



# NESEA

NORTHEAST SUSTAINABLE ENERGY ASSOCIATION

## The Cannabis Cultivation Conundrum

Wednesday, March 08, 2017  
10:30 am to 12:00 pm

**BUILDINGENERGY BOSTON**

**MARCH 7-9, 2017 • SEAPORT WORLD TRADE CENTER • [NESEA.ORG/BE17](http://NESEA.ORG/BE17)**

Conference + Trade Show of the Northeast Sustainable Energy Association (NESEA)

# The Cannabis Cultivation Conundrum

NESEA will report credits earned by course attendees to AIA CES.  
NESEA will provide certificates of completion to course attendees on request.  
NESEA is registered as an AIA Approved Provider and this course has been approved.  
This course will not be used to promote or market products or services during the educational portion of the course.

Attendees must add their names to the sign in sheet in order to receive credit for the course.

AIA The American Institute of Architects 1 credit per hour

PHIUS CPHC Certified Passive House Consultant 1 credit per hour

# The Cannabis Cultivation Conundrum

## Course Description:

As an increasing number of states legalize cannabis for not only medical but also recreational use, the energy consumption of indoor cannabis cultivation can no longer be ignored. Its relatively tentative legal state and its somewhat taboo status have stifled efforts to reduce the impacts of cannabis cultivation. Furthermore, why is indoor growing so dominant? This session will explore some of the main barriers to addressing the efficiency of cannabis cultivation, both from technical and program delivery perspectives.

CEU Information: BOS17-109

# The Cannabis Cultivation Conundrum

Learning objectives:

Describe some of the main impacts of cannabis cultivation

Identify key reasons cannabis cultivation occurs primarily indoors

Describe some of the largest challenges to achieving greater efficiency in cannabis cultivation

Discuss some of the strategies for increasing efficiency in cannabis cultivation



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# The Cannabis Cultivation Conundrum

**Fred Davis** will frame this talk. For three decades, Fred has been a leading voice in energy and lighting; his company is a wholesale supplier of efficient lighting products.

President, Fred Davis Corp. Energy & Lighting

**John Morris** In 2016, John co-founded the Resource Innovation Institute, a nonprofit organization dedicated to water and energy conservation in cannabis production.

Vice Pres. Market Development, D+R International

**Ian Gordon** has been a contractor of both residential and commercial projects for over 15 years, his understanding of cultivation facilities is thanks to his broad experience in building as well as many trials and errors in growing.

Co-Owner, GroTec Builders

# The Cannabis Cultivation Conundrum

***Fred Davis Corporation***  
***Efficient Lighting Specialists***

**FRED DAVIS  
CORPORATION**

Efficient Lighting Since '83  
Wholesalers Nationwide

**THE LIGHTENING VOLT™**

*an occasional newsletter on energy efficient lighting from Fred Davis Corporation*

phone: 800-497-2970  
fax: 508-359-3644

[info@FredDavisCorp.com](mailto:info@FredDavisCorp.com)  
[www.FredDavisCorp.com](http://www.FredDavisCorp.com)

**Please subscribe to our free occasional e-newsletter on  
developments in efficient lighting**

# The Cannabis Cultivation Conundrum

Cannabis Cultivation

Buildings

Sustainability



# The Cannabis Cultivation Conundrum

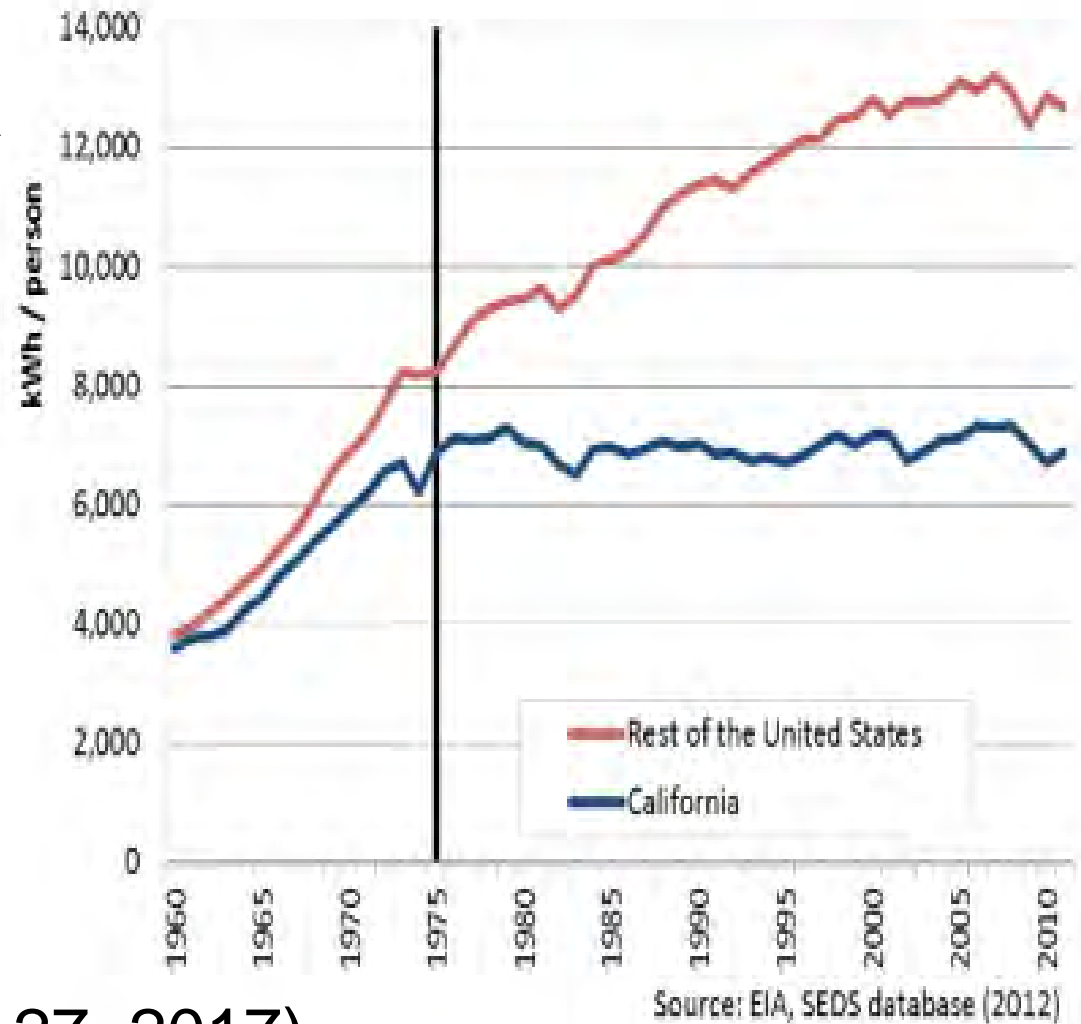
Fred says:

Cannabis Cultivation  
Inside  
Buildings  
is not compatible  
with  
Sustainability  
!

# The Cannabis Cultivation Conundrum

## The Rosenfeld Curve

California: per-capita electricity use essentially flat over three decades



Art Rosenfeld (1926-Jan. 27, 2017)

National Medal of Technology and Innovation

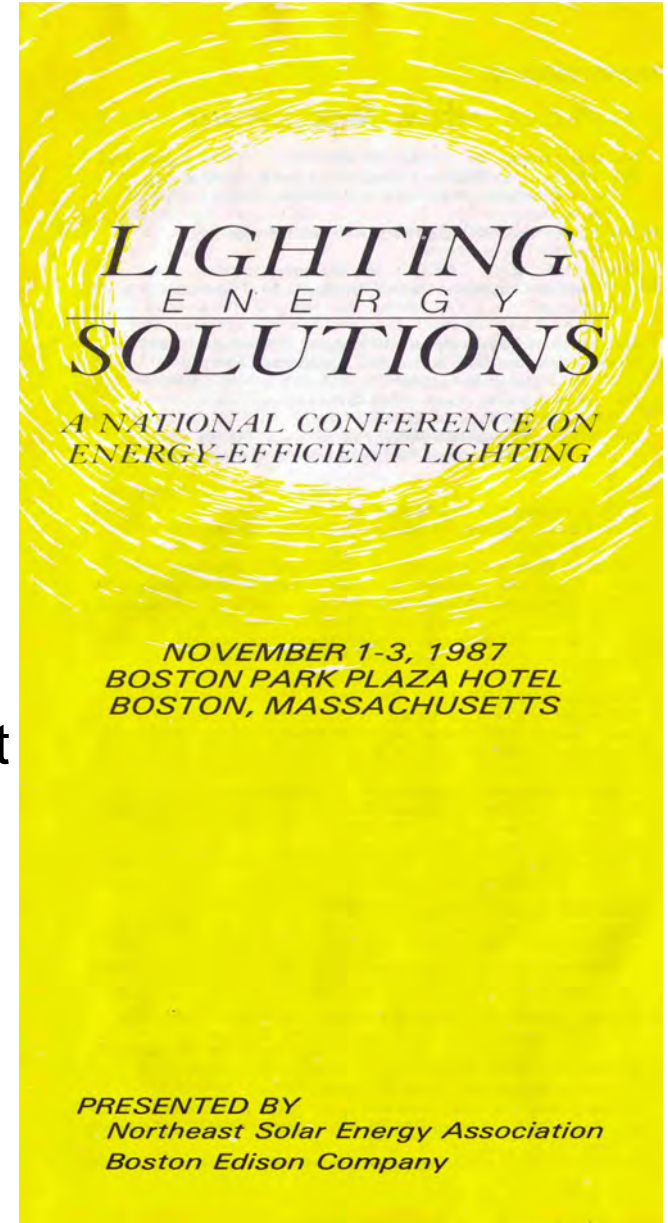
# The Cannabis Cultivation Conundrum

1987: Lighting Energy Solutions

Some of the names

a NESEA Conference

Amory Lovins	Glenn Reed
Rudy Verderber	Robert Sardinsky
Harvey Bryan	Alex Wilson
David Goldstein	Fred Berryman
Steve Nadel	Bruce Maeda



