



CHAPTER 1

BUILDING THE CASE FOR SMOKE-FREE MULTI-UNIT HOUSING

PURPOSE

Understanding the importance of adopting smoke-free multi-unit housing policies

OUTCOMES

- Secondhand smoke drifts from unit to unit
- Secondhand smoke is a health hazard for renters and staff
- Renters want to live in smoke-free environments
- Cigarette-related fires are costly and deadly
- Property managers can save thousands of dollars on cleaning costs
- There are thousands of smoke-free buildings in the United States

BEGINNING A SMOKE-FREE MULTI-UNIT HOUSING PROGRAM

When you initially create a smoke-free multi-unit housing program, you may be overwhelmed because the issue feels new and difficult to understand. You may feel isolated and concerned that you will not be able to convince property managers to make their buildings smoke free. If you have not previously worked with the multi-unit housing industry, you may be wondering where to begin. You'll have to learn a new field with new terminology, develop new outreach strategies, and forge new relationships.

Although you will have to commit some time and energy learning how to be a smoke-free multi-unit housing professional, many of the skills that you may already possess will be transferrable to working on smoke-free multi-unit housing.

Whether you have experience in community organizing, public health, or another related field, you will find that portions of working on smoke-free multi-unit housing will be similar to work with which you're already familiar.

Locally, you may be challenged by some of the tasks related to smoke-free multi-unit housing, but you have allies in the smoke-free multi-unit housing movement who have also had those experiences. You can take comfort in knowing that smoke-free multi-unit housing is a movement that is happening globally, and that you are a part of a trend that is growing exponentially around the world.

THE NATIONAL LANDSCAPE OF SMOKE-FREE MULTI-UNIT HOUSING

The trend toward smoke-free multi-unit housing

Many states and countries have at least one smoke-free multi-unit housing program. The staff working on these programs regularly shares information, challenges, and successes, which allows everyone to learn from each other and support each other's work. Currently, smoke-free multi-unit housing staff communicate this information through a global email listserv and occasionally at national conferences.² Anyone who is working on or learning more about smoke-free multi-unit housing can contact the Smoke-Free Environments Law Project in Michigan to join the listserv (see this chapter's Resources section for more information).

There are hundreds of people working on smoke-free multi-unit housing around the world and they have had great success as a growing move-

KEY TERMS:

PRIORITY POPULATIONS: *Groups of people who are dissimilar from the majority — usually in income and health; in public health contexts this usually refers to groups that are poor in income and health and often face inequities when seeking solutions for their health problems. Also referred to as disparate populations and health inequities.*

APARTMENT UNIT TURNOVER: *Cleaning and preparing a unit to be rented.*

THIRDHAND SMOKE: *Residual tobacco smoke contamination that remains on surfaces after the cigarette is extinguished.¹*

ment. There are currently thousands of privately-owned multi-unit housing buildings and hundreds of publically-owned multi-unit housing buildings that are smoke free. As you learn about the smoke-free multi-unit housing movement and get to know others who work on smoke-free multi-unit housing, you will hear about the successes and challenges that property managers have when adopting smoke-free policies. You can utilize those case studies to help property managers in your area understand the trend toward smoke-free multi-unit housing.

It's particularly important to understand the trend toward smoke-free multi-unit housing in Public Housing Authorities (for more information on public housing, read Chapter 2, "Getting to Know the Housing Industry"). Public Housing Authorities house many of the country's low-income families.³ In a 2010 journal article, Dr. Jonathan P. Winickoff, M.D., M.P.H. states that "tobacco smoke exposure in public housing is particularly troubling because it afflicts disadvantaged and vulnerable populations."⁴ Since renters in public housing often have low incomes

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and chronic health conditions, it is especially important for them to live in healthy, smoke-free environments.

The rental housing population

One of the reasons that smoke-free multi-unit housing policies are so important is because so many people live in multi-unit housing. According to the 2011 American Community Survey, 35% of U.S. households are renter occupied,⁵ and 61% of those rental households are in multi-unit housing buildings. That means that approximately 53.75 million U.S. residents live in rented multi-unit housing. In the 10 largest U.S. cities, between 25-50% of all housing units are occupied by renters.⁶ Of course, the amount of multi-unit housing in your area may be significantly less, particularly if you are in a rural area. Nevertheless, multi-unit housing is a place where many people live very close together and are affected by their neighbors' smoking behaviors.

Priority populations in multi-unit housing

Multi-unit buildings can be home to many demographics, but there are some populations that live in multi-unit housing and are considered "priority populations" because of their health inequities.

In the U.S., 16% of rental housing occupants are 65 years of age or older.⁷ That means that nearly one-fifth of the rental population is of an age where chronic health conditions that are affected or caused by secondhand smoke exposure are common. With the aging of the Baby Boomer population, this number is expected to rise significantly.

