Applying ducted, split-ductless systems

in High-Performance Homes

MITSUBISHI ELECTRIC
COOLING & HEATING

PERFORMANCE BUILDER

Presenters

Chad Gillespie
Senior Manager, Performance Construction

Kimberly Llewellyn
Performance Construction Manager

Mitsubishi Electric Trane HVAC US

Learning Objectives

Describe characteristics, requirements and objectives of high-performance design and construction

Discuss methods associated with applying split-ductless and variable-capacity ducted systems including compact duct design

Discuss how to achieve high performance by applying split-ductless and variable-capacity ducted systems together

Advise on advantages of split-ductless + variable-capacity ducted systems in areas of comfort, health and total cost of ownership

Goals for High-Performance Design and Construction

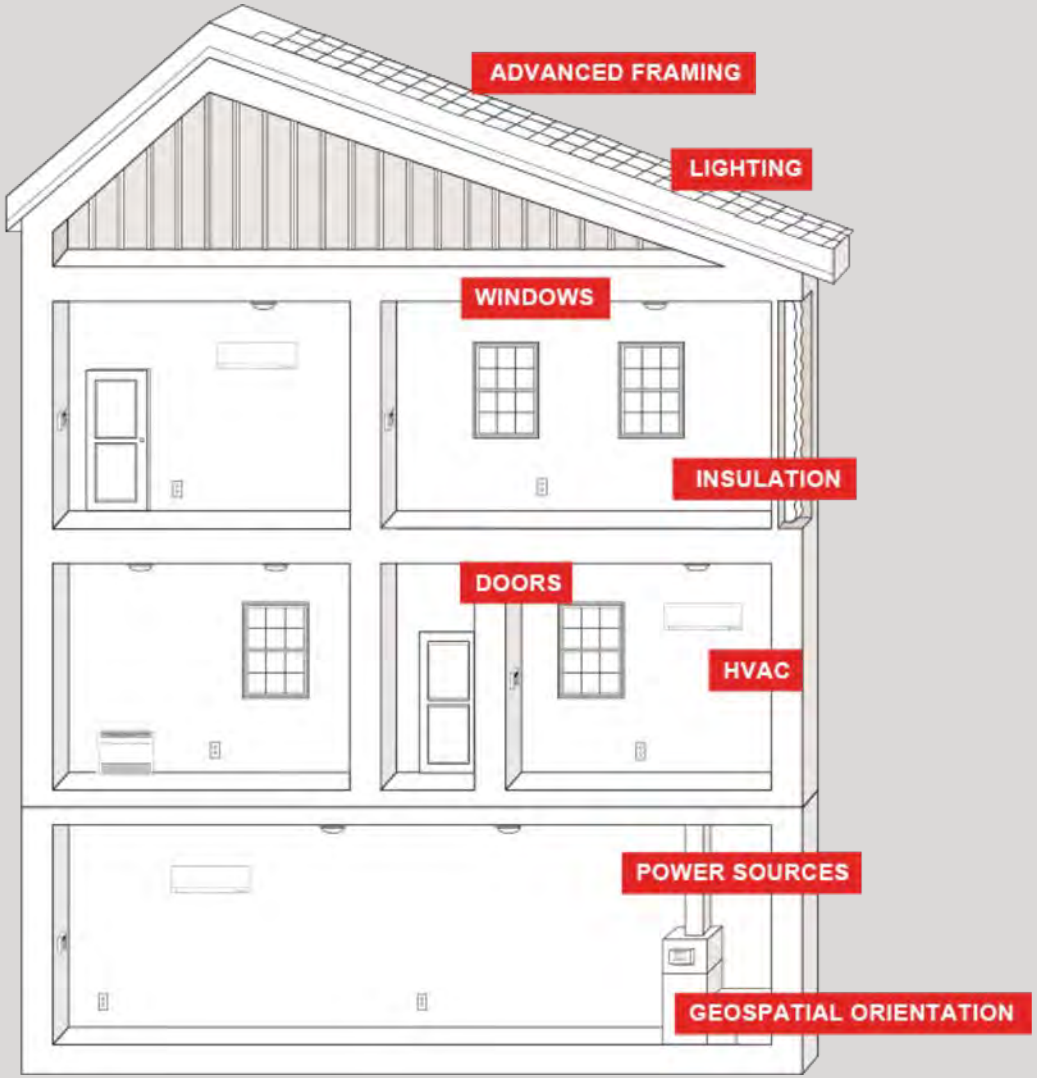
Comfort, health, efficiency, durability produced by proper design, installation of strategically-selected building components

COMFORT

HEALTH

ENERGY EFFICIENCY

Achieving High-Performance



Whole-home system design with consideration for relationships between building components, environment, solar exposure, occupant behavior

