RESIDENTIAL VENTILATION FOR CALIFORNIA

Max Sherman

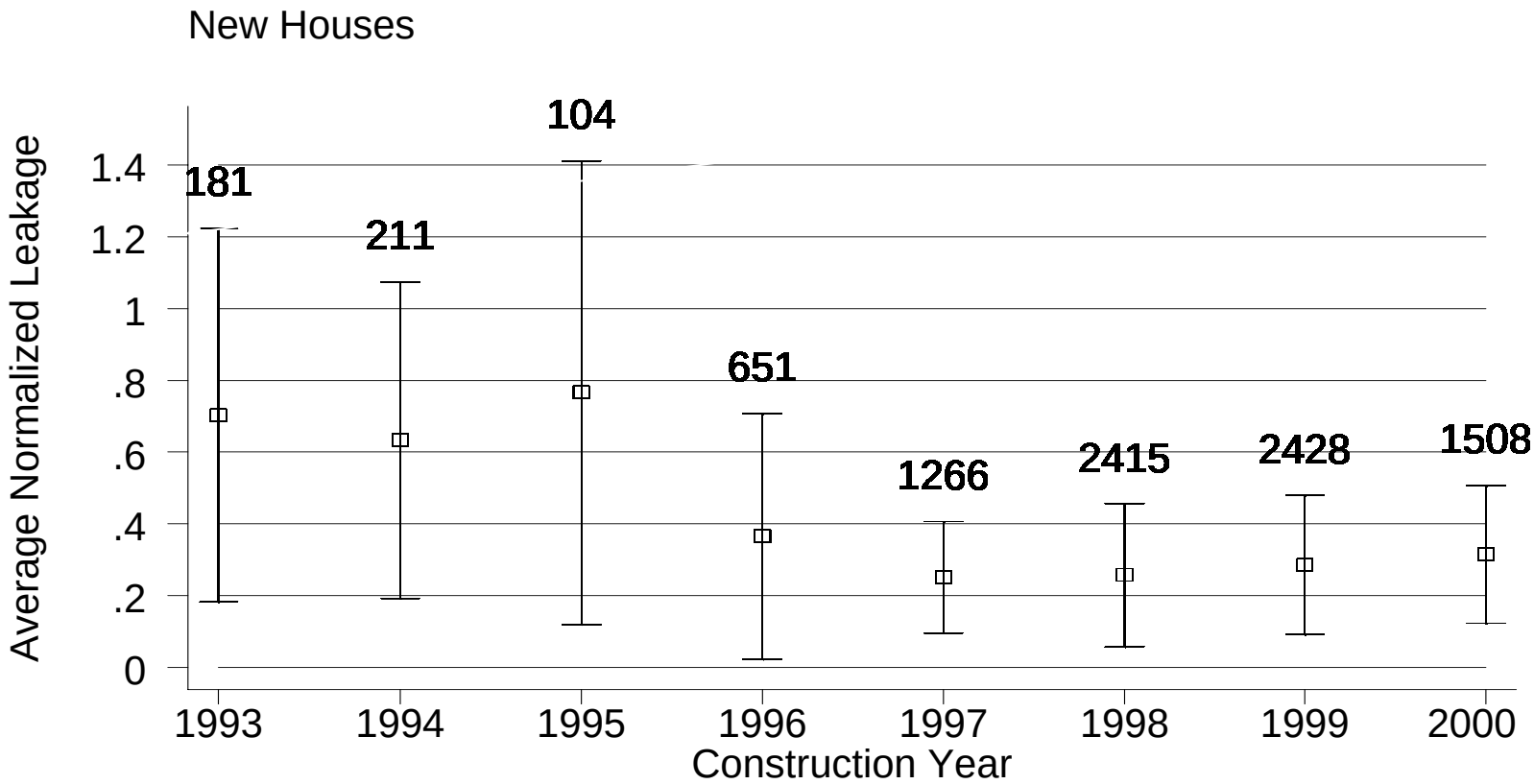
Lawrence Berkeley National Laboratory

ISSUES

- Houses are getting tighter
  - NL=.3 (SLA=3)
- T24 gives tights ducts
  - 22% to 6% leakage
- Changing contaminants
- Changing expectations
- NEED FOR VENTILATION

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NL TREND FOR NEW U.S. HOUSES



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CONTAMINANTS OF CONCERN

- Volatile Organic Compounds
  - E.g formaldehyde
- Products of combustion
  - Unvented combustion
- Moisture & water
  - Mold, asthma
- Phthalates, toxics, ...

