FLAIR

Unlocking Ductless Heat Pumps as Grid Resources

Demand response in a distributed, inverter-driven world

Presented for the Northwest Energy Efficiency Alliance · April 2026

Who we are

Flair builds purpose-built controls for the equipment categories that traditional thermostats can't reach. We started with ductless and zoning — and have since expanded into staged heating, hybrid systems, and grid integration.

Who we work with

Distributors

F.W. Webb Company · SupplyHouse.com · Johnstone Supply · Ferguson · Winsupply · The Granite Group · S. G. Torrice · Sid Harvey's · Gensco · Homans Associates · EMCO HVAC · National Energy Equipment Inc. · Robinson Supply · CE

Technology / Smart Home / Thermostat Companies

ecobee · Honeywell · Nest · bryant · Carrier · LENNOX · Olimpia Splendid · works with alexa · works with Hey Google · Control4 · Home Assistant · DAIKIN · sensi

Energy Providers and Managers

Pacific Gas and Electric Company · SDGE · Southern California Edison · conEdison · Portland General Electric · NYSERDA · efficiency MAINE · PSEG · EnergyTrust of Oregon · mass save · Efficiency Vermont · openADR Alliance · leap · energize CONNECTICUT · MMWEC · NEXTZERO

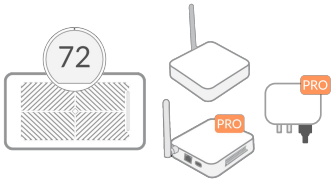
OEMs

DAIKIN · Panasonic · FUJITSU · MITSUBISHI ELECTRIC · LENNOX · GREE · LG · BOSCH · HITACHI · Midea · SANYO · 200+ BRANDS

Flair **hvac**OS™ Solutions

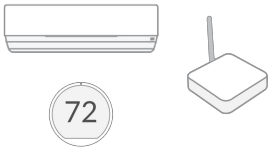
FLAIR

ZONING & AIR BALANCING



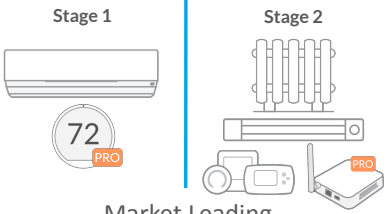
High Performance and
Affordable Zoning

DUCTLESS CONTROLS



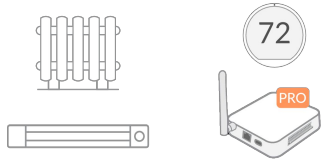
Truly Wireless
Universal Control

STAGED HEATING



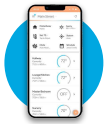
Market Leading
Integrated Controls

SMART HEATING CONTROL



First Party Boiler / Electric
Baseboard Stat

SOFTWARE PLATFORM - hvac**OS**™



Flair App
User & Control Interface
Pro Interface

Smart Thermostat and Sensor Integration
ecobee, Nest, Honeywell Home, Sensi configured in Flair app

Smart Home Integration
Alexa, Google Assistant, Control4, Crestron, Home Assistant

Demand Response
Utility Load Management
Fleet Program Support
Flair API, OpenADR 2.0b

What we'll cover today

A look at why ductless heat pumps need a different demand response playbook — and what's standing between them and meaningful grid participation.

1. **Why ductless is different**
   Scale, distribution, zonal control, and how mini-splits actually live in homes.
2. **Lessons from the field**
   What we've seen in deployment — including a 2020–22 study with Energy Trust of Oregon and PGE.
3. **The structural barriers**
   Measurement, qualification, and program design gaps that lock ductless out today.
4. **A technical agenda for unlocking it**
   Inverter-aware control, ramped recovery, synthetic runtime, and program design choices.

A fast-growing load the grid hasn't fully met

Ductless adoption is climbing while the region's peaks shift toward winter heating. The result is a large, distributed, behind-the-meter resource that DR programs haven't been designed to use.

