# The Future of Farming Current Developments in Indoor Agriculture

Bryan Jungers, E Source Beau Whitney, New Frontier Data Derek Smith, Resource Innovation Institute Andrew Blume, BlueHouse

Web conference

**E** Source

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Introductions The US cannabis update Resource efficiency in cannabis Smart cities and indoor agriculture

Q&A

# **Today's speakers**



**Bryan Jungers** Lead Analyst Customer Energy Solutions



**Beau Whitney** Senior Economist New Frontier Data



**Derek Smith** Founder & Executive Dir. Resource Innovation Institute



Andrew Blume Director of Sales & Business Dev. BlueHouse

# Introduction

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# Is "indoor ag" code for cannabis?



#### Reaching Customers Who Operate Indoor Agriculture Facilities



Harvesting Energy Savings in Indoor Agriculture Facilities

Budding Opportunities for Energy Efficiency in Indoor Agriculture

# A new class of hard-to-reach customer



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Source: Indoor Agriculture Customer Type: Small Indoor-Outdoor Grower

# The US cannabis update

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## **US UPDATE**

- As global cannabis markets expand, US markets are in flux
  - · New adult use markets are slowly rolling out
  - · Regulatory structures still being deployed; expect a bumpy ride
  - · More states exploring legalization as a means to address budget issues
    - \$1.7b combined revenue in OR/WA/CO (01/14 12/17)
- Recent New Frontier Data report outlined job creation and increased revenues associated with full legalization
  - 1.1M jobs, over \$100B in federal tax revenue
- Cities and counties are playing a key role in the growth (or barriers) of cannabis opportunities
  - Prohibition through legalization
  - Potentially driving consumers and suppliers back to illicit market
- Feds still concerned about diversion

NORTH AMERICA IS LAYING THE FOUNDATION FOR A GLOBAL INDUSTRY



#### SALES IN CURRENT MARKETS ARE GROWING, BUT ARE DWARFED BY THE ILLICIT MARKET

With most states only allowing restricted medical use, and other regulatory factors, including high tax rates and regional cannabis business bans limiting consumer participation, there will remain a well-entrenched illicit market for the foreseeable future.





#### Total US Cannabis Demand

FRONTIER FINANCIAL GROUP, INC



#### THIRTEEN STATES ARE POISED TO PASS NEW LAWS IN THE NEXT FOUR YEARS

- With more states coming online, there will be more energy consumption overall.
- Keeping up to date on which states are likely to legalize will help utilities forecast consumption and set rates.



Change	Medical 🕨 Adult Use	CBD 🕨 Medical
States	<ul> <li>Connecticut</li> <li>Michigan</li> <li>Montana</li> <li>New York</li> <li>Ohio</li> <li>New Jersey</li> <li>Rhode Island</li> </ul>	<ul> <li>Missouri</li> <li>Texas</li> <li>Utah</li> <li>Virginia</li> </ul>

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## WEST COAST UPDATE

- California is the main focus on the WestCoast
  - North America's largest market
  - Regulatory deployment is stumbling out of the gate with restrictive city and county policies and high local taxes
  - Energy use will be concentrated in counties with more licenses and favorable regulations
- Colorado/Washington/Oregon are maturing, but not without pitfalls
  - Colorado faces consolidation, regulators stepping up enforcement of coops and exporters. Growth is slowing
  - Washington market very robust, but also facing consolidation, pricing pressures and slower growth
  - Oregon retailers are in distress, prices are commoditizing, business saturation is causing over supply. Illicit market remains a challenge
- While markets are maturing, regulatory changes continue to pose a threat to the industry. Stay informed, stay agile



EVOLVING CONSUMER DEMAND IS INFLUENCING THE TYPES OF CANNABIS GROWN

- The market is shifting to more oil-based products.
- Oregon is an example, but this is a common trend in all legal states



