



The Building Science Fight Club Roars

ASHRAE 62.2 vs. Building Science Corporation's New Ventilation Standard

24 February 2014

RESNET Conference



The Energy Vanguard Blog

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The Sludge That Kills — Post Mortem of an Air Conditioner

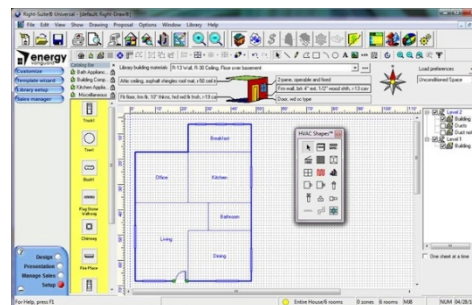
Posted by Allison Bailes on Mon, Aug 20, 2012



HERS Provider



HVAC Design

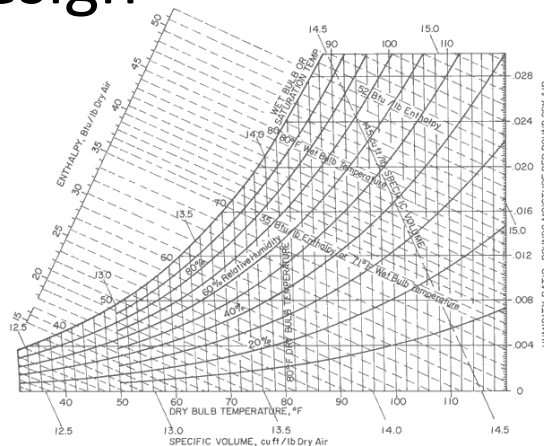


*High Performance Homes
– Knowledge + Service*



Positive Energy

- Building Science Consulting & Training
- High Performance HVAC Design
- Energy Modeling & Monitoring
- Building Performance Testing
- Program Compliance & Cx
- Net Zero Design
- IAQ Testing



The Bones

- Why we need ventilation
- Ventilation methods
- Ventilation rates
 - 62.2
 - BSC-01
- Dr. Joe's beef with 62.2
- Where will this lead?
- Q&A



