REGIONAL CLEAN ENERGY INNOVATION

Policy and economic opportunities in the United States

May 1, 2020

1:00 pm EST // 10:00 am PST

Download the report: *go.umd.edu/regionalenergy*

Hosted by the University of Maryland Global Sustainability Initiative with support by the Center for Global Sustainability, the Energy Futures Initiative, and Colorado Cleantech Industries Association.

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Speakers

Joseph Hezir, Managing Principal, Energy Futures Initiative

Kavita Surana, Assistant Research Professor, University of Maryland Center for Global Sustainability and School of Public Policy

Ellen Williams, Distinguished University Professor, University of Maryland Department of Physics

Chris Votoupal, Legislative Affairs Director, Colorado Cleantech Industries Association

ENERGY FUTURES INITIATIVE

The Energy Futures Initiative (EFI)

Mission: The Energy Futures Initiative advances solutions to the climate crisis through building coalitions, thought leadership, and evidence-based analysis. Under the leadership of Ernest J. Moniz, all final EFI analysis is published and publicly available.

Learn more at energyfuturesinitiative.org

@ErnestMoniz
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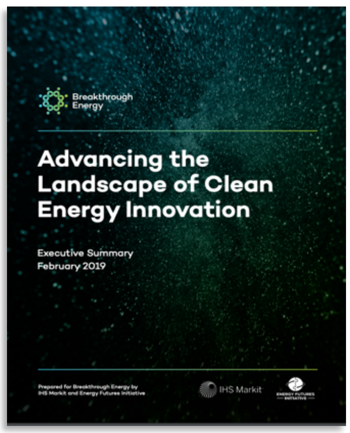
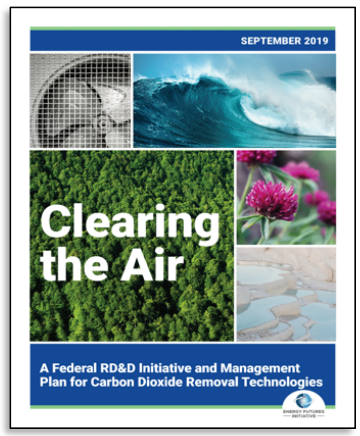
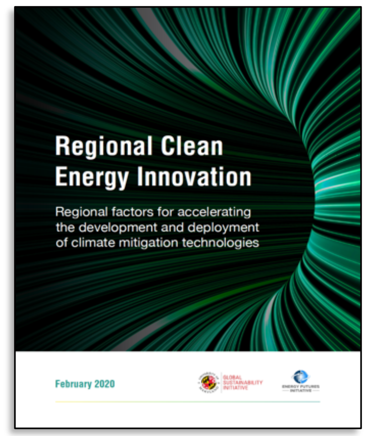
The Energy Futures Initiative – Major Reports







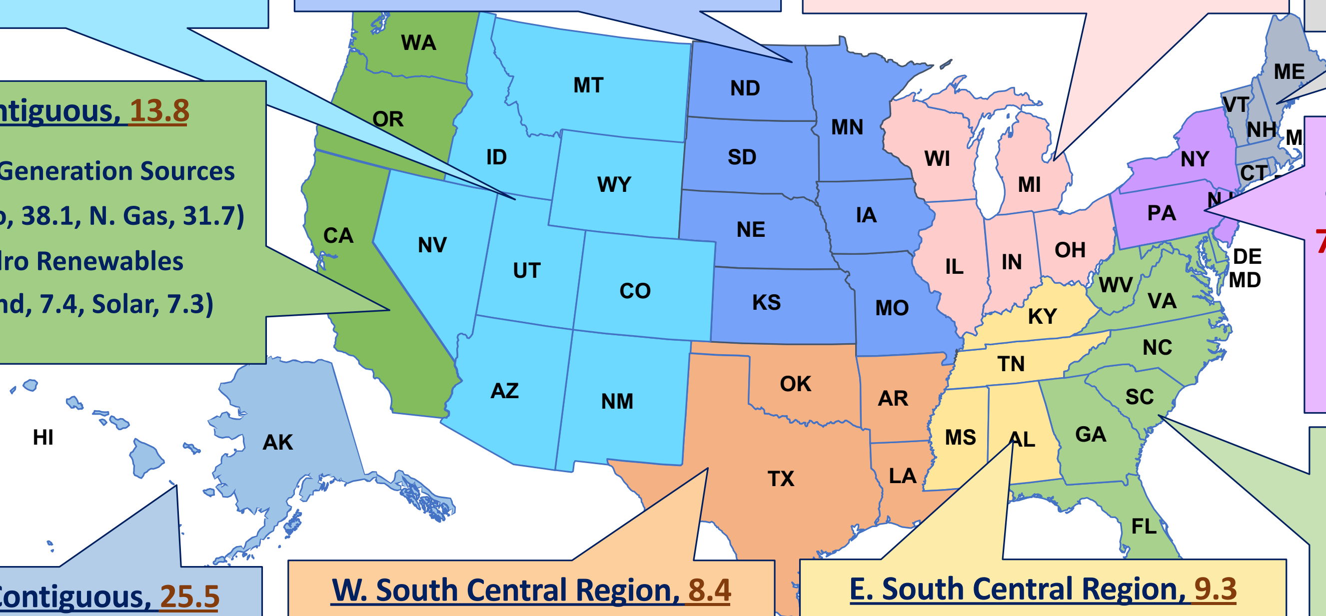
Mountain Region, 9.5
% Two Largest Generation Sources
69.3% (Coal, 40.8, Gas 28.5)
% Non-Hydro Renewables
12.6% (Wind, 7.2, Solar 4.0)

W. North Central Region, 9.8
% Two Largest Generation Sources
72.6% (Coal, 52.6, Wind, 20)
% Non-Hydro Renewables
22.1% (Wind, 21, Solar, 0)

E. North Central Region, 10.1
% Two Largest Generation Sources
70.6% (Coal, 44.8, Nuclear, 25.8)
% Non-Hydro Renewables
5.5% (Wind, 4.5, Solar, 0.1)

New England Region, 17.5
% Two Largest Generation Sources
77.7% (N. Gas, 48, Nuclear, 29.7)
% Non-Hydro Renewables
11.3% (Wind, 3.5, Solar, 1.5)

Pacific Contiguous, 13.8
% Two Largest Generation Sources
69.8% (Hydro, 38.1, N. Gas, 31.7)
% Non-Hydro Renewables
20.2% (Wind, 7.4, Solar, 7.3)



Mid-Atlantic Region, 12.6
% Two Largest Generation Sources
76.4% (N. Gas, 39.1, Nuclear, 37.3)
% Non-Hydro Renewables
3.6% (Wind, 1.9, Solar, 0.3)