Youth and young adults also constitute a significant percentage of the population in multi-unit housing. Forty-three percent (43%) of all people under the age of 30 live in rental housing.⁸ This means that nearly half of the younger U.S. population, a population whose health conditions and immune system may still be developing, is living in an environment that can be affected by the activities of the other residents in the building.

In 2006, almost 16 million of the 36 million

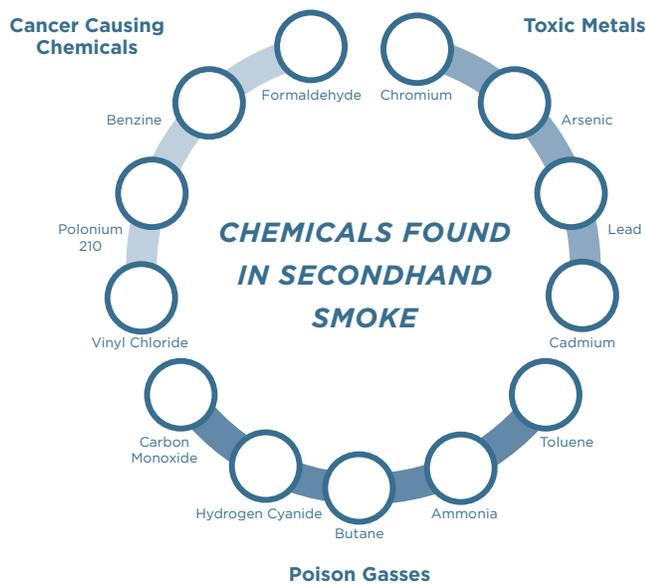
rental households (45%) were minority households.⁹ It is particularly important to protect these households from involuntary secondhand smoke exposure because many minority populations have higher than average rates of certain chronic diseases. According to the Centers for Disease Control and Prevention (CDC), current asthma prevalence [is] higher among the multi-racial, Puerto Rican Hispanics, and non-Hispanic blacks than among non-Hispanic whites.¹⁰ A similar study by the CDC concluded that black men and women have much higher rates of coronary heart disease death rates in the 45-74 age group than women and men of the three other races.¹¹ "A higher percentage of black women (37.9%) than white women (19.4%) died before age 75 as a result of chronic heart disease, as did black men (61.5%) compared with white men (41.5%)." The same disparity between blacks and whites was seen among men and women who died of stroke.¹¹ Protecting minority populations from secondhand smoke exposure in the home can help prevent the onset or worsening of asthma, coronary heart disease, stroke, and many other chronic illnesses.

Across the board, the greatest single predictor of tobacco use is low socioeconomic status (SES). Low SES populations are multi-cultural, multi-ethnic, multi-lingual, and dispersed throughout the United States. Low SES characteristics include: low-income, individuals with less than 12 years of education, medically underserved, unemployed, and the working poor.¹² The smoking prevalence is much higher among adults living below the poverty level (28.9%) than those living at or above the poverty level (18.3%).¹³ A higher proportion of nonsmokers living at or below the poverty level are exposed to secondhand smoke.¹⁴

THE DANGERS OF SECONDHAND SMOKE

Secondhand smoke is deadly

There are many studies and reports regarding the health risks posed by secondhand smoke exposure, and more are released each year. Secondhand smoke is classified as a Group A Carcino-



Secondhand smoke has more than 4,000 chemicals.¹⁶

Many of these chemicals are toxic and cause cancer.¹⁸

gen (a substance that is known to cause cancer in humans) by the US Environmental Protection Agency (EPA),¹⁵ the US National Toxicology Program,¹⁶ and the International Agency for Research on Cancer (IARC),¹⁷ a branch of the World Health Organization. There are over 4,000 chemicals in secondhand smoke.¹⁸ Two hundred fifty (250) of those chemicals are known toxins and 50 are known carcinogens.¹⁹

Property managers may know that secondhand smoke is dangerous, but they might not be aware of just how bad secondhand smoke is for their renters and staff who work in the building. The Centers for Disease Control and Prevention (CDC) publishes a consumer summary of the 2006 Surgeon General's Report "The Health Consequences of Involuntary Exposure to Tobacco Smoke,"¹⁸ which contains a useful graphic about secondhand smoke that you can use to educate property managers, renters, and others who may be unfamiliar with the dangers of secondhand smoke. You can order the consumer summary ("Secondhand Smoke: What It Means to You") and a poster of the graphic through the CDC's online publication catalog.²⁰

The 2006 Surgeon General's Report contains several important conclusions:²⁰

- Secondhand smoke can cause or worsen illnesses such as bronchitis, pneumonia, ear infections, and asthma.
- Nonsmokers who are exposed to second hand smoke increase their risk of developing heart disease by 25-30% and their risk of

developing lung cancer by 20-30%.

