A Smoking Gun

Cancer-causing chemicals in e-cigarettes

CEH
center for environmental health

CEH

2201 Broadway, Suite 302 Oakland, CA 94612
T: (510) 655-3900 F: (510) 655-9100
www.ceh.org

This report was written by Caroline Cox, Research Director at the Center for Environmental Health.

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Summary

E-cigarettes (technically known as electronic nicotine delivery systems) have become big business. While e-cigarettes have been widely marketed for less than a decade, today U.S. sales are about 3.5 billion dollars a year and some estimates say that about 10% of Americans have used e-cigarettes. Use by teens has grown exponentially, tripling in one year. Part of the appeal of these devices is that they are marketed as safe and free of the health problems caused by cigarettes. In particular, many users believe that e-cigarettes do not produce cancer-causing chemicals.

The Center for Environmental Health commissioned an independent laboratory to test 97 e-cigarette products purchased from major retailers and online sellers for the production of two cancer-causing chemicals, acetaldehyde and formaldehyde. We tested products made by 24 companies, including all of the leading U.S. brands. Twenty-one of the 24 companies whose products were tested had at least one product that produced high levels of one or both of these chemicals, in violation of California's consumer protection law, Proposition 65. CEH is taking legal action against these companies for failing to warn consumers about exposures to these chemicals from their products, as required under Prop 65. This follows our previous legal action against companies that were not informing customers about the nicotine in their products.

Some e-cigarette consumers use nicotine-free products. While some people may believe that e-cigarettes without nicotine are safe, our testing showed that high levels of these cancer-causing chemicals are produced even by some e-cigarettes without nicotine.

CEH is also concerned about the deceptive and dangerous marketing practices of e-cigarette companies. Studies show that the majority of e-cigarette companies make unverified safety claims and other questionable claims about their products. Many companies market their products as a tool for quitting tobacco, but recent research suggests that e-cigarettes may provide a gateway to traditional cigarettes, in particular for young people who never smoked tobacco. Other marketing suggests that e-cigarettes can be used in locations where smoking is not allowed, despite hundreds of communities where e-cigarettes have been added to indoor-smoking bans

Further, hundreds of e-cigarettes are sold in candy and dessert flavors and/or bright colors that appeal to teens and children. This has resulted in a major increase in nicotine poisoning incidents, especially among young children. CEH is calling on e-cigarette companies to end these deceitful and dangerous practices.

What are e-cigarettes?

Ten years ago, most of us had not heard of e-cigarettes. Today the e-cigarette and vaping industry is booming. Technically called “electronic nicotine delivery systems,” e-cigarettes are devices that use battery power to heat up an “e-liquid” to create a vapor (smoke or mist) that the user of the e-cigarette breathes in. Liquids used in e-cigarettes generally contain a base, flavoring, and (typically but not always) nicotine.

E-cigarettes come in a wide variety. Some are disposable products that a person uses for a day, consumes all of the liquid, and then discards. These products often are about the same shape and size as a conventional cigarette. Other products are designed to be reused and have rechargeable batteries and either replaceable cartridges to hold the liquid or refillable tanks. Many of the products come with or can use a multitude of flavored liquids.

Products can be classified into three broad types:

Cigalikes

Also called Mini-E-cig, Slims: About the size and shape of conventional cigarettes, often disposable and pre-filled with liquid, but may also be sold in a two-piece with a replaceable cartridge.

eGo’s

Also called vape pens, slightly larger in length and width than cigalikes, with a larger, more powerful battery and usually with a refillable tank or replaceable cartridge.

Mods

Known as modules or vaporizers (aka, personal or advanced personal vaporizer (PV or APV), these larger products make use of reusable/refillable tanks or cartridges, more powerful batteries capable of variable voltage and wattage, with different types of atomizers and heating elements; typically for more experienced users.