Tightly constructed envelope

More insulation, less thermal bridging

Efficient, high-performance mechanical systems

Statistics and Trends

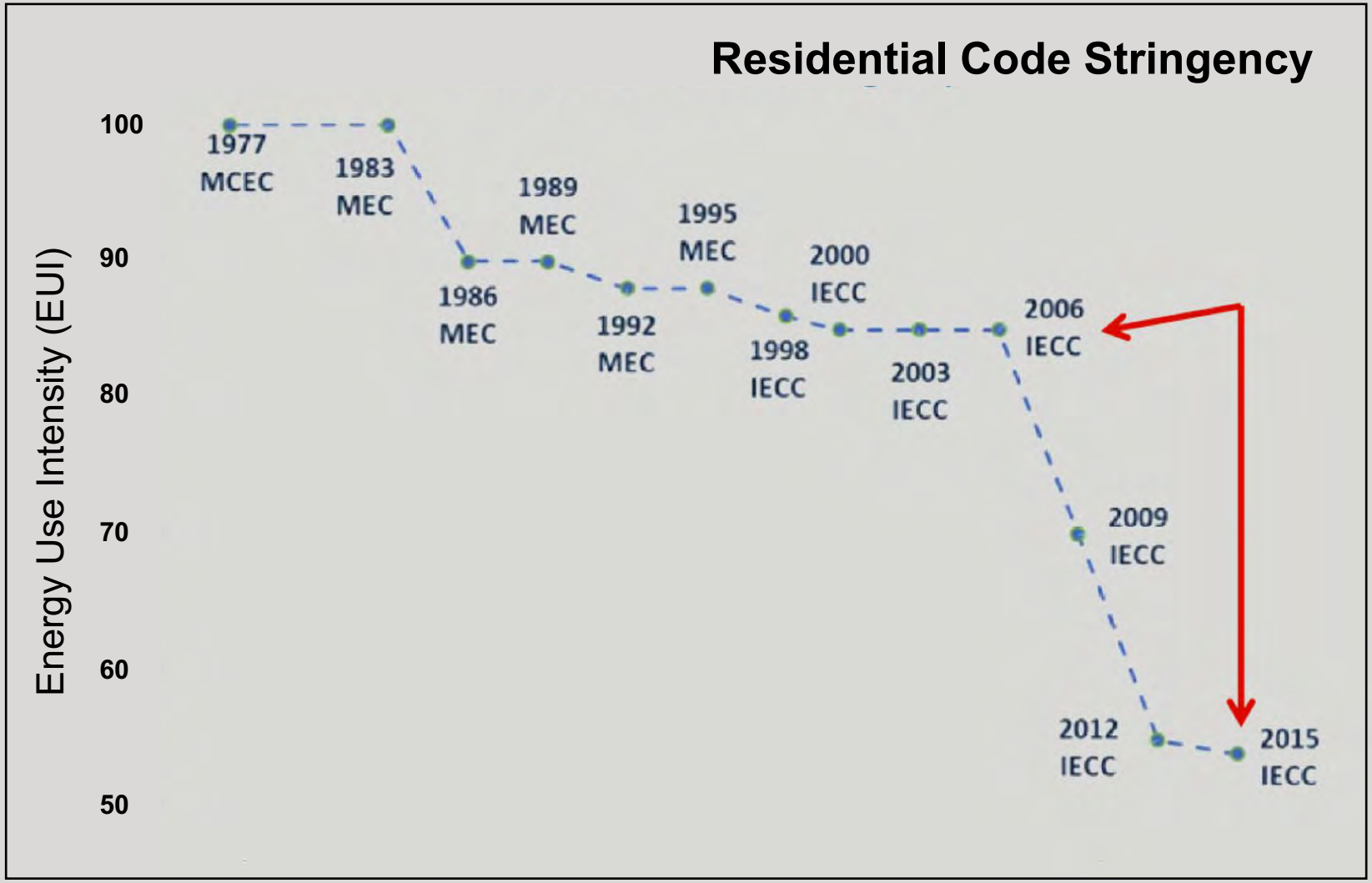
High-performance is not just for “tiny homes,” but for **homes of all types** including larger, luxury homes

26 – 33% of **newly-constructed** single-family homes*

Lower loads **driven by innovation**, new codes, programs, incentives

* McGraw Hill-Construction

More Aggressive Residential Codes



Graphic: Building Codes Assistance

Data: U.S. Department of Energy

High-Performance Building Programs

Measuring Home Performance

Improved HERS® Rating

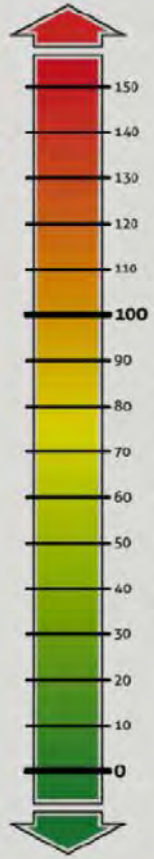
Home Energy Rating System (HERS®) Index

(100) New Construction

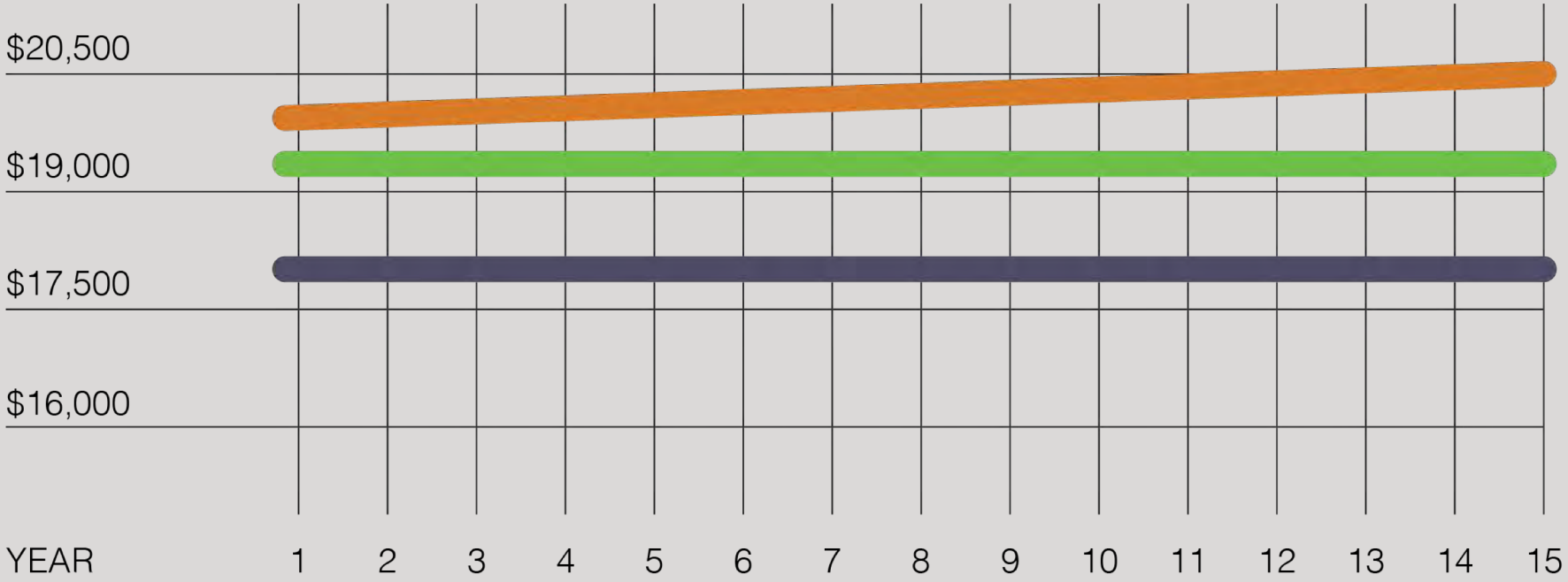
(60) ENERGY STAR Homes

(30) Passive Homes

(0) Net Zero Homes



Zero Net Energy Ultimately Costs Less



Standard Home Energy Costs Plus Mortgage

Zero Home Mortgage & Hook Up Fee

Standard Home Mortgage

$298, 798	Cost of Ownership (Standard Home)
$273, 420	Cost of Ownership (Zero Home)
$25,378	**Net Savings (Zero Home)**

The Zero Energy Project

Design Considerations

Critical design considerations for high-performance construction include:

- Proper Load Calculations
- Sensible Heat Ratio (SHR)
- Latent Loads
- Ventilation
- Equipment Selection

Design Considerations

Addressing Loads in High-Performance Homes

The Importance of Proper Load Calculations

Loads and Geospatial Orientation

Rhvac - Residential & Light Commercial HVAC Loads Elite
EcoScience LLC
Austin, TX 78704

