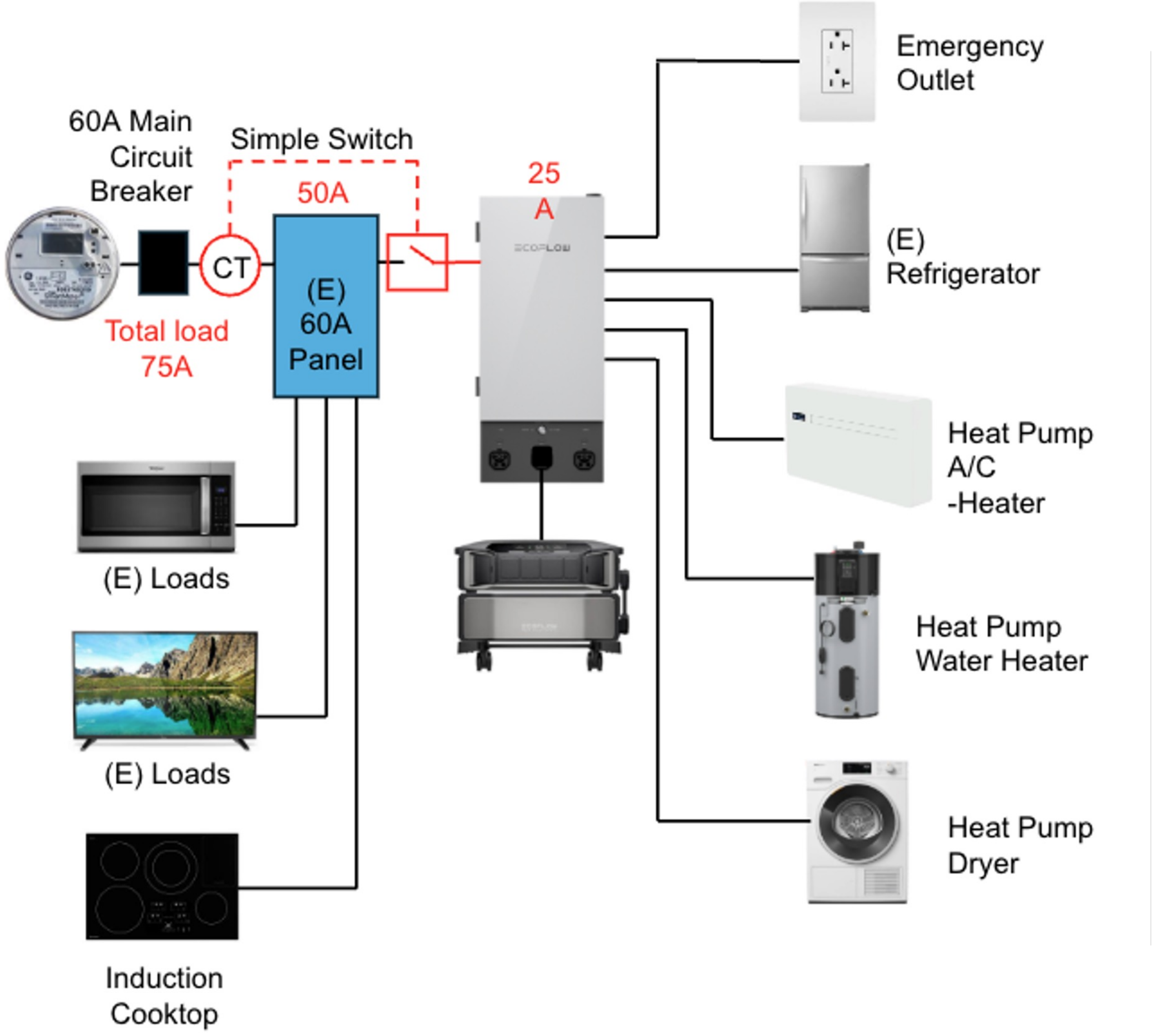
Use off-the-shelf technology

Work within existing service

Target the multi-family market

Build a better system with more advantages than the cost of upgrades

Capacity Management



Load approaches 80% of panel capacity

- Split EcoFlow SP/Battery and main panel
- Run critical circuits on EcoFlow
- Run additional circuits on power grid
- Monitor loads