Recent Lighting Sessions at Building Energy:

2016: Lighting Consumer's difficulty

2016: Has the LED Caught the Fluorescent Tube?

2015: Advanced Control Strategies Efficient & Smart

2015: How Many Light Bulbs Will it Take?

2014: LED Status and Surprises

Please mention whether you'd like to see lighting sessions at BE in the future

# The Cannabis Cultivation Conundrum

late 1980s: “California Compact” to increase availability and affordability of CFLs

Chris Calwell



Evan Mills



# The Cannabis Cultivation Conundrum

1990s: International Association for  
Energy-Efficient Lighting, Stockholm, Sweden

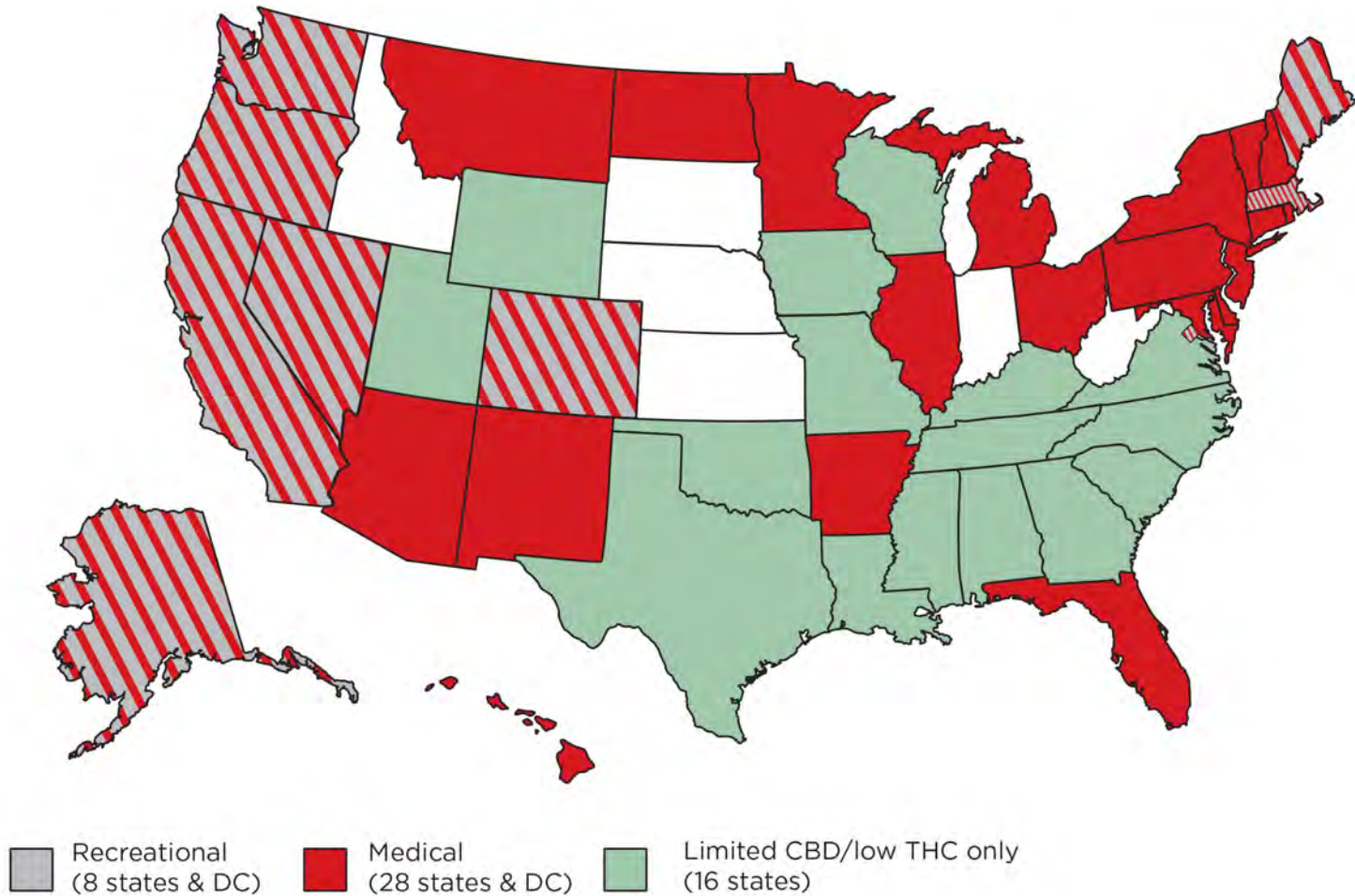
Evan Mills



1998-: U.S. Department of Energy,  
Lawrence Berkeley National Laboratory

# The Cannabis Cultivation Conundrum

Where do you live? Where is your pot grown?

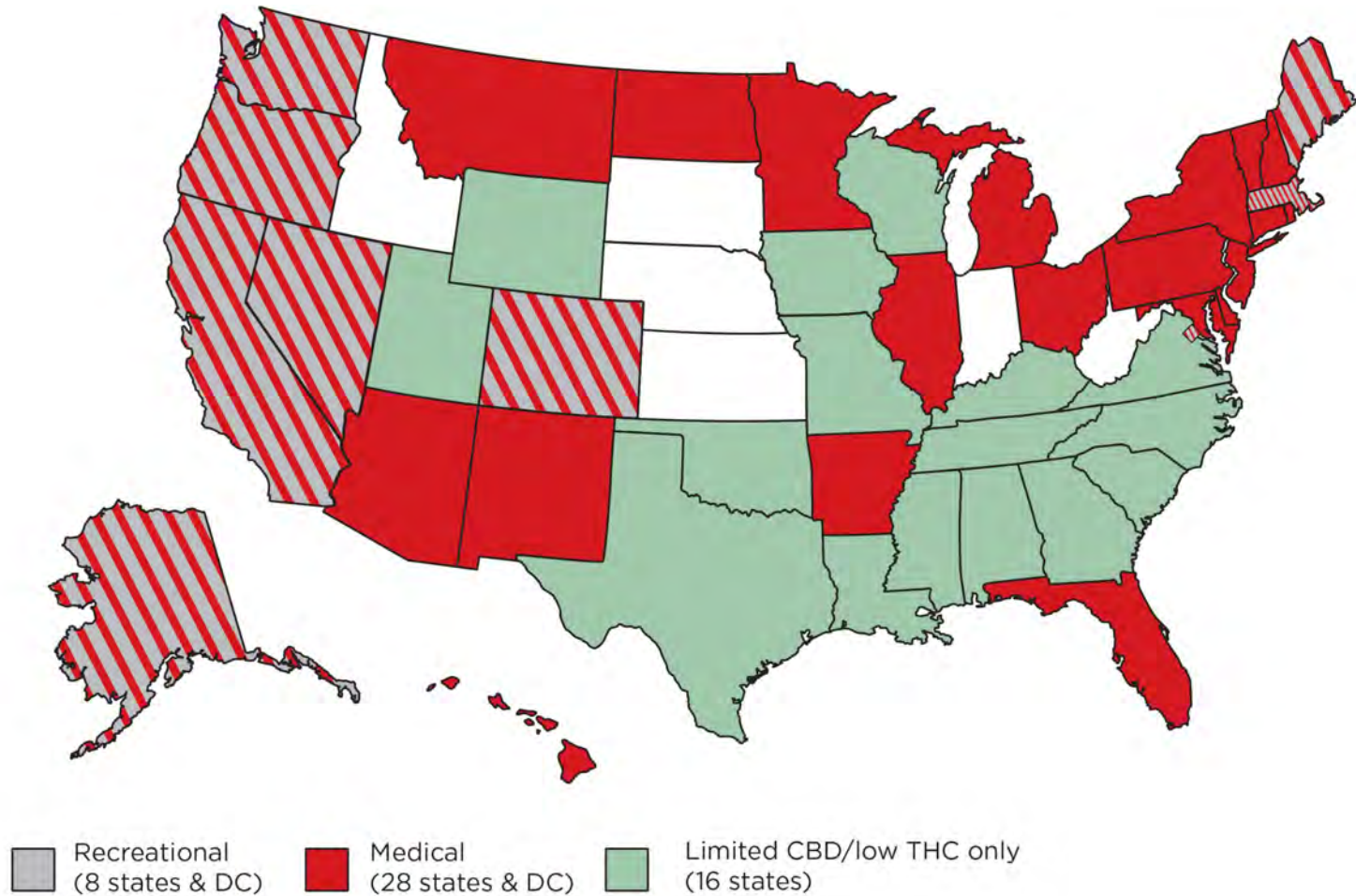


map created by Third Way ([www.thirdway.org](http://www.thirdway.org))