Fastest	Winter	Untapped
growing hvac electrification segment in the NW residential sector	peaks driven by heating electrification, not summer cooling	as a DR resource — most programs target central HVAC

Big resource, wrong tools

THE OPPORTUNITY

- Distributed flexibility behind every meter
- Strong coincidence with NW winter peaks
- Installed base nearing critical mass
- Granular, zone-level control inherent to the equipment

THE GAP

- DR programs designed around central HVAC
- Proprietary, inverter-driven controls
- Outside ENERGY STAR + utility marketplace structures
- Blunt setbacks degrade efficiency and comfort

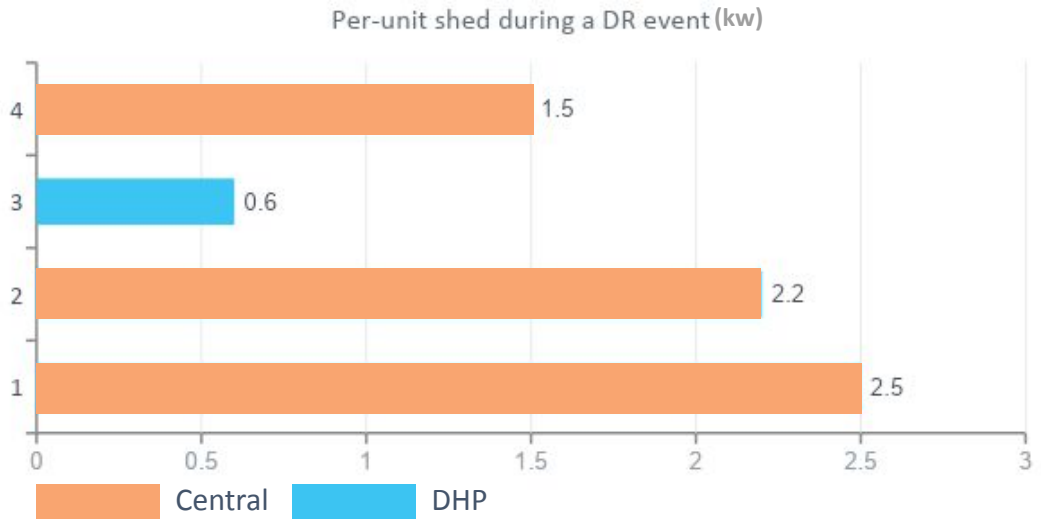
PART ONE

Why ductless is different

It's not just a smaller central system — it behaves differently, lives in homes differently, and breaks DR program assumptions.

One big load vs. many small ones

Central HVAC steps in 1–3 kW chunks. A ductless head is a fraction of a kilowatt — and a home may have several of them, each with its own setpoint and schedule.



THE TAKEAWAY

Smaller per-unit loads aren't a problem — they're an opportunity.

In many ways, DHPs are more suitable to DR because they are smaller and zonal by nature.

Comfort as a feature, not a constraint

Each head is its own zone. DR doesn't have to be whole-home — bedrooms, offices, and living spaces can respond differently based on occupancy and preference.

Room-by-room

Condition only what's occupied — empty bedrooms can ride through events.

Differentiated response

Living room holds setpoint; bedrooms defer recovery until after peak.

Targeted shed

Trim load where it matters least to the occupant — not uniform across the home.