Load Preview Report

Scope	Net Ton	ft.²/Ton	Area	Sen Gain	Lat Gain	Net Gain	Sen Loss
Building	5.05	654	3,302	56,448	4,132	60,580	73,988
System 1	3.43	574	1,972	38,833	2,372	41,205	49,524
Zone 1			1,972	38,833	2,372	41,205	49,524
11-Living/Dining			523	18,579	767	19,346	23,646

Load Preview Report

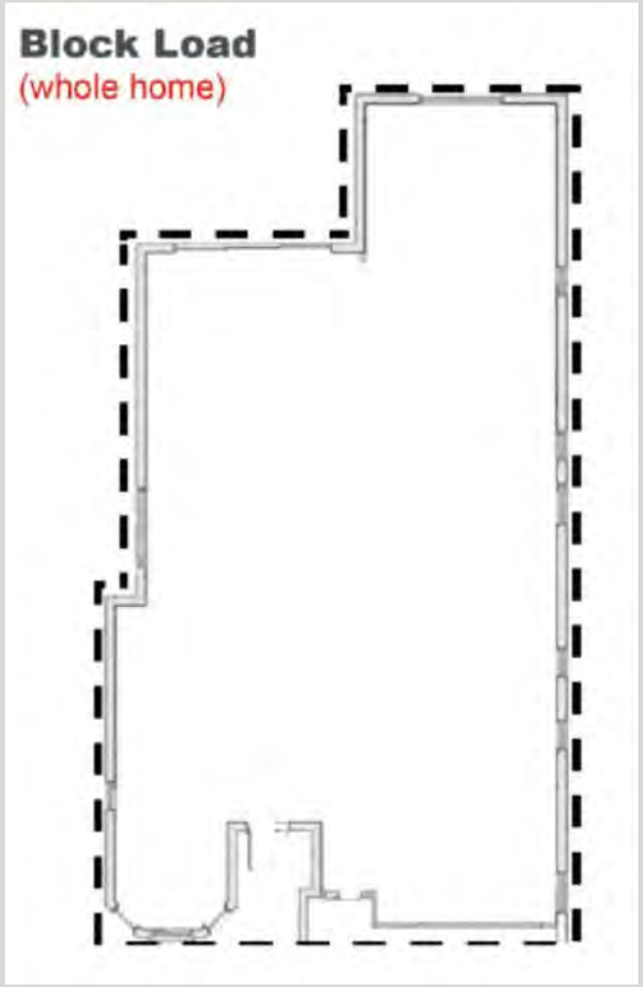
Scope	Net Ton	ft.²/Ton	Area	Sen Gain	Lat Gain	Net Gain	Sen Loss	(
Building	6.96	474	3,302	79,433	4,132	83,565	73,988	2
System 1	5.24	377	1,972	60,462	2,372	62,834	49,524	1

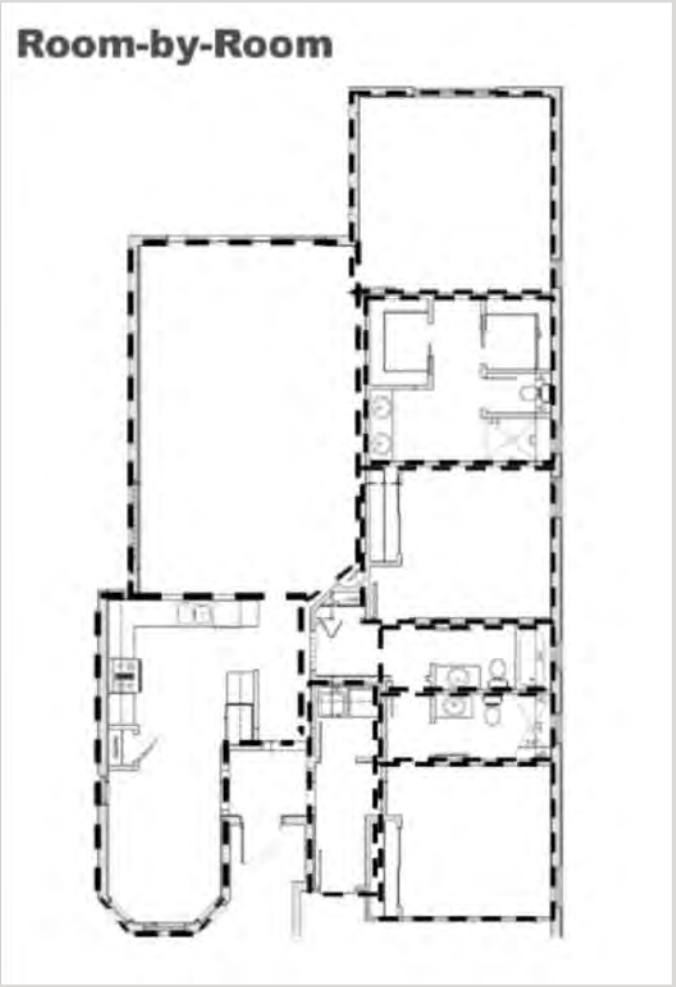
90 degree rotation in orientation

Types of Load Calculations

Load of home: Manual J®

Tonnage: Manual S®





Loads and Sensible Heat Ratio (SHR)

Weather: Richmond International AP, VA, US

Winter Design Conditions

Outside db	21	°F
Inside db	70	°F
Design TD	49	°F

Summer Design Conditions

Outside db	92	°F
Inside db	75	°F
Design TD	17	°F
Daily range	M	
Relative humidity	50	%
Moisture difference	41	gr/lb

Heating Summary

Structure	4782	Btuh
Ducts	0	Btuh
Central vent (SER=79% 40 cfm)	*452*	Btuh
Energy recovery		
Humidification	0	Btuh
Piping	0	Btuh
Equip	5234	Btuh

0.81 SHR with 45% LER
0.74 with no ERV

		nt
		0

	Heating	Cooling
Area (ft²)	995	995
Volume (ft³)	7960	7960
Air changes/hour	0.15	0.08
Equiv. AVF (cfm)	20	11