Is load back to <80%? → SimpleSwitch rejoins panels

Load Management & Demand Response

- Load approaches 80% of panel capacity
- Demand Response signal
- Time of Use rate change

Adjust HVAC set points

Switch off optional plug loads

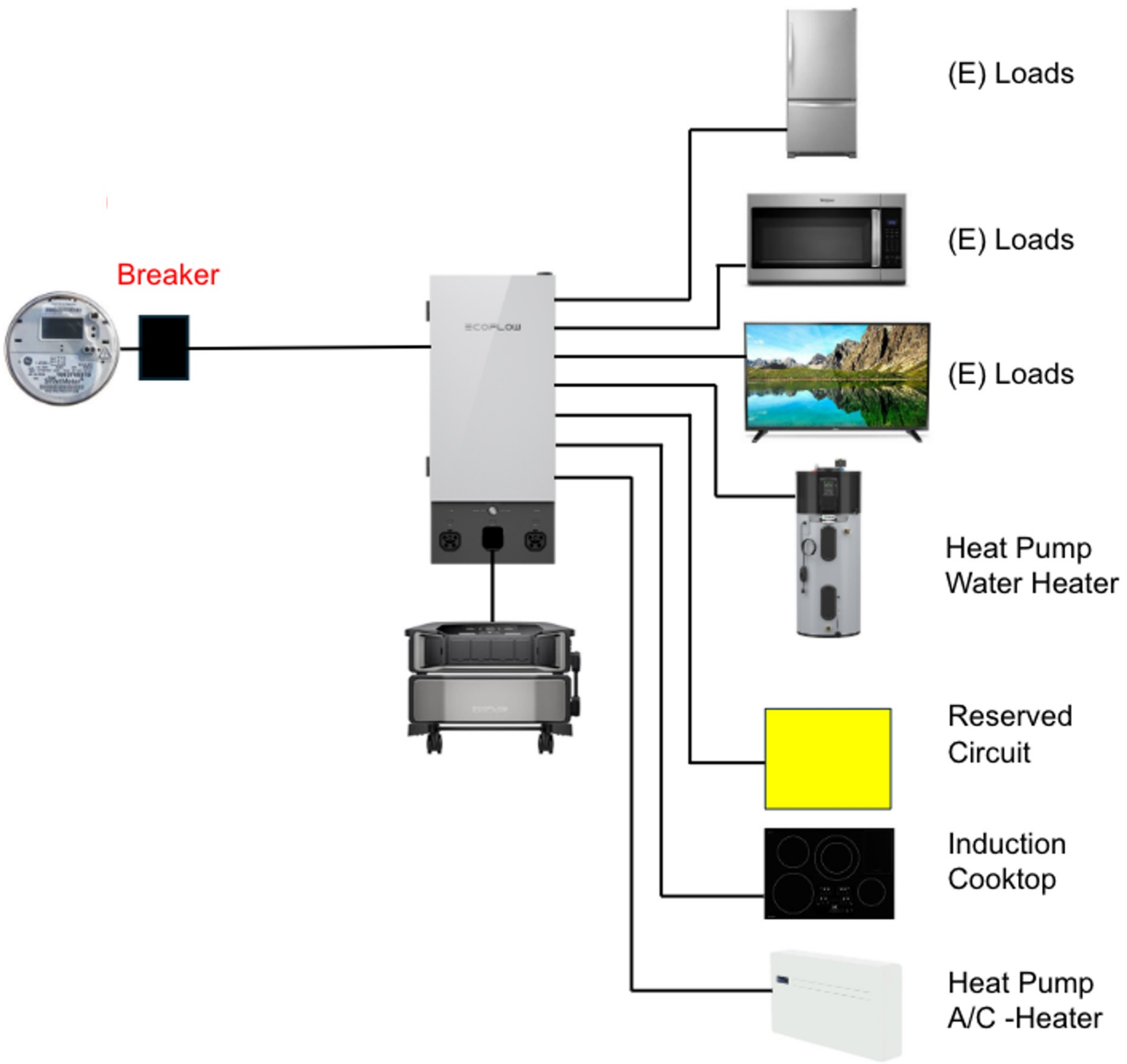
Curtail non-essential circuits

Monitor loads

- Is load back to <80%?
- Has TOU rate subsided?
- Has Auto-DR subsided?