Recent surveys show that e-cigarette use has increased dramatically. According to a recent poll by Reuters, about 10 percent of U.S. adults now use e-cigarettes. The CDC recently reported that e-cigarette use among middle and high school students tripled from 2013 to 2014 and a report published by the California Department of Public Health found that almost 14 percent of 11th graders, and 6 percent of 7th graders had used e-cigarettes recently. The National Youth Tobacco Survey found that about 2 million high school students and half a million middle-schoolers use e-cigarettes.

CEH is concerned about the unregulated marketing of e-cigarettes, and especially sales to teens and young people, while little is known about the health hazards from inhaling e-cigarette smoke. One of the attractions of e-cigarettes is that many people believe that they are safer or cleaner than conventional cigarettes. And while the smoke* (often called vapor) produced by e-cigarettes does not look or smell like cigarette smoke, previous studies of a limited number of products have shown that it does contain some of the cancer-causing chemicals found in cigarette smoke.

Our review of 97 e-cigarettes and other vaping products is the first to show, through testing of actual products purchased from major retailers, based on real-world use, that the majority of e-cigarette products tested produce high levels of the cancer-causing chemicals formaldehyde and acetaldehyde.

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*Note: In technical terms, e-cigarettes produce an aerosol containing nicotine and other compounds. In this report we refer to the aerosol as smoke, in the sense of the dictionary definition: "fume or vapor often resulting from the action of heat on moisture."

The e-cigarettes industry

E-cigarettes are an enormous and diverse industry. Recent research has found almost 500 e-cigarette brands offering more than 7,700 flavors, with nearly a dozen new brands coming to the market every month. Annual sales in the US are estimated at roughly 3.5 billion dollars. The newer models, rechargeable and refillable devices, account for about 60% of that (2 billion dollars).

Major tobacco companies now own the leading e-cigarette brands, including Imperial Tobacco/ITG (blu), Altria (Green Smoke and Mark Ten), and Reynolds (Vuse, the number one e-cigarette in the US, according to Reuters). NJOY is the most popular U.S. brand not owned by a tobacco company.

Unlike tobacco, e-cigarettes are virtually unregulated. While there are hundreds of brands and thousands of varieties sold, there are no quality or testing standards to assure product consistency or accuracy of e-cigarette labeling. A 2014 review of studies on chemicals produced by e-cigarettes showed that nicotine levels actually produced by e-cigarettes often vary widely from the nicotine level listed on the label.

Further, tobacco has been subject to federal marketing rules for decades: in 1970, tobacco companies were barred from advertising cigarettes on radio or television. But in 2014, tobacco company Reynolds American began running television ads for its Vuse e-cigarettes.

Strict rules on tobacco marketing were created by the 1998 Tobacco Master Settlement Agreement, including restrictions on advertising, lobbying and sponsorship. The rules forbid tobacco marketing to children and use of tactics that appeal to kids and teens – including virtually all of the tactics used commonly today by the e-cigarette industry.

The FDA has proposed draft rules on e-cigarettes, though the agency's final proposal, slated for release in June 2015, has still not been released as of this writing. Even after the proposal is made public, it is expected to be years before rules are adopted and implemented. Many observers have pointed to serious deficiencies in FDA's initial draft. In a written comment to the agency, 29 state attorneys general called for additional rules

> "for the protection of the public health and, in particular, to protect youth from the dangers of tobacco use."

Anti-smoking advocates have also criticized the agency's draft as leaving vital issues unresolved, including marketing restrictions and sales to young people.

In the absence of federal rules, states and localities are taking action on e-cigarettes. Some states and hundreds of cities and towns have added e-cigarettes to indoor air rules that ban smoking and/or adopted other rules to prohibit uses of e-cigarettes in public places. In California, the state has sent warning letters to more than 150 e-cigarette and vaping companies, urging them to stop targeting minors and end deceptive marketing practices. However, our review of current e-cigarette marketing shows that the use of such practices has continued unabated.

E-cigarettes & California law

Proposition 65 (formally known as the Safe Drinking Water and Toxics Enforcement Act) is California's consumer protection law concerning toxic chemicals. Proposition 65 requires businesses to warn Californians about products that expose consumers to significant amounts of chemicals that cause cancer or reproductive harm.