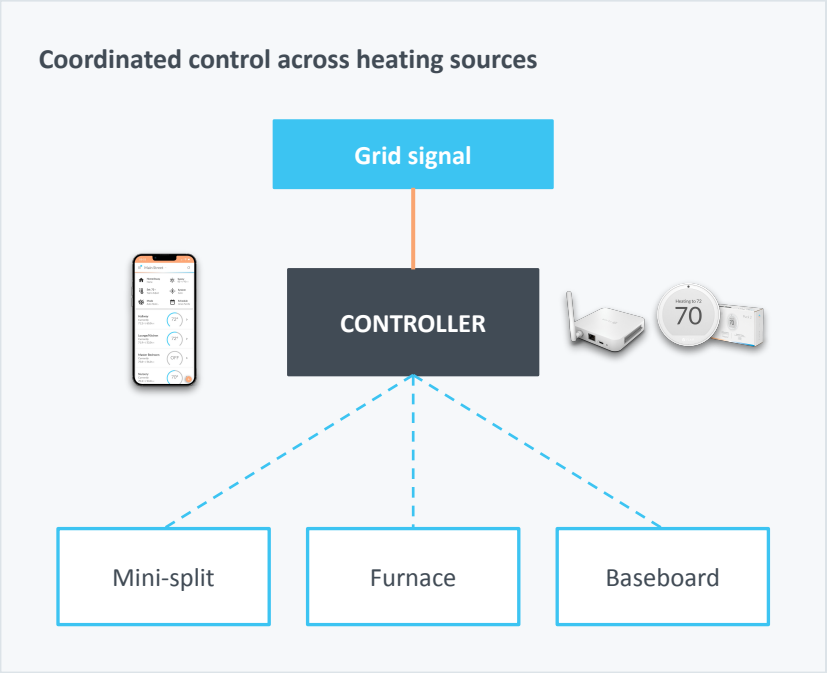
Higher acceptance

Customers stay comfortable where they are, so DR participation sticks. Comfort trade off of traditional DR is major driver of enrollee attrition (10-20%).

Most homes aren't all-(efficient)-electric — yet

Many ductless homes still have legacy heating: gas furnaces, boilers, baseboard, electric resistance. A modern control layer can coordinate across them — running the heat pump when the grid is happy, falling back to alternatives when it isn't.

- **Fuel switching —** Shift heating load off-peak using available alternatives.
- **Preserve comfort —** No setpoint sacrifice — the home stays at temperature.
- **Optimize across assets —** One controller orchestrates multiple systems.



Controller, not thermostat: a subtle distinction

This nuance matters — for product design, customer expectations, and DR participation. Most ductless head units run their own thermostatic loop internally; an external control sends setpoints, not commands.

CENTRAL HVAC THERMOSTAT	DUCTLESS CONTROLLER (ORIGINAL)
Reads room temperature, decides when to call for heat or cool, drives the equipment directly.	Sends setpoint to head unit. The head's return-air sensor and onboard logic decide what to do. The user asks for 75°F and gets 70°F — and assumes the controller is broken.

Today, Flair's Puck 2 has its own thermostatic control loop — observing actual room temperature and applying offsets so the user gets what they ask for.

How mini-splits actually live in homes

Field experience reveals deployment realities that controls alone can't fix — but that controls have to design around.

Single-head ≠ whole-home comfort

American consumers coming from central HVAC routinely don't realize a single mini-split can't condition a complex floor plan.

Partial vs. full load matters

Zonal overlap with existing systems determines real impact. Unexplored opportunities exist to leverage central blowers.

Decommission vs. coordinate

Many users keep functional legacy systems. Smart controls have to handle both — and guide users toward sensible operating patterns.

Hidden new AC load

Mini-splits in homes that didn't have AC bring new cooling load. Invisible to load forecasting if not anticipated.

PART TWO

Lessons from the field

The physics, the pilot, the customers, and what we built next.

Modulation changes the equipment, not the building

THE MYTH

“Inverters can't shift load.”

The reasoning: inverter compressors modulate continuously, so they don't have the on/off cycles that traditional DR strategies act on.

THE REALITY

Building physics are unchanged.

Heat loss = envelope + setpoint + weather. That equation doesn't care whether the compressor is fixed-speed or modulating. Load shifting is still possible — the control strategy just has to fit how the equipment runs.

THE REAL QUESTION

Not whether we can shift ductless load —

but how we shift it.