Why We Need Ventilation



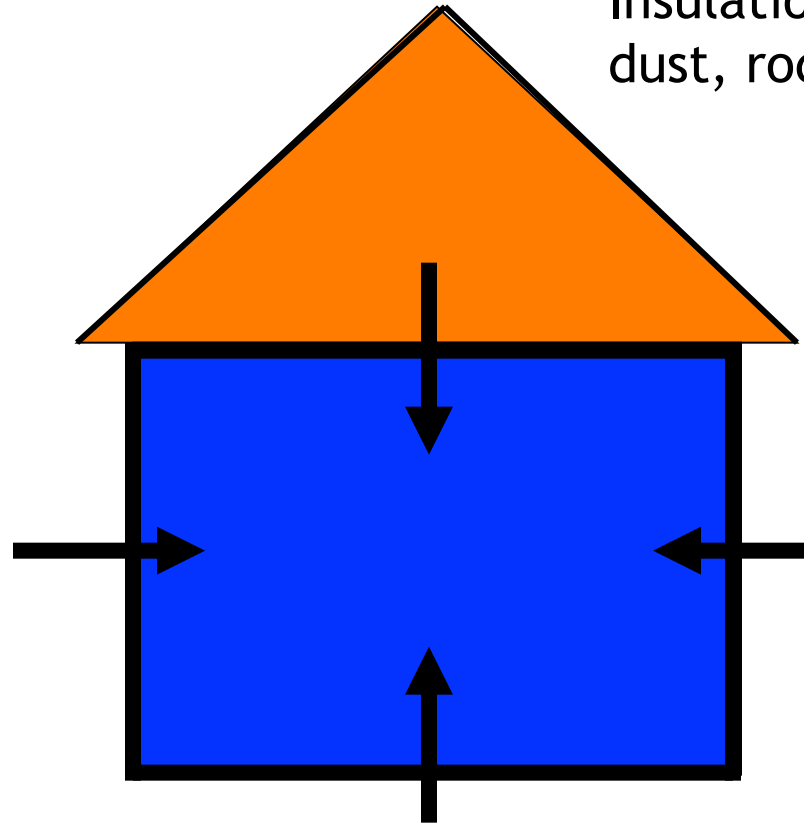
Airtight
enclosures

Infiltration Doesn't Cut It

ATTIC

Insulation fibers,
dust, rodent scat

OUTSIDE
Pollen, auto
fumes, dust



GARAGE

Carbon monoxide,
pesticides, gasoline,
fertilizers

CRAWLSPACE

Mold, dust, lead, radon,
moisture, termiticide

Bad Stuff in the Air

Water vapor

CO₂

VOCs

Formaldehyde

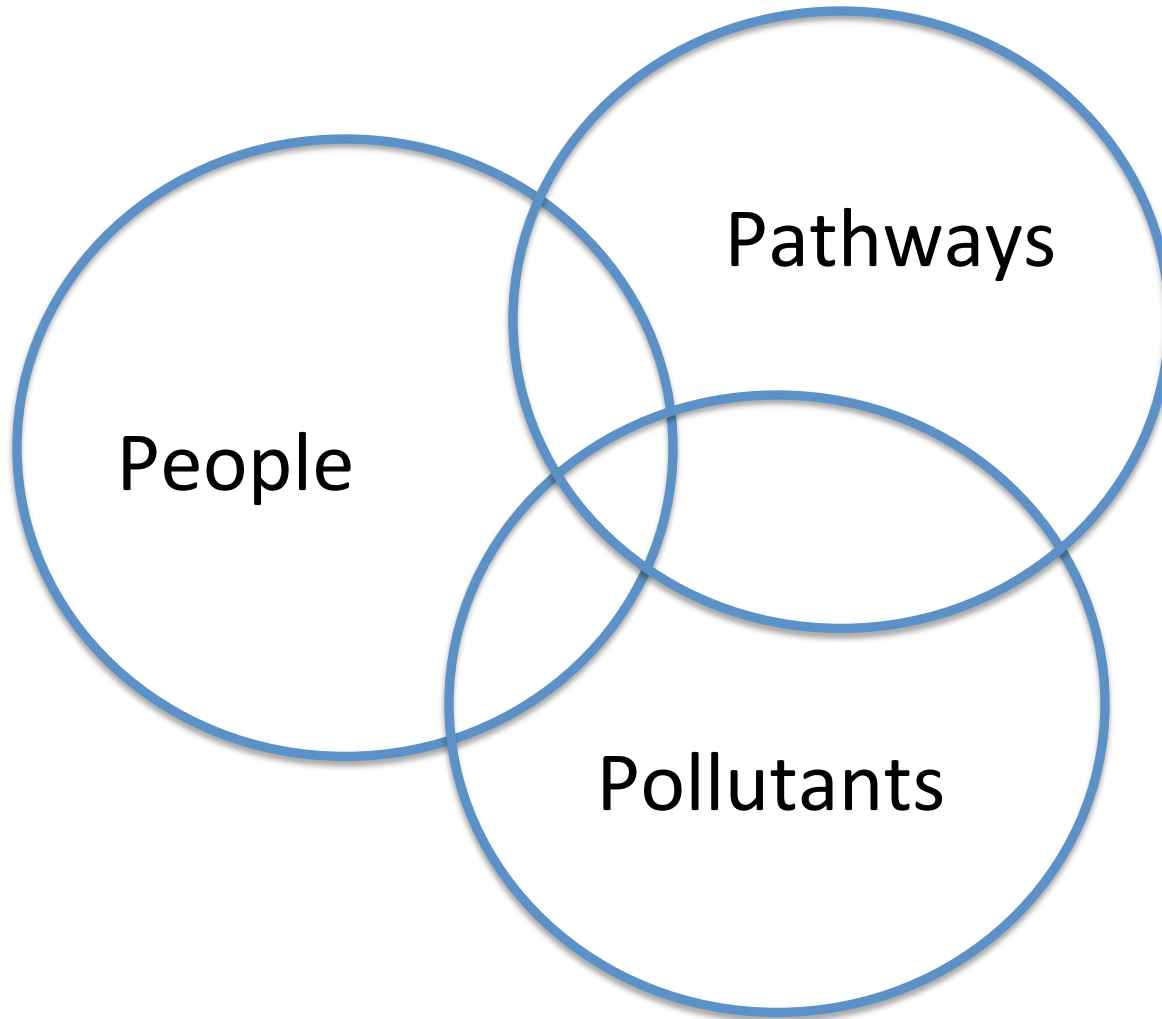
NO_x

Radon

...and more!



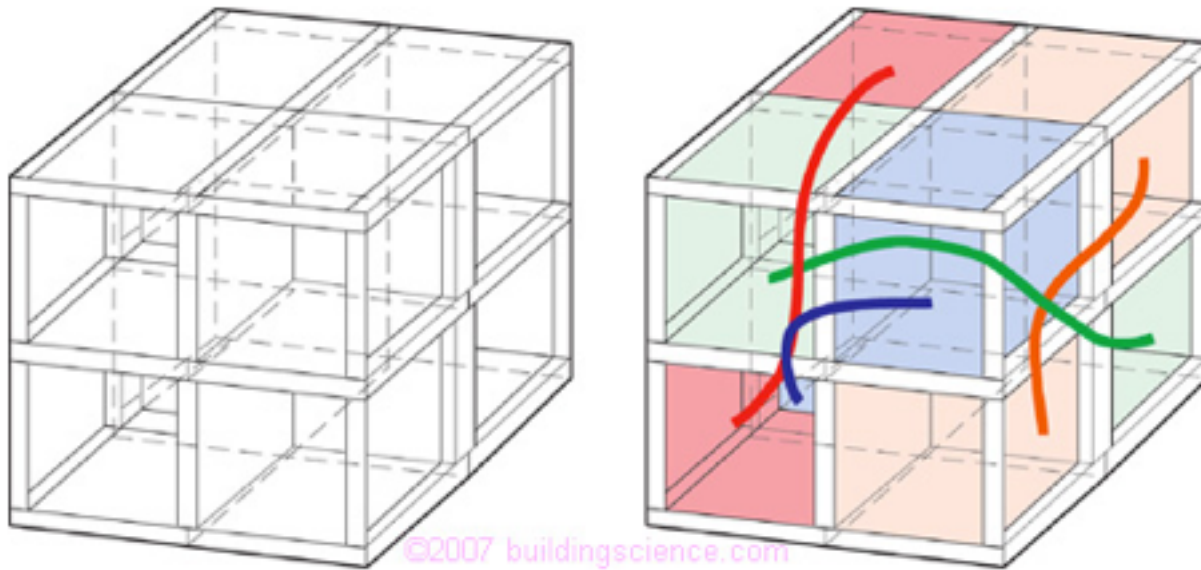
Connections



2 Ways to Achieve Good IAQ

Source control

Mechanical Ventilation



“Build Tight.
Ventilate Right.”