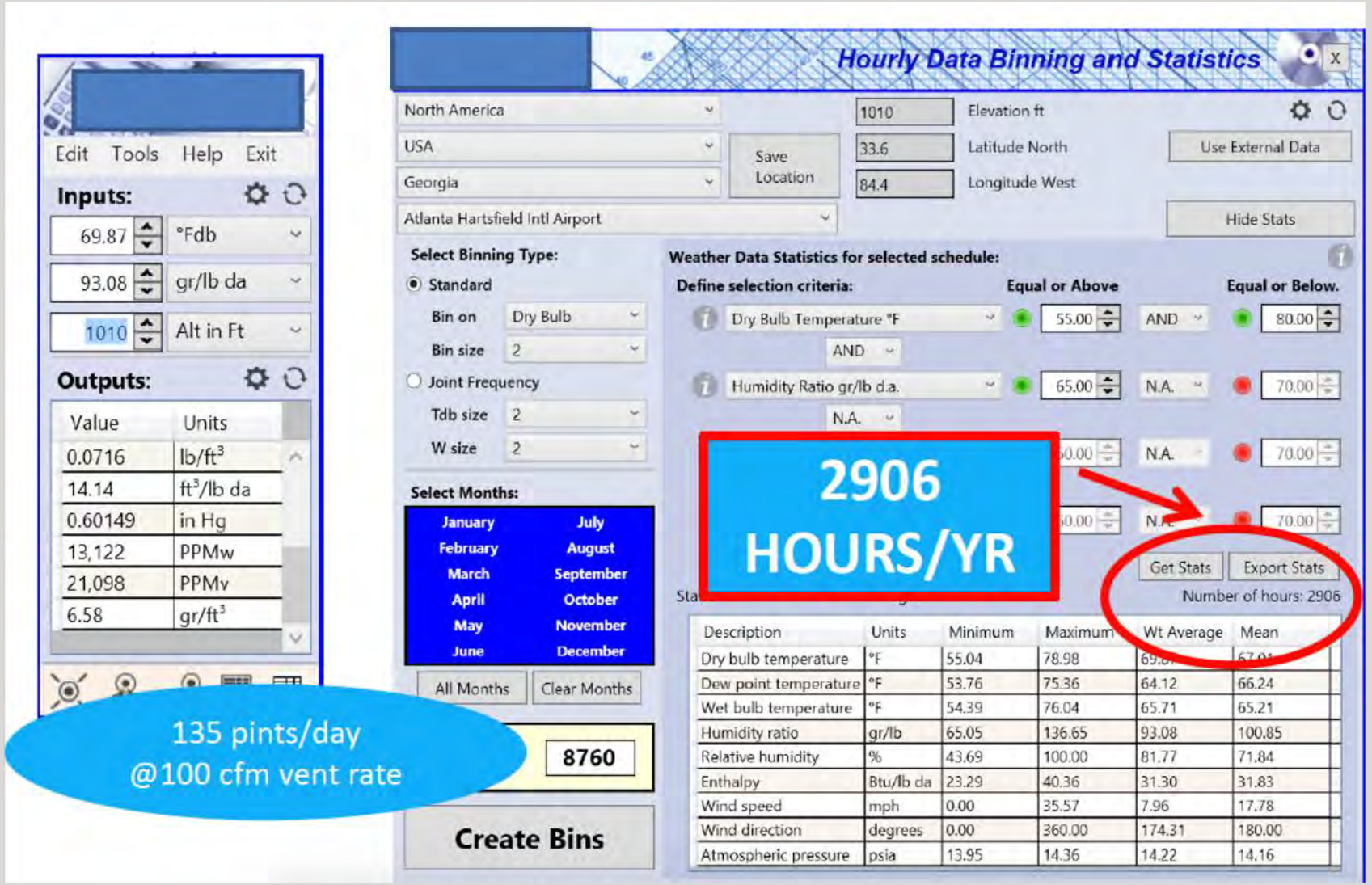
Sensible Cooling Equipment Load Sizing

Structure	6189	Btuh
Ducts	0	Btuh
Central vent (SER=40% 40 cfm)	454	Btuh
Energy recovery		
Blower	0	Btuh
Use manufacturer's data	y	
Rate/swing multiplier	1.00	
Equipment sensible load	6643	Btuh

Latent Cooling Equipment Load Sizing

Structure	896	Btuh
Ducts	0	Btuh
Central vent (LER=45% 40 cfm)	615	Btuh
Energy recovery		
Equipment latent load	1511	Btuh
Equipment total load	8154	Btuh
Req. total capacity at 0.70 SHR	0.8	ton

Latent Loads and Ventilation



Applying HVAC Systems for **High-Performance Homes**

HVAC for High-Performance Homes

MITSUBISHI ELECTRIC COOLING & HEATING | PERFORMANCE BUILDER

AIR HANDLER

SVZ 12-18 | MVZ 12-36 | PVA 12-42

CEILING MOUNT

SLZ 9-15 | MLZ 9-42 | PLA 12-42 | PCA 12-42

FLOOR MOUNT

KJ 9-18

HORIZONTAL DUCTED

SEZ 9-18 | PEAD 12-42

CONTROLS

kumo cloud®

Wireless Sensor

kumo station™

BACnet/Modbus

Thermostat Adapter

Wired and Wireless Controllers

WALL MOUNT

HM 9-24 | GL 9-24 | D 30-36 | EF 9-18 | FH 6-24 | PKA 12-36

SINGLE-ZONE

COOLING ONLY
STANDARD HP
HYPER-HEATING

MULTI-ZONE

COOLING ONLY
STANDARD HP
HYPER-HEATING

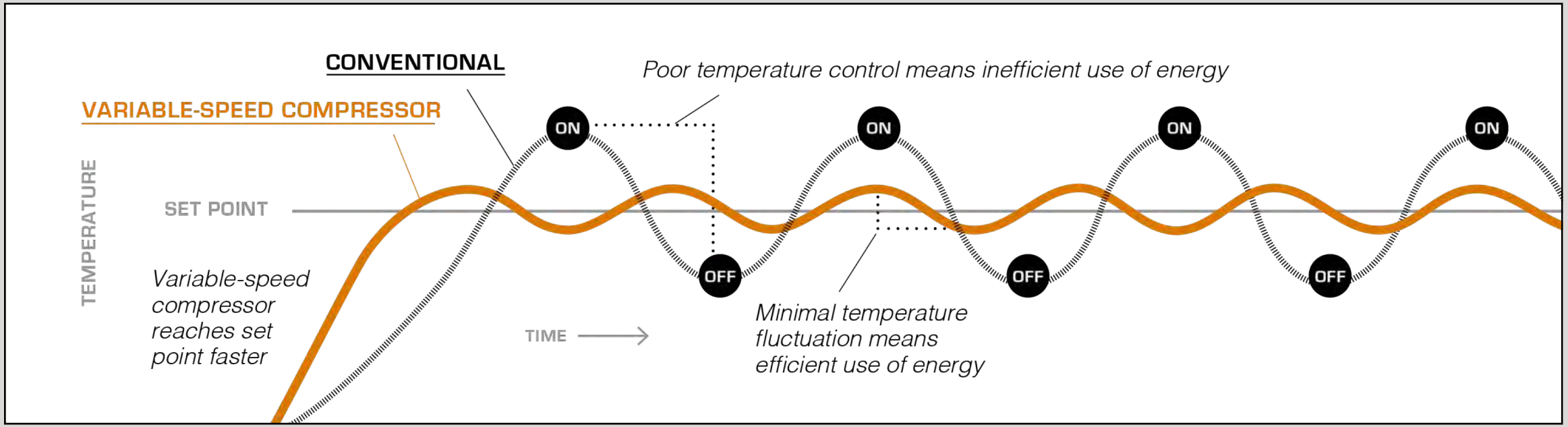
BRANCH BOX

3 & 5 ZONE

One-Way Ceiling Cassette

Increase Efficiency and Durability

Split-ductless + ducted systems with variable-speed compressors use only precise amount of energy needed to meet a space's actual load at any given point of time