Source: EIA website, accessed June, 2019

South-Atlantic Region, 9.9
% Two Largest Generation Sources
68.9% (N. Gas, 44.1, Nuclear, 24.7)
% Non-Hydro Renewables
4.4% (Wind, 0.3, Solar, 1.7)

Pacific Non-Contiguous, 25.5
% Two Largest Generation Sources
65.2% (Pet. Liquids, 45.6, N. Gas, 19.6)
% Non-Hydro Renewables
9.6% (Wind, 4.2, Solar, 1.3)

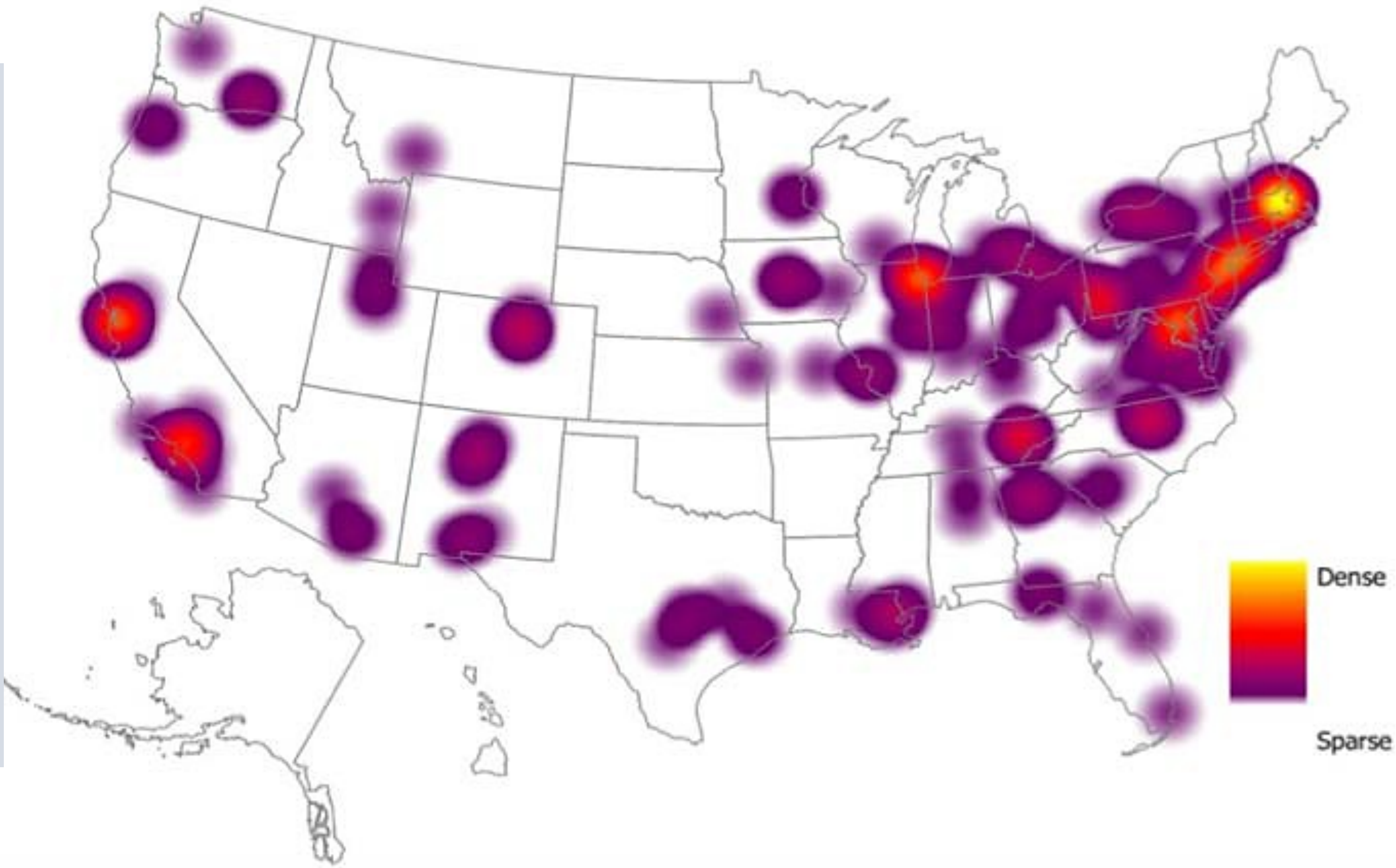
W. South Central Region, 8.4
% Two Largest Generation Sources
72.3% (N. Gas, 49.3, Nuclear, 23)
% Non-Hydro Renewables
15.4% (Wind, 14.1, Solar, 0.5)

E. South Central Region, 9.3
% Two Largest Generation Sources
58.8% (N. Gas, 44.1, Nuclear, 24.7)
% Non-Hydro Renewables
2.0% (Wind, 0, Solar, 0)

Avg. retail electricity price, cents/kwh
Data are for 2018

Regional Clean Energy Innovation Index

EFI's Regional Clean Energy Innovation Index combines locational data for energy RD&D resources across the country to analyze the potential benefits to innovation of regional clustering.



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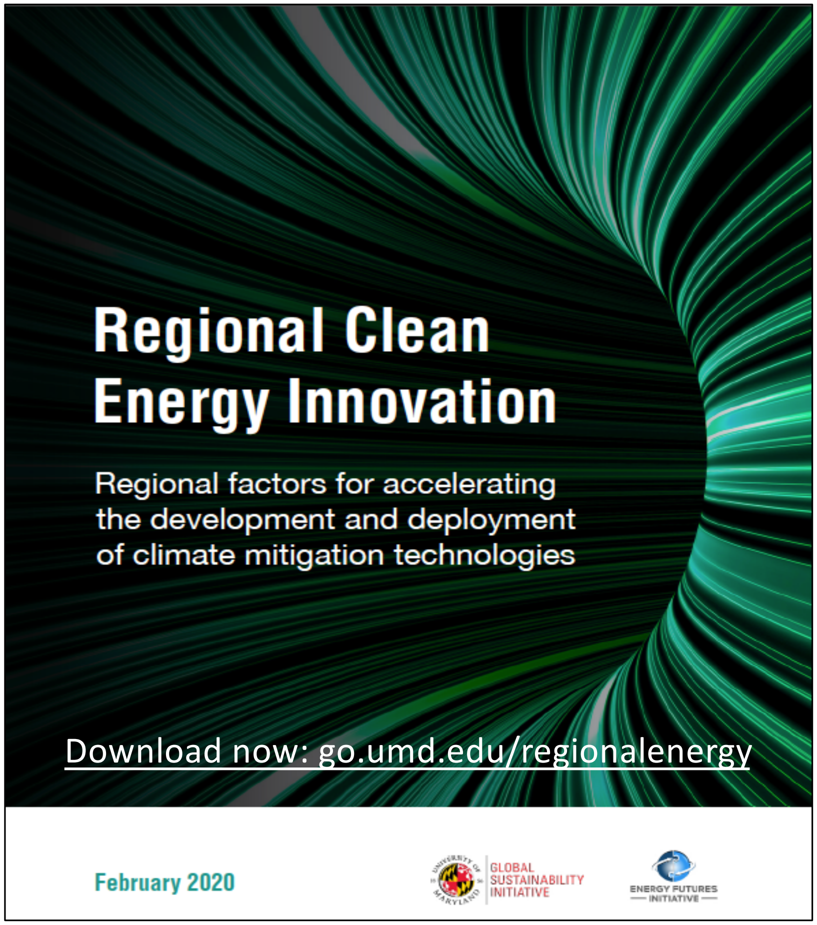
Top 10 States Unemployment Claims (3/21-04/18), Top 10 States for Employment in Key Energy Job Categories (2019)