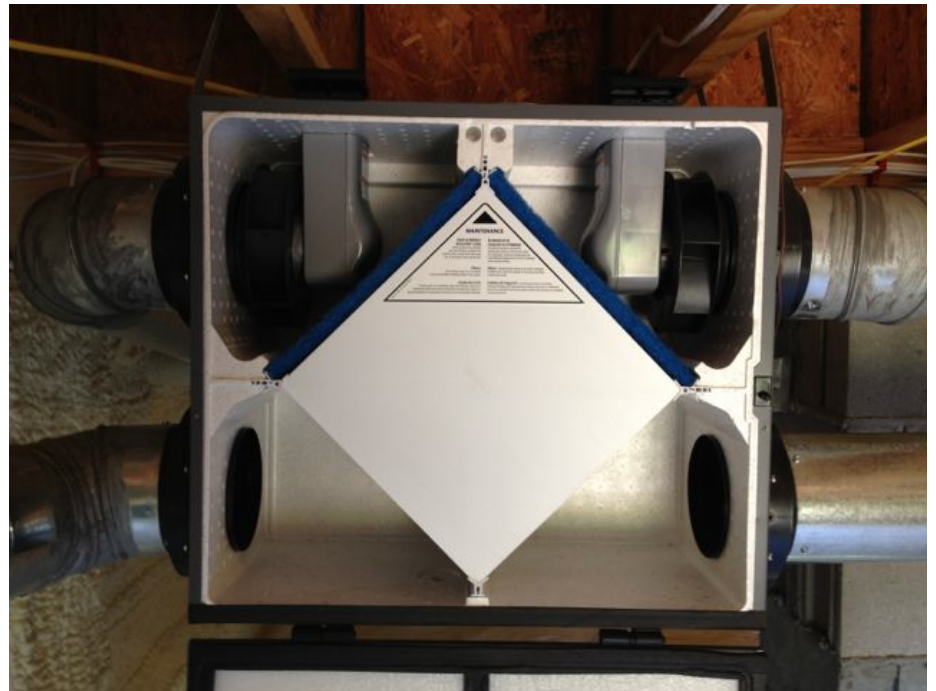
3 Types of People

1. Those who can do math
2. and those who can't.

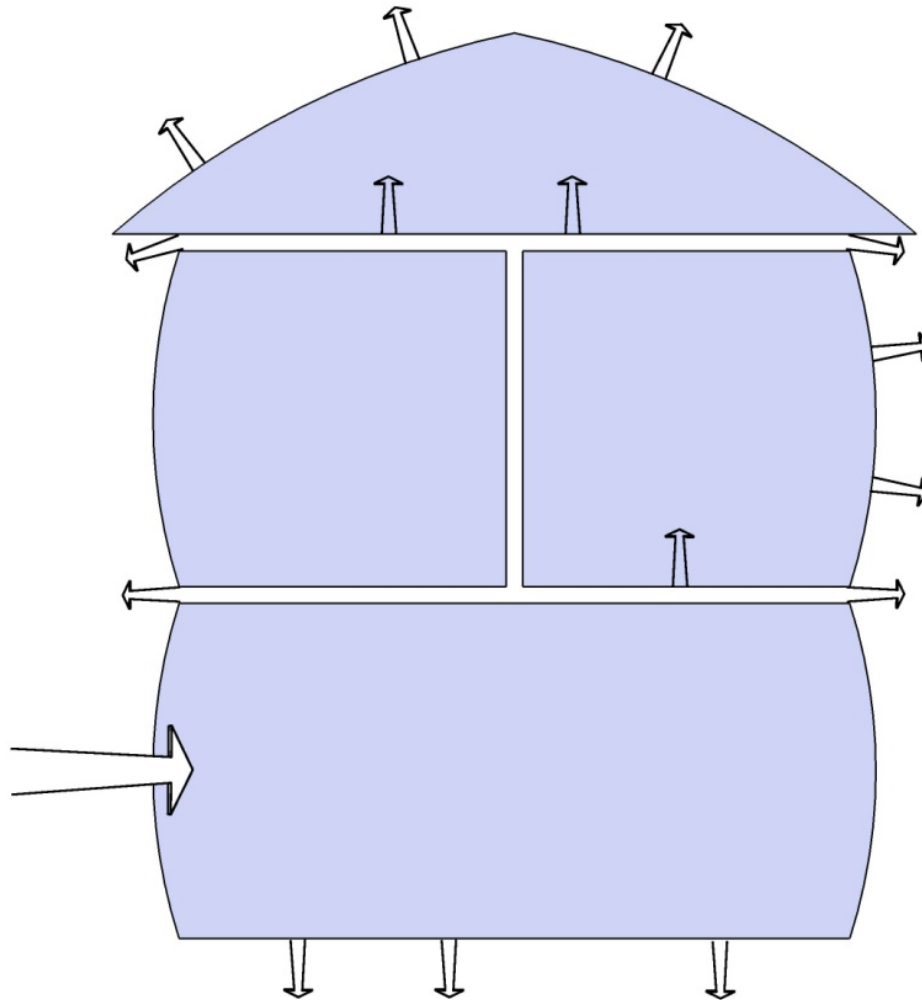


3 Types of Ventilation

1. Whole house
2. Local
3. Buffer space

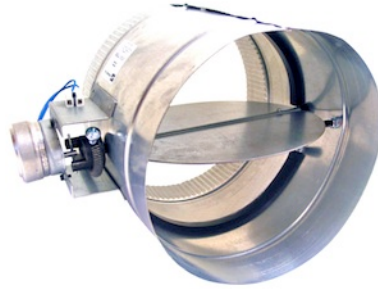