## SUPPLIER SATURATION INFLUENCES BUSINESS STRATEGY

# Cultivator saturation is having a major influence on pricing and licensure.

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Oregon								
Method	Tier	Sq ft	Number	Total Square ft				
Indoor	Micro 1	625	41	25,625				
	Micro 2	1250	52	65,000				
	Tier 1	5000	174	870,000				
	Tier 2	10000	106	1,060,000				
				-				
Outdoor	Micro 1	2500	6	15,000				
	Micro 2	5000	8	40,000				
	Tier 1	20000	67	1,340,000				
	Tier 2	40000	269	10,760,000				
				-				
Mixed	Micro 1	2500	3	7,500				
	Micro 2	5000	6	30,000				
	Tier 1	20000	49	980,000				
	Tier 2	40000	137	5,480,000				
		Total	->	20,673,125				

Washington			
Tier	Number	Sq ft	Total square feet
Tier 1	257	2000	514,000
Tier 2	581	10000	5,810,000
Tier 3	457	30000	13,710,000
Total			20,034,000

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FALLING PRICES WILL MAKE IT DIFFICULT FOR LOW-PERFORMING OPERATORS TO COMPETE

Colorado is facing declining prices as well. This will impact the number of suppliers in the market as well as energy consumption patterns



#### CONTACT US

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# Resource efficiency in cannabis

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# **About RII: Our audiences and impacts**

Mission: We advance resource efficiency to fuel the cannabis economy

Vision: The cannabis industry can be an innovation platform for sustainable agriculture

We are: Non-profit | Data-driven | Objective





## Cannabis is a convergent opportunity

# Controlled Environment Agriculture (aka, CEA, indoor ag, urban ag, vertical farming)

#### **Private Investment**





# RII convenes stakeholder gatherings to facilitate the exchange of information and best practices





# RII is advancing best practices and standards on cannabis energy, water and waste



Early-Stage Chaos Market Transformation



#### 🕼 Cannabis PowerScore

#### **Cannabis PowerScore**

Data entered into this non-profit site will be kept anonymous. The more accurate your data, the more empowered you are to improve your grow environment. X

#### OKAY, LET'S GO

#### ANNADIS PUWERSCORE

An energy benchmarking tool for growers of all type





## **Objectives of the Cannabis PowerScore**



- **1.** Create industry benchmarks on cultivation facility energy performance based on efficient production (grams per annual kWh consumed) and efficient use of the facility (annual kWh per square foot of flowering canopy)
- **1.** Help cultivators and business operators anonymously self-assess their energy performance and gain support in moving toward efficiency, inclusive of all growing methods
- **1.** Assist governments, utilities and manufacturers in establishing policies, incentives and R&D approaches to drive conservation
- **1.** Create the framework for WaterScore, CarbonScore, WasteScore, etc.



# **Cannabis PowerScore findings**

(Note: Initial dataset skews to Oregon, smaller canopy, "sustainable")

Sungrown 0 kWh/sq ft 16 grams/kWh

#### Light dep greenhouse 33 kWh/sq ft 8 grams/kWh

Efficient indoor 234 kWh/sq ft 1+ grams/kWh Inefficient indoor 500+ kWh sq ft < 1 grams/kWh











### RII's Cannabis PowerScore data engine is objectively informing stakeholders about energy use among a variety of technologies, techniques and climates