Ranking of Top 10 States, Highest to Lowest	Total Unemploy-ment Claims (03/21-4/18)	Claims as % of Workforce	Natural Gas and Oil Fuels Jobs Actual	Natural Gas and Oil Fuels Jobs as % of Workforce	Efficiency Jobs Actual	Efficiency Jobs as % of Workforce	Gas/Oil Generation Actual	Gas/Oil Generation as % of Workforce	Solar Generation Jobs Actual	Solar Generation Jobs as % of Workforce	Wind Generation Jobs Actual	Wind Generation Jobs as % of Workforce
1	CA	HI	**TX**	WY	**CA**	VT	**CA**	KS	**CA**	NV	**TX**	ND
2	NY	KY	LA	ND	**TX**	WY	**FL**	**HI**	MA	**HI**	**IL**	SD
3	TX	MI	OK	**AK**	**NY**	DE	**TX**	**NH**	**NY**	**CA**	CO	CO
4	MI	RI	**CA**	OK	**FL**	**RI**	KS	UT	**FL**	VT	IN	IA
5	PA	NV	**PA**	**LA**	**IL**	MA	**NY**	**FL**	**TX**	UT	**CA**	IN
6	FL	GA	CO	NM	MA	MD	MA	**AK**	**NV**	MA	**FL**	ME
7	GA	LA	NM	**TX**	NC	WI	**IL**	MA	AZ	NM	**MI**	**TX**
8	OH	PA	**IL**	WV	**MI**	OR	AZ	SC	NJ	OR	IA	NH
9	NJ	NH	ND	CO	**OH**	UT	**MI**	AZ	NC	AZ	**NY**	KS
10	IL	WA	**OH**	KS	VA	CT	**OH**	MS	**OH**	CO	**WA**	**IL**
Total US*	24,139,608		906,998		2,378,893		128,031		345,393		114,774	

Bold denotes top 10 states that are in top 10 for actual unemployment claims or claims as percent of workforce and are also in top 10 jobs for specific energy sector, both actual and as % of workforce

* Includes DC, Puerto Rico



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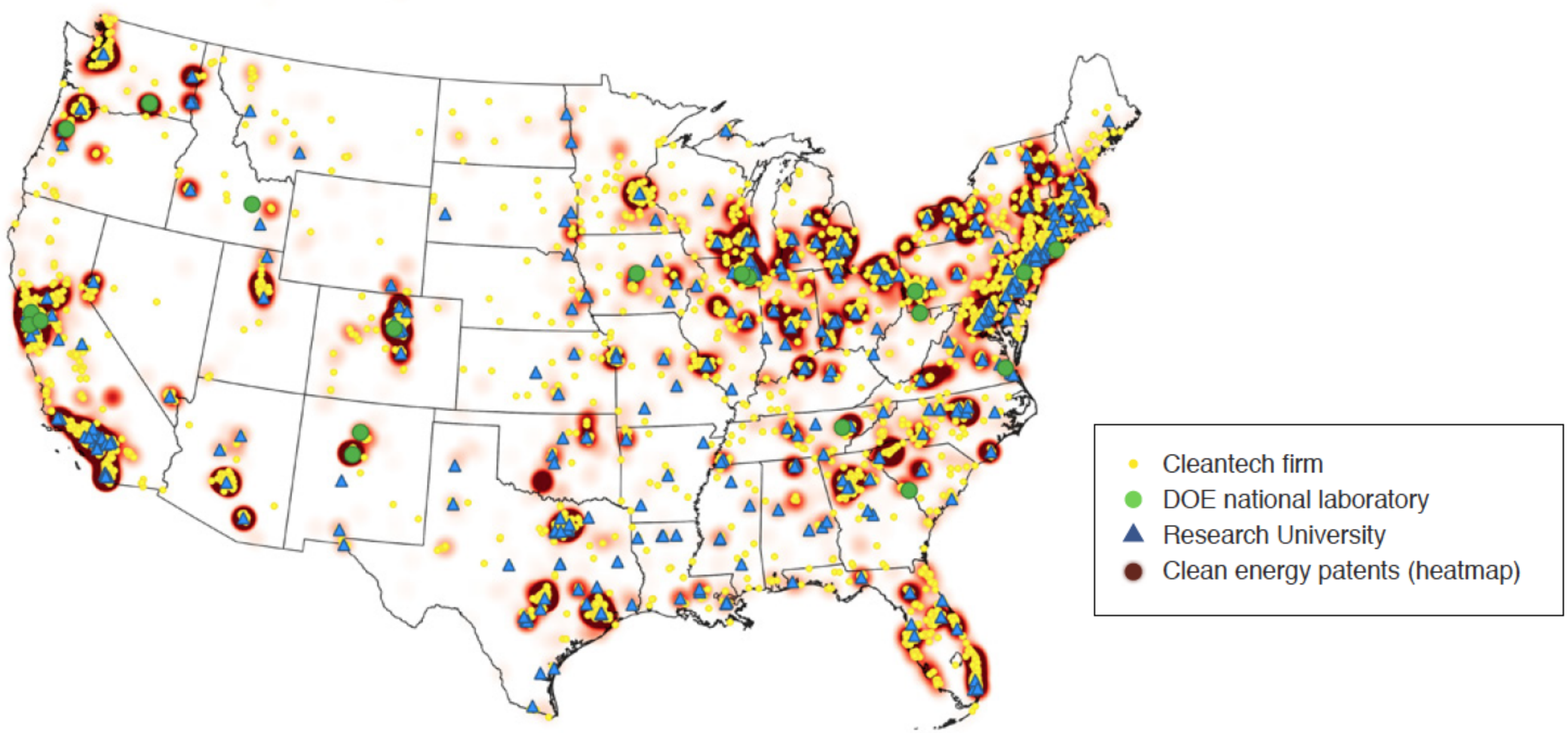
REGIONAL CLEAN ENERGY INNOVATION

Policy and economic opportunities in the United States

Kavita Surana & Ellen Williams
May 1, 2020

ENERGY FUTURES INITIATIVE

The US clean energy innovation system: **innovation clusters** around DOE labs and/or universities



Why **regional** clean energy **innovation**?