- Children are especially vulnerable to the effects of secondhand smoke because their bodies are still developing.
- There is no risk-free level of secondhand smoke exposure.

Secondhand smoke exposure in the home

Despite this research on the dangers of secondhand smoke and the growing number of organizations which recognize that secondhand smoke is a health hazard, many people continue to be exposed to secondhand smoke in their home. In 2007-08, 40% of nonsmokers in the United States were exposed to secondhand smoke and much of this exposure occurred in the home, especially for children.²⁰ During that time, exposure was even higher for the low-income population; over 60% of persons living below the poverty level were exposed to secondhand smoke.²²

Because of the recognized health dangers of secondhand smoke, many people have rules that prohibit family members and guests from smoking in their home. **However, residents in a multi-unit building, they can only make rules that apply to their unit.** If their neighbors allow smoking indoors, that smoke can drift into other units and affect the health of residents who do not allow smoking in the home. See the section later in this chapter entitled "Secondhand Smoke Transfer" for additional information on smoke drift in multi-unit housing.



Smoking-related property damage is a key concern for many managers.

Smoke-free multi-unit housing is a social justice issue

Unhealthy living environments are a social justice issue because many disparate populations, including low-income families, people of color, recent immigrants, and those with chronic disease, tend to live in multi-unit housing.²¹ They also tend to live in buildings with residents who may have higher smoking rates, thus exposing them to higher than average levels of secondhand smoke.²⁴ Finally, many people cannot afford to simply move out of their apartment if there is a problem; so, residents often feel helpless and unable to protect their health.

PROPERTY DAMAGE CAUSED BY SMOKING

Managers want to hear about property damage

While many apartment managers and owners are willing to discuss health and social justice, these talking points rarely compel managers to adopt a smoke-free policy. When discussing smoke-free policies with a manager, your first inclination may be to focus on protecting the health of renters. Unfortunately, overemphasizing health impacts may cause a manager to lose interest in the issue. Tobacco control professionals must speak to the points that managers are most interested in, and often those points focus on the financial bottom line. By discussing the costs of property damage and the savings that come with adopting a smoke-free policy, advocates will help managers see that smoke-free policies are not only good for health, but they are also good for business.

Smoke-free policies reduce cleaning costs

Apartment units are occupied by renters, but it is managers and owners who have the decision making power over policies and who have a stake in the cost of operating the building. Smoking in an apartment unit can cause significant property damage that a manager must fix before renting the unit to a new resident. When turning over a unit that’s been smoked in, many managers encounter a sticky residue (thirdhand smoke) that secondhand smoke leaves behind on the walls, countertops, cabinets, blinds, appliances, and other fixtures. This residue occurs because some of the particles in secondhand smoke, particularly those in nicotine, stick to surfaces and attract other particles, dirt, dust, and grime.¹ This residue usually coats the walls and other surfaces in a yellow or brown color. Damage also often includes a stale odor in porous surfaces like carpets; and burn marks in carpets, countertops, and other surfaces caused by dropped cigarette butts or ash.

Because of the residue and odor left behind, managers report that it often costs two to three times more to clean up and turn over a unit that has been smoked in compared to a smoke-free unit.²³ If no smoke-free policy exists in the building, managers will have to continually clean smoked-

Average Apartment Cleaning Costs

	Non-Smoking	Light Smoking	Heavy Smoking
General Cleaning	\$240	\$500	\$720
Paint	\$170	\$225	\$480
Flooring	\$50	\$950	\$1,425
Appliances	\$60	\$75	\$490
Bathroom	\$40	\$60	\$400
TOTAL	\$560	\$1,810	\$3,515

in units every time a smoking resident moves out. These costs can add up quickly and cause financial strain for a manager. Smoke-free policies prevent these costs by eliminating the cause of the residue and odor.

Many managers readily associate with data about cleaning costs and property damage related to smoking because they see it firsthand as they clean their units. If a manager needs more concrete evidence, encourage him/her to track the turnover costs for a few months. This will provide tangible proof that there is a potential for significant cost savings in adopting a smoke-free policy.

Thirdhand smoke is also a cause of property damage and health risk

When talking with managers about property damage, questions about thirdhand smoke may arise. Managers are starting to hear about thirdhand smoke in the news and may have questions. Even if a manager does not bring up the subject, you might want to offer some information and education on the topic in order to emphasize the issues of property damage.

The American Academy of Pediatrics defines thirdhand smoke as “residual tobacco smoke contamination that remains after the cigarette is extinguished.”²¹ Although some particles in secondhand smoke are sticky and stay on top of surfaces, many of the gases in secondhand smoke absorb into the surfaces. As those chemicals break down over days, weeks, and months, the chemicals “off gas” or desorb back into the air. This means that people are exposed to the same chemicals found in secondhand smoke long after the smoking activity has stopped.