~~*Hard setbacks*~~	~~*Aggressive recovery*~~	~~*On / off thinking*~~
Gradual modulation	**Staged recovery**	**Inverter-aware control**

A real-world data point: Energy Trust + PGE, 2020–22

We participated in a coordinated research project run by Energy Trust of Oregon, with a demand response component through the PGE Smart Grid Test Bed. Important context for what the data does — and doesn't — say.

WHAT IT SHOWED

- Load-shifting capability confirmed
- 0.33 kW summer / 0.27 kW winter avg shed
- Connectivity + self-install were the dominant pain points

IMPORTANT CAVEATS

- Flair platform was earlier-stage (first DR integration)
- Ductless market itself was less mature in 2020
- COVID scrambled baseline behavior — remote work shifted home-use patterns mid-study

Source: Evergreen Economics, "DHP Controls Coordinated Research Project Evaluation," for Energy Trust of Oregon, June 2022.

What's changed since

Bridge, 2024

Bridge Pro, 2025

Puck 2, 2026

Five years is a long time in this space. The product, the platform, and the program design playbook have all matured. Here are examples of how our platform has evolved to give a sense of how fast this sector is changing.

New chipsets + Ethernet

Modern radios resolve mesh-router compatibility; Ethernet via Bridge eliminates Wi-Fi as a single point of failure.

Reverse-lookup IR codeset

Puck 2 identifies the unit instantly from any handset — no more “my model isn't in the app.”

Productized Bridge architecture

From one-off pilot bridge to a general-purpose platform device for fleet deployment.

Controller → thermostat

Puck 2 closes the loop locally so the user gets the temperature they ask for.

Expanded equipment coverage

Boilers, electric baseboard, and multi-system staging — orchestrated through a single platform.

Multi-utility DR experience

Multiple DR programs operating across the country since 2022. The first integration is no longer the only one.

Pilot participants aren't early adopters

A genuine challenge for any utility ductless DR pilot — and one we underestimated when we entered the Energy Trust study.

WHO BUYS DUCTLESS CONTROLS	WHO ENROLLS IN A UTILITY PILOT
Self-selecting tech enthusiasts. Researched the product, came in with expectations, troubleshoot their own setup. High patience for novelty.	Whoever responds to the recruitment letter. Retirees, casual users, people who'd never have bought the product otherwise. Low expectations of self-install complexity.

Implication: program design and vendors must assume the median customer, not the early adopter — this raises the bar for simplicity AND implies that controls installed with equipment installation can be a good way to reduce the burden on participants.

PART THREE

Structural barriers

Three places where existing frameworks can't see modern equipment — so modern equipment can't participate.

Why ductless is locked out of today's programs

Three distinct gaps — measurement, qualification, program design — combine to keep ductless out of DR programs that should be using it.

01

Measurement

Runtime-based M&V can't read modulating equipment. Inverter HVAC has no clean binary signature.

02

Qualification

ENERGY STAR thermostat program doesn't recognize communicating controls — and DR programs lean on ENERGY STAR.

03

Program design

Electrification programs and DR programs aren't talking. Value-stacking opportunities go missed at install time.

Measurement: runtime can't see modulation

Runtime works as a load proxy because legacy equipment cycles binary on/off. A compressor calling for heat = a kW step you can see in interval data. Modulating equipment breaks that signature.

Same total energy, same load impact — but inverter equipment has no clean step change to count. Without a runtime equivalent, modulating loads are illegible to programs designed around it.

Qualification: the ENERGY STAR gap

ENERGY STAR's thermostat program doesn't recognize communicating controls — and a lot of utility DR program plumbing leans on ENERGY STAR as the front door.

1

The product

High-end ducted and nearly all ductless HVAC equipment is communicating.

2

The certification

ENERGY STAR thermostat program is built around runtime metrics. Communicating controls don't fit the framework.

3

The market access

Many utility DR programs use ENERGY STAR as the qualifying threshold. No badge, no marketplace, no enrollment path.

Net effect: the highest-end equipment — and the controls that would best serve grid integration — are the ones structurally locked out of program participation.