Maximize Comfort with Zoning

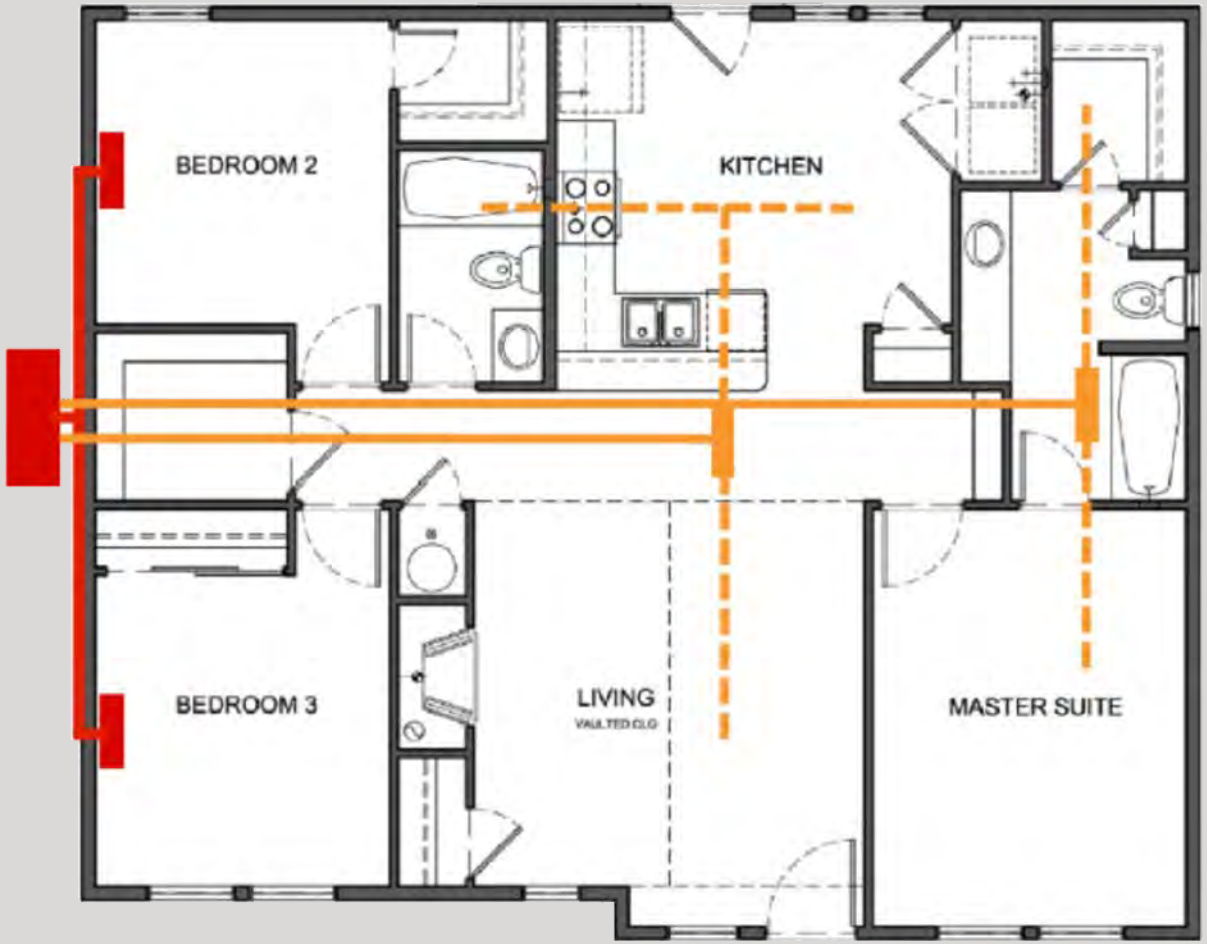
Customize comfort for homeowners with zones of various sizes

Apply ductless units in **smaller zones**; ducted units to serve floors, **larger spaces**

Each zone is **individually controlled**, served by its own indoor unit

Applying Indoor Units

Reduce Ductwork for Health, Efficiency, Durability



Variable-capacity ducted systems applied with **compact duct designs**

Centralized ducts run to interior walls, blow toward exterior walls

Shorter duct runs **easier to keep insulated**

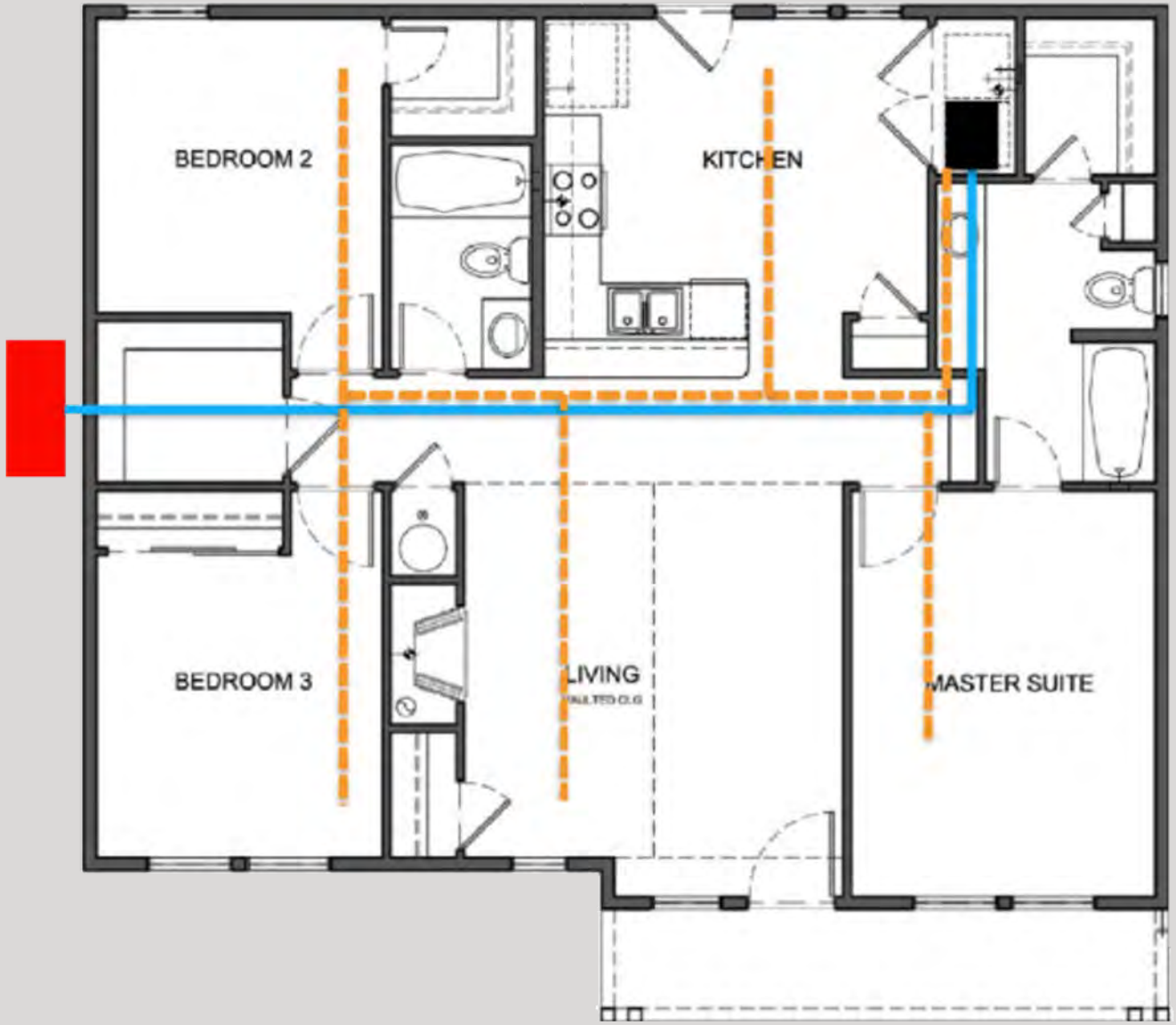
Reduce harmful particulates, energy loss