Some apartment managers complain that even though they spend time, effort, and money cleaning up a unit, they find that the smoke odor is back after a few weeks. Some managers also find that the walls become discolored again. They are experiencing the effects of thirdhand smoke, and unfortunately, they will likely have to spend even more time, effort, and money to clean that residual damage.

Smoking is a fire hazard

⊗ Cigarette-caused fires often result when a smoker — who may also be impaired by drugs or alcohol, or may have fallen asleep — drops or improperly disposes of a lit cigarette. A dropped cigarette can lie in furniture or bed linens and smolder for up to 30-45 minutes, eventually causing a fire or large amounts of smoke.²⁴

You probably see regular reports in your local news about fires that occur in multi-unit housing buildings. While there are many causes of fires, smoking-related fires are one of the most common and are the *leading* cause of residential fire deaths in the United States.²⁵ Luckily, smoking-related fires

APARTMENT FIRE FACTS

- Apartments account for a larger share of smoking related fires than other types of residences in the United States.²⁶
- Approximately 25% of victims who die in smoking-related fires in the United States are not the smoker whose cigarette caused the fire.²⁷
- The fatality rate of smoking-related fires is eight times greater than other fires and the injury rate is three times greater.²⁵
- The average dollar loss per multi-unit housing fire was nearly \$44,000 per incident in 2010.³²
- Property damage is caused not only by the fire’s flames, but also by the fire’s smoke and water from the building’s sprinkler system.²⁸

are easily prevented by eliminating the smoking activity from in and around buildings.

You can find data about fires caused by smoking in apartment buildings by talking with your local fire department or state fire marshal. The fire depart-

ment might be able to tell you how many apartment fires were caused by smoking, how many injuries and deaths occurred, and the average cost of property damage resulting from the fires. You can also talk with the fire department about how

CASE STUDY:

MINNESOTA'S RENTER RESEARCH

In the early 2000s, the Association for Nonsmokers—Minnesota (Live Smoke Free's parent organization), was funded by ClearWay MinnesotaSM to partner with the Center for Energy and Environment to conduct research about smoke-free housing. Part of the research project included a survey of a random sample of Minnesota renters in 2001 to measure experiences and attitudes toward secondhand smoke in apartment buildings.³²

Live Smoke Free utilized the results of the survey for a number of years; this data was presented to managers at conferences and in written materials. In 2009, Live Smoke Free had the opportunity to fund a new survey in partnership with Wilder Research.³³ At that time, Live Smoke Free was funded to work only in the seven-county Twin Cities Metropolitan Area, so the new survey could not be conducted in the same geographic area as the first survey. Nevertheless, one of the goals of the survey was to keep much of the methodology and many of the questions consistent with the original survey to trend any patterns in attitudes.

The new survey results provide several useful talking points to share with managers:

- **Renters are exposed to secondhand smoke:**
In 2001, approximately 30% of renters reported being exposed to secondhand smoke that drifted into their apartment unit from somewhere else in the building. In 2009, that number was down to about 20% (though the geographic area surveyed was more limited in 2009). Unfortunately, the number of renters who reported being exposed to secondhand smoke "often" and "most of the time" went up 3% and 6% respectively.
- **Renters have an interest in smoke-free environments:**
When asked how interested they would be in living in a building where smoking is not allowed in

specific areas of the property, 73% wanted a policy that would cover all of the residential units, 62% wanted a policy that covered patios/decks/balconies, 64% wanted smoke-free building entrances, and 64% wanted the entire property to be smoke free.

- **Some renters will give up certain amenities for a smoke-free building:**
Forty-seven percent (47%) would live in a building without a pool or playground, 36% would drive 10 minutes further to work, and 23% would pay \$25 more each month in rent to live in a smoke-free building.

The last talking point was developed based on a question that was created by the housing industry. Live Smoke Free approached the Minnesota Multi-Housing Association (MHA) to get ideas for questions that the housing industry would find relevant. MHA recommended a question about amenities in order to give managers a sense of how smoke-free policies compare to other amenities that managers feel help attract renters.

Having local data helps us make the case to managers that renters in Minnesota experience secondhand smoke exposure and want to live in smoke-free buildings.

they educate managers on the dangers of fires and whether they would be willing to partner with your program.

Managers know that there is a large fire risk that comes from having multiple people living in one building, so they will want to find ways to prevent as many fires as possible. You can include statistics about local fire rates in your materials and presentations in order to educate managers about the dangers of smoking-related fires, and let managers know that smoke-free policies are an easy and effective way to reduce the risk of smoking-related fires, damages, injuries, and deaths by eliminating lighted smoking materials from the building.