Individual facility data

Aggregation, anonymization, analysis

Investors/operators >> Performance assessment

Supply chain >> R&D

Utilities >> Program/incentive design, load planning

Governments >> Policy, regulation

Analytics



## **Cannabis PowerScore back engine**

irch Q	Com	pare	All Po	owerSc	ores					Get F	Random 🗹 Exc
owerScores	✓ All Farm Outdoo	n Types r	-	mate Zones	\$ All U.S. & C	Canada 🗘	All Light Type	в 🕴	All HVAC Systems	¢ 00	T Filter
ore Averages	Greenho	ouse/Hybrid,	Mixed Light	er Pumps	ting		Solar PV Wind		Generator Propane		
ritten Report ultivation Classic rocess Uploads	No Com	petition Filte		Aechanical Wate Aanual Environm atomatic Enviro Aertical Stacking	r Heating ental Controls mmental Controls		<ul> <li>Biomass</li> <li>Geotherm</li> <li>Pelton Wh</li> </ul>	al eel	Natural Gas     Woodstove     Other Energy Sour	ce	
WPCC Import	48 Found										
oubleshooting edback Survey	Score ID#	Туре	Overall *	Facility Score	Production Score	Lighting Score	HVAC Score	Grams kWh Sq Ft	County State Z Email	ip	
ails Export	Averages		51%	166	2.75	458	98.8	690,306 g	457,856 kWh 5,769	sq ft	
Content	#1694 ecc	Indoor	112%	1.86	29.2	60.8	115	163,293 g 5,590 kWh 3,000 sq ft	CLACKAMAS C	OR 97013	
ers	#2296	Indoor	112%	41.1	13	92.2	65	7,306,914 g 562,732 kWh 13,680 sq ft	ATHENS OH 45	5761	
apse Menu	#920 e10	Hybrid	106%	3.86	7.94	39	115	158,757 g 20,000 kWh 28,798 sq ft	JOSEPHINE OF	R 97527	
	#899 \$\$2	Hybrid	103%	0.16	22.7	101	115	90.718 g 4,000 kWh 28,500 sq ft	JOSEPHINE OF	R 97527	
	#901 •10	Outdoor	100%	2.33	6.88	102	115	320,842 g 46,601 kWh 4,500 sq ft	JACKSON OR	97539	



# **RII's roadmap**

CURRENT

- Supporting Massachusetts rollout of Lighting Power Density law
- Connecting cannabis supply chain to DesignLights Consortium development of horticultural lighting qualified product list
- Aggregating energy data from State of Oregon, NW Power Council and others
- Developing services to connect growers with tools to support resource efficiency
- Producing grower-targeted efficiency events for Energy Trust (Lighting July 10)

FALL

• Co-authoring industry energy report based on data from Cannabis PowerScore

**EARLY 2019** 

• Preparing to launch "LEED for weed" certification system



# Smart cities and indoor agriculture

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# My Background



 Former North America Regional Manager



- Former Business
   Development Director
- Former Food & Agriculture Cluster Lead
- Director of Sales

# Global Agriculture Problems





#### **Food Transport**

Leads to significant food waste & greenhouse gas emissions



#### **Global Warming**

Threatens global food supply Accelerate Soil Erosion

#### **Rapid Population Growth & Urbanization**

Expected 10 billion people globally and 75% urban population by 2050 Increasing demand for food by 70% (United Nations FAO, 2017)



Pesticide Use

Leads to 75% of world polluted water



#### **Freshwater Use**

80% of all freshwater is used in agriculture 30

# **CEA Farming Benefits**





#### **Economic**

- Year-Round Production Independent of:
  - Climate,
  - Region
  - Weather Events
  - Pest Outbreaks
- 2 to 3x Faster Growth
- Efficient Land Use



#### **Food Quality**

- Locally Grown, Fresher Greens for Consumer
- No Heavy Metals or Herbicides
- Limited or No Pesticide
- High Vitamin and Mineral
   Content
- Optimized Food Safety



#### Environmental

- Up to 99% Less Water Used
- Less Food Waste
- Less Food Miles

# VC-Backed CEA Vendors:



				_
Company	Location	Туре	Amount Raised	Investors
Freight Farms	Boston	Container Farms	\$12.2 mm	Spark Capital
				Initialized Capital, Liquid 2 Ventures, Fuel Capital,
iUNU	Seattle	Greenhouse Machine Vision	\$6 mm	Second Avenue Partners
Motorleaf	Toronto	Sensor Controller Hardware & AI	\$1.1 mm	500 Startups, BDC Venture Capital
Agrilyst	New York	Farm Management Software	\$2 mm	Brooklyn Bridge Ventures
Illumitex	Austin	LED Lighting	\$90.8 mm	WP Global Partners
				TEL Venture Capital, Tsingda International Venture
Light Polymers	San Francisco	LED Lighting	\$5 mm	Capital
Agrilution	Munich	Domestic Hardware	\$2.75 mm	Tengelmann Ventures
Grove	Boston	Domestic Hardware	\$4 mm	Upfront Ventures, Tim Ferriss
Infarm	Berlin	Retail Hardware	\$34.1 mm	Cherry Ventures
Farmshelf	New York	Retail Hardware	\$450 k	Urban X, Sansiri
Square Roots	New York	Farm / Education	\$5.4 mm	Kimbal Musk, Collaborative Fund
Iron Ox	San Francisco	Farm Automation	\$1.5 mm	Y Combinator
Tortuga AgTech	Denver	Farm Automation 32	\$2.4 mm	Root Ventures
Total			\$167.7 mm	