# The Cannabis Cultivation Conundrum

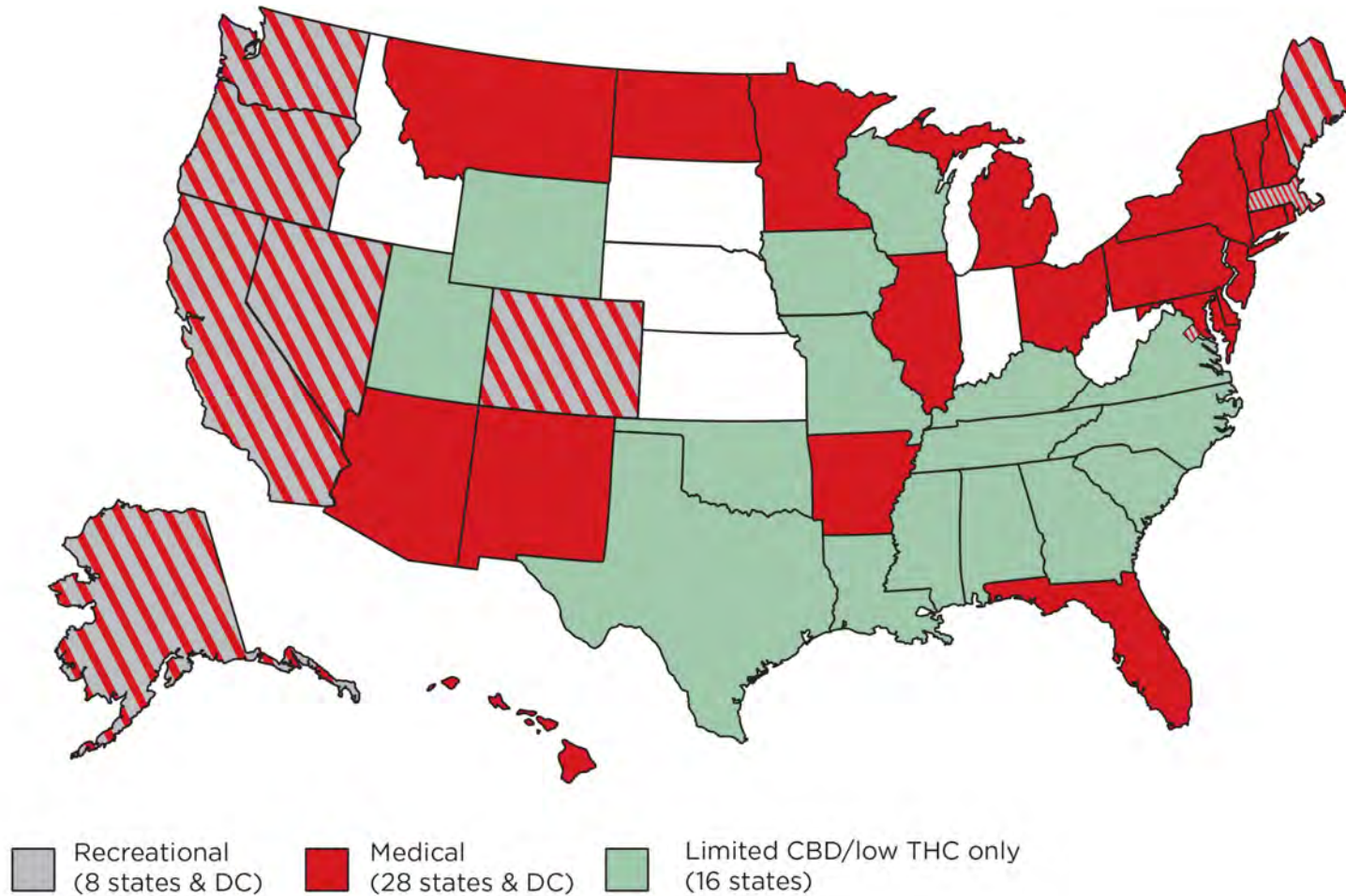
What's wrong with this map?



map created by Third Way ([www.thirdway.org](http://www.thirdway.org))

# The Cannabis Cultivation Conundrum

Let's re-frame



map created by Third Way ([www.thirdway.org](http://www.thirdway.org))



# The Cannabis Cultivation Conundrum

Where do you live? Where is your pot grown?



# The Cannabis Cultivation Conundrum



What happens inside this building?

# The Cannabis Cultivation Conundrum



What happens inside this building?  
(it's not cannabis)

# The Cannabis Cultivation Conundrum

What happens inside this building?



*Colorado startup targets self-storage for marijuana growers  
Bruce Goldberg, SpareFoot Storage Beat, December 1, 2015*



# The Cannabis Cultivation Conundrum

It's a (closed) box.



# The Cannabis Cultivation Conundrum

**(Note sky)**



# The Cannabis Cultivation Conundrum

Inside the box, goes equipment something like this.



interior shot, courtesy of DEA

# The Cannabis Cultivation Conundrum

2012: Evan Mills, Ph.D., Energy Associates,  
independent consulting

Energy Policy 46 (2012) 58–67

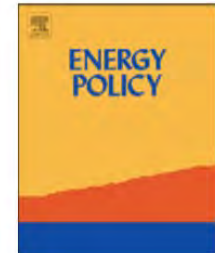


ELSEVIER

Contents lists available at [SciVerse ScienceDirect](#)

Energy Policy

journal homepage: [www.elsevier.com/locate/enpol](http://www.elsevier.com/locate/enpol)



