

CRITICAL REVIEW ON THE AIR EMISSIONS FROM CANNABIS CULTIVATION

WITH FOCUS ON OCCUPATIONAL HAZARDS

**Davi De Ferreyro Monticelli, M.Sc./B.Eng. Environmental Engineering
Ph.D. Student in Atmospheric Sciences, EOAS Department
University of British Columbia**



Disclaimer: The following presentation uses results from “*de Ferreyro Monticelli D, Bhandari S, Eykelbosh A, Henderson SB, Giang A, Zimmerman N. Cannabis Cultivation Facilities: A Review of Their Air Quality Impacts from the Occupational to Community Scale. Environmental Science & Technology. 2022 Feb 9;56(5):2880-96.*” This paper is a collective work of UBC researchers and project partners

CONTENT

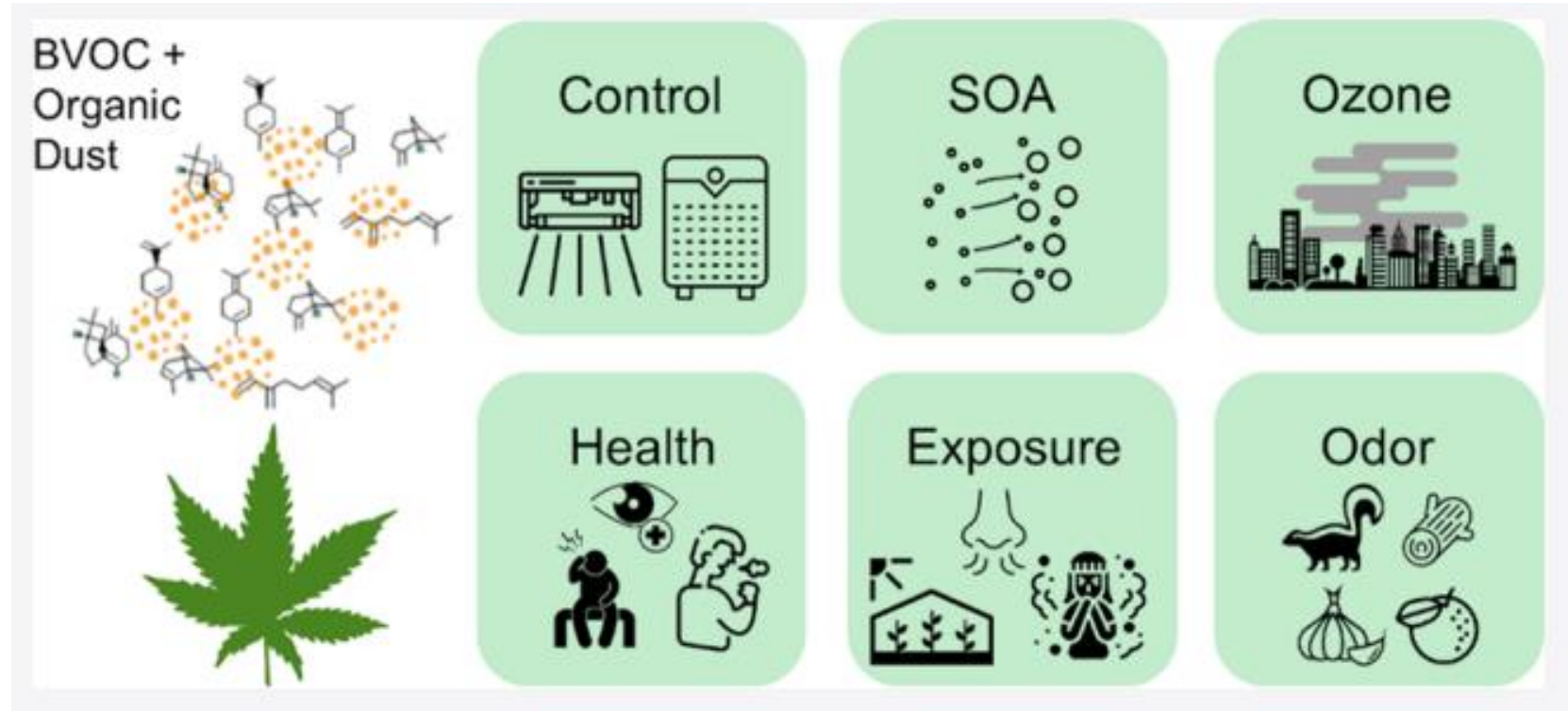
1. Cannabis air emissions – why do we care?
2. Best Available Technologies (BATs) and Best Environmental Practices (BEPs)
3. Key gaps on Cannabis air emissions
4. Occupational Hazards – the indoor air quality of Cannabis Cultivation Facilities (CCFs)
5. Industry Guidelines
6. Key gaps on occupational exposure science inside CCFs