Whole House Ventilation

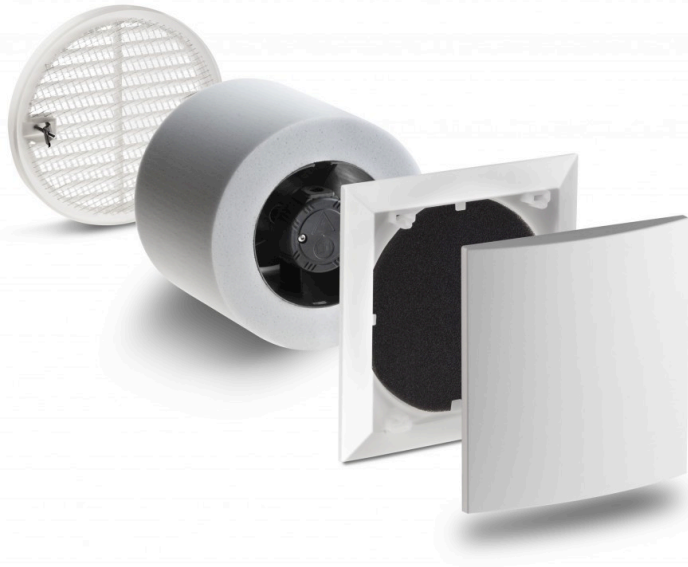


Positive
Pressure

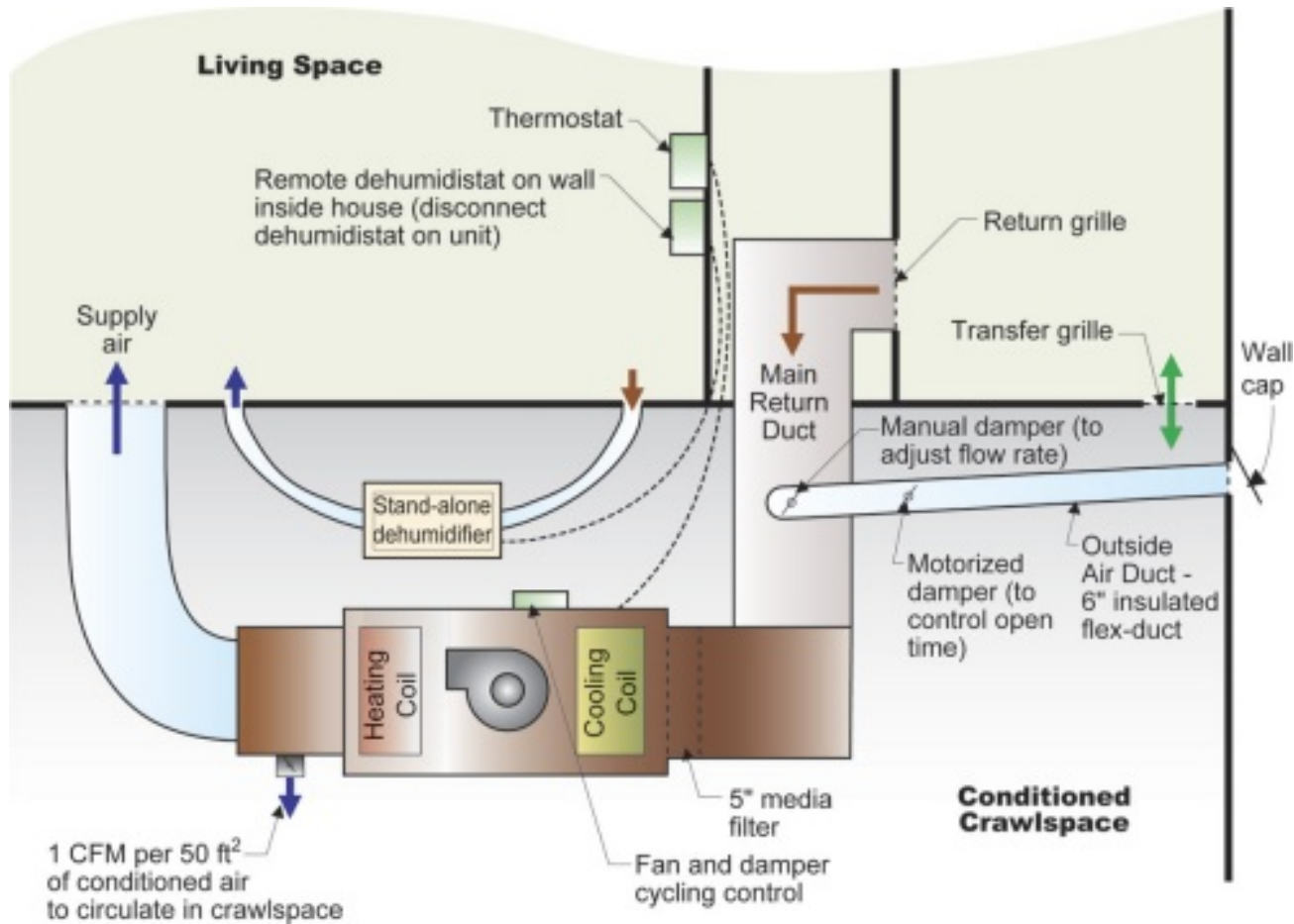
Whole House Ventilation



Positive
Pressure



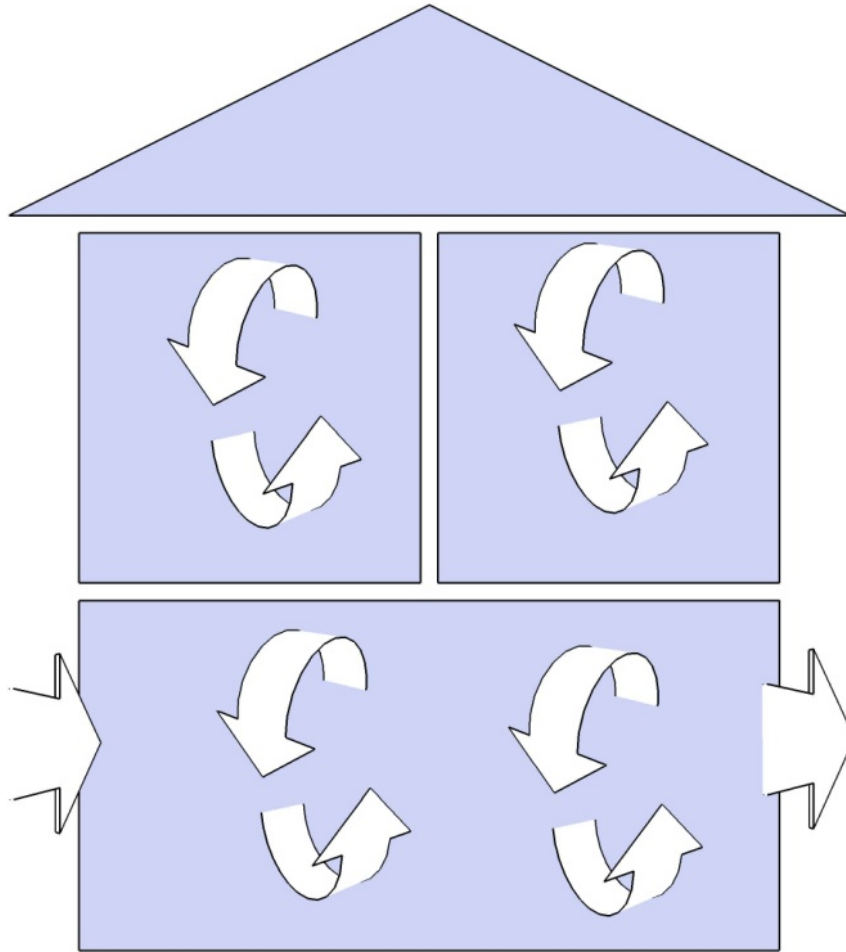
Whole House Ventilation



Central Fan Integrated Supply (CFIS)