Warnings under Proposition 65 must be "clear and reasonable" so consumers know about the health threat from a product before purchasing. None of the products purchased for our testing had labeling to inform consumers about risks from the formaldehyde and/or acetaldehyde produced by the product. Several of the products were candy or dessert flavored and brightly colored, and some used unsubstantiated safety claims in their marketing.

CEH is taking legal action against the companies whose products produce formaldehyde and acetaldehyde above the Proposition 65 threshold. This legal action follows on our earlier action regarding nicotine-containing e-cigarette liquids sold in California without required warnings.

Our testing

The Center for Environmental Health purchased 97 e-cigarettes and other vaping products between February and July 2015. Our purchasing included combinations of e-cigarette devices and liquids or cartridges.

We tested:

15 disposable devices

32 cartridge devices

50 refillable devices

We commissioned an independent lab to test the products for two chemicals, acetaldehyde and formaldehyde. Both California and the federal National Toxicology Program have classified these as cancer-causing chemicals.

Cancer is not the only health hazard linked to exposure to these chemicals. Both chemicals, according to the National Institute for Occupational Safety and Health, also cause genetic damage, birth defects, and reduced fertility.

We contracted with a leading cigarette testing laboratory that is accredited by the American Association for Laboratory Accreditation and that has been testing both cigarettes and e-cigarettes for many years. They performed the tests using standard smoking machines that simulate how consumers use the products. A previous study finding formaldehyde in e-cigarettes has been criticized for using unrealistically high temperatures; our testing found high levels of the chemical in e-cigarettes at temperatures common for normal use.

We compared the exposures measured using the smoking machines to the safety levels for formaldehyde and acetaldehyde set under California's Proposition 65 law.

acetaldehyde
formaldehyde
cancer-causing chemicals

Our results

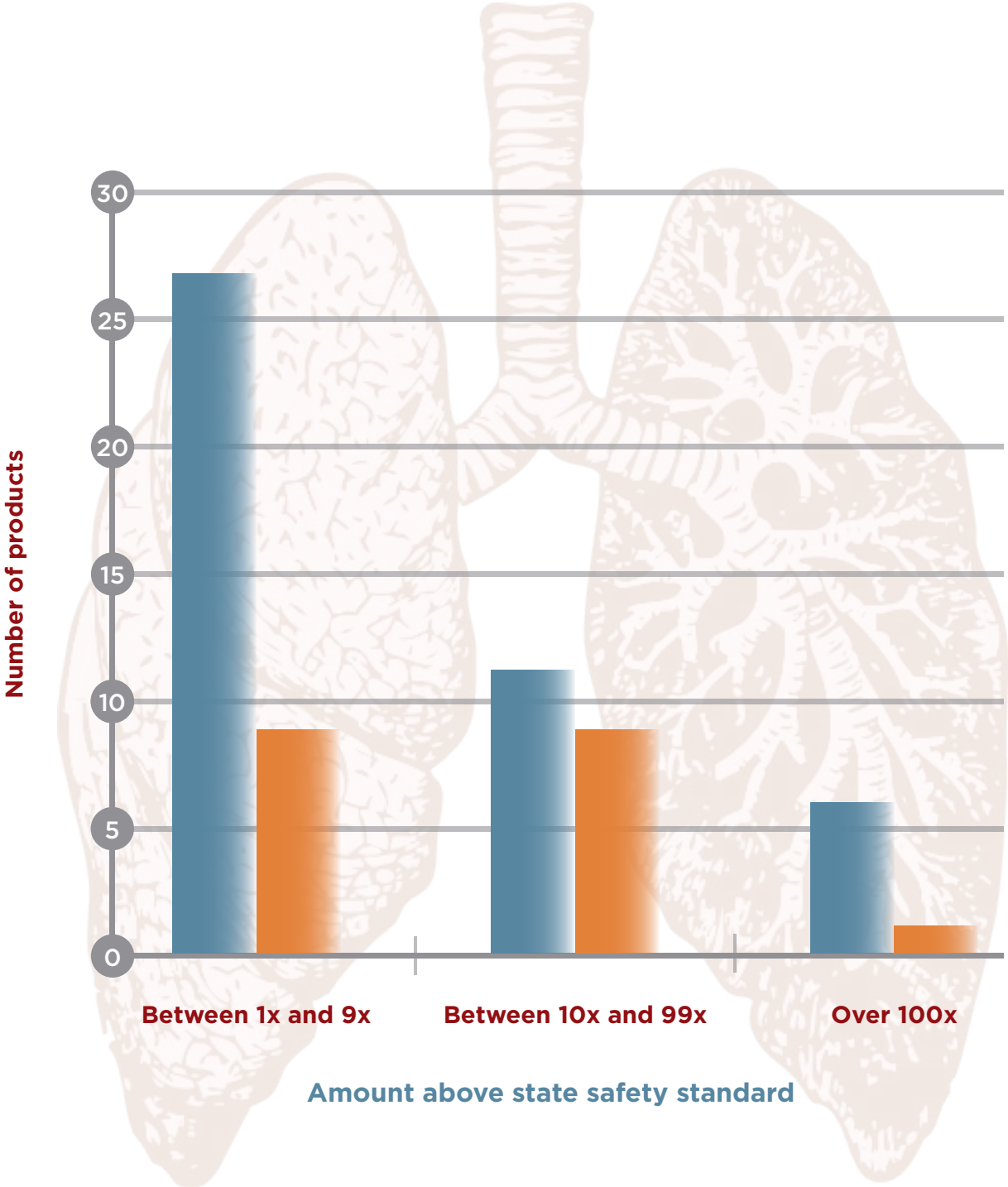
We found that e-cigarettes expose users to significant amounts of cancer-causing gases. In some cases the amounts are extremely high. We found formaldehyde exposures up to 473 times the Proposition 65 safety level and acetaldehyde exposures up to 254 times the safety level. Almost ninety percent (21 of 24) of the companies whose products we tested had one or more products that produced hazardous amounts of one or both chemicals, in violation of California law.

