Controlled Environment Agriculture (CEA)
HVAC Design & Building Codes Trends

Midwest Building Energy Codes Conference

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ACEEE

American Council for an Energy-Efficient Economy

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Our work is made possible by foundation funding, contracts, government grants, and conference revenue.

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ACEEE conducted research, assisted states, and worked with the industry on indoor agriculture.

aceee.org/topic-brief/indoor-ag

Cannabis PowerScore

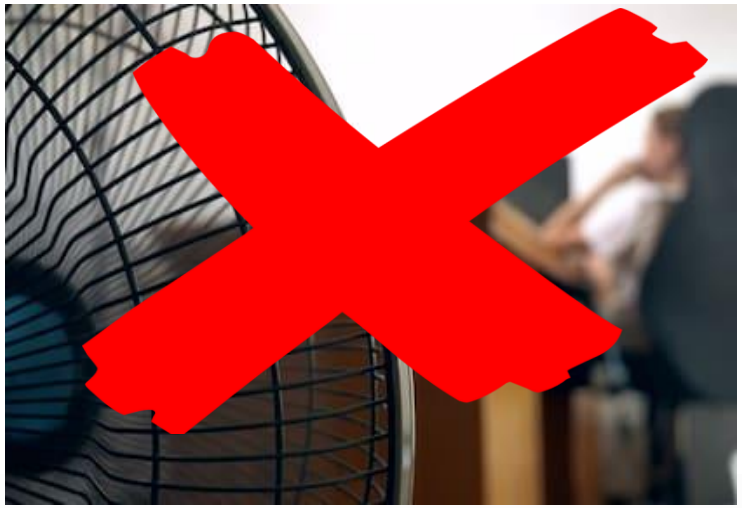
Controlled environment agriculture (CEA)

"is production of plants and their products, such as vegetables and flowers, inside structures such as greenhouses. By using CEA, we can produce high value crops at maximum productivity in an efficient and environmentally friendly way."

University of Arizona, Controlled Environment Agriculture Center

HVAC in a CEA facility is a **process load**, so typical building practices may not apply.

Plant comfort



Human comfort

HVAC and dehumidification systems are critical to enabling production in CEA facilities.

- Maintain **tolerances** for temperature, humidity, airflow, and CO_2 levels for optimal crop production
- Control **problems** like mold, mildew, and other pests
- Provide **flexibility** to move plants or change conditions throughout the day and the plant's growth cycle
- Deliver optimal conditions at the individual **plant level** (rather than overall ambient conditions)

HVAC accounts for 25-50% of facility energy use depending on crop, location, and facility type.

These facilities face challenges for HVAC efficiency.

- **Dehumidification** produces heat leading to additional demands on cooling systems
- **Ventilation** creates several challenges:
  - Exhaust of needed **CO_2** (possibly from CO_2 injection systems)
  - Introduction of **contaminants** (e.g., through economizers)
  - **Odor** control (primarily of concern in cannabis cultivation)

Policies must be tailored to the unique needs of these facilities to avoid unintended consequences

Both **traditional** and **specialty** HVAC systems can provide efficient conditioning and ventilation.

- High-efficiency variable speed rooftop units
- Chilled water systems
- VRF systems
- Integrated cooling-dehumidification systems w/ hot gas reheat
- High-efficiency free-standing ductless dehumidification units
- Advanced temperature, humidity, CO_2 controls
- Passive ventilation (where appropriate)