Compact register design complements compact duct design

Compact register design **directs airflow to hug ceiling plane**

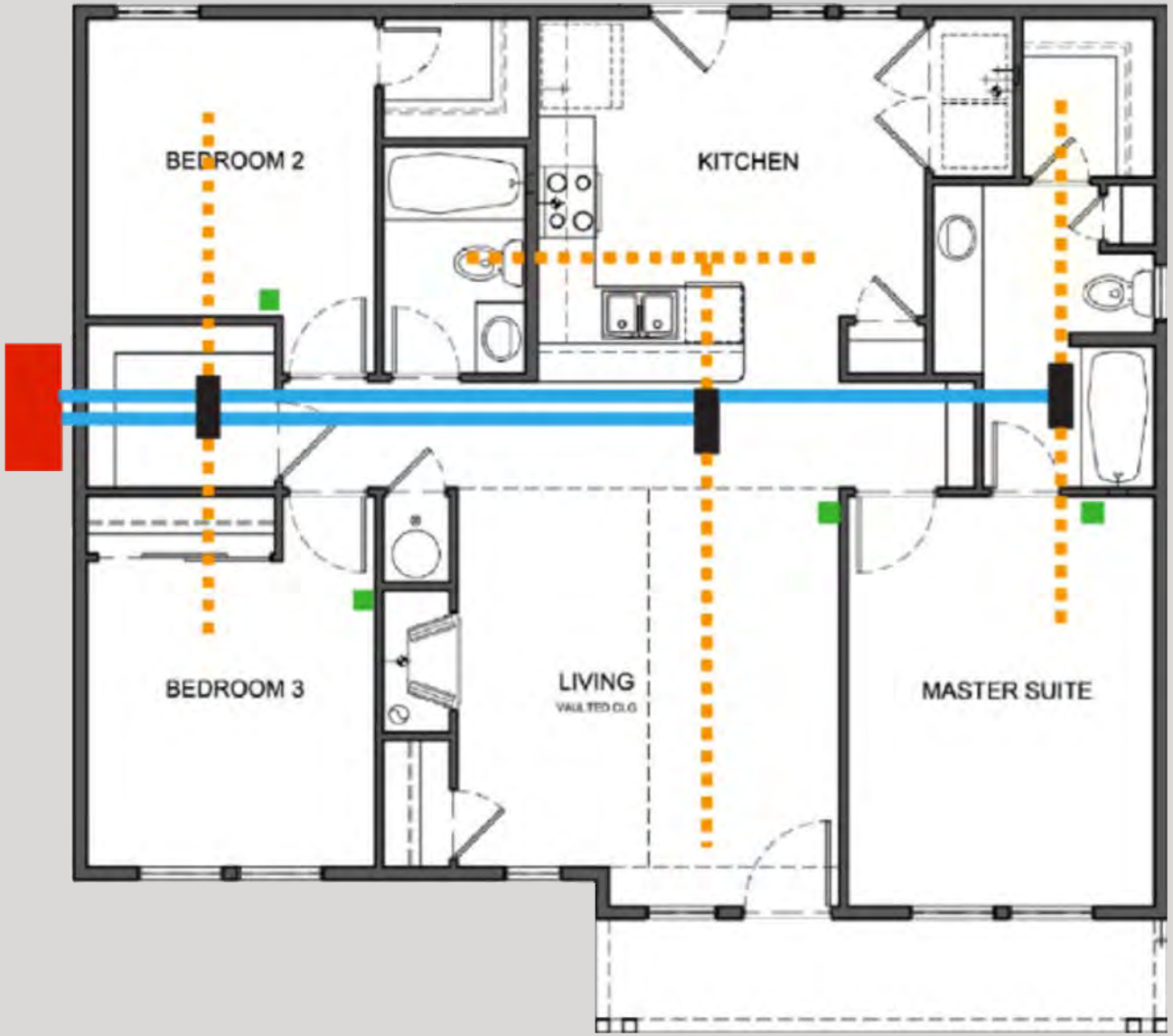
Ducted Multi-Position Air Handler

- Outdoor Unit
- Indoor Unit
- Lineset
- Ductwork
- Controller



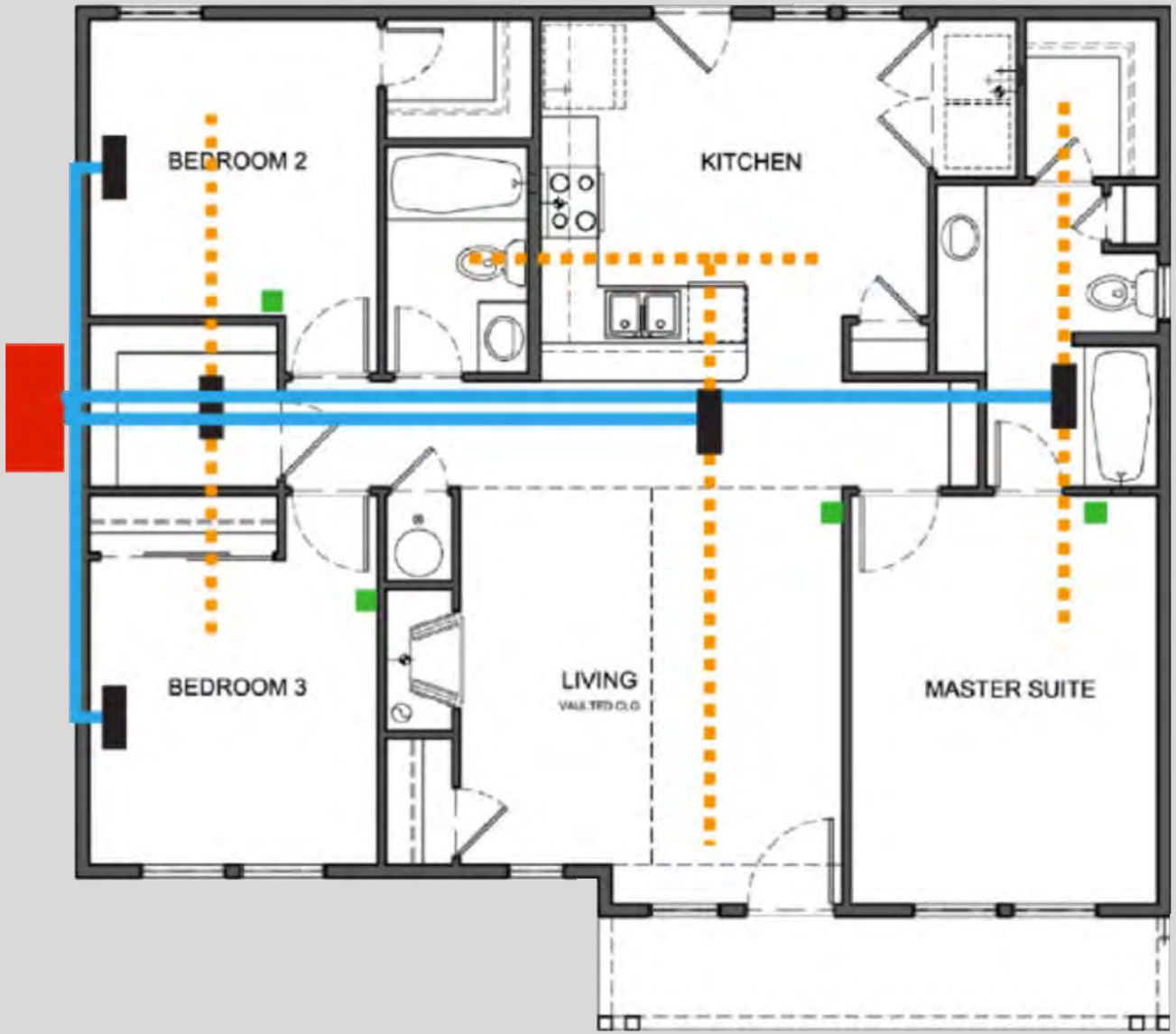
Concealed Horizontal Ducted Units

- Outdoor Unit
- Indoor Unit
- Lineset
- Ductwork
- Controller



Hybrid Design

- Outdoor Unit
- Indoor Unit
- Lineset
- Ductwork
- Controller



Integrate Ventilation System

Incoming air enters ERV, is conditioned as it passes through heat exchanger

Before being exhausted outside, stale indoor air passes through heat/moisture exchanger

Fresh air is **not mixed** with stale indoor air at heat/moisture exchanger

Humidity-balanced, conditioned fresh air may be directed to air handler or **ducted directly** to rooms