THE MARKET DEMAND FOR SMOKE-FREE MULTI-UNIT HOUSING

Typical renter concerns regarding smoke

Around the world, renters want a smoke-free living environment; however, there is currently not enough smoke-free multi-unit housing to meet the need. Most renters who are looking for smoke-free apartments are concerned about the health effects that they (and their families and guests) are either currently experiencing or have the potential to experience due to secondhand smoke exposure. Renters in senior or subsidized housing may be particularly concerned because their housing options are often more limited (for strategies on helping renters, read Chapter 8,

i “Working with Renters Who are Exposed to Secondhand Smoke”). As more people learn about the dangers of secondhand smoke and as more public places become smoke free, a growing number of renters will demand that their own living space be smoke free, as well.

Renters want smoke-free housing

Many smoke-free multi-unit housing programs have conducted surveys to identify and demonstrate the need for smoke-free multi-unit housing. Some studies are local and are confined to particular buildings or municipalities, while other studies survey larger regions or entire states. You can use the results from these studies to demonstrate the demand for smoke-free multi-

unit housing to managers in your area, or you can conduct your own surveys. For more information on conducting community surveys, read Chapter 9, “Cultivating Program Sustainability.”

Results from select community surveys

- A survey of Sault Tribe Housing Authority residents in Michigan found that 70% of respondents preferred to live in smoke-free housing. Forty-four percent (44%) of residents smoke or live with a smoker.²⁹
- The Healthy Androscoggin program located in Auburn, Maine surveyed 850 renters and found that 76% would choose to live in a smoke-free apartment building.²⁷
- According to the New York Adult Tobacco Survey, a majority of respondents who live in multi-unit housing (56%) support a policy that prohibits smoking in all areas of their building, including residential units. Support was significantly higher among ethnic minorities and individuals who live with children.³⁰
- In Oregon, 70% of renters (and 40% of smokers) say they would choose a smoke-free rental, “other things being equal.”³¹

SPECIAL SECTION: Secondhand Smoke Transfer in Multi-Unit Housing

RESEARCH OVERVIEW

The Center for Energy and Environment (CEE) “is a nonprofit organization that promotes energy efficiency to strengthen the economy while improving the environment.”³⁴ One of their areas of expertise is indoor air quality research. In the early 2000s, CEE was funded by ClearWay MinnesotaSM to conduct a four-part research study that consisted of:³⁵

- A survey of a random sample (n=600) of Minnesota renters to measure experiences and attitudes toward secondhand smoke in apartment buildings and smoke-free building policies;
- In-depth interviews with Minnesota apartment owners and managers to learn about experiences and attitudes toward secondhand smoke in apartment buildings, as well as their experiences (where applicable) with smoke-free policies;
- Legal research on secondhand smoke transfer and smoke-free policies, conducted by the law firm of Hanbery, Neumeyer & Carney, P.A. and overseen by an advisory committee including apartment managers, renters, and public housing authority attorneys as well as staff from the Association for Nonsmokers—Minnesota and CEE; and
- A field study that quantified air movement between units in apartment buildings and tested whether air sealing and ventilation work could reduce air movement and second hand smoke transfer.³⁶

CEE’s work with secondhand smoke transfer is ongoing. CEE is currently analyzing the results of another study on secondhand smoke transfer in apartment buildings. The new research utilized selected random samples of apartments that reported secondhand smoke incursions and apartments in smoke-free buildings, monitored particulate and gas phase tracers of secondhand smoke in each. Results of this study will be available in 2013 at www.mncee.org.

The 2001 research set out to answer several key questions

- How much air is transferred between apartments?
- How big are the air leaks between apartments?
- Where are the air leaks between apartments?
- What drives air through these openings?
- How much can air transfer be reduced by sealing and ventilation?
- How can you measure secondhand smoke transfer?

HOW MUCH AIR IS TRANSFERRED BETWEEN APARTMENTS?

Six different types of apartment buildings (all located in the Twin Cities Metropolitan Area in Minnesota) were studied in the winter:

- An 8-unit, 2-story building built in 1970
- A 2-unit duplex built in the 1930s
- A 12-unit, 3-story building built in 1964
- A 178-unit, 11-story building built in 1982
- A 38-unit, 4-story building built in 2001
- A 138-unit, 3-story building built in 1999

The researchers continuously “tagged” the air in each apartment with minute quantities of a unique tracer gas, and quantified air movement between units by measuring the amount of each type of tracer gas that arrived in the other units.

Results: Up to 65% of the air coming into a given apartment came from other units in the building.

Air from Adjoining Apartments as a Percent of Inflow

LOCATION	RANGE	MEDIAN
Top Floor Units	2 to 65%	16%
Mid-Floor Units	1 to 20%	5%
Lowest-Floor Units	1 to 4%	2%

by Martha Hewett, Director of Research, Center for Energy & Environment

HOW BIG ARE THE AIR LEAKS BETWEEN APARTMENT UNITS?