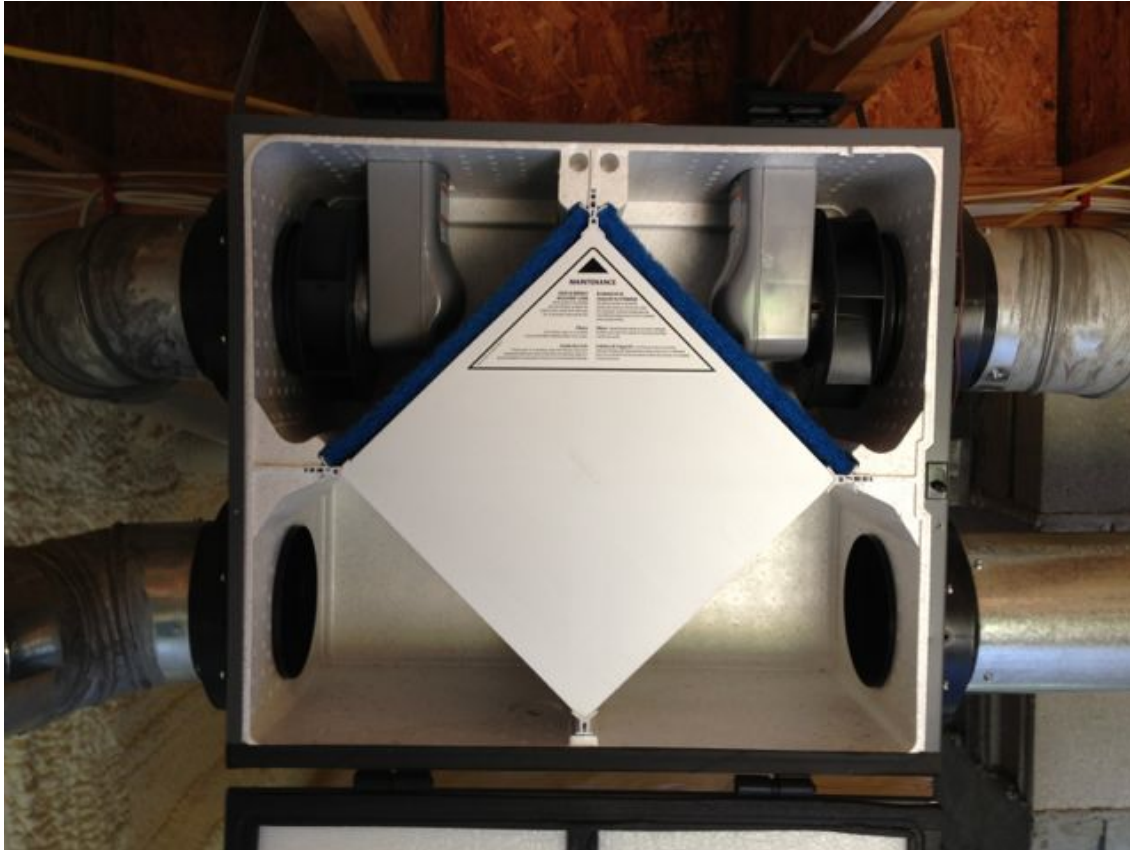
Image courtesy of Building Science Corporation