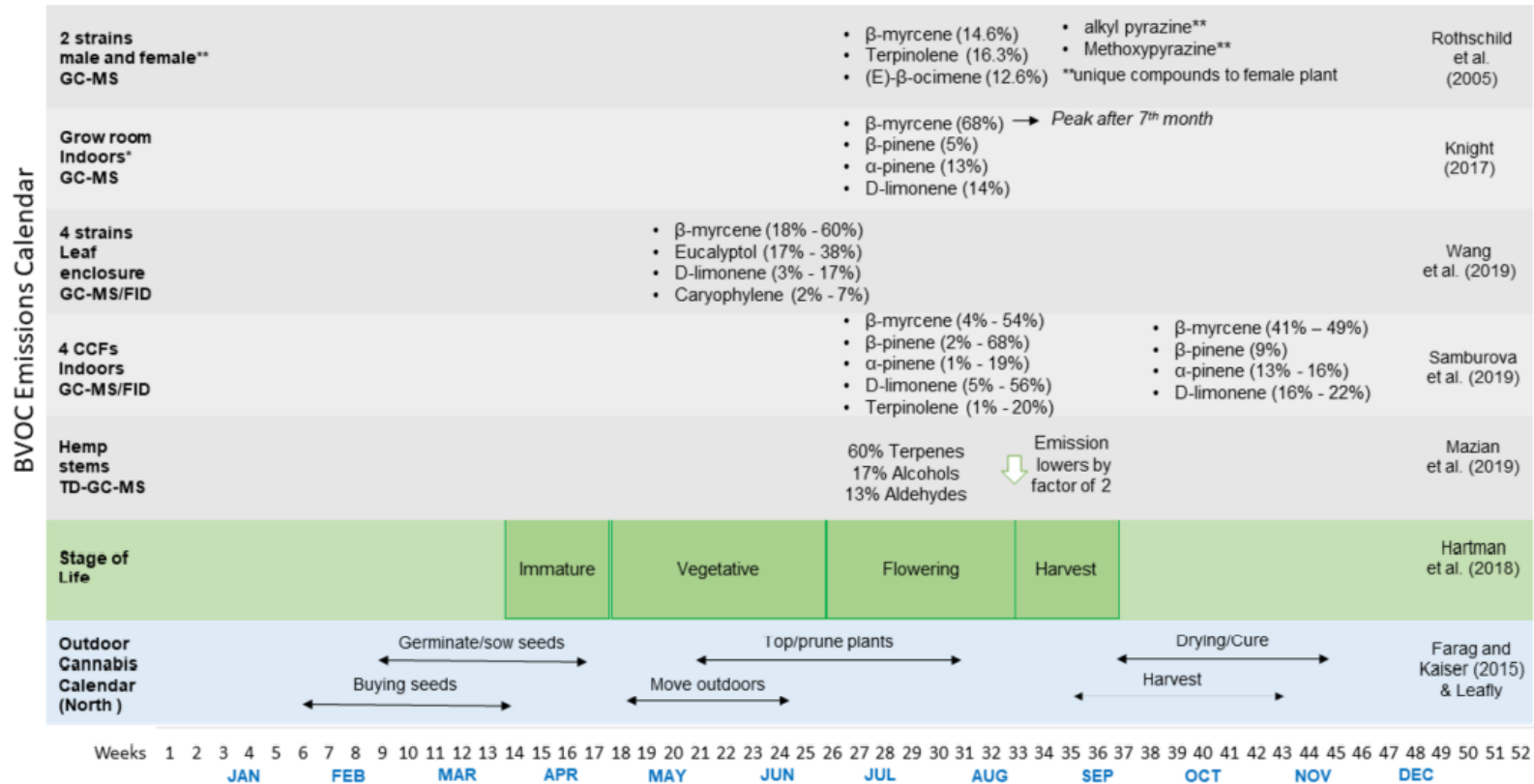
1. CANNABIS AIR EMISSIONS – WHY DO WE CARE?