## The carbon footprint of indoor *Cannabis* production

Evan Mills

Energy Associates, Box 1688, Mendocino, CA 95460, United States

### ARTICLE INFO

#### Article history:

Received 7 September 2011

Accepted 10 March 2012

Available online 17 April 2012

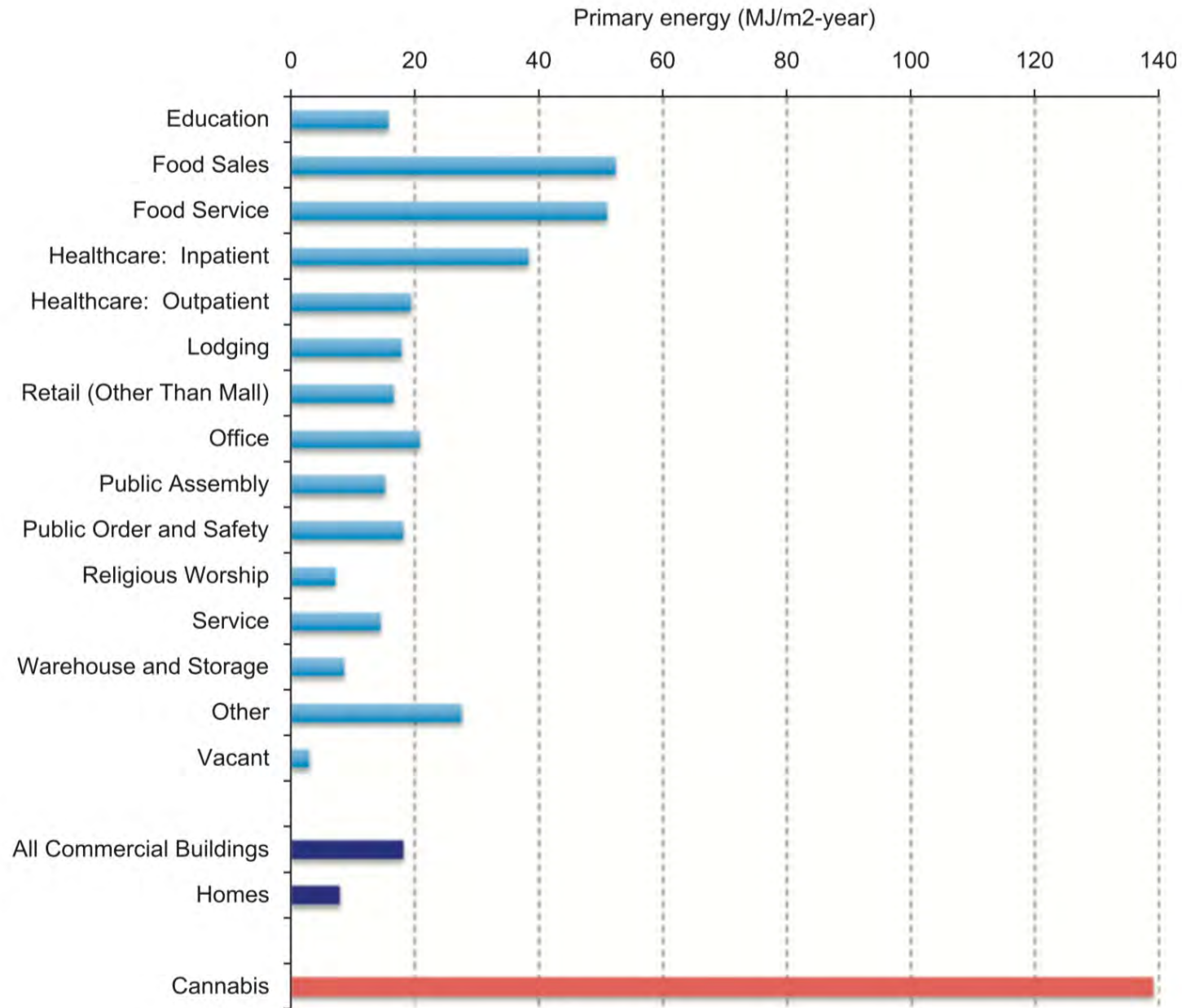
#### Keywords:

### ABSTRACT

The emergent industry of indoor *Cannabis* production – legal in some jurisdictions and illicit in others – utilizes highly energy intensive processes to control environmental conditions during cultivation. This article estimates the energy consumption for this practice in the United States at 1% of national electricity use, or \$6 billion each year. One average kilogram of final product is associated with 4600 kg of carbon dioxide emissions to the atmosphere, or that of 3 million average U.S. cars when aggregated



# The Cannabis Cultivation Conundrum



**Fig. 4.** Comparative energy intensities, by U.S. building type (2003).

# The Cannabis Cultivation Conundrum

Evan Mills, 2012, excerpts:

## The carbon footprint of indoor Cannabis production

Driving the large energy requirements of indoor production facilities are **lighting levels matching those found in hospital operating rooms** (500-times greater than recommended for reading) and 30 hourly air changes...

# The Cannabis Cultivation Conundrum

Evan Mills, 2012, excerpts:

The carbon footprint of indoor Cannabis production

power densities are on the order of 2000 W/m<sup>2</sup>

In California, ...**indoor cultivation is responsible for about 3% of all electricity use...**["medical" only]

# The Cannabis Cultivation Conundrum

Evan Mills, 2016-7:

many local ordinances are requiring cannabis production to be conducted indoors [!!!]

arguably the only truly acceptable indoor production approach is a zero-net-energy setup

# The Cannabis Cultivation Conundrum

Evan Mills, 2016-7:

Is it possible to achieve net-zero indoor facilities?

my estimate is that the **PV area is about 18x the facilities floor area.**

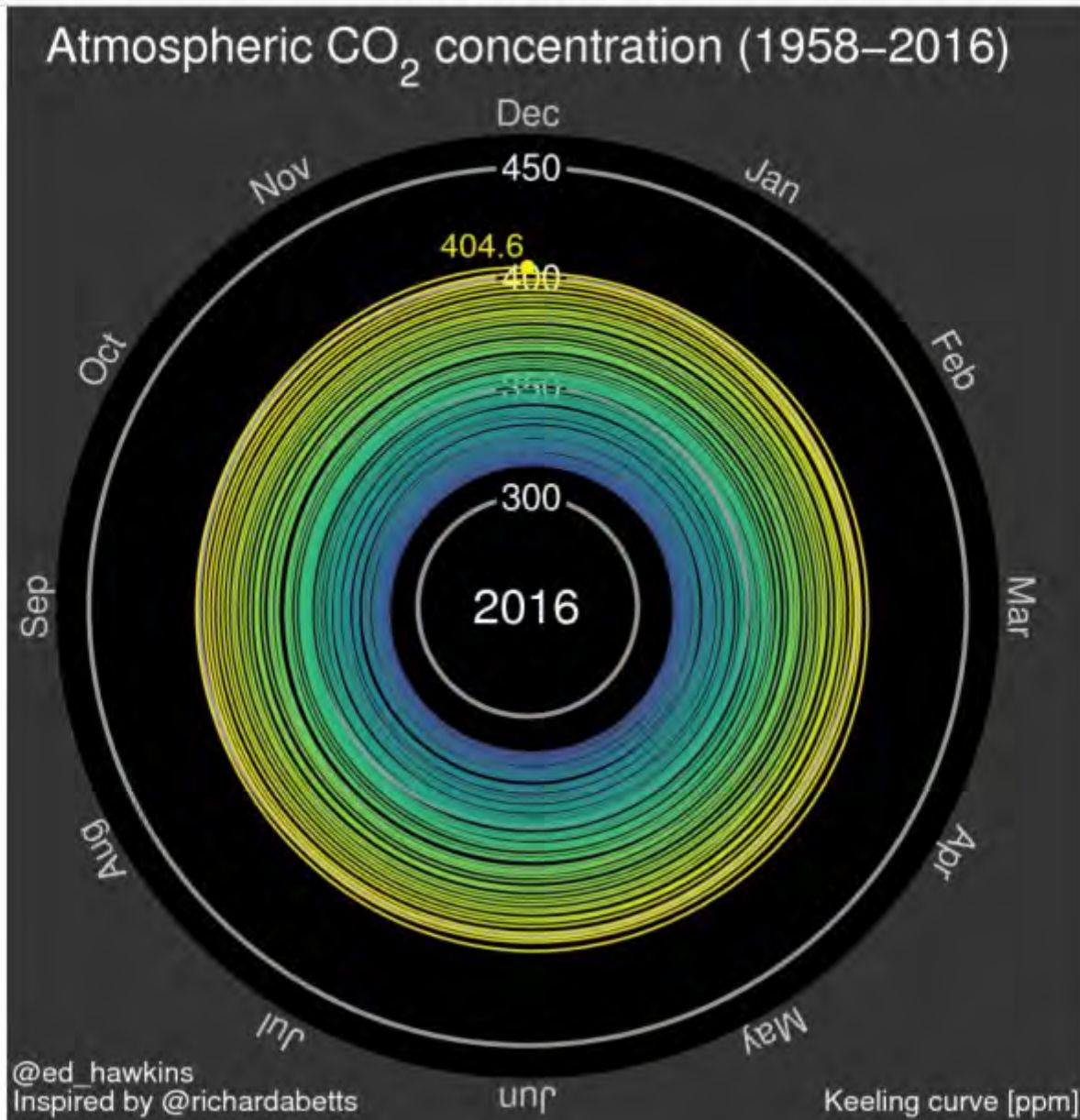
**[OR], with ~90% energy savings it could be 1:1 or so**

# The Cannabis Cultivation Conundrum

Evan Mills, 2016-7:

**Why grow something inside with high or low energy use, when it can be done outdoors?**

# The Cannabis Cultivation Conundrum



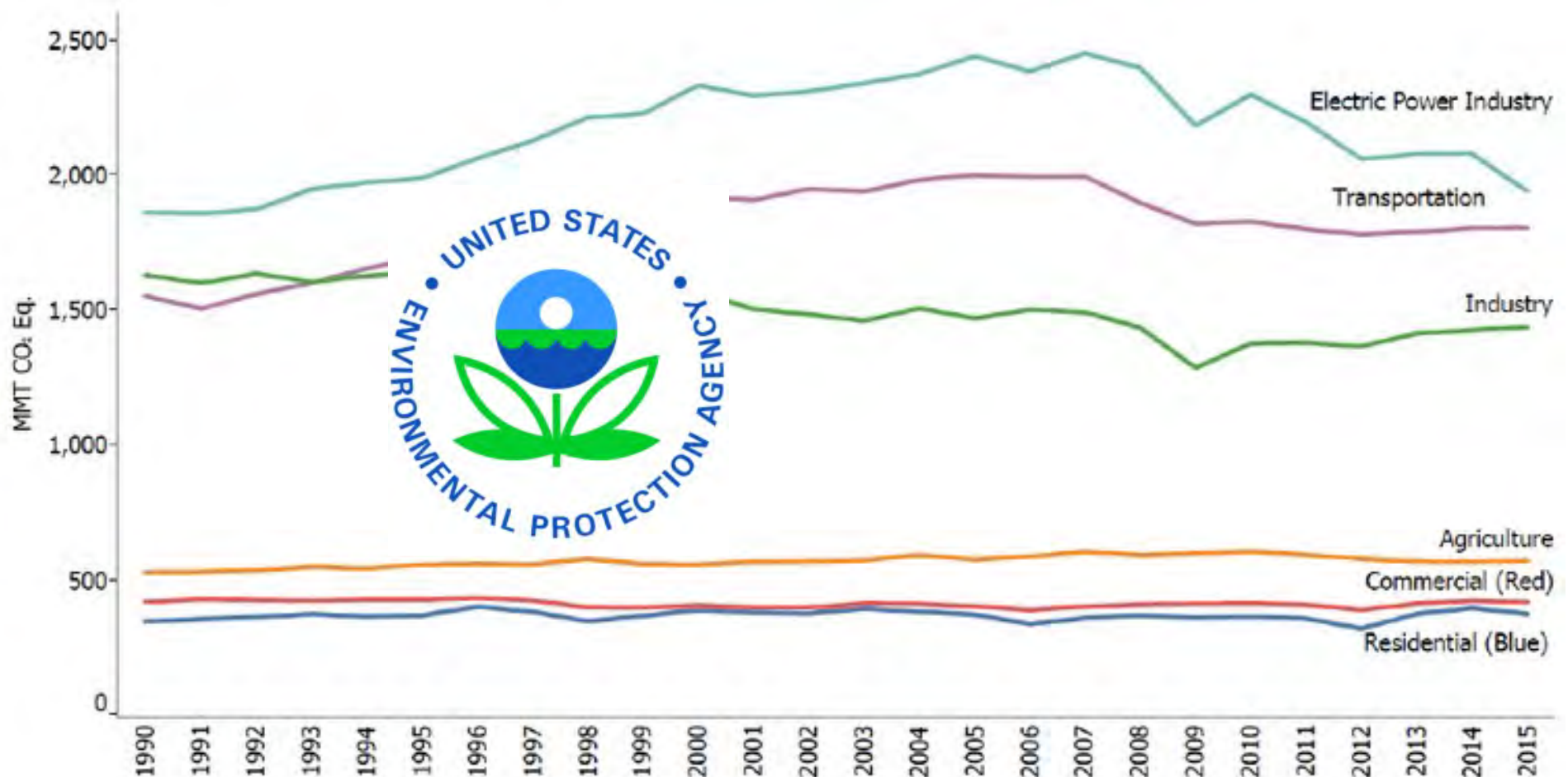
Mauna Loa readings

by Ed Hawkins,  
Climate scientist,  
National Centre for  
Atmospheric Science,  
University of Reading,  
England

<http://www.climate-lab-book.ac.uk/spirals/>

# The Cannabis Cultivation Conundrum

**2015 U.S. Greenhouse Gas Emissions:  
Commitment (Paris 2015):  
reduce 26-28% below 2005 level by 2025.  
as of 2015: down ~11%**

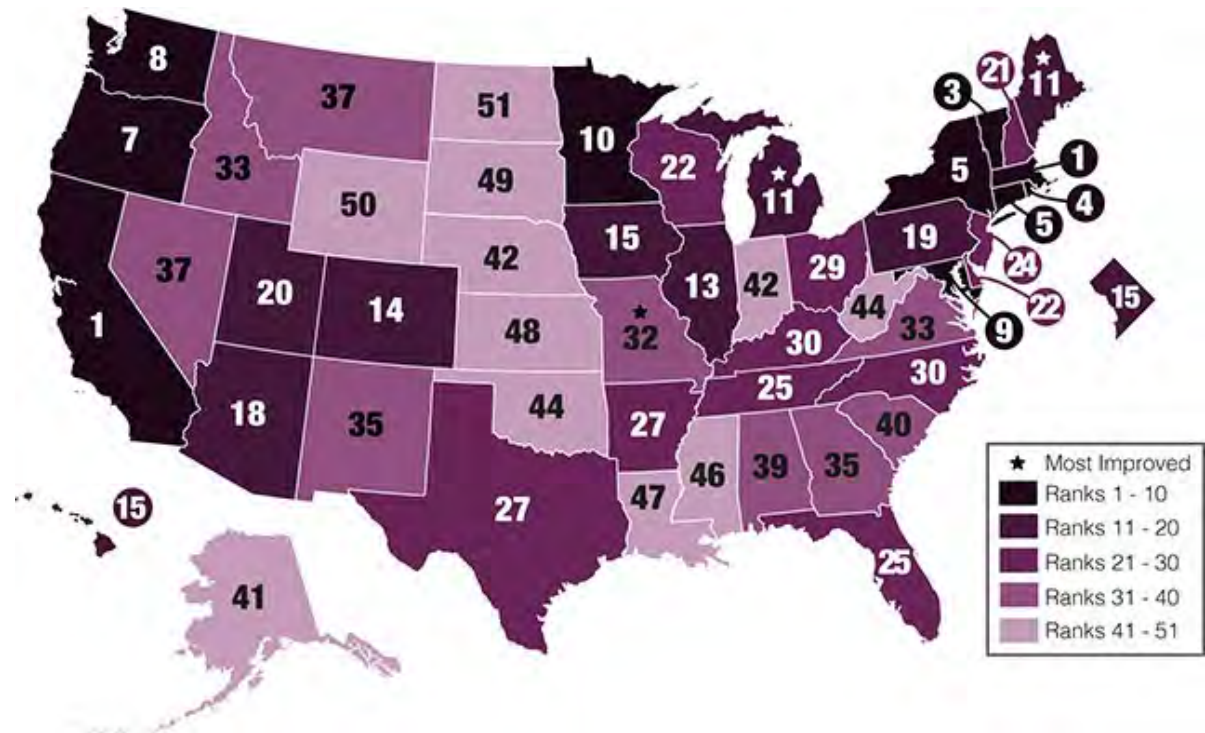




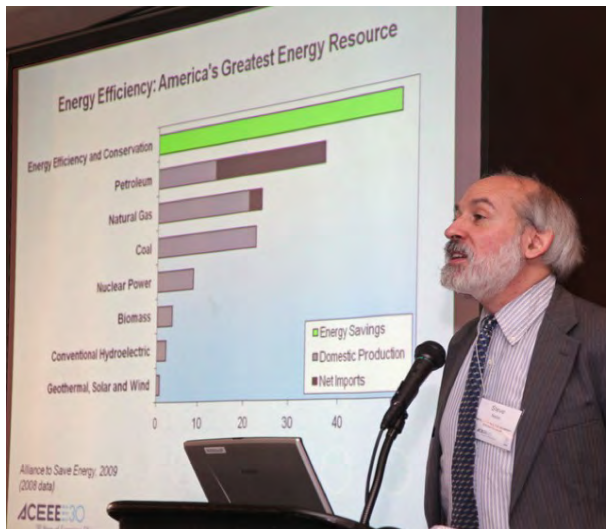
# The Cannabis Cultivation Conundrum

Massachusetts Leads for Sixth Year!

## The 2016 State Energy Efficiency Scorecard



Steve Nadel, Executive Director



**Massachusetts tied for 1st place in the 2016 State Energy Efficiency Scorecard, maintaining its leadership position for the sixth year in a row.**

# The Cannabis Cultivation Conundrum

## **Year-over-year Electric Savings as Percent of Actual Sales in Massachusetts**

<b>2011</b>	<b>1.9%</b>
<b>2012</b>	<b>2.5%</b>
<b>2013</b>	<b>2.7%</b>
<b>2014</b>	<b>2.8%</b>
<b>2015</b>	<b>2.8%</b>

Gross Annual Energy Savings Electric Meter Level  
Northeast Energy Efficiency Partnerships, Inc.  
Regional Energy Efficiency Database  
Retrieved 2/11/17 from [www.neep-reed.org](http://www.neep-reed.org)

# The Cannabis Cultivation Conundrum

**very little expertise exists in efficiency efforts**

**accumulated over the past 5 years**

**west of the Mississippi**

**our speakers represent the best of those efforts**

**big challenge is whether anyone in the east**

**will stand up and say what needs to be said**

# The Cannabis Cultivation Conundrum



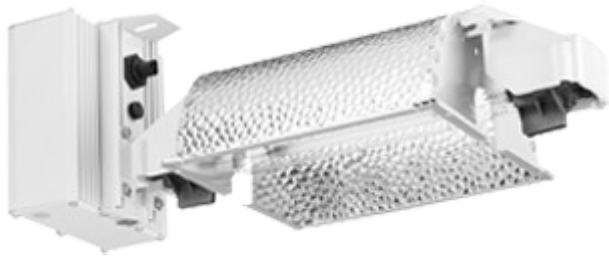
Photo courtesy of DEA

“Gina Warren, a professor at Texas A&M University School of Law, warned that uncontrolled fossil fuel use to grow indoor marijuana has the **potential to "completely nullify any previous environmental advancements made under local climate change policies."**

*Colo. struggles with marijuana's huge carbon footprint*  
John Fialka, E&E, Climatewire, April 27, 2016  
<http://www.eenews.net/stories/1060036287>

# The Cannabis Cultivation Conundrum

## Representative Fixtures



HPS (high pressure sodium)



LED (light emitting diode)

# The Cannabis Cultivation Conundrum

In general (human) illumination, LEDs *can* save a lot of energy

highest savings, now around 63%, found in outdoor (night time) applications, esp. roadway lighting,

where desired light levels are *very low*.