→ Resume normal operation

Resiliency



Grid is OUT

- Disconnect from grid, island
- Support only Critical circuits
- Adjust HVAC set points
- Monitor loads
- Possible recharge by solar PV

Is the grid on? → Back to grid power

Unexpected Power Outage Ride-through

Smart panel + battery (EPS) keep critical loads alive — no apps, no manual switching, no operator in the loop.

EcoFlow SHP2 smart panel

Plug-in battery / EPS

12 metered circuits · 3 tiers

1 Detect

Panel senses utility voltage/frequency loss on the main feed.

grid_status → 0

2 Island

Main relay opens; home is isolated from the grid to protect line crews.

< 1 s, automatic

3 Transfer to EPS

Battery picks up the home seamlessly — critical loads never blink.

powerSta → ES_POWER

4 Shed & Sustain

Non-essential circuits stay off; battery carries critical + essential loads.

eps_mode_active = true

5 Restore

On grid return, panel re-syncs, recloses, and resumes charging.

grid_status → 1

Critical

ALWAYS ON

- Network & comms
- Computer / server
- Family-room outlets

Essential

HELD ON

- Refrigeration / lighting
- Selected comfort loads
- On while SoC is healthy

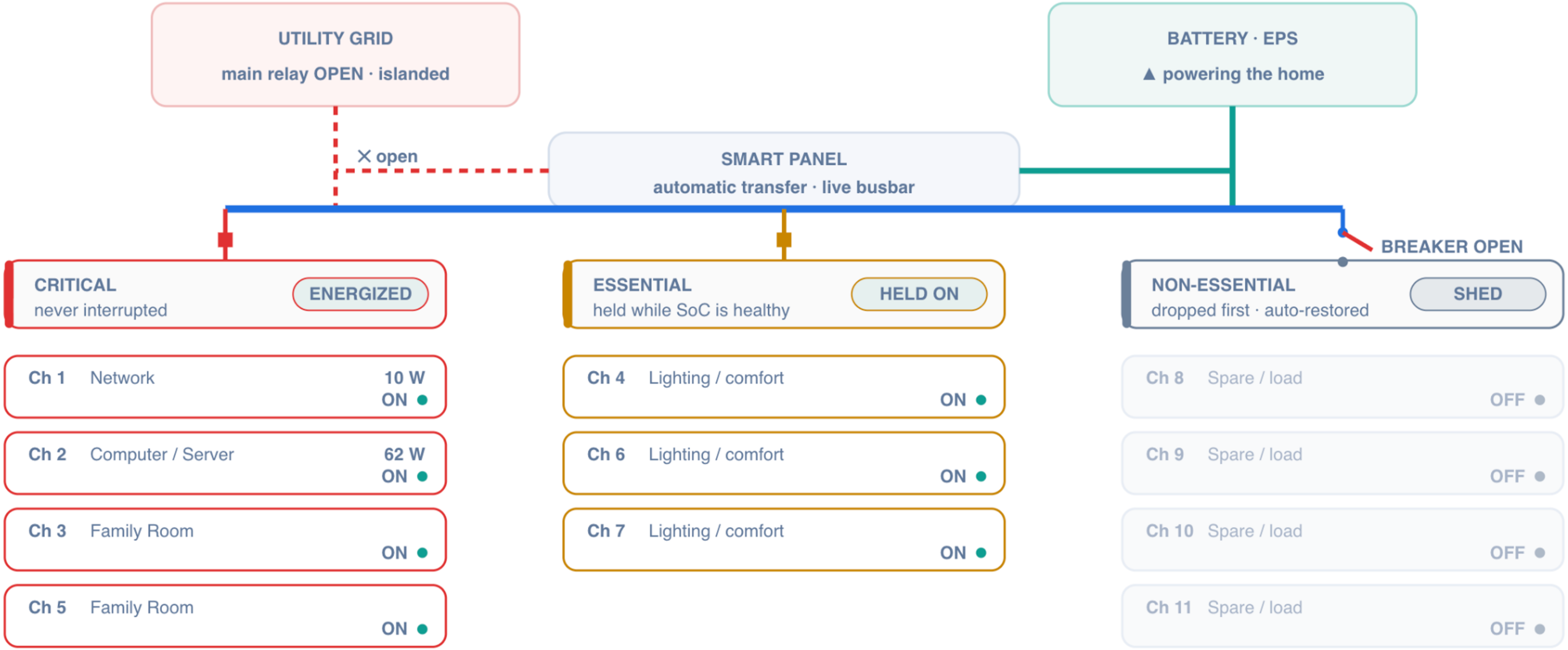
Non-essential

SHED

- Circuits 8–12
- Dropped first to extend runtime
- Auto-restored after recovery

Emergency Back-up Power Circuit Classes

Every circuit is pre-classified, so the panel knows what to keep and what to drop the instant the grid fails — test_home wired exactly as it rode through June 11.



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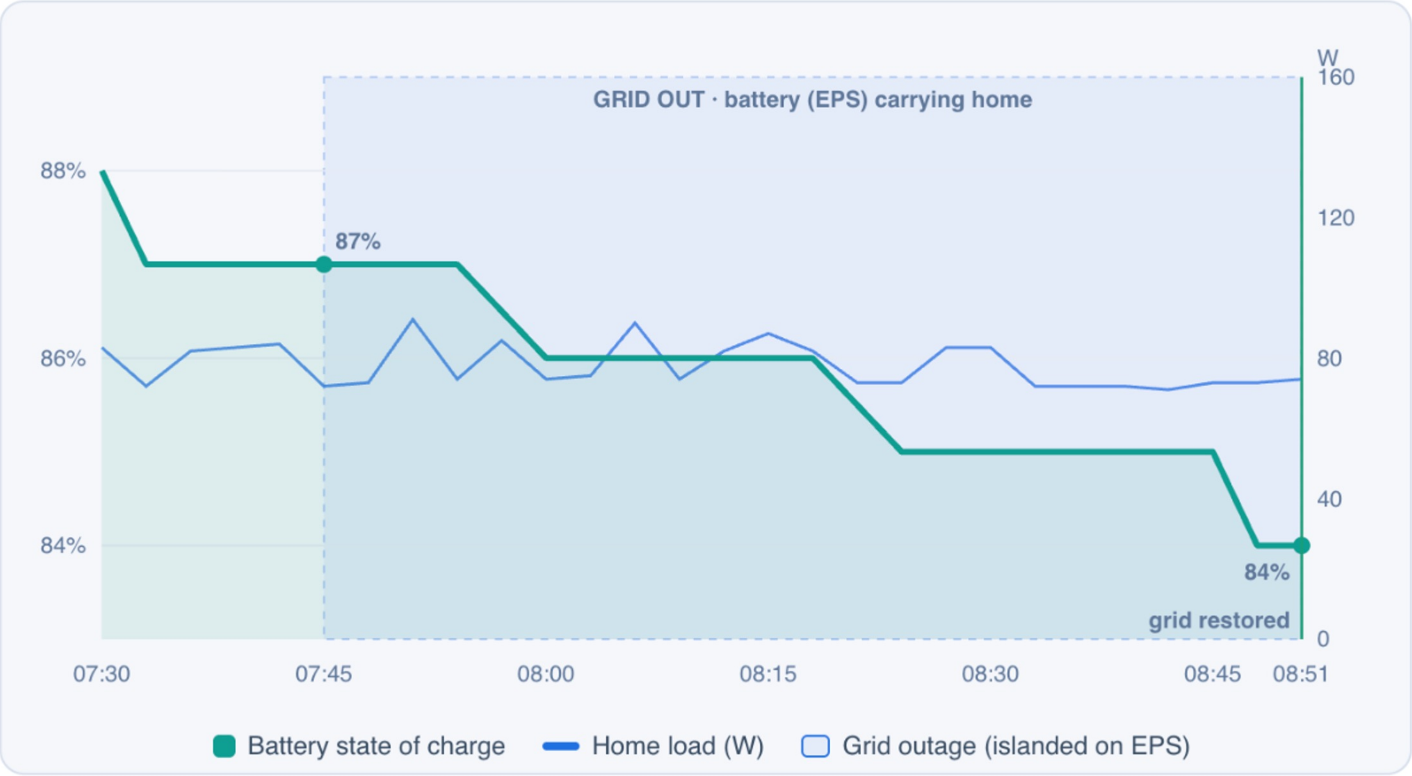
Real World Outage with Zero Downtime