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LBL PROJECT OVERVIEW

- Scoping Study
- Develop Criteria for T24
  - Completed applicability report
- Technology Evaluation
  - In progress
- Assist in Code Development

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CURRENT OPTIONS

- Model Codes
  - IECC/IRC; UMC/UBC; CABO MEC
- IAQ Programs
  - Health(y) House; Energy Star
- National Standards (Codes)
  - B, CA, DE, SF, FRG, S, UK ...
- American National Standard
  - ASHRAE 62.2



KEY ISSUES FROM LITERATURE

- Definition of Contaminant sources
- Whole-House Ventilation Rates
- Local Exhaust Rates
- Air Distribution and Duct Leakage
- Infiltration
- Windows and Passive Vents
- Combustion Equipment
- Filtration and Air Cleaning
- Noise Issues
- Energy Impacts

APPLICABILITY REPORT

T24 Perspective

- Compare Alternatives
- WRT Key Issues
- Include Survey Results
- Generate Criteria for Code

http://epb.lbl.gov/Publications/lbnl-58713.pdf

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Key Issues

- Adventitious Air Flows
- Air Distribution
- Air Cleaning
- Occupant Acceptability
- Peak Power & Demand
- “Unusual” Sources / High Polluting Events
- Window Operation

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WINDOWS IN CA

- T24 has 2 “Ventilation” issues
  - IAQ *(e.g. continuous low-level)*
  - Cooling *(e.g. big, but infrequent)*
- Currently assumed to be used in T24, but are they really?
  - CARB/CEC funded survey by UCB/LBL on behavior

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Sneak preview of ARB's

OCCUPANT SURVEY

Residential Ventilation Practices

1500 New Homes
Statistically Representative

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ACCEPTABILITY

- Less than 5% found air "Barely Acceptable" or worse
- But noticed some problems
  - Hot, humid in summer
  - Cold, dry in winter
  - Drafty, dusty sometimes
  - "Mech. Vent." slightly less(?)

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Why Open Windows?

	Very Important	Somewhat Important	Slightly Important	Not at all important	Never open for this reason
Cool the house	55/62/57/59 52/53/46/50	21/25/22/23 27/11/25/21	11/8/10/10 0/16/14/11	4/1/3/3 0/5/7/5	7/4/6/6 20/16/7/13
Warm the house	9/11/12/11 0/5/7/5	13/11/12/12 8/5/11/8	14/12/13/13 15/32/25/25	15/14/16/16 0/21/14/13	41/48/44/47 78/37/43/48
Provide air movement	55/53/57/56 56/42/55/52	27/31/28/29 13/37/24/25	9/11/10/10 0/11/10/8	2/1/2/2 6/0/3/3	7/3/4/5 25/11/7/13
Remove odors	47/40/39/40 20/26/36/**29**	28/30/28/28 13/42/18/24	13/19/19/18 20/11/18/16	4/7/6/6 13/5/14/11	8/5/7/7 33/16/14/19
Remove moisture	22/16/18/18 14/6/17/14	17/17/12/14 0/20/10/10	21/16/17/17 14/25/21/20	12/15/19/17 21/13/7/12	27/36/35/33 50/38/45/**44**
Air out the house post cleaning	40/31/33/34 31/37/46/39	26/27/27/27 0/11/19/12	18/20/23/21 19/16/12/15	6/6/8/7 13/11/12/12	10/16/9/11 38/26/12/23
Remove smoke	21/13/16/16 7/17/11/12	8/10/8/8 7/11/11/10	8/9/9/9 14/11/4/8	11/10/10/10 0/6/11/7	53/57/57/56 71/56/64/63
Provide draft for fireplace etc.	19/14/11/13 7/11/0/5	9/15/12/12 0/11/22/14	15/15/17/16 7/17/19/15	13/14/13/13 0/11/0/3	45/42/47/46 86/50/59/63
Save energy	52/45/46/46 33/37/45/40	21/26/24/24 33/21/31/29	14/14/13/13 13/16/7/11	3/2/4/4 0/0/3/2	11/13/13/13 20/26/14/19
Allow pet access	11/8/9/9 7/11/7/8	4/6/8/6 0/5/14/8	4/6/8/7 0/16/7/8	6/6/8/7 0/16/0/5	75/75/69/71 93/53/71/71