... but:

cannabis producers want the *highest possible light levels*, > 1 sun(!) where energy advantage of LEDs decreases.



# The Cannabis Cultivation Conundrum

Claims and presumptions about productivity under different grow fixtures are all over the place.

Which is similar to where general-illumination LED fixtures were 5-10 years ago: faulty claims and inaccurate specs were rampant.

# The Cannabis Cultivation Conundrum

The reason the general LED industry straightened out as much as it did is significantly due to one brilliant and intrepid researcher:

Mia Paget



CALiPER (Commercially Available LED Product Evaluation and Reporting)

DOE launched 2006

unbiased, trusted product performance information in the early years of SSL.

The logo for CALiPER, featuring a dark blue horizontal bar above the word "CALiPER" in a bold, black, sans-serif font. The letter "i" is lowercase and smaller than the other letters.

**CALiPER**



# The Cannabis Cultivation Conundrum



What happens inside this building?  
(it's not cannabis)

*photo with permission  
WaterWorks Museum*

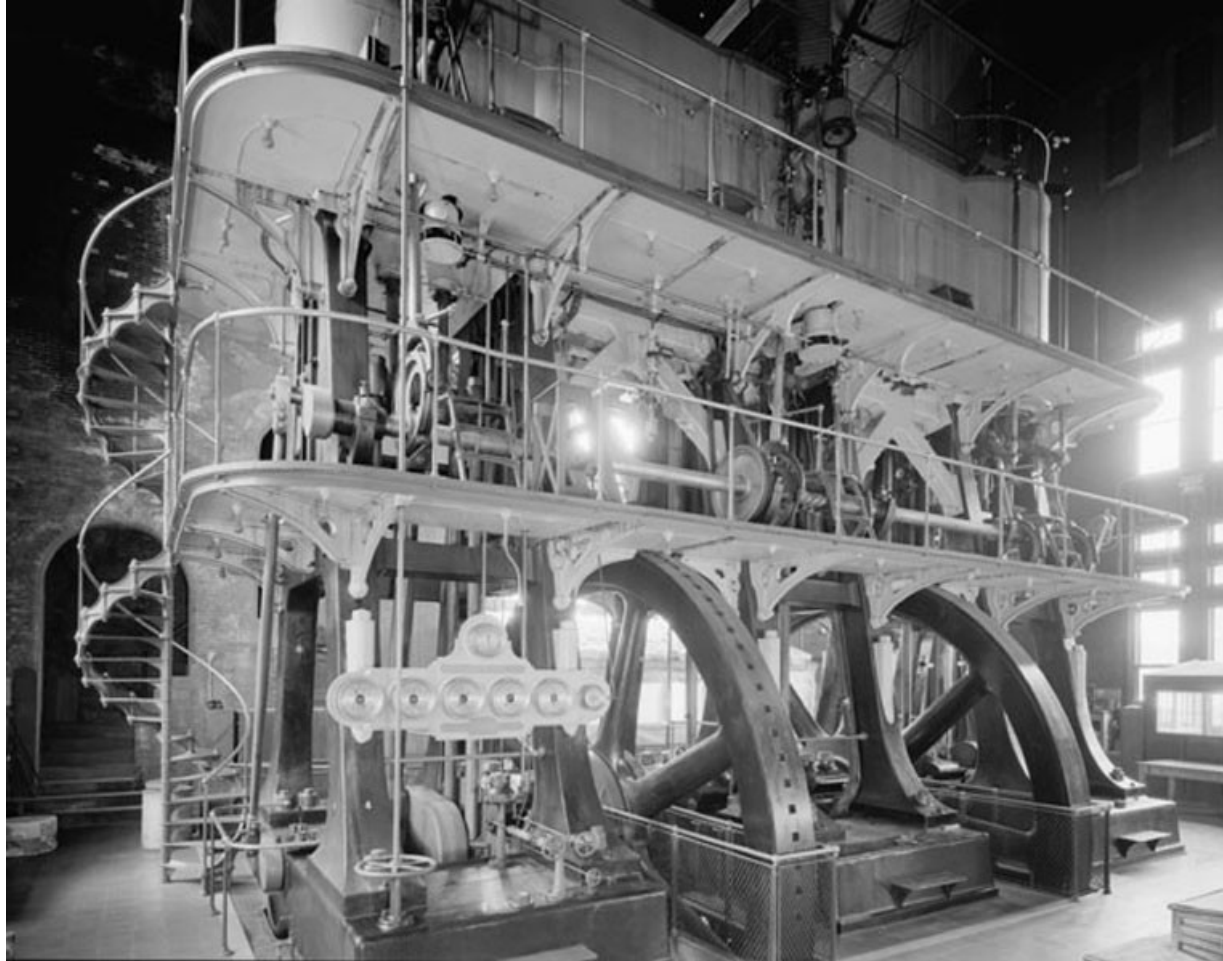
# The Cannabis Cultivation Conundrum



Leavitt-Reidler Triple Expansion Engine Installed in 1894  
and ran for 38 years

*photo with permission  
WaterWorks Museum*

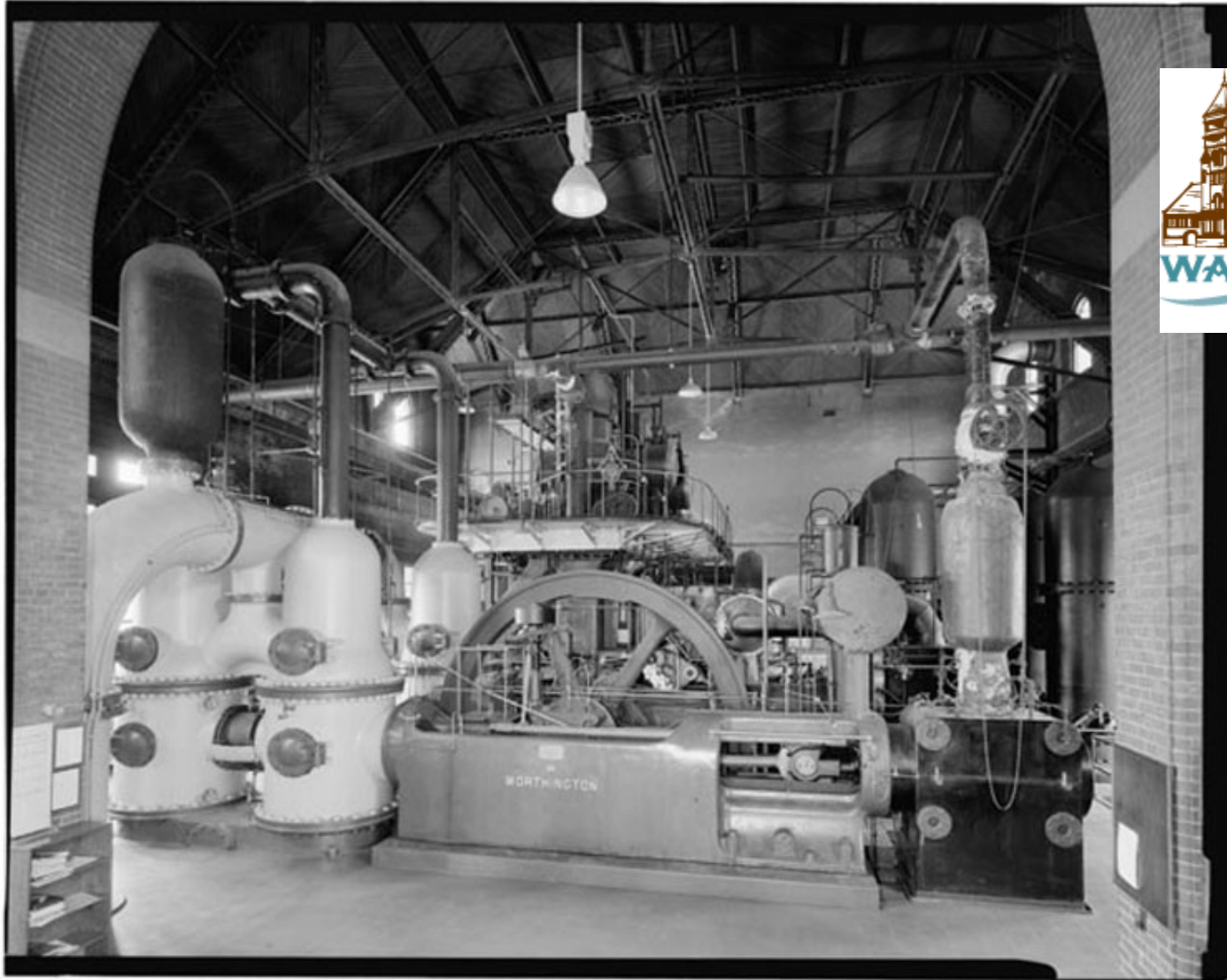
# The Cannabis Cultivation Conundrum



Allis Triple Expansion Engine Installed in 1898  
and ran for 76 years

*photo with permission  
WaterWorks Museum*

# The Cannabis Cultivation Conundrum



Worthington-Snow Double Expansion Engine Installed in 1916  
and ran for 60 years