Program design: electrification ≠ DR

In many regions, the electrification team and the load-flex team don't talk to each other. Sometimes literally different organizations. The result: every install is a missed value-stacking opportunity.

TODAY	WHAT SHOULD HAPPEN
Heat pump deployed for electrification mandate	Install includes DR-ready controls by default
DR program never contacts the customer at install	Customer enrolls in DR at install time
Months later, separate recruiting effort attempts to enroll	Both programs share the install + enrollment cost
Many homes never enroll	Heat pump becomes a grid asset on day one

Built for thermostats, not for fleets

Today's DR frameworks assume a single thermostat per home, binary control, and central HVAC.

Measurement & verification was designed around that picture: predictable kW shed per device, simple baselines, on/off events. Ductless breaks every assumption — many small zones, modulating loads, fleet-level orchestration.

ASSUMPTION → REALITY

~~*One thermostat per home*~~	→ **Many zones per home**
~~*Binary on / off control*~~	→ **Continuous modulation**
~~*Single-device M&V*~~	→ **Fleet-level orchestration**

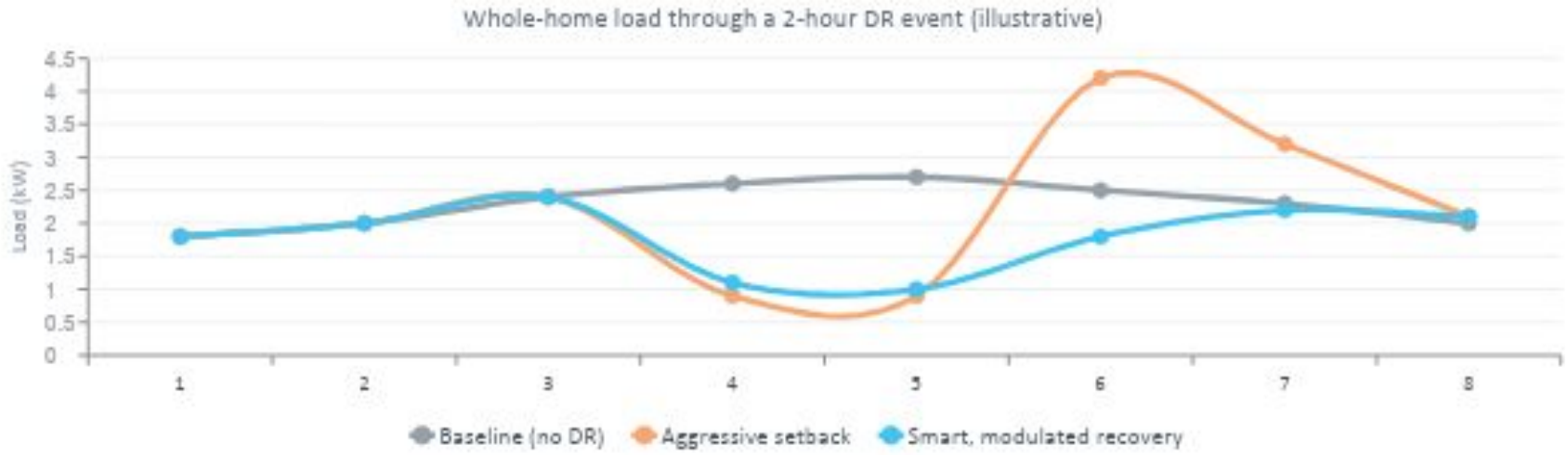
PART FOUR

A technical agenda

Specific approaches that close the gap — and why they don't require wholesale program restructuring.

