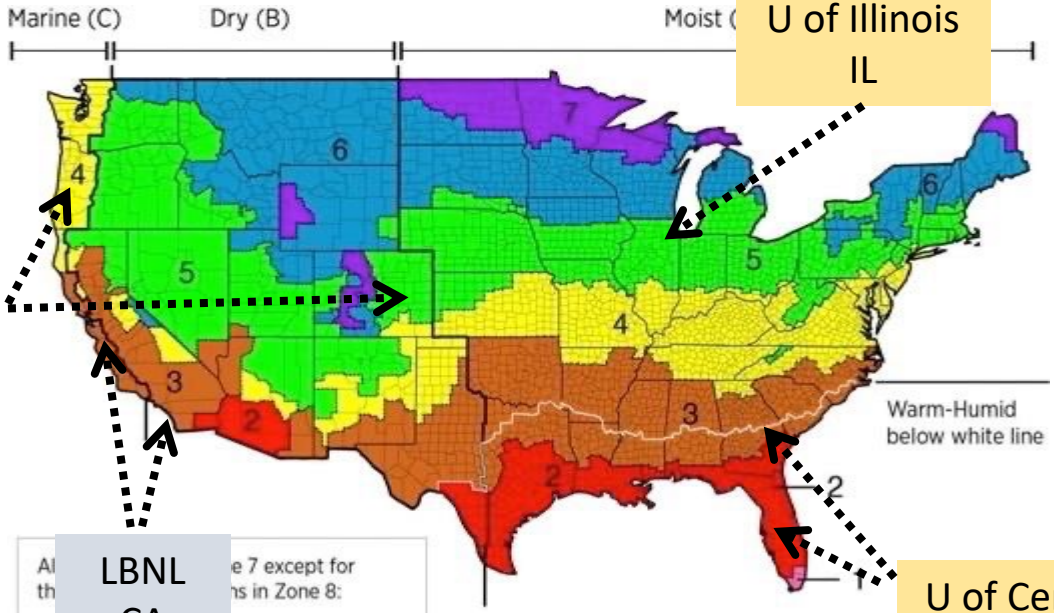
Preliminary data from New Home IAQ Study in the US

Study Sites



U of Illinois
IL

PNNL
OR, CO

LBNL
CA

U of Central FL
FL, GA, SC

Over 200 homes

Characterize home & ventilation equipment

Monitor ventilation, IAQ, activities for 1 week

Repeat with WHMV on and off in some homes

House Characteristics

Low occupant density:

- Average floor area = 230 m^2 (132-385 m^2)
- Average occupancy = 3

Not very airtight

- 3.7 ACH50 (1.9 – 6) [about 2.8 L/s/m^2 @ 50 Pa] code in some states is 3, Passive house is 0.6

90% had kitchen exhaust: 80% gas cooktop, 41% gas oven

Ventilation System Characteristics

80% had Whole House Mechanical Ventilation

- 5 ventilating dehumidifier (in humid SE)
- 14 with heat recovery
- 37 supply integrated into forced air heating/cooling
- 109 exhaust

32% operating

23% meeting ASHRAE 62.2

57% could meet ASHRAE 62.2 if turned on

Almost all exhaust systems

Equipment Monitoring

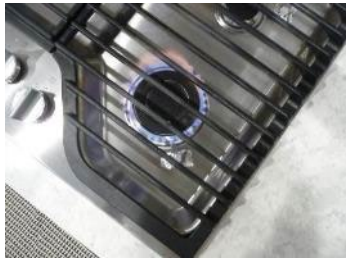
Clothes Dryer

Bath Fan

Range Hood

Heating/Cooling

Door Use: Garage,
Master Bedroom, Patio



Cooking

WH Ventilation
Runtime

Condensate
(Southeast only)

Air Quality Measurements

Photometric
Outdoor $PM_{2.5}$

Photometric
Indoor $PM_{2.5}$

Gravimetric
Indoor $PM_{2.5}$

CO_2, $PM_{2.5}$
In multiple rooms

1 minute

30-min resolved
Formaldehyde

1-week avg.
Formaldehyde

1-week
NO_2, NO_X

1 week of
hourly Radon

6-month
integrated
Radon

Subset of Homes

Clarity Real-
time NO_2

Ultrafine
particles

Air Quality Measurements (ICRT)