*photo with permission  
WaterWorks Museum*



# The Cannabis Cultivation Conundrum



What powers Boston's water works today?

*photo with permission  
WaterWorks Museum*

# The Cannabis Cultivation Conundrum





# The Cannabis Cultivation Conundrum



What powers Boston's water works today?

# The Cannabis Cultivation Conundrum



What powers Boston's water works today?



# The Cannabis Cultivation Conundrum

(Note sky)



What powers Boston's water works today?

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(Note sky)



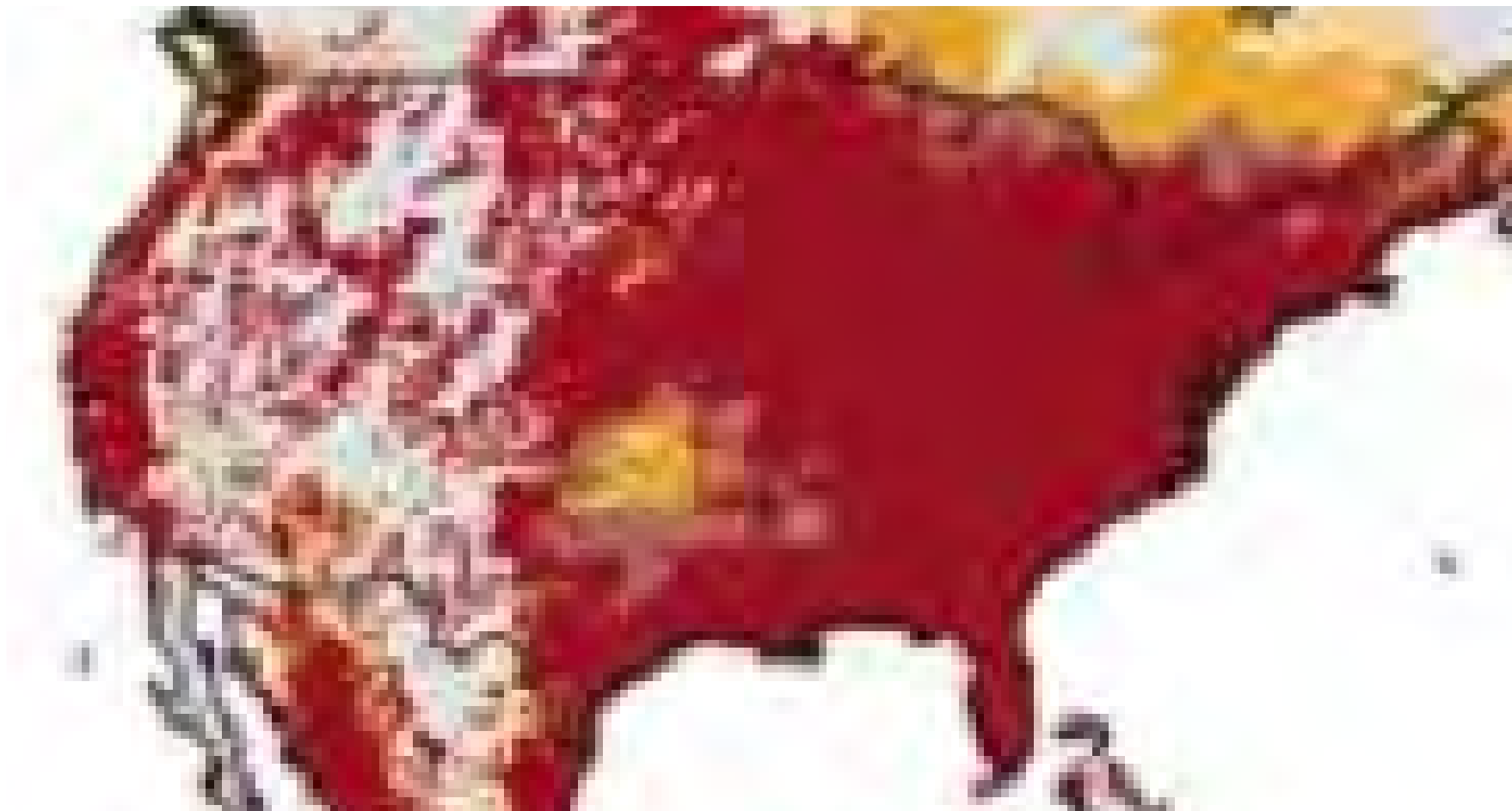
*Hempglobalsolutionscom Wallpaper*

<http://www.wallpapersxl.com/wallpaper/1152x872/field-hemp-foto-vast-from-hempglobalsolutionscom-946176.html>