The companies producing at least one product with high levels of one or both cancer-causing chemicals are:

Artisan
Avail
E-Puffer
Eversmoke
International Vapor
Joyetech
Imperial Tobacco/ITG Group
Njoy
Nicopure
Pax Labs, Inc
Reynolds
Ritchy
Smoke NV
SS Choice
Totally Wicked
United Tobacco
Vapin
Vapor Corp
Vapor 4 Life
VMR Products
White Cloud

Despite the claims of industry and assumptions by many users, we found that even nicotine-free e-liquids produced high levels of both chemicals. For example, one nicotine-free product produced acetaldehyde exposures more than 13 times the Proposition 65 safety threshold and formaldehyde exposures more than 74 times the Proposition 65 threshold.

High levels of cancer-causing chemicals in e-cigarettes

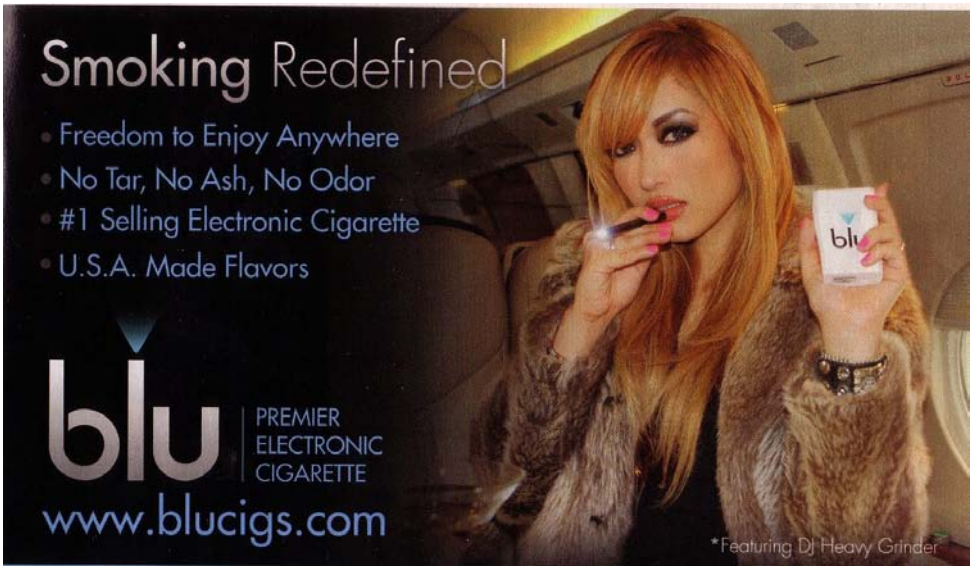


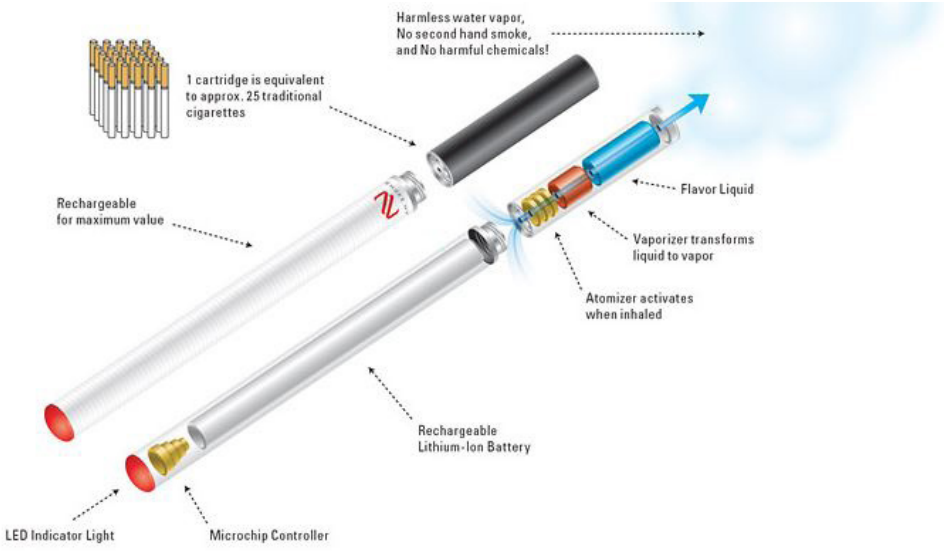
Deceptive marketing

Marketing of e-cigarettes is extensive - estimated at over 80 million dollars annually – and includes websites, television advertising (not permitted for conventional cigarettes) and a wide variety of social media techniques. This advertising often minimizes the health hazards of these products or makes unverified health or safety claims.

A 2014 study of e-cigarette websites found companies market the products as healthier (60% of brands) and cheaper (47%) than traditional cigarettes.

Other marketing claims that have been frequently used include that e-cigarettes are cleaner (95% of websites); that they do not produce secondhand smoke (76%); and are modern (73%). Ads were also found featuring doctors approving of e-cigarettes (22%).





Q. What is the vapor that Smoke NV releases?

Smoke NV releases harmless water vapor that vanishes in seconds without hazardous effects to the surroundings and the environment.

Circumventing no-smoking rules

Many companies emphasize that e-cigarettes can provide an easy and legal way to circumvent no-smoking rules. In the beginning of 2014, researchers at UC San Diego surveyed almost 500 e-cigarette brands, finding that about half of the brands claimed that e-cigarettes could be used where smoking is banned or restricted, despite numerous state rules and almost 400 localities that have prohibited such uses of e-cigarettes.

Stay Social

Forget the outdoor smoking section of shame. Forget standing in the cold to just have a smoke. Gone are the days when offensive odors, messy ash, and lingering smoke force you outside when a craving strikes. Also gone? The irritated looks from non-smokers. Enjoy the satisfaction of smoking without worrying about smoke, smells, burns- or judgement.