Whole House Ventilation



Neutral
Pressure

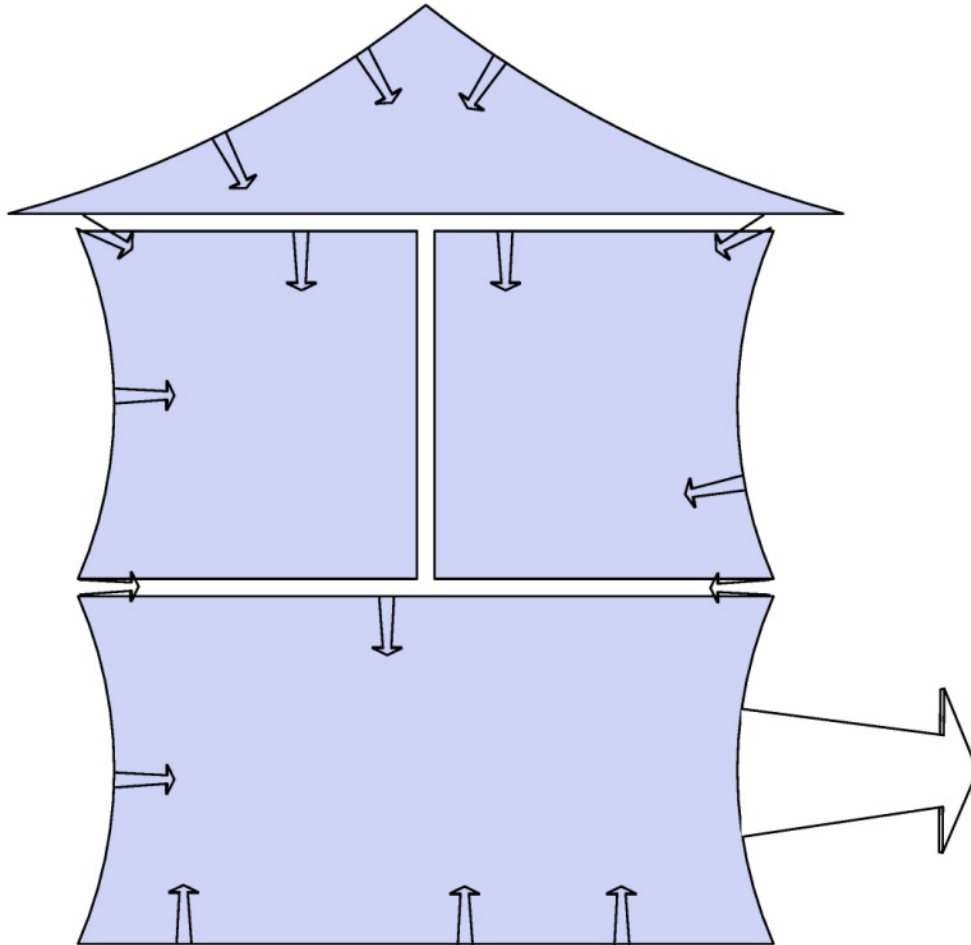
Whole House Ventilation



Neutral Pressure

- HRV
- ERV
- Balanced without recovery

Whole House Ventilation



Negative
Pressure

Whole House Ventilation

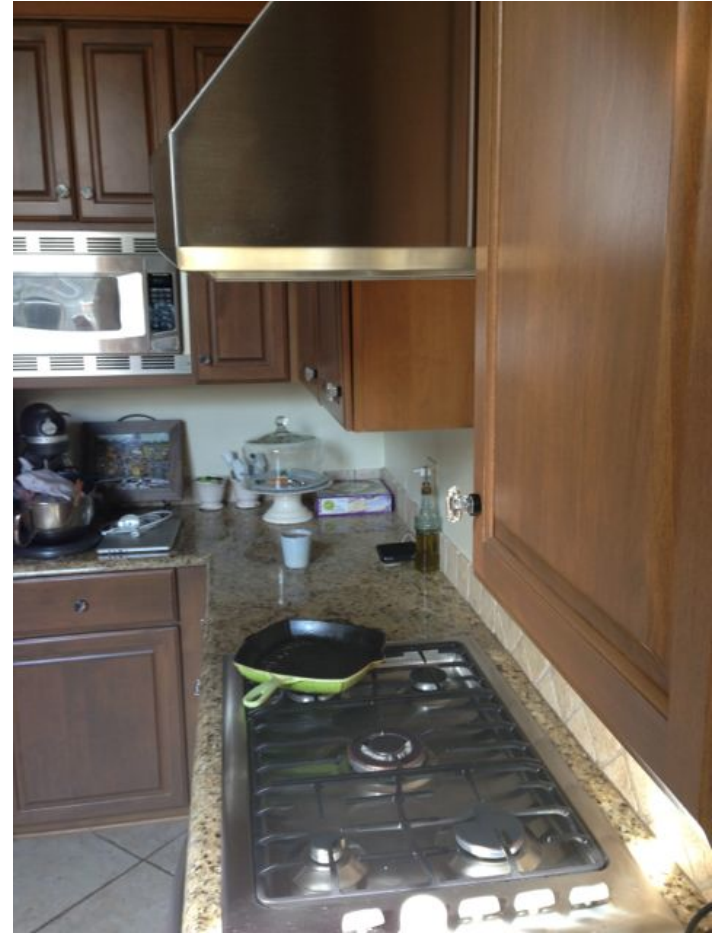


Exhaust-
only



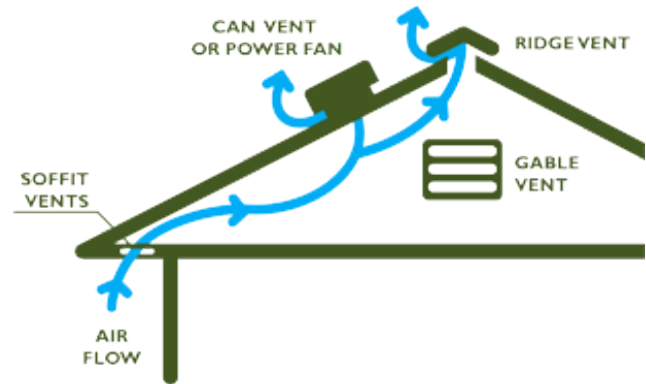
Local Ventilation

- Bathrooms
- Kitchens



Buffer Space Ventilation

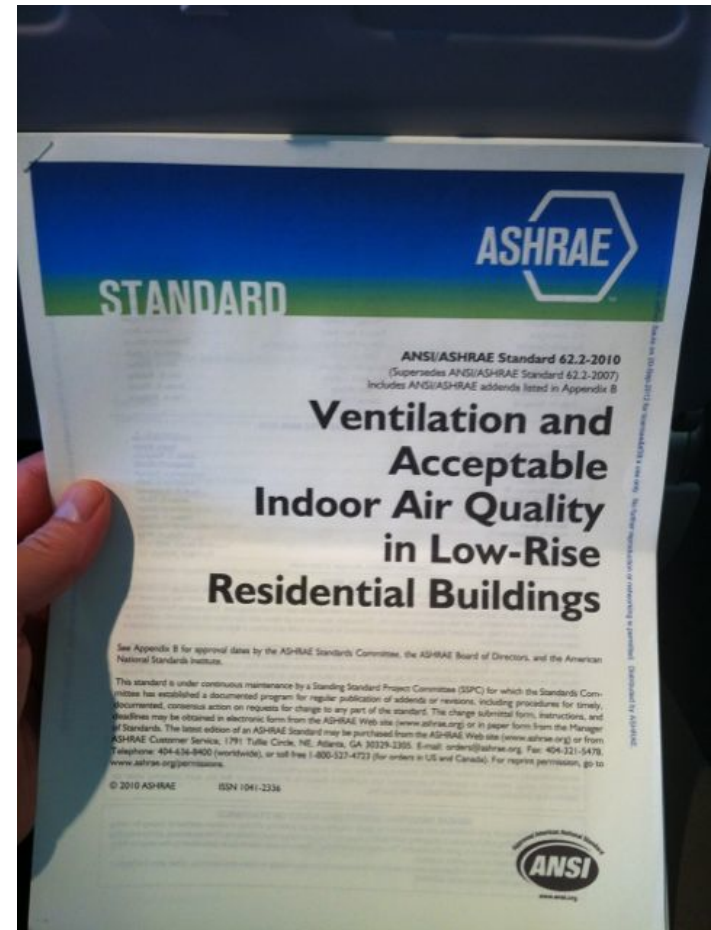
- Radon
- Crawl space
- Garage
- Attic



How Much to Ventilate?

Whole-House Ventilation

- ASHRAE 62-1989?
- ASHRAE 62.2-2010?
- ASHRAE 62.2-2013?
- BSC-01?
- Something else?



62.2 Ventilation Rates

62.2-2010 $Q_v = 0.01 A_{\text{floor}} + 7.5 (N_{\text{br}} + 1)$

62.2-2013 $Q_v = 0.03 A_{\text{floor}} + 7.5 (N_{\text{br}} + 1)$

A_{floor} = cond. floor area, N_{br} = # of bedrooms



“ASHRAE 62 is the only national consensus standard document there is. Follow 62.2. Resistance is futile.”

~ Dr. Max Sherman



“Game on.”

~ Dr. Joseph Lstiburek



BSC-01 Ventilation Rates

BSC-01 $Q_v = 0.01 A_{\text{floor}} + 7.5 (N_{\text{br}} + 1)$

A_{floor} = cond. floor area, N_{br} = # of bedrooms

But wait...there's more!