THE EMISSIONS FROM CANNABIS PLANTS HAVE MULTIPLE IMPACT-PATHWAYS



THEY VARY THROUGH THE LIFE-CYCLE OF THE PLANT...



...AND ACCORDING TO THE STRAIN(S) CULTIVATED



Pink Kush

Dominant terpenes: A-Pinene, Myrcene, B-Caryophyllene, Humulene, B-Pinene

Aroma: pine, herbal

Product details: SKU STR-019, Specific gravity .8523, Refractive index density 1.4783, clear/colourless – light yellow



Death Bubba

Dominant terpenes: A-Pinene, B-Caryophyllene, Humulene, B-Pinene, D-Limonene

Aroma: fresh, sweet, woody,

Product details: SKU-022, Specific gravity .8675, Refractive index 1.4789, clear/colourless – light yellow



Mango Haze

Dominant terpenes: L-Carvone, Menthol, D-Limonene, Myrcene, B-Caryophyllene

Aroma: fresh, minty

Product details: TFF-045, Specific gravity .8964, Refractive index 1.4773, clear/colourless – light yellow



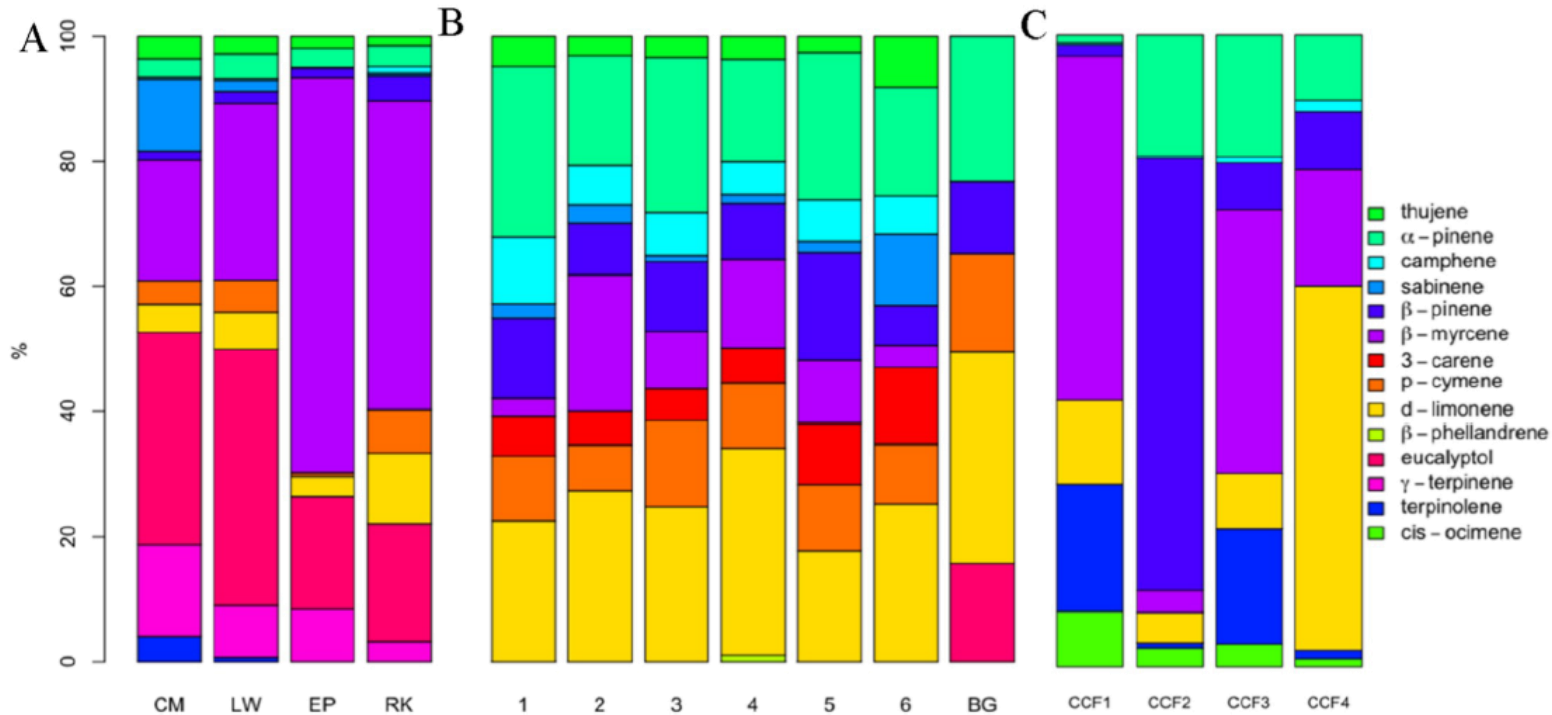
Lemon Skunk

Dominant terpenes: D-Limonene, B-Caryophyllene, Myrcene, Humulene, A-Pinene

Aroma: citrus, earthy

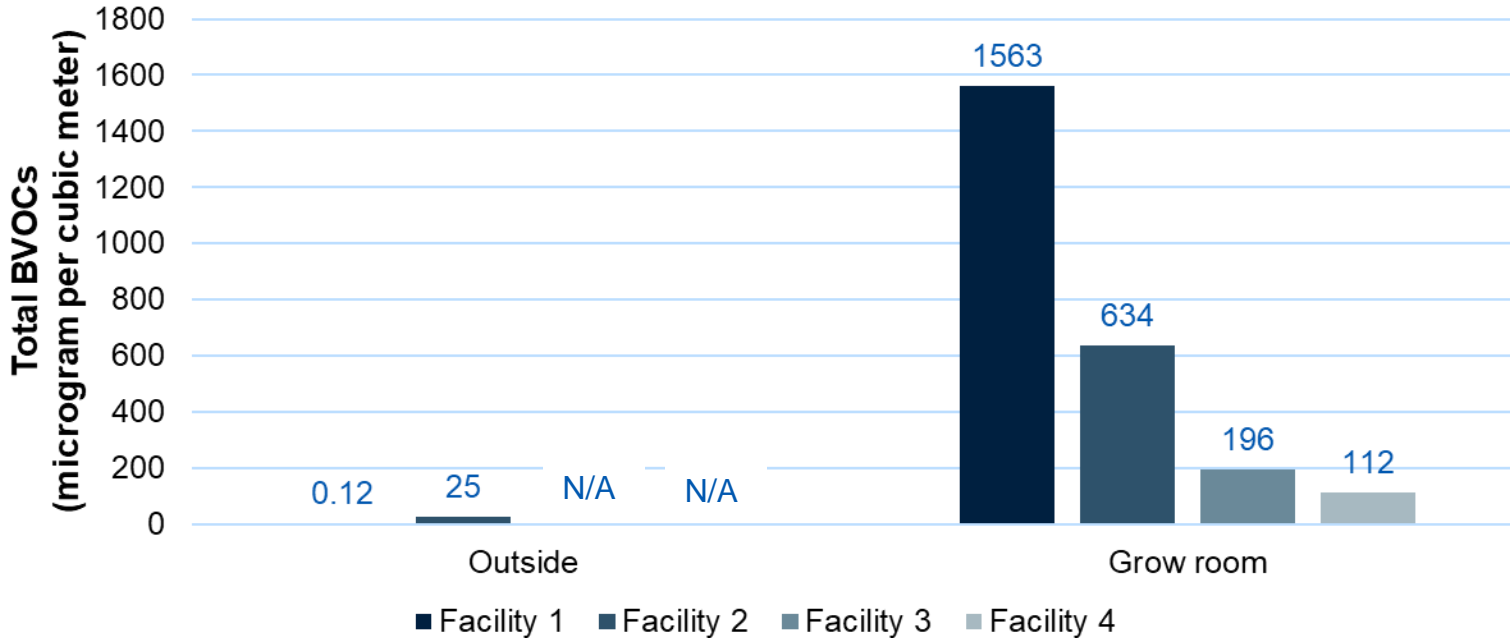
Product details: STR-026, Specific gravity .8407, Refractive index 1.4728, clear/colourless – light yellow

ANOTHER WAY TO VISUALIZE THE PREVIOUS POINT



Wang CT, Ashworth K, Wiedinmyer C, Ortega J, Harley PC, Rasool QZ, Vizuete W. Ambient measurements of monoterpenes near Cannabis cultivation facilities in Denver, Colorado. Atmospheric Environment. 2020 Jul 1;232:117510.