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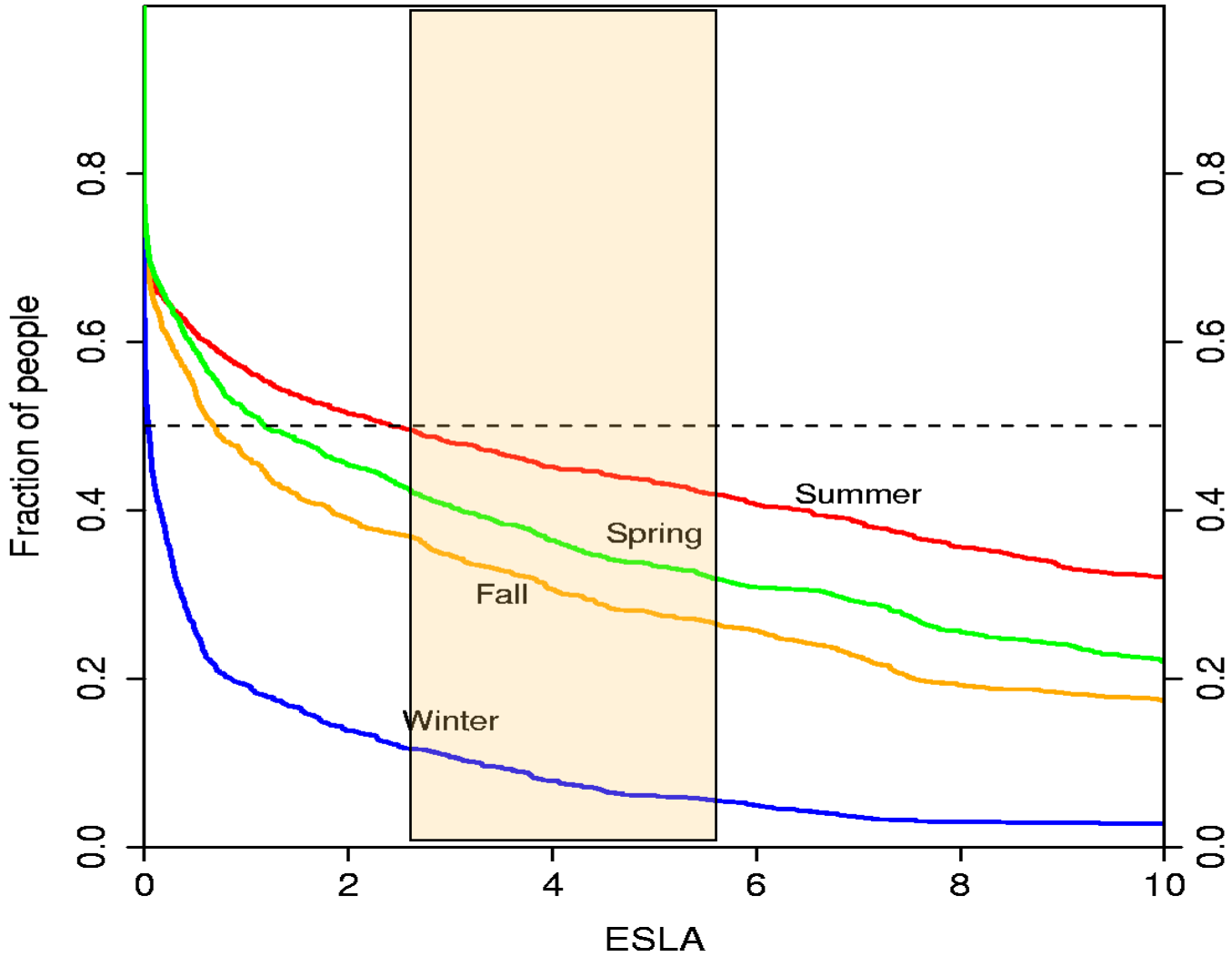
WHY CLOSE	Very Important	Somewhat	Slightly	Not at all	Never close
Nobody home	93/84/84/85 92/74/86/84	4/11/10/9 0/16/3/7	2/3/3/3 0/0/3/2	0/1/1/1 0/10/0/3	1/1/2/2 8/0/7/5
Maintain comfortable temperature	74/68/66/68 86/47/69/66	21/24/26/24 14/42/21/26	3/6/6/5 0/5/0/2	1/0/2/1 0/5/3/3	1/1/1/1 0/0/7/3
Reduce pollutants or odors from outdoors	43/37/34/36 40/44/28/36	21/23/19/20 13/22/24/21	15/15/21/19 13/11/14/13	9/14/13/12 7/11/7/8	11/11/14/12 27/11/28/23
Too windy/drafty	44/46/44/45 27/53/38/40	28/26/29/28 27/32/38/33	21/19/18/19 20/16/21/19	3/5/5/4 13/0/0/3	4/4/4/4 13/0/3/5
Keep out noise	40/41/38/39 13/42/38/33	24/25/23/24 27/32/34/32	22/21/19/20 27/21/14/19	7/7/10/9 7/5/7/6	7/6/10/8 27/0/7/10
Keep pets in/out	23/19/22/22 11/26/28/23	6/6/10/8 11/16/10/12	6/8/5/6 0/5/0/2	6/4/8/7 0/5/10/6	59/63/55/57 78/47/52/58
Save energy	68/61/59/61 67/58/69/65	21/21/22/22 20/5/17/14	6/12/10/9 0/21/0/6	2/4/3/3 7/10/3/6	3/3/6/5 7/5/10/8
Keep out rain/snow	73/68/66/68 53/53/66/59	12/12/14/13 13/21/3/11	7/12/11/10 7/21/14/14	2/4/3/3 0/5/7/5	7/4/6/6 27/0/10/11
Keep out woodsmoke	30/21/21/23 20/16/28/22	5/6/5/6 0/16/10/10	8/6/7/7 13/5/0/5	10/12/11/11 13/10/7/10	48/55/55/54 53/53/55/54
Keep out dust	47/37/41/42 29/53/52/47	23/25/23/24 29/16/21/21	16/15/16/16 29/21/10/18	6/8/7/7 7/10/0/5	9/15/13/12 7/0/17/10
Keep out pollen/allergens	45/31/35/35 20/32/34/30	22/18/17/18 33/10/28/24	15/17/18/17 27/16/14/18	5/13/11/10 0/26/0/8	12/21/19/19 20/16/24/21
Keep out insects	62/52/49/52 53/42/55/51	15/20/18/18 27/21/21/22	8/9/14/12 7/16/3/8	5/7/7/7 0/5/0/2	9/12/12/12 13/16/21/18
Privacy from neighbors	38/26/27/29 21/26/21/23	25/26/21/23 21/32/28/27	16/24/22/21 43/21/17/24	8/10/14/12 7/5/14/10	12/15/16/15 7/16/21/16
Security/safety	85/83/78/80 56/68/69/66	8/10/14/12 25/16/14/17	4/4/4/4 6/10/10/9	1/1/1/1 6/0/0/2	2/2/2/2 6/5/7/6