To determine the effective area of leaks between units, instruments called “blower doors” were used. A blower door measured the exact amount of air flow required to create a certain pressure difference between one apartment and another. The greater the size of the leaks between the two spaces, the higher the amount of air flow rate required to maintain a given pressure difference. Using this relationship, the “effective leakage area” of all the gaps and cracks between the two spaces can be expressed in terms of the size of a single idealized hole.³⁷

Results

Apartments tested had an average of 9 square inches of leakage (the idealized hole) to adjacent units. That’s a large amount of space through which secondhand smoke has the ability to travel.

Effective Leakage Area (ELA) and Leakage Area Between Units as a Percentage of Total

	RANGE	AVERAGE
Total ELA (sq. in)	25 to 130	47
to Adjacent Units ELA (sq. in)	5 to 26	9
Percentage of Total	16 to 59%	27%

WHERE ARE THE LEAKS?

Apartment units are filled with gaps. The researchers found some gaps that were accessible and easy to seal, but others were inaccessible or too diffuse to seal. Some openings were small, such as gaps around sink plumbing, sprinkler heads, and light fixtures; and some leaks were diffuse, such as those along baseboards, under carpets, and behind baseboard heaters. A few openings were large, such as those between apartment unit walls behind pegboard plumbing access panels. Other openings were hidden mechanical chases that yielded large uncontrolled air flows. The hidden openings were the hardest to access and seal.

WHAT DRIVES AIR THROUGH THESE OPENINGS?

The stack effect

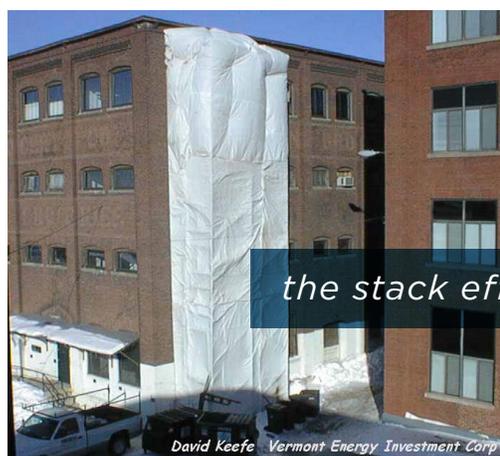
One common cause of air movement is the stack effect. During the winter stack effect, cold air comes in at the bottom of a building and goes out at the top of the building as the air inside warms and rises. The stack effect can happen in reverse during the summer months. The stack effect happens at a higher rate in taller buildings.

The winter stack effect is the reason that the researchers found such differences in shared air by floor (see chart “Air from Adjoining Apartments as a Percent of Total Inflow”). The units on the lower floors receive a lot of infiltrating air from outdoors but not much air from other units. The units on the higher floors receive a lot of air flow upward from the lower floors of the building.

However, this does not mean that secondhand smoke only moves up through a building. There are other factors that can cause secondhand smoke to move down (such as reverse stack effect) and from side-to-side.

The wind effect

As wind blows against one side of the building, air tends to flow in that side and be pushed out the other side. For instance, if the wind is blowing



SPECIAL SECTION: Secondhand Smoke Transfer in Multi-Unit Housing (con't)

against the east side of the building, air will go in on the east side, move through the building, and escape through leaks on the west side of the building. Similar to the stack effect, the wind effect is greater in taller buildings because wind speed is higher further off the ground.

Mechanical system effects

Mechanical ventilation is required by building codes in bathrooms and in some kitchens. The

typical bathroom fan is an exhaust fan. These fans pull air out of the bathroom and typically vent the air up through the roof. As air is pulled from the bathroom, air from elsewhere in the building is drawn into the bathroom to replace the air that is being vented. This can cause large amounts of air flow into a unit from other units every time a renter turns on his/her bathroom or kitchen fan. Even if a building has a continuously operating exhaust system, this can cause air to move from one unit to another if the system is not properly balanced to draw the same amount of air from each unit.

Since exhaust fans are designed to vent air up through a building and out at the top, there can be a lot of air moving through multiple floors as air from the bottom floors travels up the exhaust system. Unfortunately, when the building's roof fan turns off (most buildings do not leave the fans running 24 hours a day) or if the system is improperly balanced, air can go into the exhaust grills on the lower floors but escape out from the exhaust registers on the upper floor units, rather than getting all the way out of the building at the roof. That is why some renters will experience secondhand smoke coming out of their exhaust vents.

What if renters open a window?

Some renters try to solve the problem of secondhand smoke exposure by running their unit's exhaust fans and/or opening their windows. Due to the mechanical systems effects, renters may soon realize that running their exhaust fans does not solve the problem and might actually make it worse.