Innovation is essential for:

- Improving existing technologies: integration, performance and cost
- Developing new technologies: mitigation of sectors that are difficult to decarbonize
- Providing an engine for economic development

Implicit: Anthropogenic climate change is real,
and greenhouse gas emissions must be reduced

Regional choices matter because of:

- impact on development and uptake of clean energy technologies
- links to local social and economic priorities, workforce and resource availability

Implicit: Modernizing the energy system provides
regional economic development opportunities.

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Importance of **economic** and **environmental** goals

ENERGY BASED ECONOMIC DEVELOPMENT GOALS

- Employment in services, installations
- Start-ups and small businesses
- Supply chain and manufacturing

ENERGY, ENVIRONMENT, AND CLIMATE GOALS

- Greenhouse gas emissions reduction
- Clean air and water
- Energy efficiency for homes and businesses

Created by Adrien Coquet
from Noun Project

Created by Symbolon
from Noun Project

Created by Creative Mania
from Noun Project

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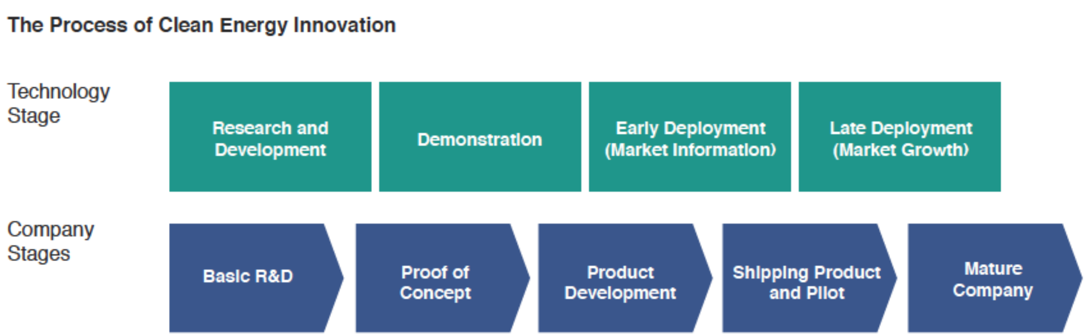
Our approach…

- **States** as regions
- A **broad definition** of clean energy
- The **full cycle** of innovation and all its stakeholders
- A focus on **start-ups and small businesses**
- Two-part approach, data and stakeholder discussions
    - 50 states analysis
    - Deep-dive case studies



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50-states analysis

Regional variation in the United States

Big picture analysis of the 50 states

Characterizing regional clean energy innovation relative to the US

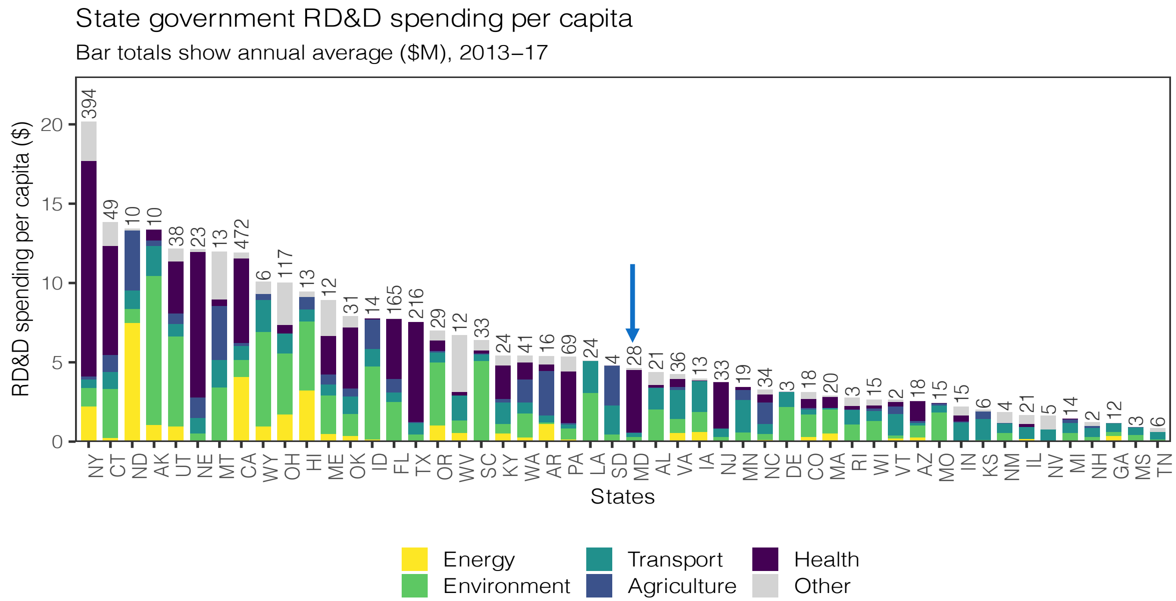
Developing locally relevant metrics

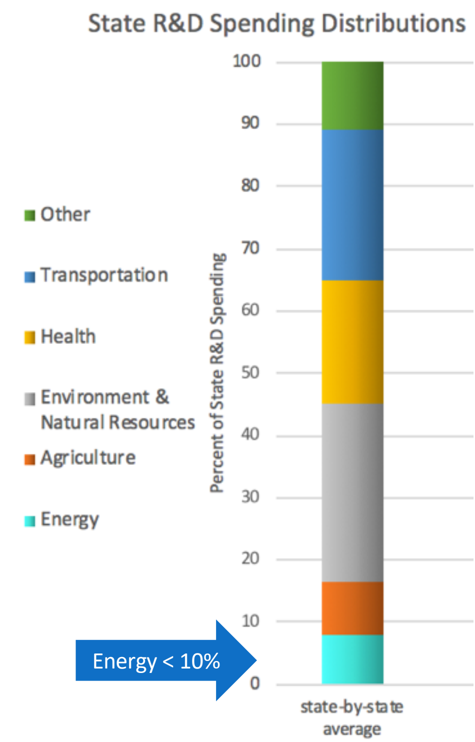
Wide **variation** in regional clean energy innovation patterns

Variability in:

- State choices of **technology** areas
  - priorities in clean energy vs other sectors
  - natural resources and other local factors
  - focus on selected clean energy technologies
- State focus on **stages of development**
  - RD&D
  - In state firms
  - Deployment
- Types of **employment**
  - Construction and service dominate statistics
  - RD&D and in-state manufacturing are smaller component