Teens and e-cigarettes

Much of the debate around e-cigarettes focuses on health and safety comparisons between the electronic products and traditional cigarettes. But with high rates of adoption of vaping among teens, questions about the health and safety effects of e-cigarettes must be considered apart from any comparisons. Our results showing the prevalence of cancer-causing chemicals in e-cigarettes mean that teens are not only being exposed to the addictive, brain-altering chemical nicotine but also to what could well end up being a lifetime of exposure to potent carcinogens.

Teens are particularly vulnerable to the effects of nicotine, including the nicotine in e-cigarettes. Adolescent brains are developing, and nicotine alters this development in important ways.

Adding to this vulnerability is sophisticated marketing targeting teens. A recent study found that the average teen saw 21 TV ads per year about e-cigarettes. These ads frequently use celebrities and depict use of e-cigarettes as a mature activity. One ad from a major company featured an actor saying, "We're all adults here. It's time to take back your freedom" - a line that clearly will appeal to teens' desires for independence and proof that they are no longer children.

E-cigarette use is particularly problematic for pregnant teens and young women. Exposure to nicotine during pregnancy can contribute to small babies, premature birth, and stillbirth.

E-cigarettes are also a gateway to smoking tobacco. A researcher at the University of Southern California, working with colleagues around the country showed that Los Angeles high schoolers who used e-cigarettes were almost twice as likely as non-users to start smoking.

Once teens begin smoking e-cigarettes it is difficult for them to stop. Nicotine is highly addictive; some believe it may be as addictive as heroin and cocaine. Teens who start using e-cigarettes may well be looking forward to a lifetime of use.

Kids and e-cigarettes

The UC San Diego survey mentioned earlier found that e-liquids in flavors that appeal to children were common. Over 80% of the brands surveyed offered fruit flavors, and just under 80% offered candy or dessert flavors. Sales of these child-oriented flavors should stop immediately.

Nicotine is especially dangerous for young children: A teaspoon of a typical e-liquid contains enough nicotine to be lethal to an adult;

smaller amounts would be lethal to a child. Already one death has been attributed to a child accidentally swallowing e-liquid. Nationwide, the number of cases of child poisoning linked to e-liquids jumped to 1,543 in 2013, and almost 4,000 in 2014.

A recent study found that 36% of parents who are e-cigarette users do not lock their nicotine-containing e-liquids and do not purchase products that have child-proof packaging. Parents most often stores e-liquids in a drawer or cupboard (34 percent), a purse or bag (22 percent) or on an open counter (13 percent). Three percent also reported their child had tried to drink the e-liquid. One in five parents surveyed had used e-cigarettes, and 1 in 8 had a family member who used them regularly.

Not an effective way to quit smoking

Many e-cigarette companies imply that these products are an easy way for smokers to quit. In the UC San Diego survey described earlier, claims that e-cigarettes were effective quitting aids were made by about half of the brands surveyed. And a quick search of social media will easily turn up anecdotes about the use of e-cigarettes to quit smoking.

Research paints a different picture, however. UC San Francisco researchers who comprehensively reviewed research about e-cigarettes and smoking cessation concluded that the available studies "suggest that e-cigarettes are not associated with higher quit rates in the general population of smokers."

The UCSF researchers identified one study that compared e-cigarettes with standard nicotine patches. This study concluded that "e-cigarettes are no better than nicotine patch and all treatments produced very modest quit rates without counseling." A 2014 study by UC San Diego researchers found that smokers who use e-cigarettes may be at an increased risk of not being able to quit smoking.

Other nicotine replacements, like nicotine gum and patches, have been approved as smoking cessation aides by the FDA, and do not expose users to cancer-causing chemicals. Our result showing high levels of cancer-causing chemicals produced by e-cigarettes provides another reason to discourage this use of e-cigarettes.

Changing the e-cigarettes industry

Through our legal action, CEH intends to influence the e-cigarette industry to change its practices that mislead users about the risks of these products. We will work with industry on making safer products and on informing consumers of the risks from nicotine, formaldehyde, and acetaldehyde, as is required in California. We will also urge companies to end marketing practices that target teens, as is already required for traditional cigarette makers.

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