BSC-01 Ventilation Rates

System Coefficient based on system type¹

System Type	Distributed	Not Distributed
Balanced	1.0	1.25
Not Balanced	1.25	1.5

¹ Where there is whole-building air mixing of at least 70% recirculation turnover each hour, the system coefficient may be reduced by 0.25.

Real Numbers

- 2000 sf, 3 bedroom house
- 3 BR → 4 people

Method	Rate (cfm)
62.2-2010	50
62.2-2013	90
BSC-01	50, 63, or 75 (w/o mixing) 38, 47, or 56 (w/ mixing)



Why Dr. Joe Went Rogue

- Comfort
- Humidity
- Energy consumption
- System effectiveness
- Lack of data on health impacts



Ventilation Effectiveness Study

- Rudd & Bergey, Building America study, BA-1309, March 2013
- 2 identical houses in Tyler, Texas
- Slab, attached garage
- 1 with sealed attic, 1 vented attic
- Tracer gas, particulates, VOCs



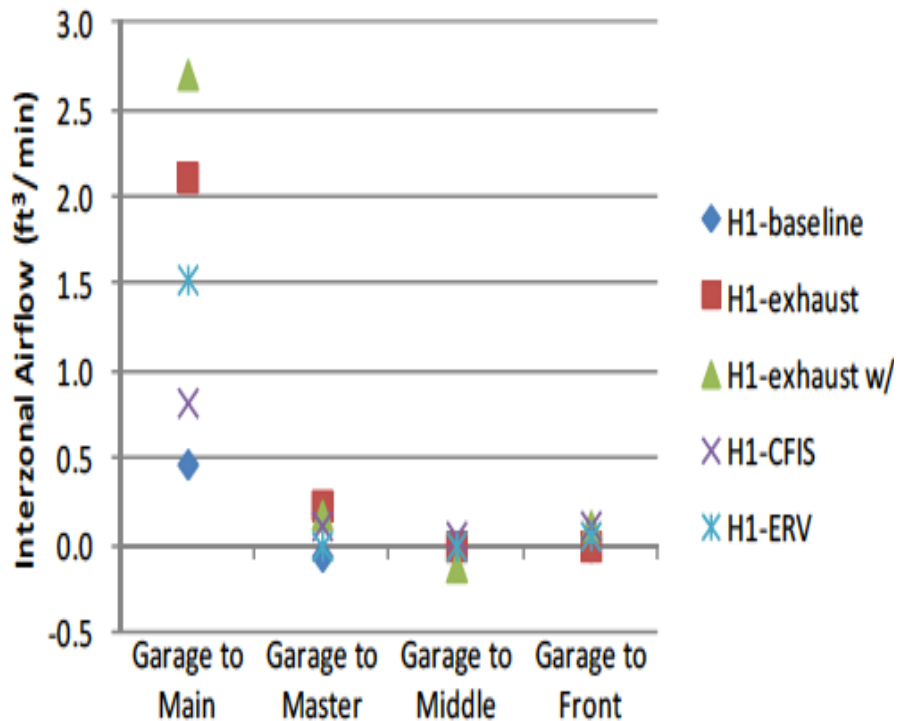
Ventilation Effectiveness Study

- CFIS had 47% lower VOC level than EO
- ERV had 57% lower VOC level than EO
- EO had 37% higher VOC level than baseline for vented attic home
- EO had 18% higher VOC level than baseline for sealed attic home
- EO drew 34% of ventilation air from vented attic

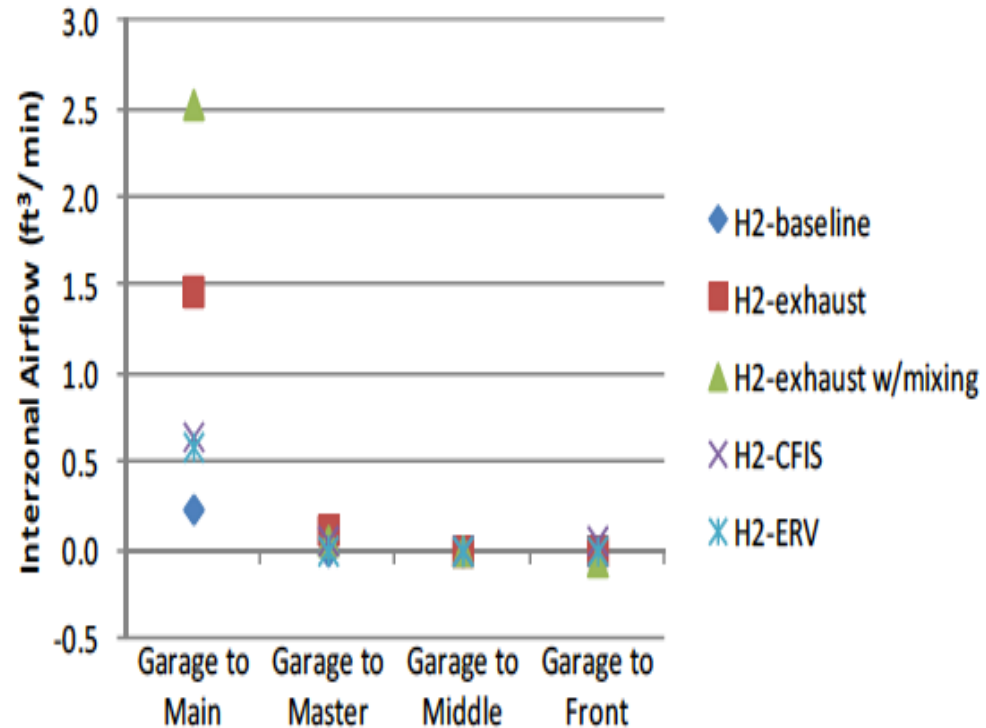


Ventilation Effectiveness

Garage to Living Zones Airflow for House 1



Garage to Living Zones Airflow for House 2



Where Do These Rates Come From?

- Odor control – 15 cfm/person, C.P. Yaglou research, 1936
- 0.35 ACH for residential since 62-89
 - ‘expert judgment,’ not health data
- Long history, mostly commercial and institutional



What Level of Pollutants Is Safe?