INDOORS THE CONCENTRATION OF EMITTED COMPOUNDS IS ABOUT THREE ORDERS OF MAGNITUDE HIGHER THAN OUTSIDE



Adapted from: Vera Samburova, Mark McDaniel, Dave Campbell, Michael Wolf, William R. Stockwell & Andrey Khlystov (2019) Dominant volatile organic compounds (VOCs) measured at four Cannabis growing facilities: Pilot study results, *Journal of the Air & Waste Management Association*, 69:11, 1267-1276, DOI: 10.1080/10962247.2019.1654038

2. BEST AVAILABLE TECHNOLOGIES (BATs) AND BEST ENVIRONMENTAL PRACTICES (BEPs)



THE BEST AVAILABLE TECHNOLOGY WON'T ALWAYS BE AVAILABLE DUE TO CAPEX AND OPEX

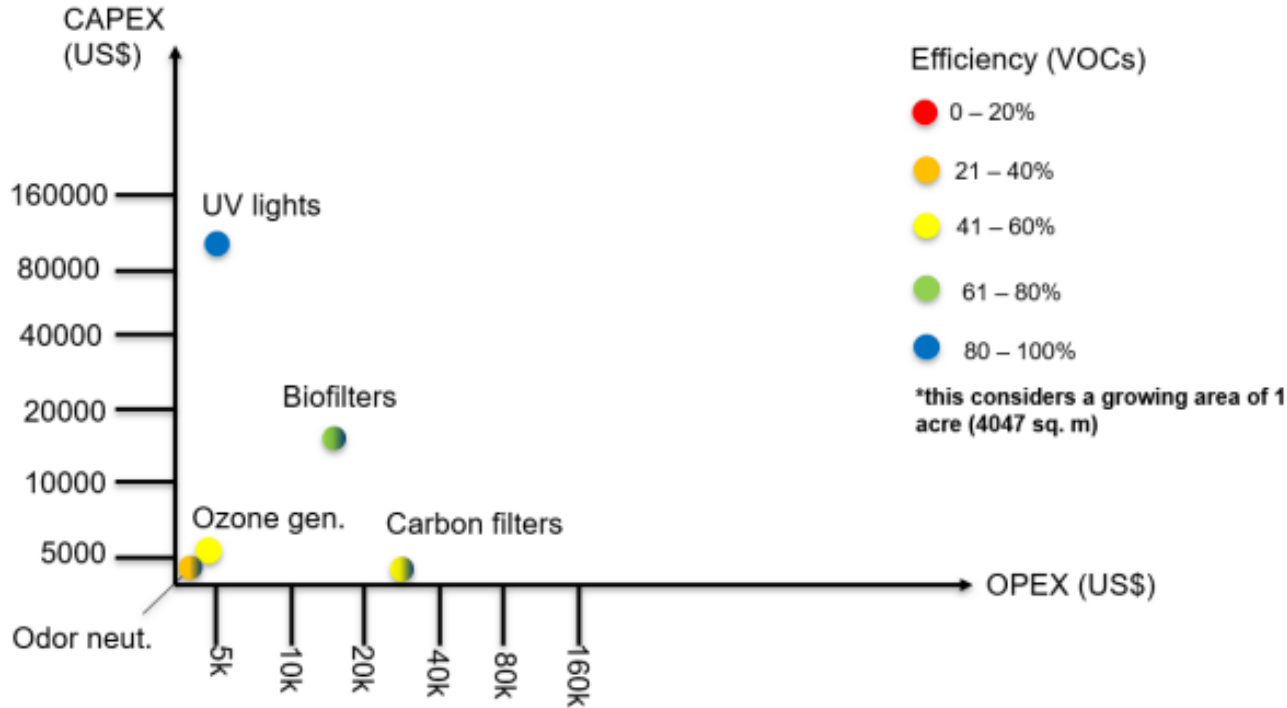


Figure S1. CAPEX, OPEX and Efficiency of BAT technologies for CCFs