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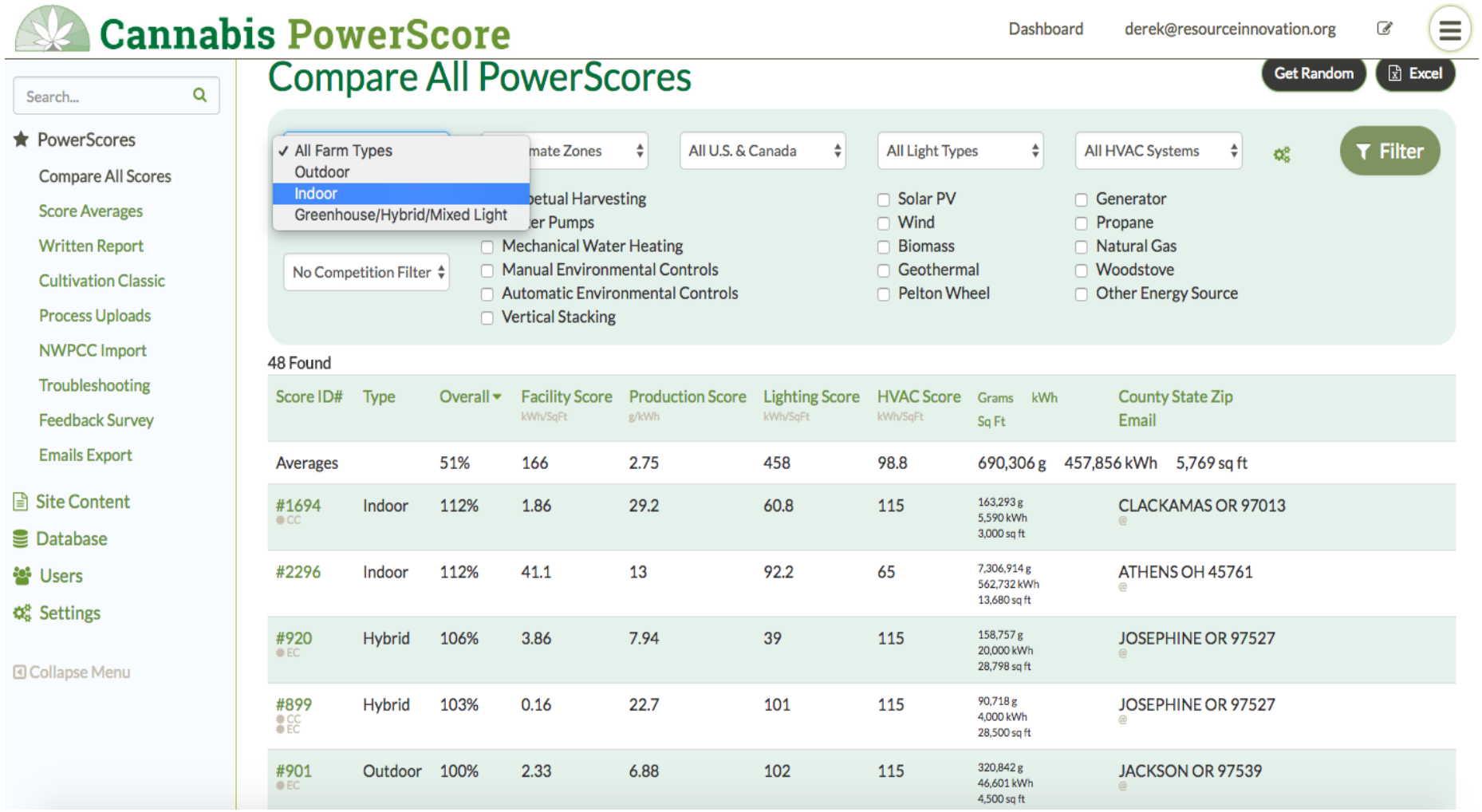
Photos: Energy 350 Inc. and Surna

We need to develop policy that works with CEA industry needs.

- **Test methods, efficiency metrics, and targets** for facility and equipment energy performance
- **Best practices** along with **guidance** on implementation
- **Efficiency program investments** in measures that increase energy efficiency without sacrificing yield
- **Energy use reporting** to address data gaps and facilitate improved policymaking moving forward
- **Research, development, and demonstration** of energy-efficient technologies and growing methods

Cannabis PowerScore helps facilities benchmark energy use.



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See cannabispowerscore.org to use the tool or to find resources and case studies

State	Energy regulations
CA	• renewable energy requirements • **energy use disclosure after 2022** • electricity GHG intensity mandates as of 2023 • **Title 24 proposal for indoor ag facilities under development (not just cannabis)**

CO	• Boulder County and City of Boulder
	  • **energy use reporting (ENERGY STAR Portfolio Manager)**
	  • renewable energy requirements (or penalty paid into offset fund)
	• Denver
	  • lighting and HVAC requirements as part of 2018 IECC adoption (**vote anticipated December 2019**)

MA	• lighting, building envelope, and HVAC standards (revised 11/2019) • **energy and water use disclosure upon license renewal application (Cannabis PowerScore)** • demonstrated commitment to renewables and energy efficiency in application • **model for Illinois legislation**
OR	• energy use forecast required • exception for air-side economizers • guidance and **incentives for installation of energy-efficient equipment**

Primary takeaways

1. HVAC in CEA facilities is a process load, not for human comfort/safety
2. Energy efficiency policies need to be balanced with indoor environment plant needs
3. Prescriptive codes can be overly restrictive to growers
4. Performance-based codes can provide more flexibility for the grower's unique situation
5. Codes should be revisited regularly and revised to reflect the latest research and data

Resources

- RII Best Practice guides for HVAC and lighting in cannabis facilities (forthcoming, December 2019, resourceinnovation.org)
- Indoor Agriculture Energy Solutions Conference Feb. 24-26, 2020 San Diego, CA **Registration open now!**
- Indoor Cannabis Growing – Taming the Wild West, Energy 350 2018 ACEEE Summer Study Paper
- ACEEE Controlled Environment Agriculture Brief
- University of Arizona, CEA Center and Cornell CEA Program

Thank you!

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