test_home — June 11, 2026 · grid lost 07:45 PDT, restored 08:51 PDT. Not a planned power outage



66 min

Outage duration carried autonomously (07:45 → 08:51)

87% → 84%

Battery SoC used — just **3 points**; ample reserve remained

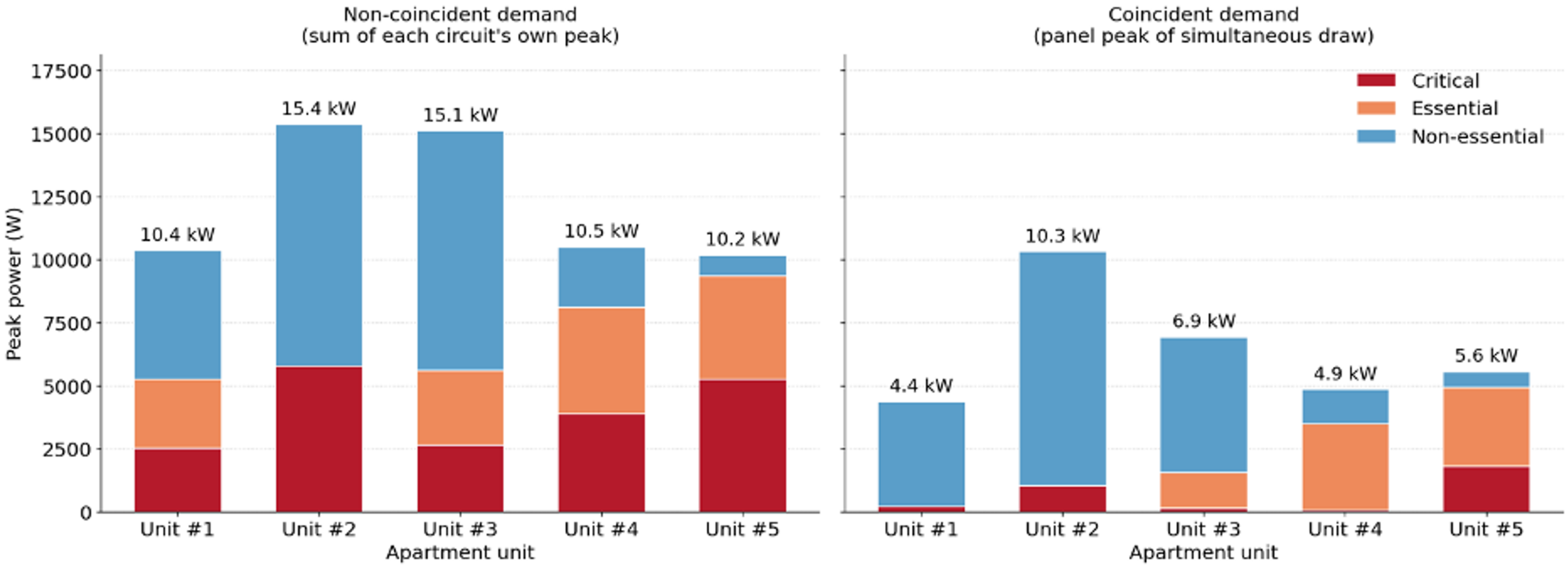
~75 W

Avg backed-up load · critical circuits never dropped

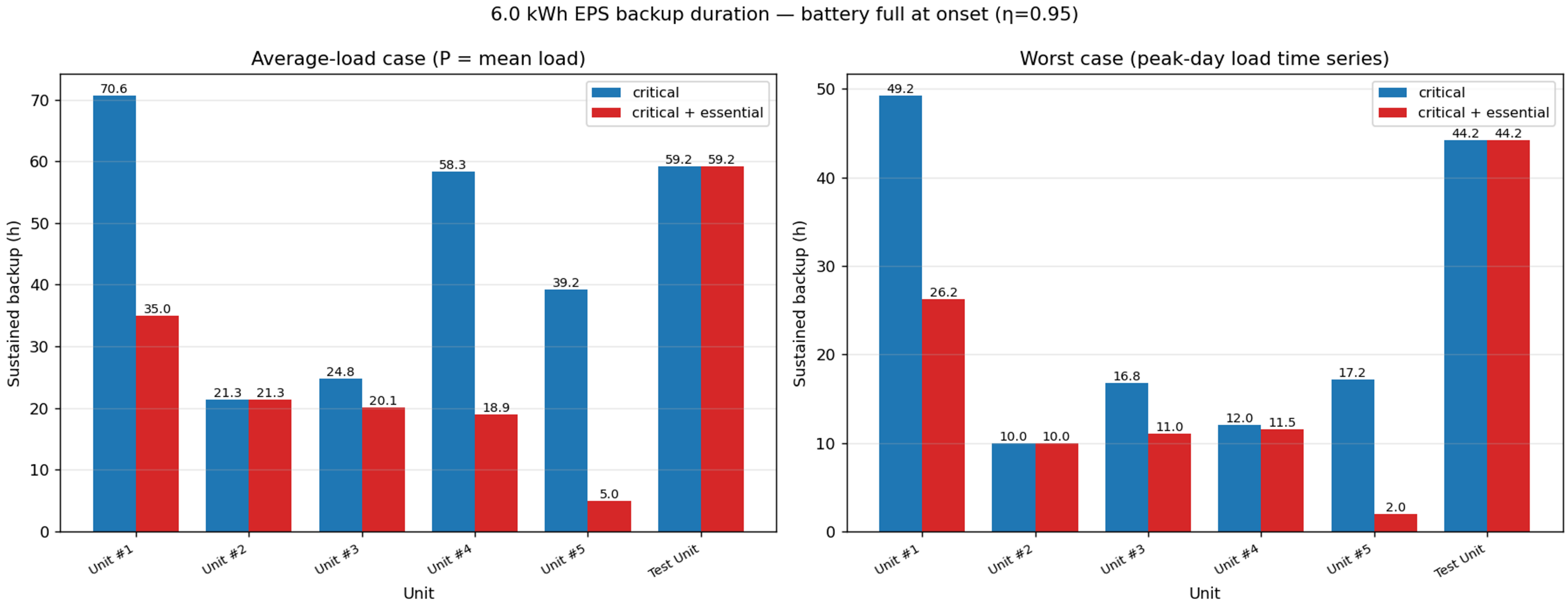
0

Manual actions, dispatched commands, or critical-load interruptions

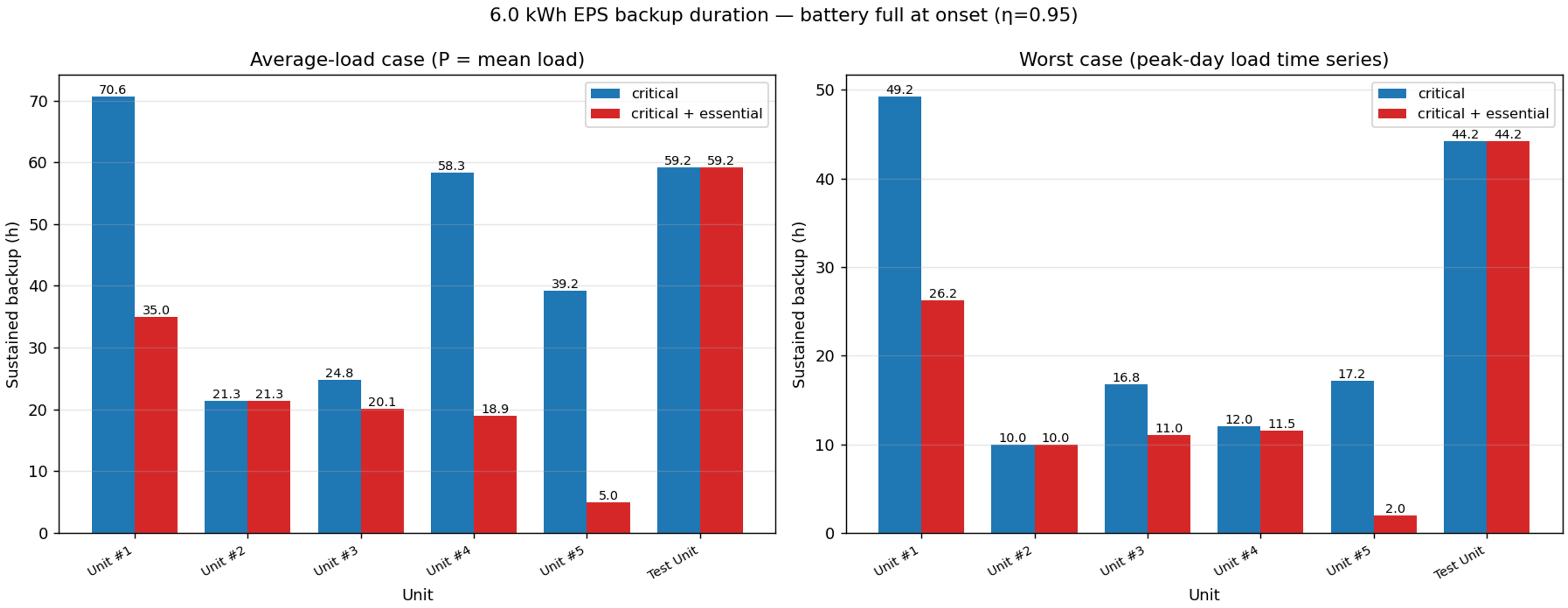
Field Demonstration Site Circuit Class Distributions



Field Demonstration Site Expected Backup Durations



Under the average-load case the critical tier is sustained for 21–71 h across the six units (median ≈ 2.5 days), decreasing to 5–59 h once essential loads are added. On the peak day, critical-tier circuits can be sustained over 10–49 h and critical + essential is 2–44 h



Performance Metrics

Metric	Low	High
Power output	7.2 kW	21.6 kW
Battery capacity (after 10 years or 3000-3500 cycles)	70% capacity	80%+capacity
Expanded capacity	12 kWh	90 kWh
Percentage of whole building load	60%	100%
Annual bill savings from time-of-use rate	$20/kWH	$30/kWH
Effective Capacity	Provides <100A	Provides <100A
Switchover Time	20 ms	10 ms

Site Installation

Permitting Process

The tale of 2 AHJs

AHJ #1

- experienced with battery project installations
- no questions
- simple review
- 6 week processing time

AHJ #2

- more rural
- less experienced
- longer process
- more questions
- resubmittal needed

Early engagement with permitting authorities is critical, as local requirements and review processes can vary significantly across jurisdictions, particularly for emerging electrification technologies. We are working on guidance to provide education on emergent decarbonization strategies for a variety of stakeholders.

What kind of resources/guidance would be valuable to your organization for decarbonization?