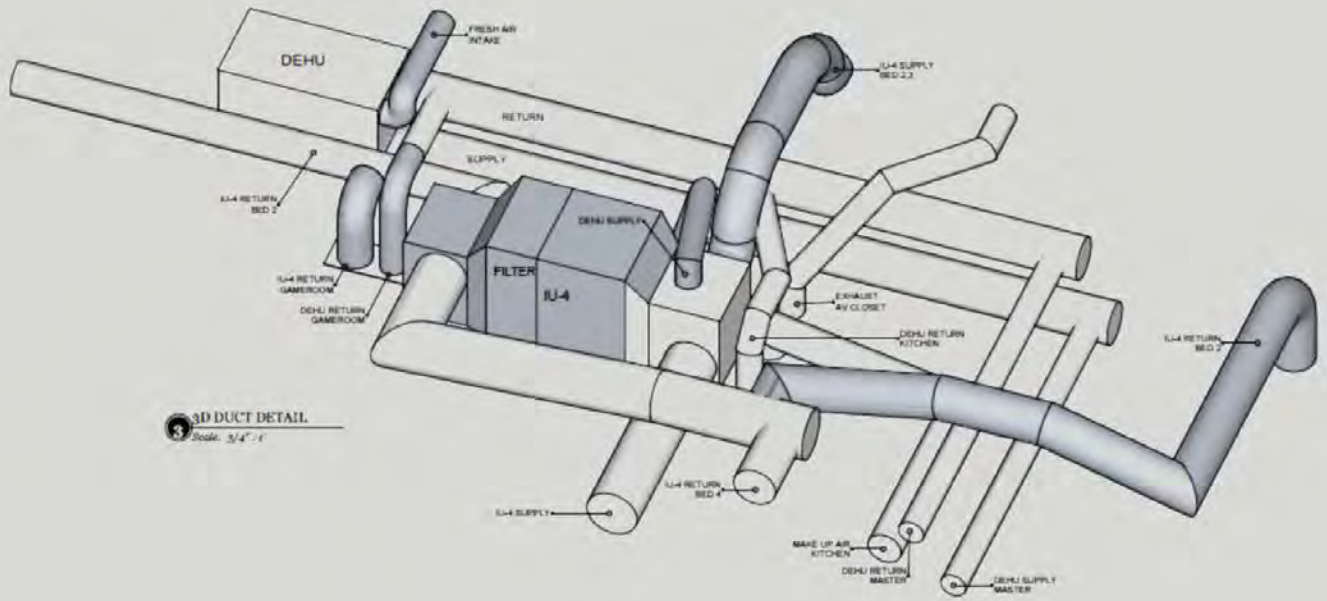


Image credit: Positive Energy, LLC

Controls to Personalize Comfort, Manage Systems

High-Performance
Application Examples

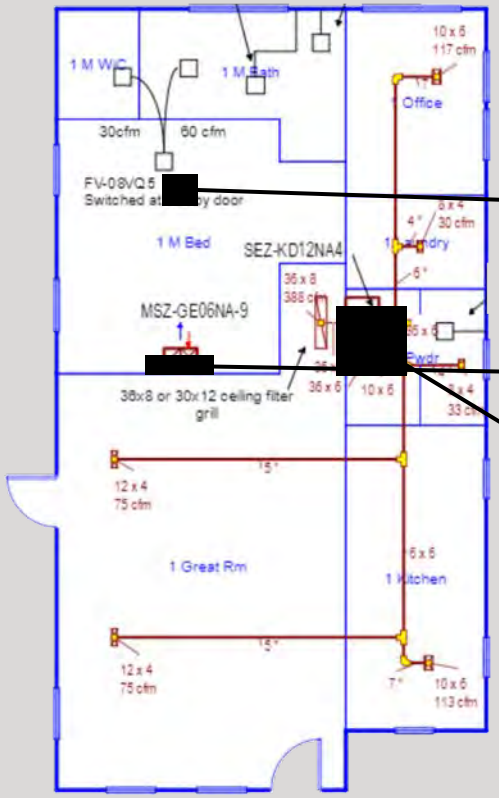
Drift House – North Carolina

1,776-square-foot,
4 bedroom home

ENERGY STAR Qualified

Green Built North Carolina

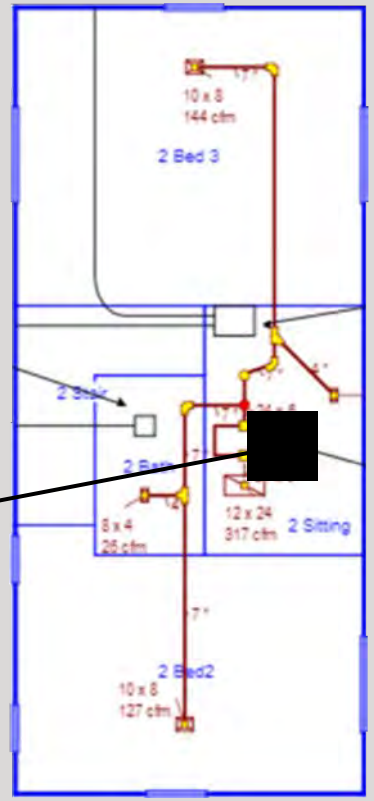
Mills Residence - Georgia



Transfer fan

GE-09

Two horizontal-ducted units



The New American Home® 2018 - Florida

Located in **Montverde, Florida**

6,600-square-foot, 3-level home

9 cooling, heating zones

3 split-ductless units, **6** ducted units

1, 2-ton single-zone outdoor unit