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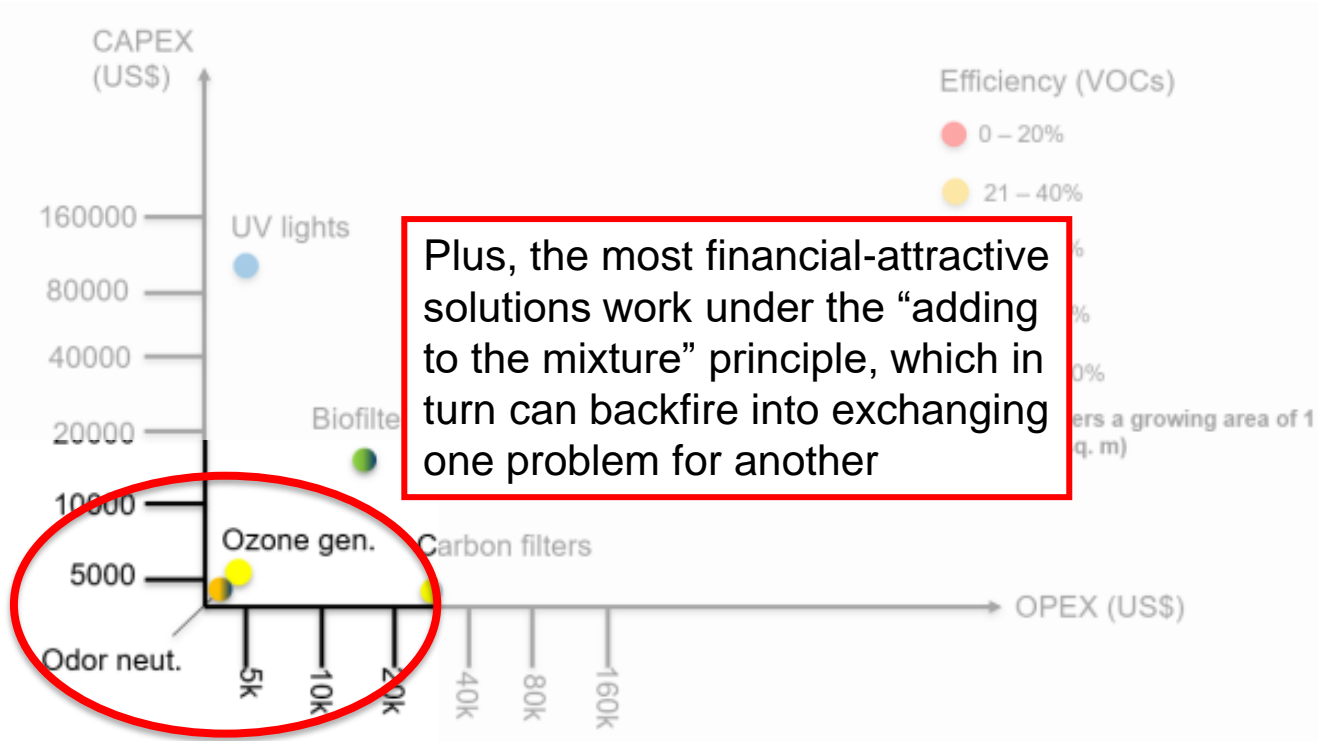


Figure S1. CAPEX, OPEX and Efficiency of BAT technologies for CCFs

KEY BEST ENVIRONMENTAL PRACTICES FOUND CONSIST OF

- Enclosing processing operations
- Improving building envelope to block escape of indoor air
- Temporarily enclosing outdoor cultivation during emission's peak
- Use an odour qualification instrument
- Actively manage odour mitigation activities
- Timing harvest with periods of low ozone levels (outdoors)
- Make use of a good HVAC system, avoiding under/oversizing
- Have an Air Emissions Management Plan

Sources:

Metro Vancouver, A Proposed Emission Regulation for Cannabis Production and Processing Operations in Metro Vancouver; 2019.