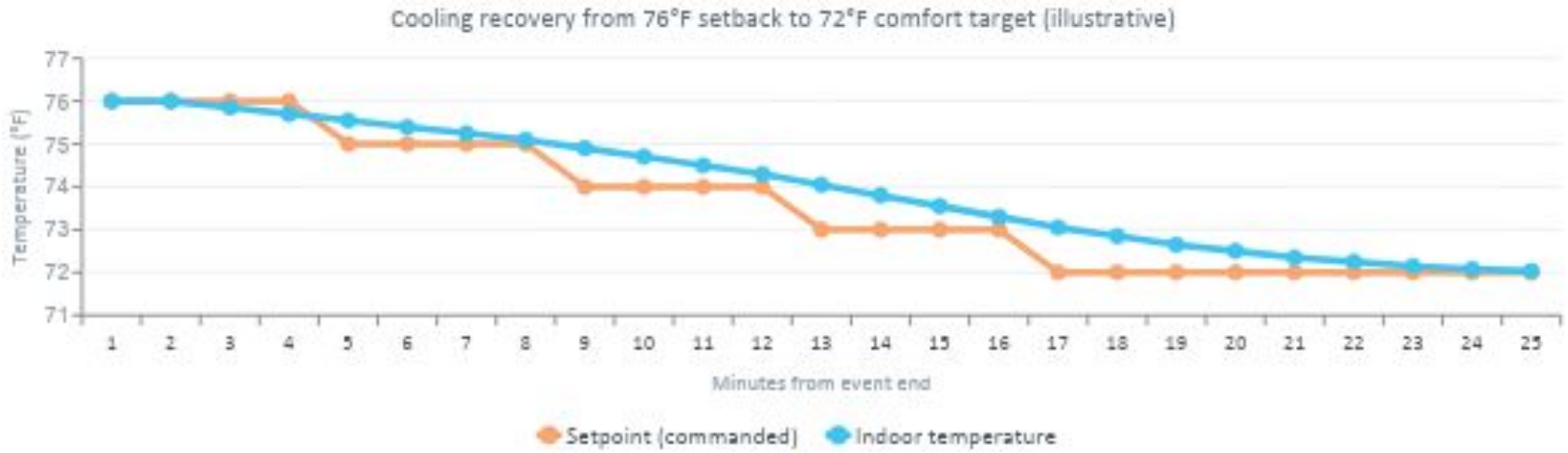
Avoid the rebound — don't just dodge the peak

After a DR event, blunt strategies snap setpoints back, creating a recovery spike that can erase the savings. Inverter-friendly recovery ramps gradually, holding peak relief beyond the event window.



Ramped recovery: walk the setpoint back

Instead of a single setpoint snap, the controller advances the setpoint in small steps as the room responds — keeping the heat pump in its efficient modulation band rather than driving it to high capacity.



Stage-aware setback in hybrid homes

If recovery will be served by auxiliary heat (resistance, gas), deeper setbacks are fine — there's no inverter-COP penalty. If it'll be served by the heat pump, ramp it. Some users may be OK with spending more to recover faster.

HEAT PUMP RECOVERY EXPECTED	AUXILIARY RECOVERY EXPECTED
Limit setback depth	Deeper setbacks are fine
Use ramped recovery to stay in efficient band	Conventional fast recovery is OK
Start recovery earlier to allow gentler ramp	Optionally invoke auxiliary stage to meet deadline

Same building, two strategies — chosen automatically based on outdoor temp, lockout thresholds, occupancy, and cost/carbon signals.

Synthetic runtime: a legibility shim

Programs don't actually need runtime — they need aggregate load impact. A physics-based equivalent runtime lets inverter equipment participate in existing runtime-based DR frameworks without wholesale program restructuring.

Inputs

Indoor temp, setpoint, outdoor temp, rated capacity. All temperature-based — no power telemetry required.

Computation

Outdoor severity term + indoor comfort gap term, normalized by rated capacity. Calibrated regionally.