Master Bedroom: T/RH, $PM_{2.5}$, HCHO, CO_2

Master Bathroom and 2nd Bathroom: T/RH

Secondary Central Indoor Location: T/RH, $PM_{2.5}$, CO_2

Basement/Crawlspace: T/RH, Radon

Results Summary – One Week Average

Little impact on formaldehyde: about 23 ppb

Little impact on PM2.5: about 3.5 ug/m^3

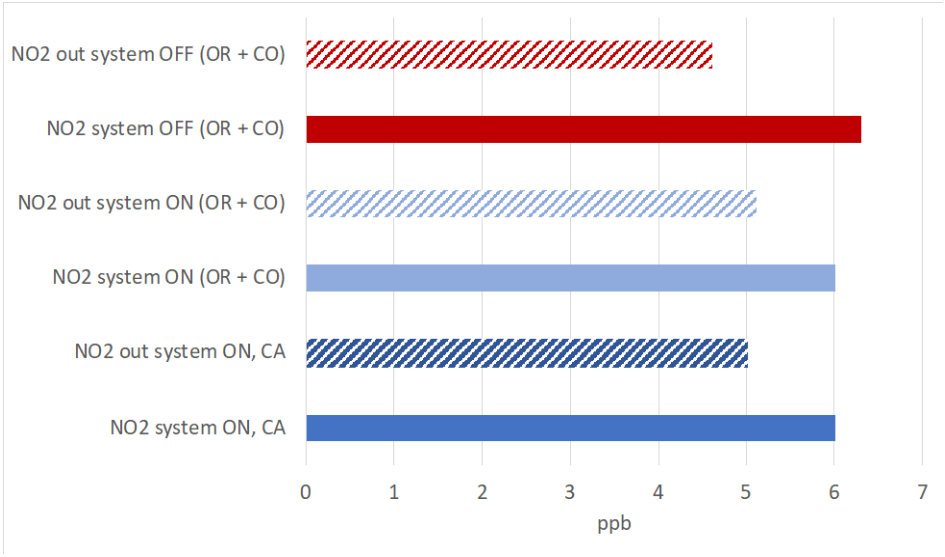
Radon reduced from 0.69 to 0.44 piC/L

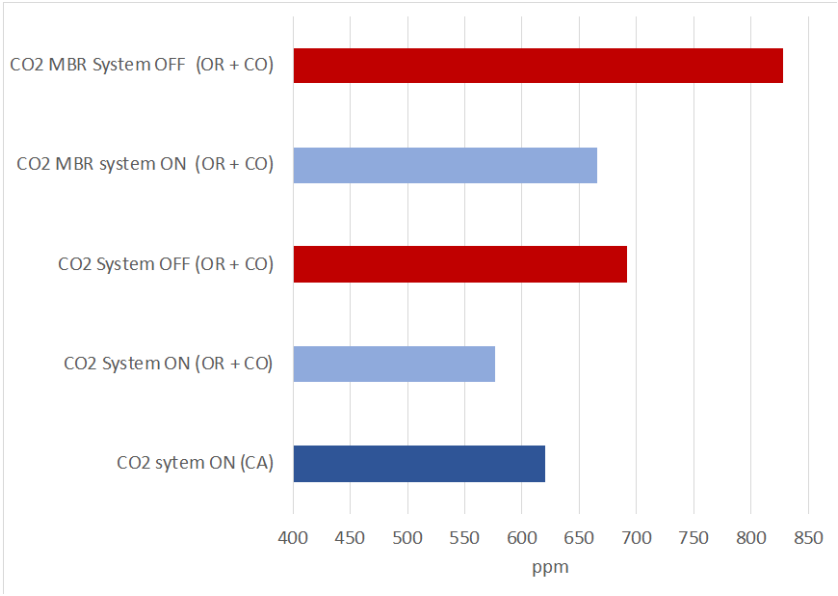
Formaldehyde WHO 80 ppb chronic

PM2.5 WHO Chronic 25 ug/m3

Radon WHO reference level 2.7 piC/L

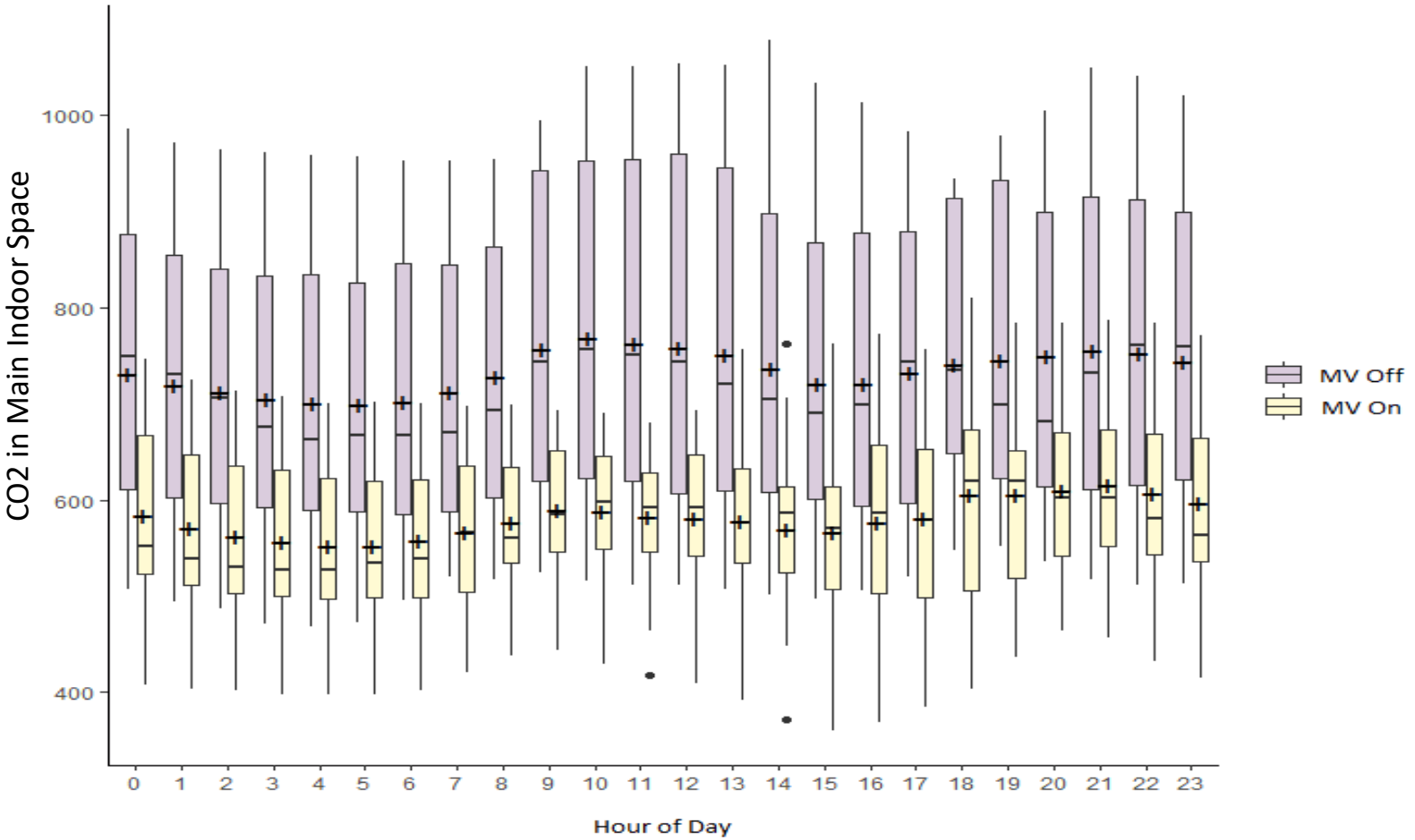
Results Summary – One Week Average



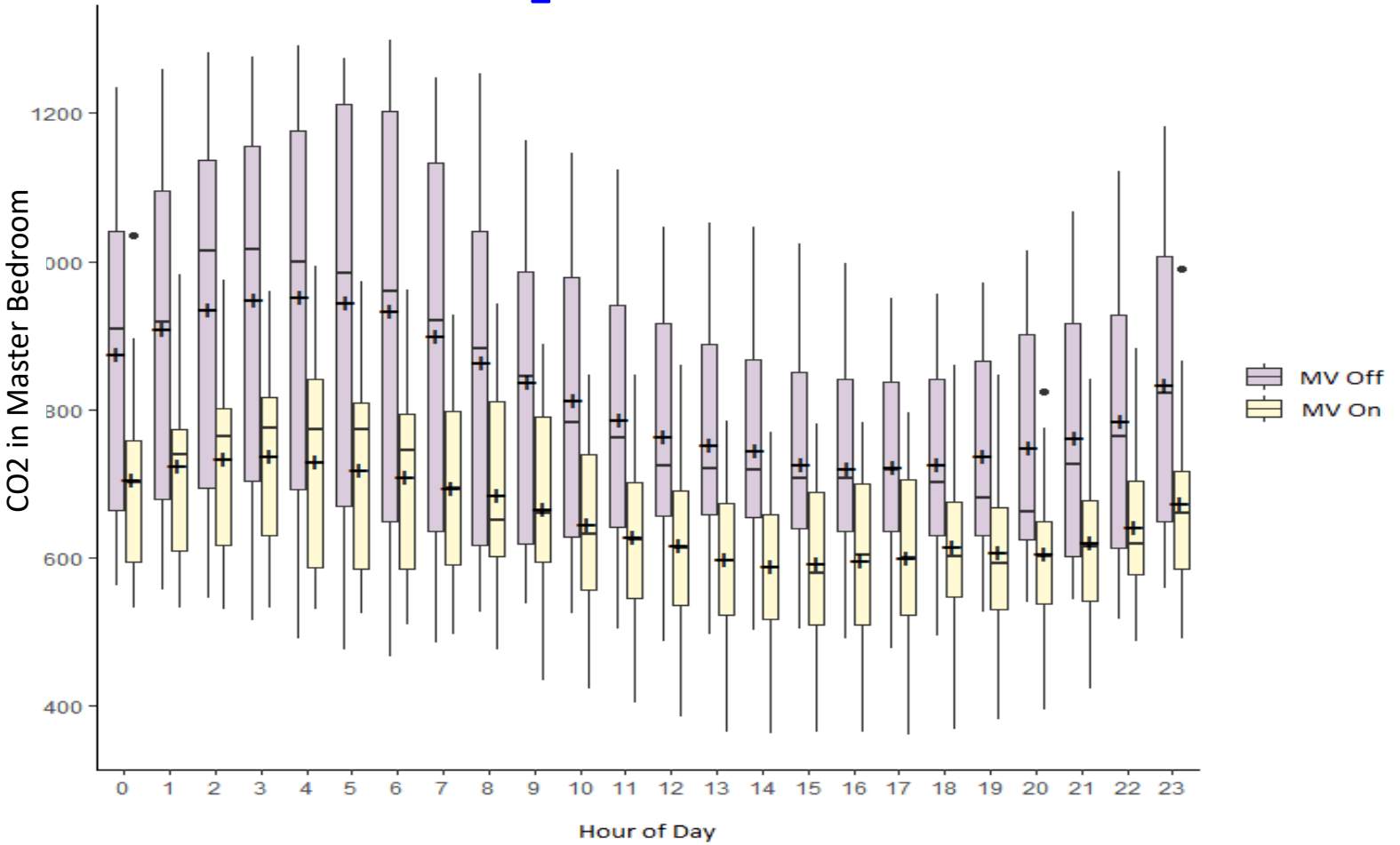