3, 4-ton multi-zone units

The New American Home® 2018 - Florida

Support for Builders

The Performance Builder Program at Mitsubishi Electric demonstrates how manufacturers of split-ductless, variable-capacity ducted systems can:

Provide **advanced technical training** for sales staff and project team

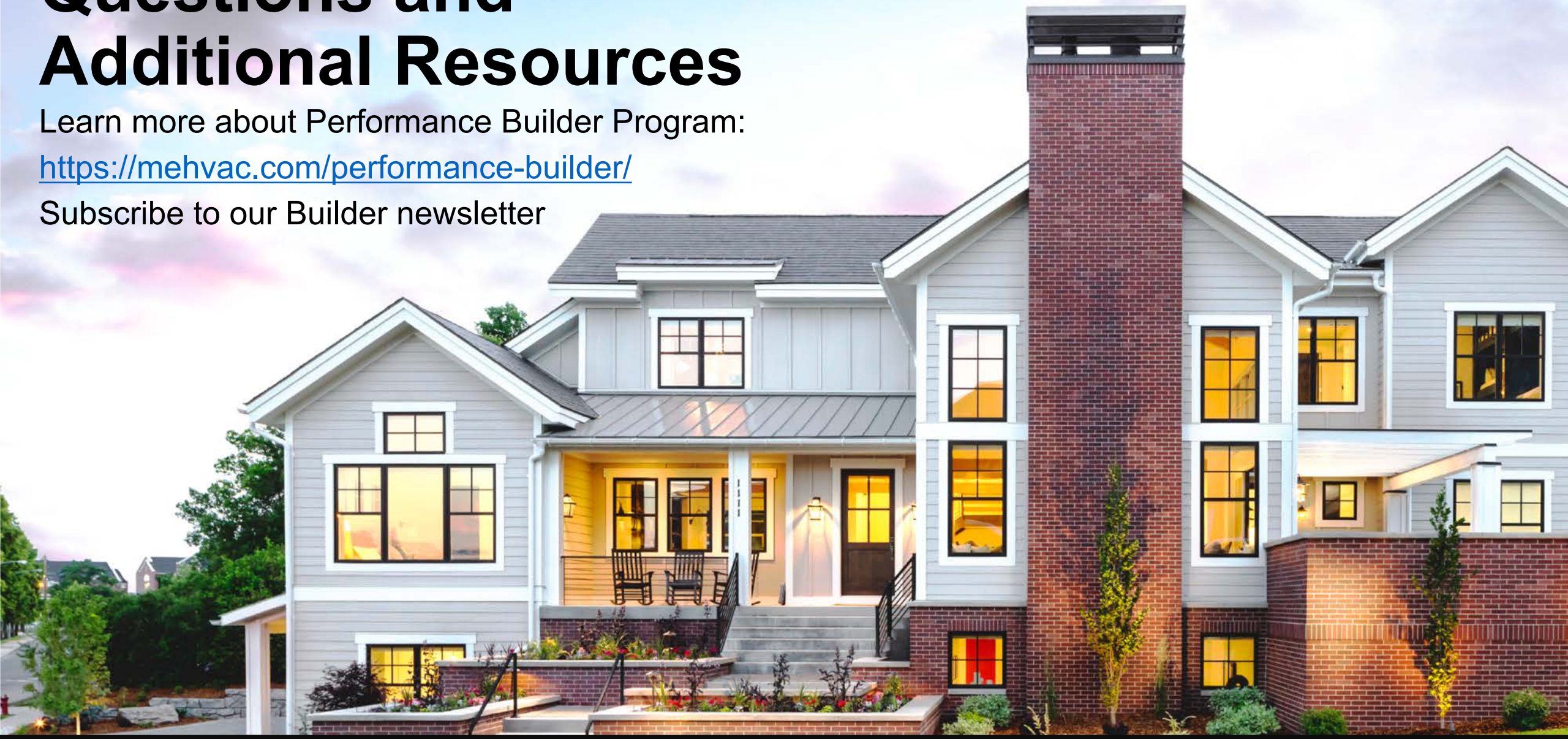
---

Provide design assistance, best practices for installation

Collaborate with HVAC contractors, architects, designers, energy raters

Questions and Additional Resources

Learn more about Performance Builder Program:

https://mehvac.com/performance-builder/

Subscribe to our Builder newsletter