States have different technology **R&D priorities**





R&D spending | Patents | Firms | Deployment | Employment

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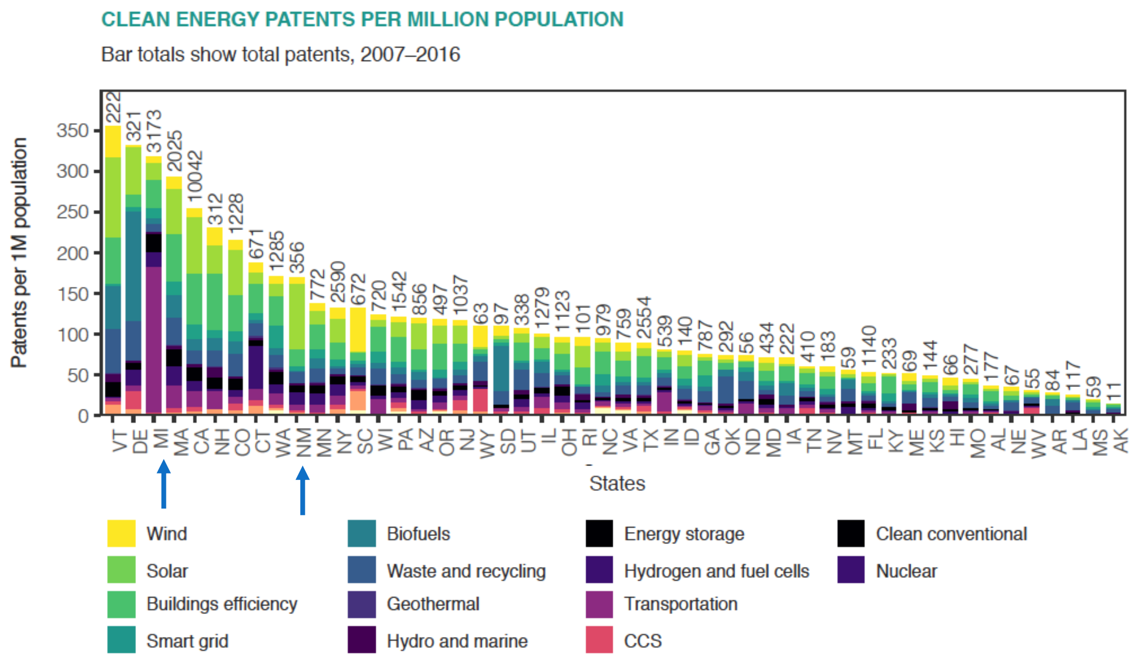
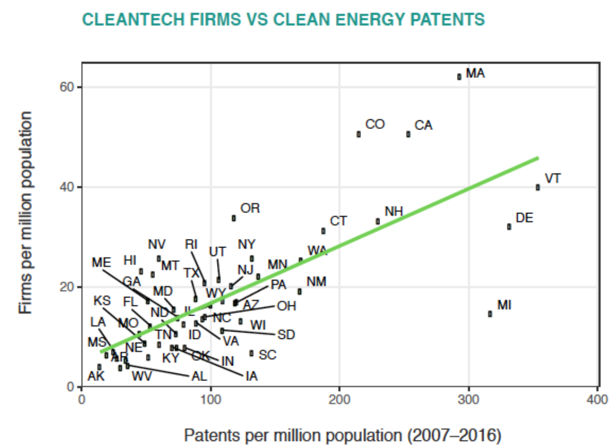
State R&D focus and in-state technology transfer vary by **state** and by **energy technology**





Large spread around the average trend-line indicates strong regional variability.

R&D spending | Patents | Firms | Deployment | Employment

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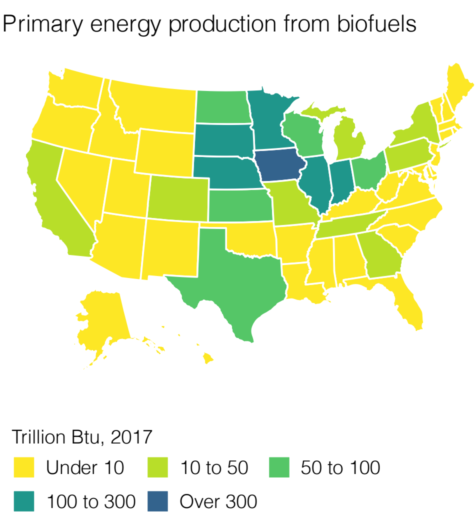
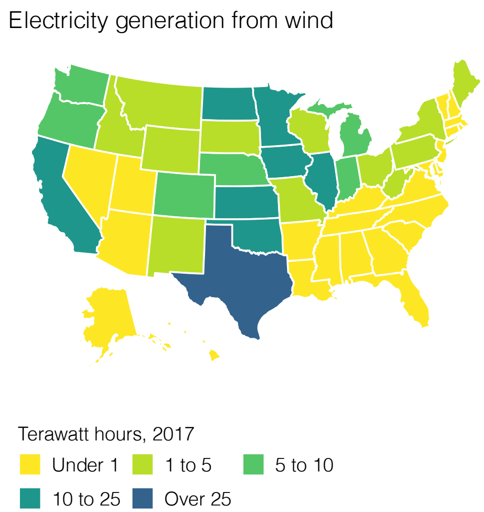
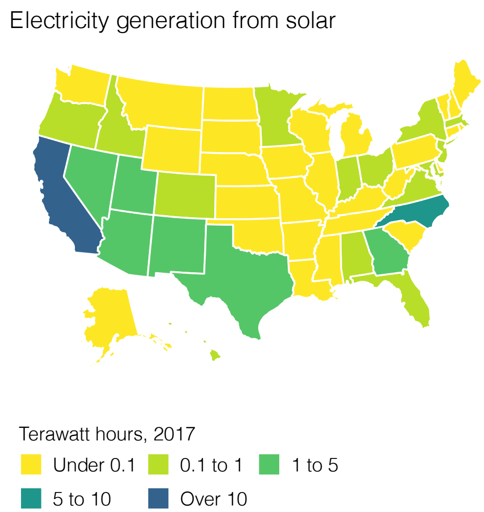
Natural **resource base** is important but not the sole factor