# Investment in CEA Farms:



Company	Location	Туре	Size	<b>Amount Raised</b>	Investors
Plenty	San Francisco, Seattle	Vertical Farm	50,000 sq ft / farm	\$226 mm	Softbank, Bezo Expeditions, Schmidt Family Office, Others
Bowery	New Jersey	Vertical Farm	_	\$31 mm	Blue Apron Founder, General Catalyst, First Round Ventures, GGV Capital, others
Aerofarms	New Jersey	Vertical Farm	69,000 sq ft	\$142.9 mm	Goldman Sachs, IKEA, Crown Prince of Dubai, others
Freshbox Farms	Boston	Vertical Farm	~15 shipping containers	-	Henkel
Green Spirit Farms	Michigan	Vertical Farm	-	-	Karlani Capital
Shenandoah Growers	Virginia	Greenhouse	Large	\$8 mm	Advantage Capital Agribusiness Partners, S2G Ventures
Houweling's Tomatoes	California	Greenhouse	Very Large	-	
Windset Farms	California	Greenhouse	Very Large	-	
Bright Farms	Washington DC	Greenhouse	Large	\$112.9 mm	NGEN, WP Global Partners, Catalyst Investors
Edenworks	New York	Vertical Farm	Medium	\$2.3 mm	Founder.Org, Christian Tansey
Podponics (Bankrupt)	Atlanta	Shipping Container Farm	33	\$14 mm	New Ground Ventures, Raj Choudhoury
Total				\$533.2 mm	







# \$13.7 billion





## \$200 million



# \$500 million Valuation


































Ourfoods









#### California Independent System Operator Duck Curve<sup>1</sup>





# **Southern Company**

### THE AGLANTA CONFERENCE

#### "SMART AG FOR SMART CITIES" MARCH 27-28, 2018









# **Vertical Farming Graveyard**



Local Garden

### **PodPonics**

# FarmedHere







# Indoor agriculture: A comparative analysis of hydroponics and soil-based crop production



#### Subhrajit Saha, Ph.D.

Assistant Professor Department of Biology, Georgia Southern University Statesboro, GA 30460

Project Funded by the Southern Company/Georgia Power





# Alabama Power

#### **Operations Snapshot – Indoor Vertical** % of Total OpEx







Photo Credit Iron Ox (left) and Tortuga Agtech (right)







## Vertical Farm vs Greenhouse





# Energy Comparison

Greenhouse	Vertical Farm
7 – 10 Watts /sf	30 – 60 Watts /sf
20,000 sf greenhouse = 140 – 200 kW	20,000 sf cultivation area = 600 – 1,200 kW

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# Georgia Southern Greenhouse

- 540 sq ft greenhouse
- Avg daily electricity consumption is 22 kWh
- 22 kWh costs \$1.25 (5.6 cents per kWh)







Source Soliculture



#### Estimated greenhouse vegetable production area and vertical farming concentrations

Total global area of vegetables and herbs grown in greenhouses (permanent structures) is estimated at about 500,000 hectares, of which about 40,000 hectares in glasshouses and the remainder in plastic greenhouses.





# 1.15 Therms / sq ft



http://www.flor.hrt.msu.edu/assets/ReducingEnergyCostsinCalifoniaGreenhouses.pdf





Image Credit: Perkins+Will


## Thank you.



## **Andrew Blume**

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## **Thank you! Questions?**



## **Bryan Jungers**

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