ESLA

- Need to Quantify Impact of Windows on IAQ
  - Equivalent Leakage
- ESLA (Effective Specific Leakage Area) turns window operation into fixed hole
  - Uses current SLA definitions

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ESLA BY SEASON



MECH VENT USAGE

Builder Sample only	Continuous	Somewhat	Infrequent	Never	N/A
Summer	18	25	8	3	45
Fall	13	18	20	3	45
Winter	21	18	12	5	45
Spring	13	21	16	5	45

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SOME CONCLUSIONS

- Few people use windows a lot
  - Many barriers; few cues
- When they do, its for cooling
  - Not managing IAQ
- Mechanical systems seem acceptable to users
  - Education would be helpful

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CRITERIA FOR T24

Summary of Recommendations

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STANDARD OF CARE

- "Old" T24 based on "Old" ASHRAE 62 and Windows
- Other Codes Not Good Models
- EPA etc. too Aggressive
- Use only ANSI-approved Std: ASHRAE Standard 62.2-2004



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DUCT LEAKAGE

- Leaky Ducts Impact IAQ
  - Can draw air from garages, & other contaminated spaces
- 5% Leakage Is Practical
  - Routinely achieved in BA/EFL
- Require Total Duct Leakage to be No More than 5%

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COMBUSTION

- 62.2, CMC, T24 requirements
  - T24 restricts systems @ SLA<1.5
- Stick with those, but
  - Drop Requirements @ SLA<1.5
- Do not adopt more stringent EPA Indoor Air Package
  - CO, fireplaces, furnaces, DHW

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INTERMITTENCY

- CA Needs Intermittent Vent.
  - Bad OA; Load shifting/TDV
- 62.2 allows it, but not flexible
  - Improvement being considered
- Allow use of new approach
  - Study needed to include whole-house fans/economizers

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WINDOWS FOR IAQ

- Few people operate windows reliably for minimum IAQ
- Do not allow window operation to meet any minimum ventilation requirements
  - Other window use OK

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SIZING

- Extra Capacity Helpful
  - Enables intermittent ventilation
  - Tight envelope response
  - Mitigates poor distribution
- Increase mechanical capacity by 25 cfm over 62.2
  - But allow operation at 62.2

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PRESCRIPTIVE EXAMPLE

- 2000 sq. ft. 3 bdrm house
  - 30+20+25=75 cfm quiet exhaust
    - Quiet; continuous; may be in bath
- 50 cfm bath fans
- 150 cfm vented range hood
- 5% total duct leakage

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QUESTIONS?