R&D spending | Patents | Firms | **Deployment** | Employment

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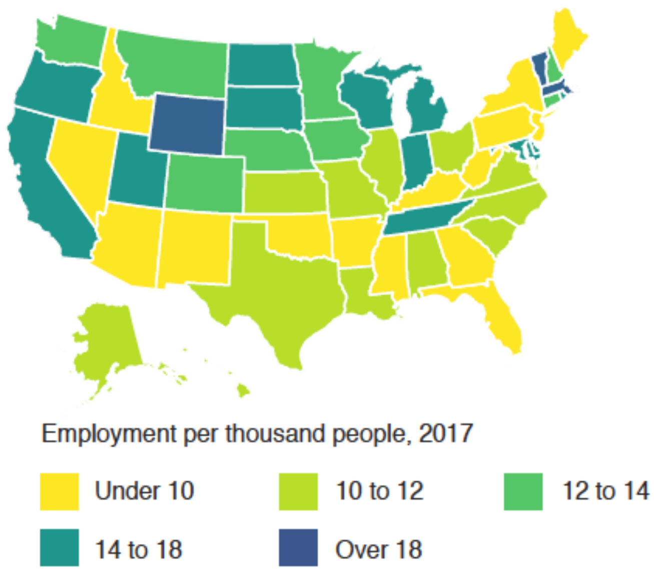
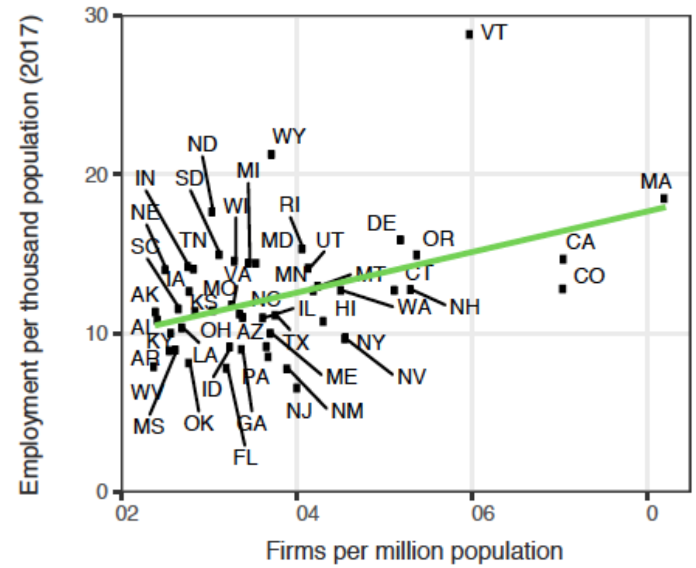
Energy RD&D and deployment lead to different **types of employment**

CLEAN ENERGY EMPLOYMENT



CLEAN ENERGY EMPLOYMENT VS CLEANTECH FIRMS



R&D spending | Patents | Firms | Deployment | **Employment**

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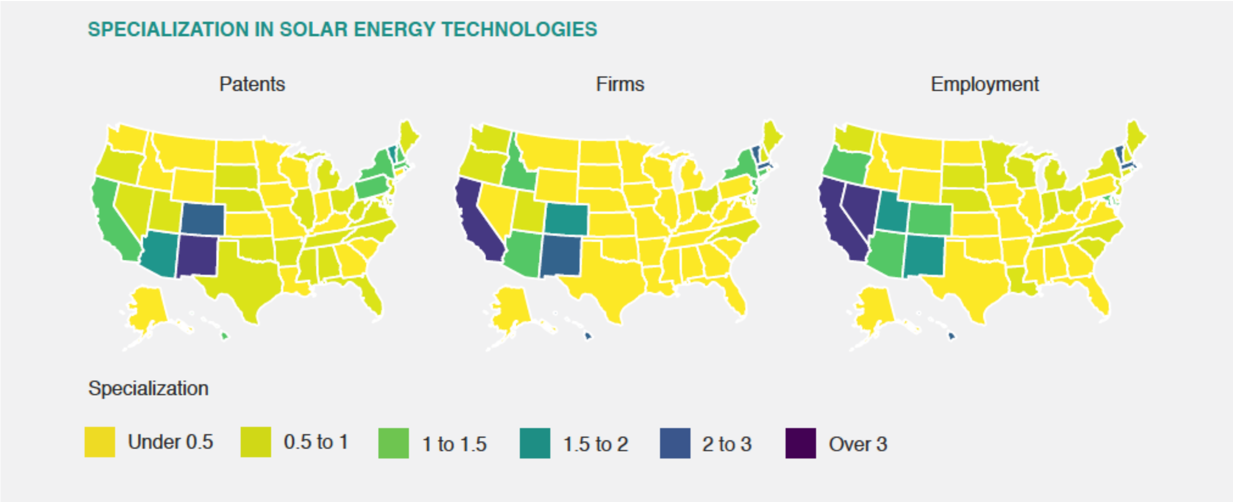
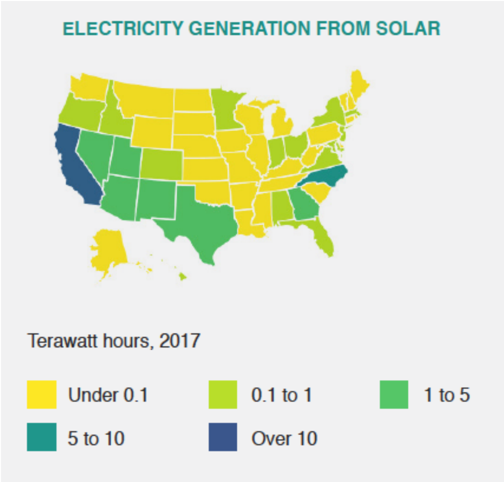
Large spread around the average trend-line indicates multiple factors driving employment.

Each technology has a wide variation across the **stages of development:** e.g., Solar energy





R&D spending | Patents | Firms | Employment | Deployment

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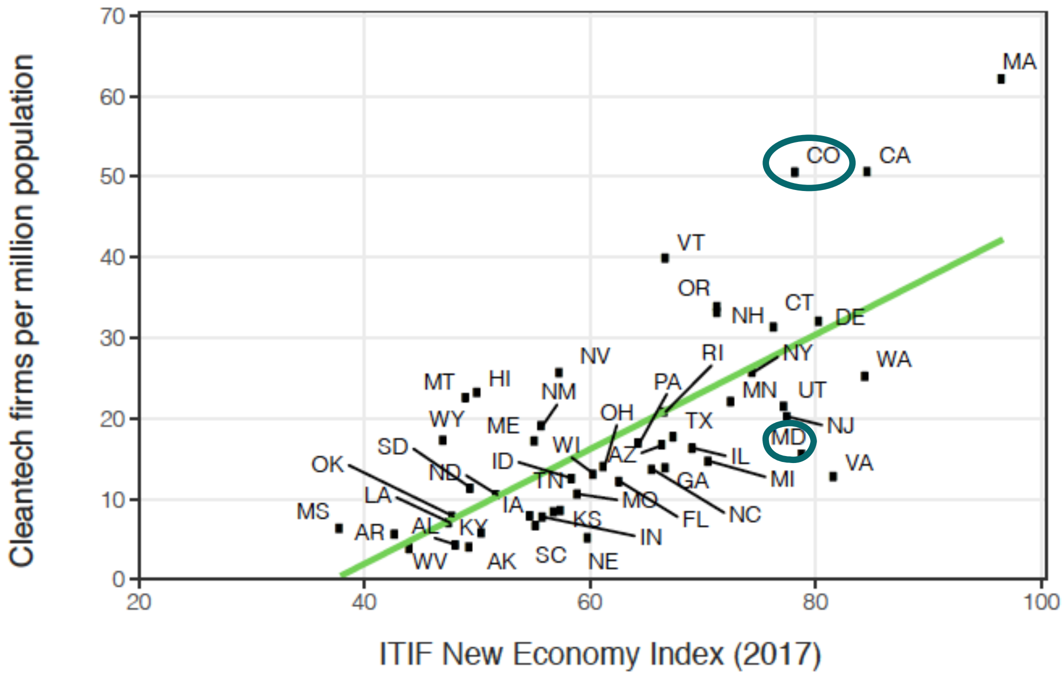
Regional factors for advancing energy innovation & economic development