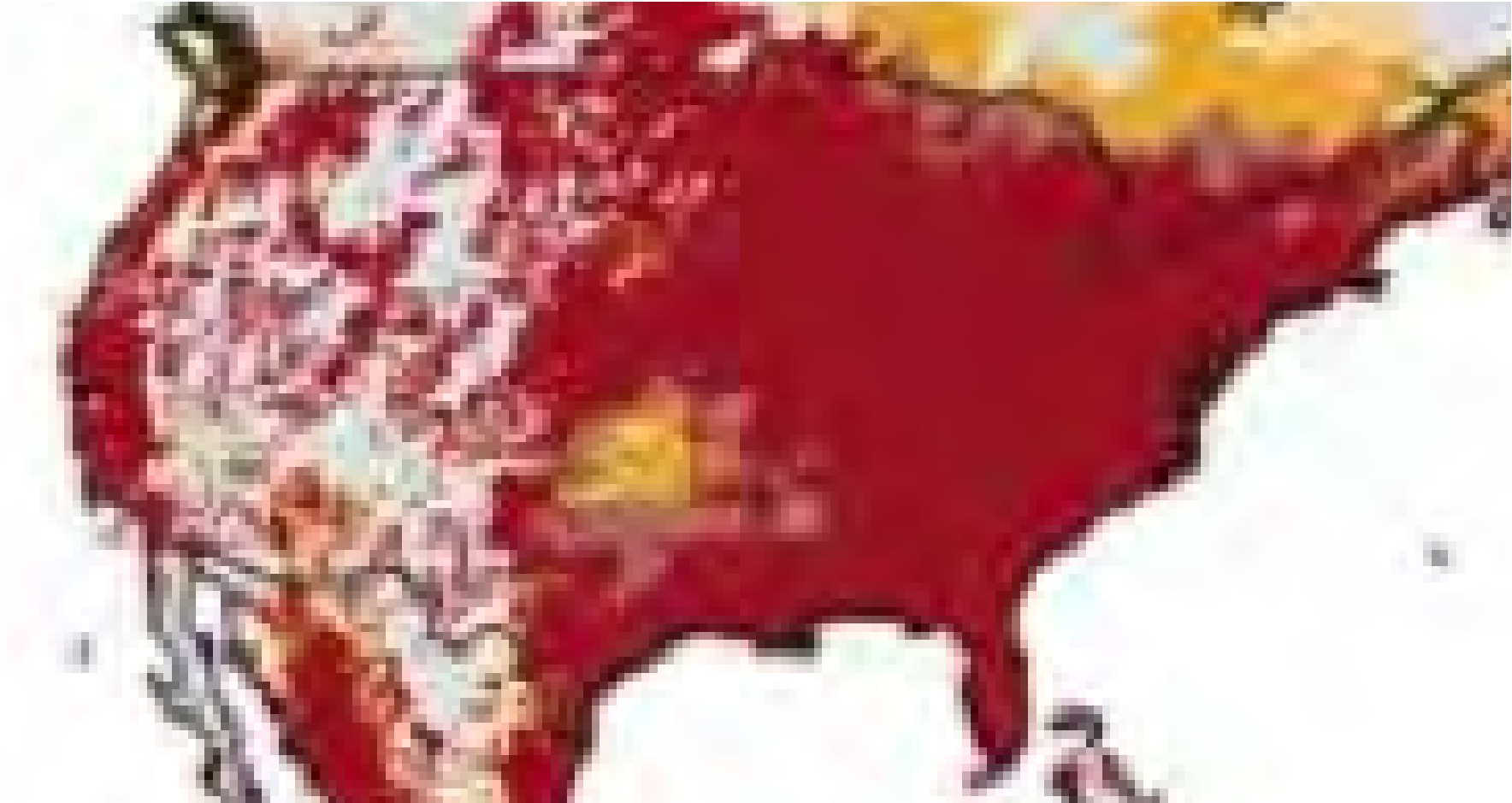
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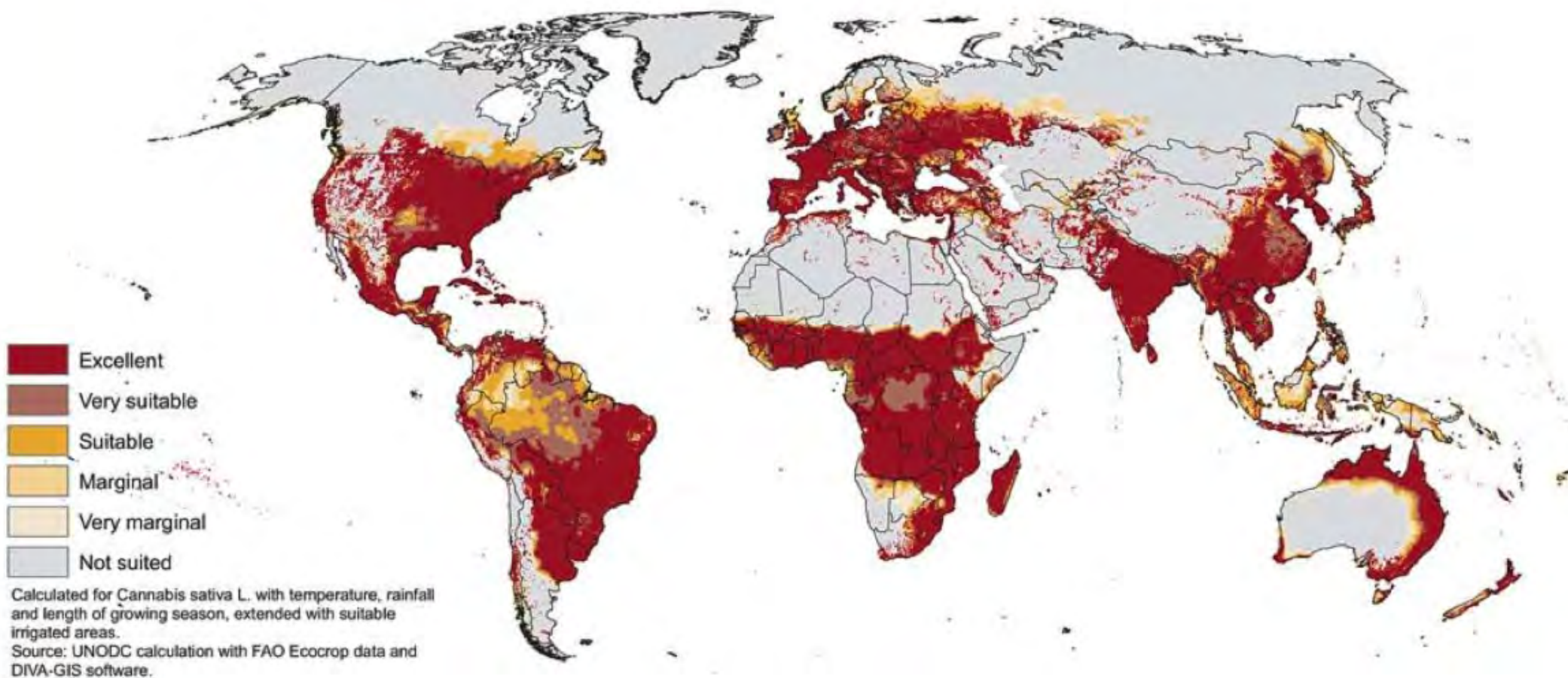
what is this a map of?





# The Cannabis Cultivation Conundrum

**Map 13: Climatologically suitable areas for outdoor cultivation of cannabis**

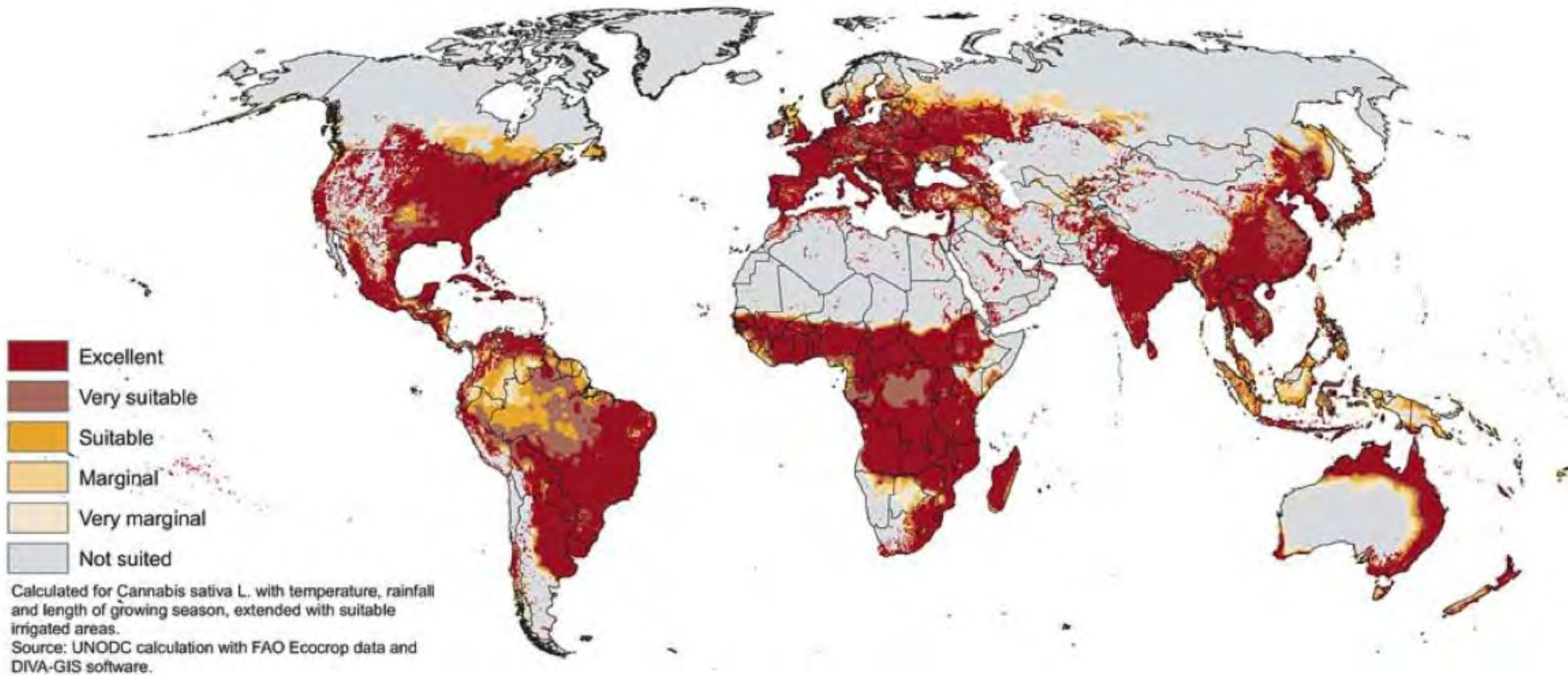


*Cannabis map* by Hillfighter  
<http://hillfighter.deviantart.com/art/Cannabis-map-208280200>

# The Cannabis Cultivation Conundrum

“I guess everyone settled where the pot is”

**Map 13:** Climatologically suitable areas for outdoor cultivation of cannabis





# The Cannabis Cultivation Conundrum

THE 190TH GENERAL COURT OF THE  
COMMONWEALTH OF MASSACHUSETTS

## JOINT COMMITTEE ON MARIJUANA POLICY

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Hannah Kane  
Nicholas A. Boldyga

# The Cannabis Cultivation Conundrum

Let me know if you'd be interested in  
the  
CCCCC:

Cannabis-Cultivation / Climate-Concern  
Coalition



**People's Climate March**

**April 29th, 2017  
Washington, D.C.**

**BE THERE!**



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