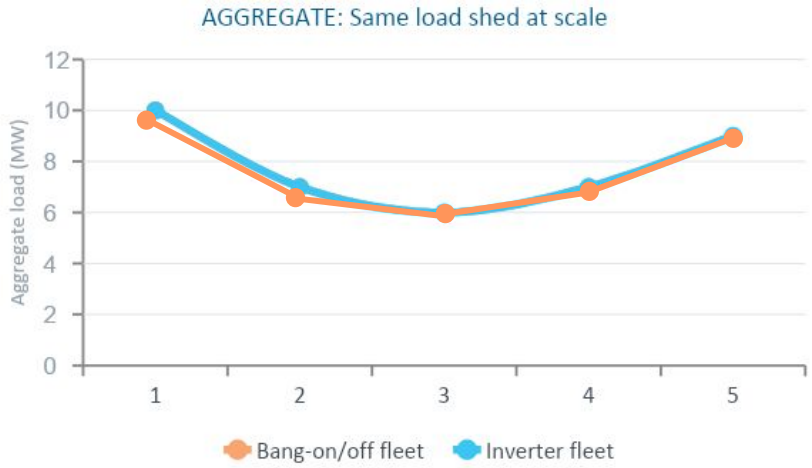
Output

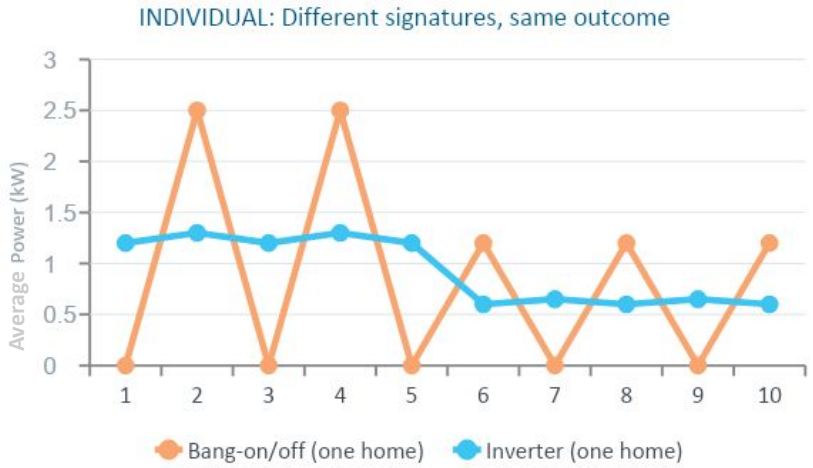
Equivalent Full-Load Minutes (EFLM) — directly analogous to thermostat runtime, usable by existing M&V.

The grid doesn't care whether your equipment was binary or modulating — it cares that load went down.

Same impact at scale, different stories per home

At population level, modulating and bang-on/off equipment deliver equivalent grid impact during a DR event. At individual-meter level, modulating equipment is illegible to runtime-based M&V — until synthetic runtime translates it.





Synthetic runtime gives the inverter equipment the same kind of legibility the on/off equipment has — without changing what the program is fundamentally measuring.

Third Party ductless control vs Third Party Ducted

Most third-party ductless controllers (including ours) connect via IR.

WHAT IR GIVES YOU

- No wiring, no equipment derating
- Universal across nearly all mini-splits with handsets
- Fast, clean, line-of-sight pairing
- No RF cross-talk between rooms

WHAT IR DOESN'T GIVE YOU

- One-way comm — no feedback from the unit
- No direct power telemetry (similar to ducted)

Programs need a different proxy for utilization that doesn’t rely on runtime and doesn’t rely on getting runtime out of smart meters

Synthetic runtime is the answer to this gap

Many small loads, meaningful capacity

Each mini-split contributes a fraction of a kilowatt — but at fleet scale, they aggregate into a virtual power plant that grows alongside electrification.

0.6 kW

Per single-zone unit, typical DR shed

10,000

Units to deliver ~6 MW of dispatchable flex

300,000+

Est. installed ductless heads across the NW residential base

Illustrative figures based on typical per-unit shed and regional installed base estimates.

WHY NOW

The installed base is here.
The technology is ready.
The grid is asking.

Programs can shape the outcome — or be shaped by it.

Pilot ductless-specific DR

Stack electrification + DR at install

Signal demand for advanced controls

Thank you · Questions welcome

FLAIR

Thank you

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