If a smoking renter is on a lower floor, opening a window tends to increase outdoor air flow into the apartment and secondhand smoke transfer to upstairs neighbors. If a nonsmoking renter is on an upper floor, opening a window tends to increase air flow out of the apartment and draw in secondhand smoke from downstairs neighbors. Unfortunately, there is little that renters can do to change the air flow in a way that eliminates secondhand smoke exposure.

The Center for Energy and Environment has developed several animated videos to illustrate how air, and secondhand smoke, drifts through a multi-unit housing building. Viewing these videos will give you a better understanding of the physics behind the movement of secondhand smoke in multi-unit housing. You can also show these videos in presentations to apartment managers to educate them on how secondhand smoke moves through a building.

Winter Stack Effect

<http://www.youtube.com/watch?v=-JfP2DXqep0>

Summer Stack Effect

<http://www.youtube.com/watch?v=QnuH9P5RLZE>

Wind Effect

<http://www.youtube.com/watch?v=OGxIFCWnjUc>

Mechanical Effect (Exhaust Fans)

http://www.youtube.com/watch?v=ZiBtT_IL_rU

HOW MUCH CAN AIR TRANSFER BE REDUCED BY SEALING AND VENTILATION?

Treatments and effects

CEE's researchers implemented several treatments in the test buildings in an effort to reduce air and secondhand smoke transfer:

- Sealed leaks to an extent that was practical (a building cannot be completely sealed due to inaccessible and diffuse leakage);
- Installed effective exhaust fans;
- Converted intermittent exhaust fans to continuous exhaust fans; and

- Properly balanced exhaust air flows.

The treatments did reduce secondhand smoke transfer and increase dilution of smoke in both the smokers' and nonsmokers' apartments, but did not eliminate the problem completely. Contaminant concentrations in nonsmokers' units were reduced by a median of only 29%. Over 80% of residents with pre-existing secondhand smoke problems reported that exposure was less frequent and less severe after treatments, but the exposure was not completely gone.

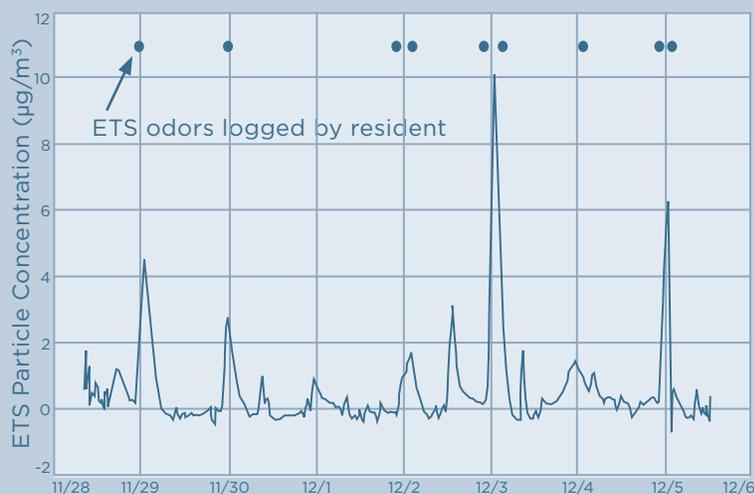
At the time (in the early 2000s), the researchers estimated that the treatments would cost approximately \$700 per unit. That is a lot of money to spend to reduce the problem by less than one-

EXAMPLE: Secondhand Smoke Transfer Via Exhaust Ducts

CEE researchers asked renters in non-smoking units to allow an Aethalometer to be placed in their unit for a period of time. The Aethalometer measures ultra-violet-absorbing particles that are found in secondhand smoke, which allowed the researchers to chart when secondhand smoke exposure peaked in the unit. At the same time, the researchers asked the renters in the nonsmoking units to keep their own logs about when they smelled secondhand smoke (the renters could not see the results of the Aethalometer to know when it measured the presence of secondhand smoke).

In the example below, there was a smoking resident on the 1st floor and the non-smoker's unit that was being monitored was on the 11th floor of the building. There was a central exhaust fan for the building that automatically turned off every day at

midnight. As you can see from the chart below, the Aethalometer measured peaks of secondhand smoke particle concentration when the exhaust fan went off, at the same times that the nonsmoking renter reported smelling smoke. This not only demonstrates that secondhand smoke does travel from unit-to-unit, but also that renters can report secondhand smoke exposure with accuracy.



SPECIAL SECTION: Secondhand Smoke Transfer in Multi-Unit Housing (con't)

third. In the interviews conducted a few years prior, 69% of managers said they would be willing to spend less than \$250 per apartment unit to substantially reduce movement of secondhand smoke or other objectionable air.