US EPA NO_2 53 ppb annual standard

Ventilation and CO_2 in OR/CO homes



Ventilation and CO_2 in Master Bedrooms (OR/CO)



Measurement Device	Parameters	Accuracy [a]	Res.	Sampling locations
Met One ES-642 Photometer	Estimated $PM_{2.5}$ by photometry	±5% traceable standard with 0.6 µm PSL	1 min	Outdoor
Met One BT-645 Photometer	Estimated $PM_{2.5}$ by photometry	±5% traceable standard with 0.6 µm PSL	1 min	Indoor central
AirVisual Pro	Estimated $PM_{2.5}$ by photometry[5], CO_2, T, RH	CO2: ±50ppm or 2% of reading e PM: Within 10% in effective range: 0–1798 µg/m3 c		Indoor central; Master BR; Office, secondary bedroom or family room
Ogawa Passive Samplers	NO_2 and NO_x	Based on field validation:[b] 7 d relative deviation of 3±2% NO_2 at 11-37 ppb; 4±3% NO_X at 16-85 ppb; 10±9% (NO_X-NO_2) at 4-56 ppb	1 wk	Outdoor; indoor central
GrayWolf FM-801	HCHO	±4 ppb <40 ppb, ±10% of reading ≥40 ppb	30 min	Indoor central; Master BR
SKC UMEx-100 Passive	HCHO	±25%, exceeds OSHA requirements	1 wk	Outdoor; Indoor central, Master BR
Onset HOBO UX100-011 Onset HOBO U23 Pro v2	T, RH	±0.21 °C from 0 to 50 °C ±2.5% from 10% to 90%; up to ±3.5% at 25 °C including hysteresis	1 min	Outdoor (U23); Indoor central (UX100-011);
RadStar RS300	Radon	<10% deviation from 0.5 to 150 pCi/L	60 min	Indoor: central and/or basement