Denver Public Health and Environment, Cannabis Environmental Best Management Practices Guide; 2018.

3. KEY GAPS ON CANNABIS AIR EMISSIONS





KEY GAPS IDENTIFIED IN THE REVIEW WERE:

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3. Developing guidelines for CCF siting that consider location of sensitive receptors, size of the facility, BVOC emissions, and odor exposure.
4. Develop Guidelines for an “Air Emission Management Plan of Cannabis Cultivation” considering occupational and community exposure

4. OCCUPATIONAL HAZARDS – THE INDOOR AIR QUALITY OF CANNABIS CULTIVATION FACILITIES (CCFs)



WORKERS AT CCFs ARE EXPOSED TO

The infographic is divided into five green rounded rectangular boxes. The first box on the left is titled "BVOC + Organic Dust" and features a cluster of various chemical structures and orange dots above a green cannabis leaf. The second box is titled "SOA" and shows a cluster of small circles connected by lines. The third box is titled "Ozone" and depicts a city skyline with purple clouds above it. The fourth box is titled "Pesticides and Fungicides" and contains icons of a spray can with a beetle and a mushroom with a prohibition sign. The fifth box is titled "Odor" and shows icons of a skunk, a hand, an onion, and a citrus fruit.

BVOC + Organic Dust

SOA

Ozone

Pesticides and Fungicides

Odor



MAIN FINDINGS OF THE REVIEW

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- Particle mass concentration (PMC), particle number concentration (PNC), and terpene concentrations are elevated during manipulation tasks (e.g., trimming, sorting, prerolling, etc.).
- High THC levels in swap surface samples (up to 53,000 ng/100cm²)



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- An interview of CCF workers found that 71% presented some work-related symptoms, and the majority of symptoms (65%) was respiratory.
- An European Commission has provided tentative limits for indoor terpene concentrations, ranging from 40 to 400 ppb. Using these limits, both illegal and legal facilities were found to exceed the lowest standard and, without control technologies, the highest standard as well.
- However, when compared to individual terpene exposure guidelines (e.g., 90 ppm for D-limonene short-term exposure), observed concentrations are far from exceeding the standard.

MAIN FINDINGS OF THE REVIEW

- A study* reported the “acceptability level” and “intensity” of odors arising from stem harvesting at each life stage based on a panel of six volunteers.

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- A study* reported the “acceptability level” and “intensity” of odors arising from stem harvesting at each life stage based on a panel of six volunteers.
- The panel found the odors very unacceptable (−4.3 harvested at seed maturity and −4.9 after flowering on a 0 to −5 scale) and of average intensity (3.3 harvested at seed maturity and 3.5 after flowering on a 0 to 5 scale)

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- The panel found the odors very unacceptable (−4.3 harvested at seed maturity and −4.9 after flowering on a 0 to −5 scale) and of average intensity (3.3 harvested at seed maturity and 3.5 after flowering on a 0 to 5 scale)
- However, 6 people is a small panel, and more (larger) studies are needed

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5. INDUSTRY GUIDELINES



UP TO THE DAY OF PUBLICATION THERE WERE 5 SOURCES OF INDUSTRY GUIDELINES



Guide to Worker Safety and Health in the Marijuana Industry
 Marijuana Occupational Health and Safety Work Group
 January 2017

State of California
DIR
 Department of Industrial Relations

Cal/OSHA Cannabis Industry Health and Safety

Cannabis Industry Health and Safety

All employers in the cannabis industry, including those who cultivate, manufacture, distribute, sell, and test marijuana products, must take steps to protect their employees from all health and safety hazards associated with their work.

Several Cal/OSHA regulations apply to workplaces in the cannabis industry. This webpage contains links to these regulations and other helpful resources for providing a safe and healthy workplace in the cannabis industry in California.