Case studies: similar economies but different clean energy outcomes

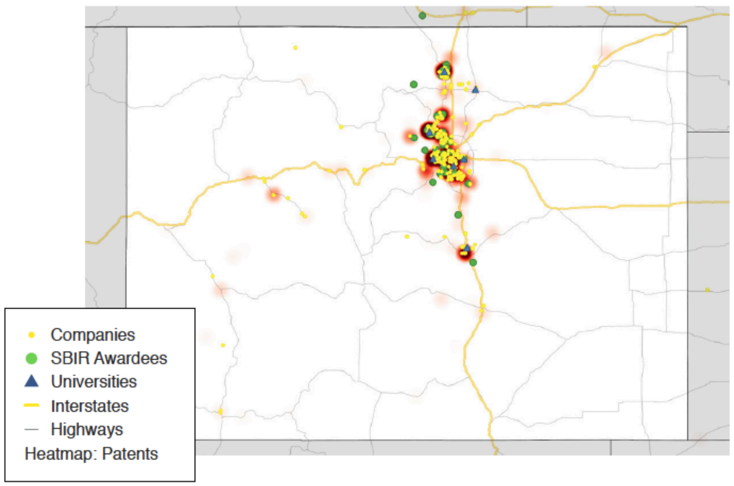
Understand outcomes relative to local resources, stakeholders, priorities, strengths, coordination

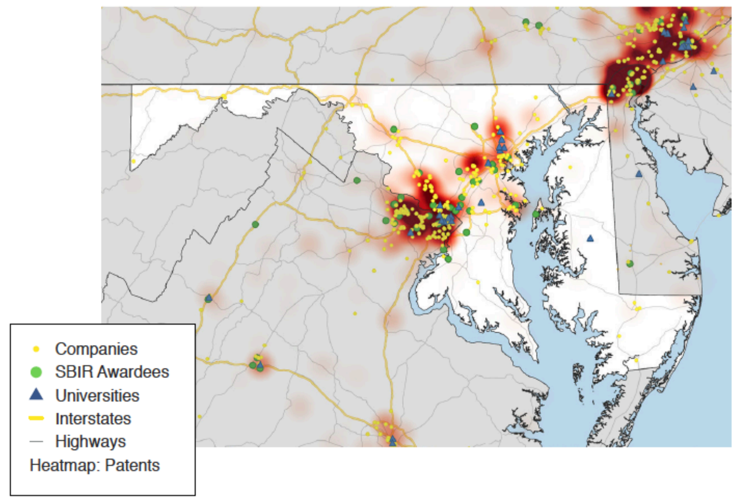
The **overall innovation capacity** explains clean energy innovation outcomes in most—but not all—states

- The number of cleantech firms per capita correlates on average with the state's **overall innovation capacity**, which is influenced by
  - GDP per capita
  - Strength of the university system
  - STEM representation in workforce
- States that do not fall near the average trend-line provide an opportunity to identify **differentiating factors** using case studies.



State policy impacts on number and health of firms





Many individual factors – in combination:

Outcomes depend on **integration of environmental and economic development** activity

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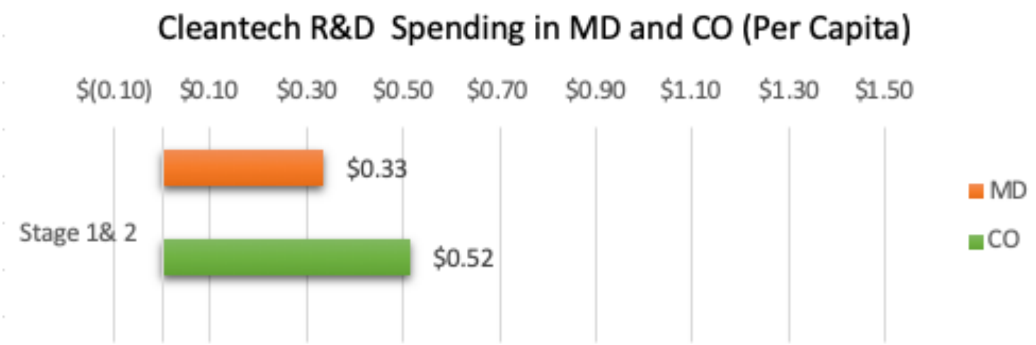
Comparison of state approaches for clean energy innovation

State spending



Direct state R&D spending for clean energy was only slightly higher in CO than in MD from 2013-2017.

MD Utilities programs spend 3.5 times more than CO's Utilities programs - primarily on building **energy efficiency**.

Differentiating factors

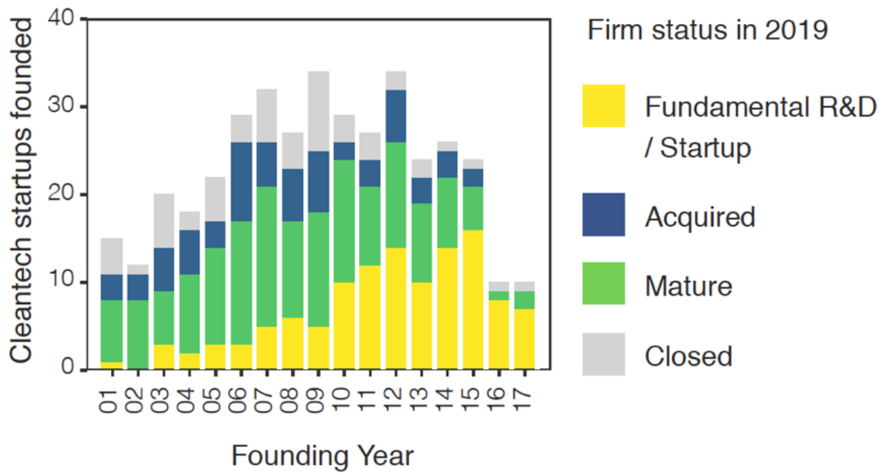
- CO: Clean energy is a **designated economic development areas**, developing over a decade.
- MD: **Economic innovation focus** has been on health, biotechnology, and cybersecurity.