When the Surgeon General's report, "The Health Consequences of Involuntary Exposure to Tobacco Smoke," was released in 2006, it concluded that there is no safe level of secondhand smoke exposure.²⁰ Similarly, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) has released multiple posi-

tion documents (the latest was released in 2010) which have concluded that "at present, the only means of effectively eliminating health risk associated with indoor exposure is to ban smoking activity."³⁸

Since engineering approaches such as air fresheners, cleaners, and purifiers have not proven to be effective, ASHRAE cautions that such devices should not be relied upon to control health risks from secondhand smoke. Instead, ASHRAE "encourages elimination of smoking in the indoor environment as the optimal way to minimize [secondhand smoke] exposure."⁴¹

These position documents underscore CEE's analysis from the early 2000s that air-sealing and mechanical fixes are not a solution to secondhand smoke problems. Only a comprehensive smoke-free policy can eliminate secondhand smoke exposure in a multi-unit housing building.

HOW GOOD IS THE HUMAN NOSE?

Research by Martin H. Junker on olfactory lab testing with nonsmokers concluded that the threshold of odor acceptability for respirable secondhand smoke particles is 1 microgram (μg) per cubic meter (m^3). The threshold of eye, nose, and throat irritation is 4.4 $\mu\text{g}/\text{m}^3$. One cigarette produces 6,000 to 14,000 μg of respirable particles.⁴⁹

This means that, if dispersed uniformly, one cigarette would require:

- 3,000 cubic meters to be below the irritation threshold (that's the equivalent of 1.2 Olympic swimming pools)
- 19,000 cubic meters to be below the odor acceptability threshold (that would be 7.6 Olympic swimming pools!).

The human nose can smell even a small amount of secondhand smoke in a very large area.

HOW CAN YOU MEASURE SECONDHAND SMOKE TRANSFER?

Many smoke-free multi-unit housing programs want a device with which they can easily and inexpensively recreate air movement research similar to CEE's. Unfortunately, there are no current methods that are low cost, widely available, and that reliably distinguish between secondhand smoke and other sources of particles in the air. Developing such a device or system is an active area of research. For more information on secondhand smoke testing and ways to measure secondhand smoke in apartment buildings, read the "Resources" section in this chapter.



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Credited Media

Photos of smoking damage in an apartment courtesy of the New Hampshire Tobacco Prevention and Control Program

Stack effect photo courtesy of David Keefe, Vermont Energy Investment Corp.

CHAPTER CONCLUSIONS:

Property managers recognize the impact of secondhand smoke on residents and staff:

- Smoke-free buildings provide a safe, healthy environment for all residents and staff.
- Regulations are in place to protect residents from other toxins such as mold and lead.
- Unhealthy living environments are a social justice issue.
- Property managers may be motivated to adopt a smoke-free policy for financial benefits rather than health benefits.

Property managers are concerned about property damage from smoking:

- It is very costly to continually clean and replace carpets, fixtures, and appliances.
- Fires caused by careless smoking are costly and deadly.
- Insurance costs may be saved by adopting a smoke-free policy.
- Cost savings are often the biggest reason managers adopt smoke-free policies.

Market demand for smoke-free buildings is important to property managers:

- Secondhand smoke exposure in apartment buildings is occurring and is a problem.
- The risk of losing renters is insignificant.
- Smoke-free buildings will likely attract more renters and retain current renters.

SAMPLE TOOLS

- *Program websites*
- *Fact sheets and DVDs describing the benefits of smoke-free multi-unit housing*

PRACTITIONER'S CHECKLIST:

ARE YOU READY TO BUILD A SMOKE-FREE HOUSING PROGRAM?

- Have you identified established smoke-free housing advocates for guidance or resources?
- Have you identified smoke-free multi-unit housing programs in your state?
- Have you joined the smoke-free multi-unit housing listserv?
- Have you identified the public housing buildings in your area?
- Have you measured the housing stock and renter make-up in your area?
- Have you developed talking points about both the dangers and benefits of adopting a smoke-free policy?
- Have you discovered buildings in your area that have had smoking related fires?
- Have you identified any local surveys that demonstrate the marketability for smoke-free multi-unit housing?
- Are you able to explain how air moves within apartment buildings?

RESOURCES

• *American Society of Heating, Refrigerating, & Air Conditioning Engineers (ASHRAE):*
<https://ashrae.org/home/>

• *Centers for Disease Control and Prevention (CDC):*
www.cdc.gov/tobacco

• *Center for Energy and Environment: (CEE)* www.mncee.org/

• *Neil Klepeis:* <http://neil.klepeis.net/>

• *Repace Associates, Inc.:*
www.repace.com/

• *Roswell Park Cancer Institute:*
www.roswellpark.edu/

• *Smoke-Free Multi-Unit Housing Listserv:*
www.tcsg.org/sfelp/home.htm