Cal/OSHA 30-hour Training: Cal/OSHA 30-hour Training for Employers with Two or More Employees

Health and safety in cannabis cultivation

Cannabis cultivation is a dynamic industry. Working in cannabis cultivation, however, can be hazardous. Workers are at risk of respiratory irritation or stress disorders, unsuitable lighting, or electrical accidents. They are also at risk of musculoskeletal injuries. Be aware and alert! Hazardous incidents can result in pain and suffering, disability, and stress. This can be financially draining to workers and employers. Come now, evaluate your risks, increased insurance premiums, and damage to property.

As an employer, you are responsible for ensuring the health and safety of your workers, including contract workers. This includes identifying hazards and assessing and controlling risks to effectively protect workers. You are also required to establish some form of occupational health and safety program. This information sheet will give you an overview of how to meet these requirements. It also discusses specific hazards faced by workers in the cannabis cultivation industry.

Facts, in helpful to understand the difference between hazards and risks. A hazard is any source of potential harm, adverse health effects, or damage to property, equipment, and, if based on a chemical, a biological agent, or an inanimate object. Risk is the chance or probability that the harm, adverse effects, or damage could occur from the hazard. Without adequate controls, the risk increases.

By working with your joint health and safety committee and workers, you can identify hazards and assess risks in your work activities. You can then establish adequate controls to reduce the risks.

Managing health and safety risks

To manage health and safety risks in your cannabis cultivation operation, think about what could harm your workers. Then, determine whether you're taking reasonable steps to prevent that from happening. There are three steps to managing health and safety risks:

1. **Identify hazards.** This starts with a workplace inspection. You may also review safety data sheets and manufacturer's instructions. You should refer to set exposure limits, standards, or guides if available. Observe how workers are doing their tasks. Talk to your workers about tasks or procedures that are unclear, uncomfortable, or cause any other health and safety concerns. You may come across the following hazards in your operation:
 - Cleaners
 - Solvents
 - Fertilizers
 - Pesticides
 - Bacteria
 - Moulds
 - Inadequate practices
 - Unbalanced lighting
 - Infrared lighting
 - Heat
 - Electricity
 - Carbon dioxide
 - Repetitive motions
 - Airborne particles
 - Heavy lifting

JOB AID HAZARD AWARENESS INFO

CANNABIS AND IMPAIRMENT IN THE WORKPLACE

Many regulations are in place regarding the health and safety of workers in the cannabis industry. This information sheet will give you an overview of how to meet these requirements. It also discusses specific hazards faced by workers in the cannabis cultivation industry.

For more information, contact:

WorkSafeBC

Occupational Health and Safety in the Cannabis Industry
 Christopher Simpson*

University of Washington, Environmental and Occupational Health Sciences, Seattle, WA 98195, USA
 *Tel: +1 206 685 2000; Email: csimpson@u.washington.edu

For context, the cannabis plant, typically Cannabis sativa and Cannabis indica, has been cultivated and used for medicinal purposes for thousands of years. However, with the recent legalization of cannabis for medical and recreational purposes, many states have established regulatory frameworks to ensure the safety and health of workers in the industry. This document provides an overview of the occupational health and safety issues in the cannabis industry, including the identification of hazards, assessment of risks, and implementation of controls to protect workers from these hazards.

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[Guide to Worker Safety and Health in the Marijuana Industry \(Colorado – USA\)](#)

[Cannabis Industry Health and Safety \(California – USA\)](#)

[Health and safety in cannabis cultivation \(British Columbia – CAN\)](#)

[Cannabis and Impairment in the Workplace \(WSPS\)](#)

[Occupational Health and Safety in the Cannabis Industry \(Special Issues – 12 papers\)](#)

6. KEY GAPS ON OCCUPATIONAL EXPOSURE SCIENCE INSIDE CCFs





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4. Developing an exposure standard for odour concentration in indoor facilities and ambient air near CCF.



THANK YOU!



Co-op students:

Stefan Colbow

Rachel Habermehl

Chris Kelly

Julian Fawkes

Master students:

Melanie MacArthur

CCF team:

Naomi Zimmerman

Amanda Giang

Sahil Bhandari

Angela Eykelbosh

Sarah Henderson

Karen Xie

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New Frontiers in Research Fund
Fonds Nouvelles frontières en recherche



Canada Graduate
Scholarships
Vanier
Bourses d'études
supérieures du Canada

Project partners:



BC Centre for Disease Control
Provincial Health Services Authority