- CO: The **Office of Economic Development and International Trade** manages a dedicated program for clean energy innovation with support from the Colorado Energy Office and other agencies.
- MD: The **Maryland Energy Administration**'s primary focus is on helping deliver energy efficiency benefits, independent of in-state development of firms.

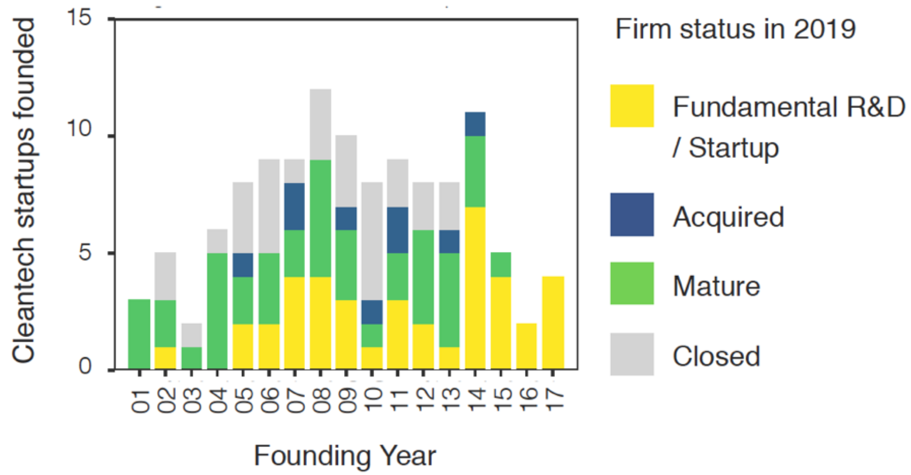
- CO: State agencies coordinate with industry associations, NREL and universities to provide developmental support targeted to clean energy start-up firms.
- MD: Developmental support for start-up firms has predominantly focused on health and biotechnology.

State outcomes: **Health of cleantech companies in the past 15 years**

PROGRESSION OF CLEANTECH STARTUPS IN COLORADO



PROGRESSION OF CLEANTECH STARTUPS IN MARYLAND



CO clean tech firms have:
- Averaged 23 new starts/year
- 14% of firms closed
- 52% of firms became mature or were acquired

MD clean tech firms have:
- Averaged 7 new starts/year
- 24% of firms closed
- 43% of firms became mature or were acquired

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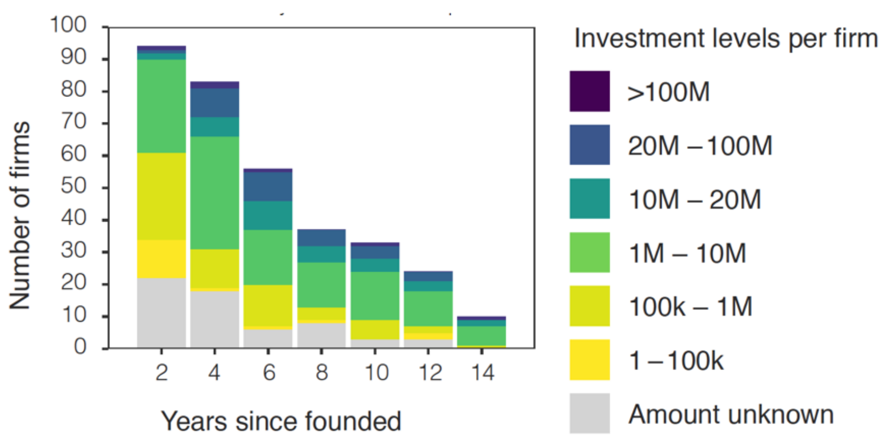
State outcomes: **Investments in cleantech companies**

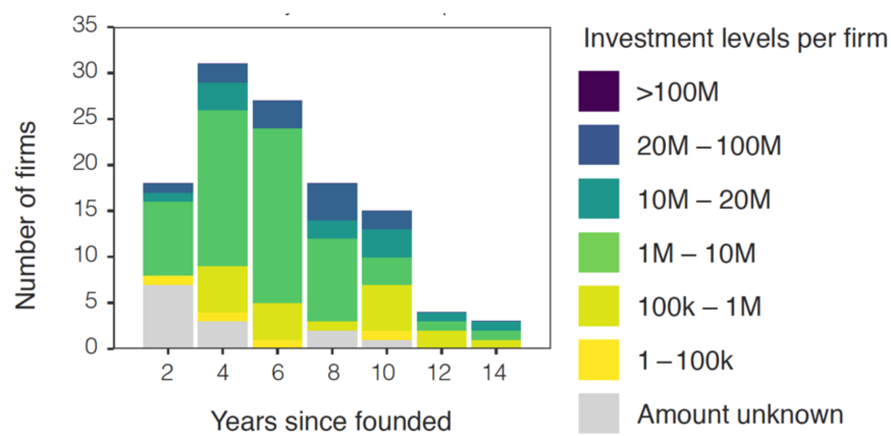
INVESTMENT HISTORY OF 162 COLORADO COMPANIES



Documented private sector investment:

- 109 firms, 2009 –2019, $3.1 Bn
- Ave: $2.8 M/firm/year

INVESTMENT HISTORY OF 62 MARYLAND COMPANIES



Documented private sector investment:

- 44 firms, 2009 – 2019, $0.79 Bn
- Ave: $1.8 M/firm/year

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What works?

- Clean energy as an economic development priority in the state
- Well defined synergies between economic development and energy/environmental policy goals from state government and multiple state agencies
- State funding—even modest amounts—can complement federal and/or private resources for cleantech start-ups
- State developmental support for start-ups (incubators, training, networks, etc.)
- Coordination between stakeholders and the ability for start-ups and firms to access different local resources

Information for state decision makers

K. Surana *et al., download at:*
http://go.umd.edu/regionalenergy

E.D. Williams *et al., download at:*
https://energy.umd.edu/sites/energy.umd.edu/files/MSAR%2311208-PRINT.pdf

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What can we do?

- Sharing stories and identifying champions
- Looking at a broader spectrum of states – and relevant federal and industry stakeholders
- Developing local clean energy innovation landscape baselines through data and visualization
- Differentiating the types of clean energy jobs and firms and their short- and long-term local impacts
- Engaging with sub-national climate and energy goals

Thank you for your attention

K. Surana *et al., download at:*
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Colorado Context

Chris Votoupal, Legislative Affairs Director, Colorado Cleantech Industries Association

Register for the May 7th Colorado-specific event: https://bit.ly/3bVnHDv