Great Training Initiative

Problem

Emerging technologies often stall at the permitting stage, not due to technical flaws, but unfamiliarity among reviewers and installers

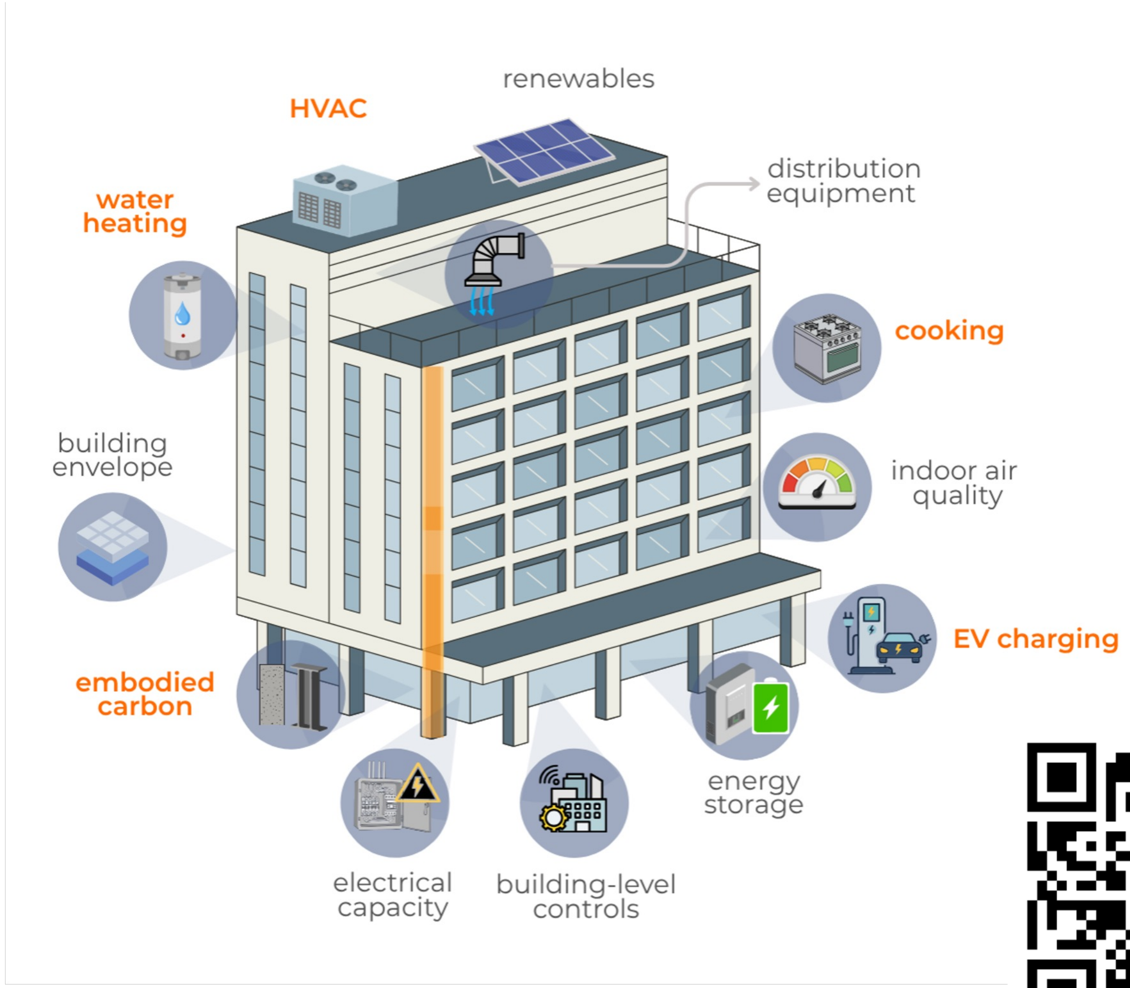
Solution

The Great Training Initiative builds decision-making fluency so AHJs and contractors can act with confidence, removing unnecessary adoption barriers

Rollout

Statewide rollout via RENs, local municipalities, and CCAs, with training delivery beginning Quarter 3, 2026

Here’s What Coming



Resources	Design Guide, Case Study, Performance Information
Training	Training Center, Webinars MECHtalk Series
Support	Project Experts Technical Assistance

For more resources, go here!

Q&A

Questions?

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