- Who's living in the house?
- Which pollutant?
- Where in the house?
- We don't really know



Related Questions

- What sources of indoor pollutants does the house have?
 - Attached garage?
 - Moldy crawl space?
 - Household chemicals?
- How bad is the outdoor air?
 - Including underground



“If there is a pile of manure in a space, do not try to remove the odor by ventilation. Remove the pile of manure.”

~ Max von Pettenkofer, 1858

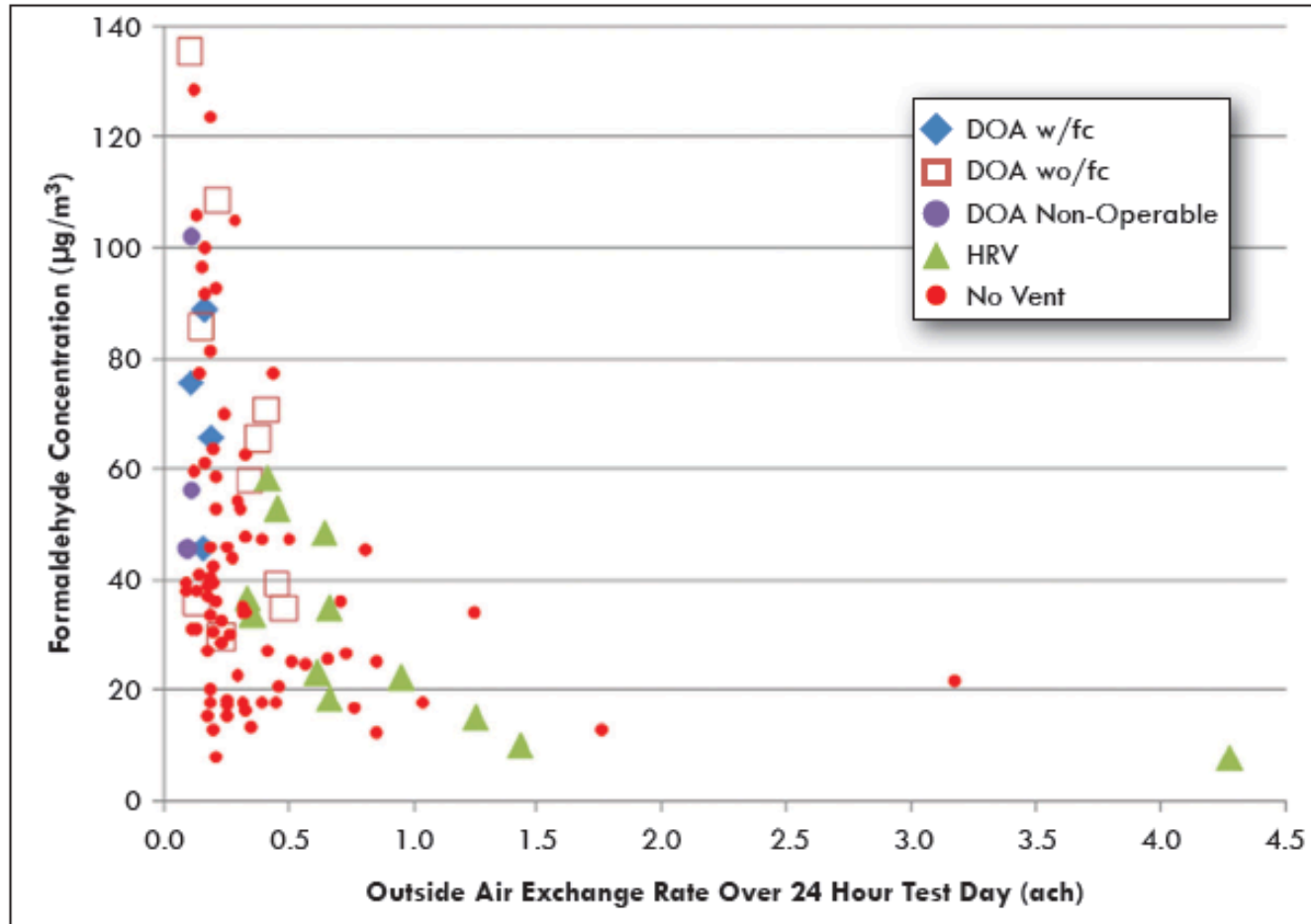


Source Control

- Best to prevent pollutants from getting into air
- Ventilation doesn't always work



Formaldehyde and Ventilation Rates

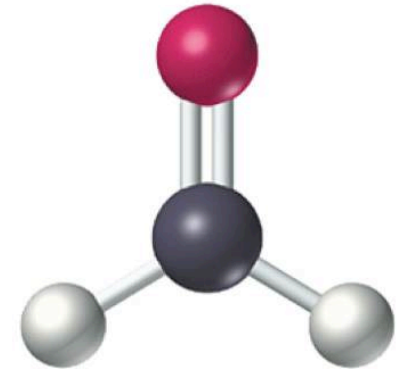
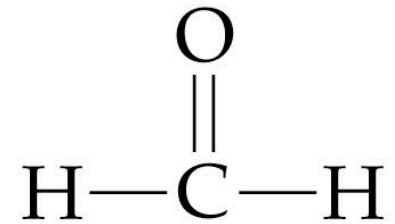


Offerman study, 2009 - *Ventilation and Indoor Air Quality in New Homes*



A Lesson in Source Strengths

- Formaldehyde emission from materials increases when you ventilate more.
- Materials that emit formaldehyde at lower levels result in less formaldehyde in home's air.



What Should Happen Next?

- 62.2 committee needs to address the issues Joe raised
 - System effectiveness
 - Humidity
 - Source control
 - Science behind ventilation rates
- Make the standard simpler!
- Add design flexibility

Thanks to Eric Werling for making these great suggestions first!



“On a long enough timeline, the survival rate for everyone drops to zero.”

~ Fight Club narrator



Other Ventilation Talks

Ventilation: Effective Strategies & Lessons Learned

Tue, 10:30. Doug McCleery, MaGrann Associates

IAQ, Ventilation, and Airtightness in High Performance New and Existing Homes

Tue, 3:30. Brennan Less & Iain Walker, Lawrence Berkeley National Laboratory

The “V” in HVAC: Mechanical Ventilation in ENERGY STAR Certified Homes

Wed, 8:30. Dean Gamble, U.S. EPA; Ashley Fowler, ICF International



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