Nice Work if You Can Get It? The Distribution of Employment and Earnings during the Early Years of the Clean Energy Transition

Jonathan Colmer
University of Virginia

Eva Lyubich
U.S. Census Bureau

John Voorheis
U.S. Census Bureau

December 9, 2023

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

The Clean Energy Transition

Decarbonization implies an economic transition

- Businesses in legacy fossil fuel & related industries exit or change activities; new clean businesses enter

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

The Clean Energy Transition

Decarbonization implies an economic transition

- Businesses in legacy fossil fuel & related industries exit or change activities; new clean businesses enter

Costs and benefits of this transition are an economic measurement problem

$\Rightarrow$ Need to know what jobs and what businesses are being created, their characteristics, and who they are going to

$\Rightarrow$ i.e. how has the current energy transition *to date* impacted different people/groups?

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

This Presentation

Part 1

How were employment, earnings, and economic opportunities from clean and legacy energy jobs distributed in the early years (2005-2019) of the clean energy transition?

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

This Presentation

Part 1

How were employment, earnings, and economic opportunities from clean and legacy energy jobs distributed in the early years (2005-2019) of the clean energy transition?

- Aggregate trends in establishment counts and employment and demographic composition
- Job spells and wage premia at clean and legacy jobs
- The extent to which workers move from dirty to clean jobs

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

This Presentation

Part 1

How were employment, earnings, and economic opportunities from clean and legacy energy jobs distributed in the early years (2005-2019) of the clean energy transition?

- Aggregate trends in establishment counts and employment and demographic composition
- Job spells and wage premia at clean and legacy jobs
- The extent to which workers move from dirty to clean jobs

Part 2

Can we track how new business formation in clean and legacy sectors is evolving at high temporal frequencies (in close to real time)?

- Aggregate monthly trends in new clean and legacy business formation

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

Measuring the Clean Transition

- We can take advantage of Census's economic measurement infrastructure, if we can identify clean and legacy establishments/firms
- **Challenge 1**: Clean energy transition activities not well contained by NAICS codes
  - Need to use text information on business names, descriptions of business in addition to NAICS

  Challenge 2: Clean energy transition is proceeding rapidly
  - Tradeoff between timeliness and detail
- **Challenge 3**: Some activities are inherently high emissions (coal mining), but some are currently high emissions, but need not be given process changes (steelmaking)
  - Need to anticipate clean transition activities that haven't happened yet

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

Measuring the Clean Transition

Measurement Approach:

1. New clean or legacy energy business formation
   - → Business Formation Statistics (BFS) Microdata on EIN Applications
   - → Observe location, industry and firm description
   - → Clean establishment identification based on industry codes *and keyword search*

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

Measuring the Clean Transition

Measurement Approach:

1. New clean or legacy energy business formation
2. Existing clean or legacy energy establishments within existing or new firms
   → Business Register and Longitudinal Business Database
   → Observe location, employment, payroll, revenue
   → Clean establishment identification based on industry codes *and keyword search*

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

Measuring the Clean Transition

Measurement Approach:

1. New clean or legacy energy business formation
2. Existing clean or legacy energy establishments within existing or new firms
3. Who works for clean or legacy energy establishments
   - → Linked Employer-Employee Data
   - → Observe individuals' W2s, wage earnings, employer spells
   - → Also observe individuals' residential histories, age, race, and ethnicity
   - → For sub-sample, observe education and occupation (from ACS)

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

Measuring the Clean Transition

Measurement Approach:

1. New clean or legacy energy business formation
2. Existing clean or legacy energy establishments within existing or new firms
3. Who works for clean or legacy energy establishments
4. Changes in activity within existing establishments (Down the line)
   → Economic Census linked to Business Register and Longitudinal Business Database
   → Surveys (e.g. Annual Business Survey, Manufacturing Energy Consumption Survey)

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

Measuring the Clean Transition

Measurement Approach:

1. New clean or legacy energy business formation
2. Existing clean or legacy energy establishments within existing or new firms
3. Who works for clean or legacy energy establishments
4. Changes in activity within existing establishments (Down the line)

Very different timescales: BFS is weekly/monthly, LBD is 2 years behind, Econ Census every 5 years

United States® Census Bureau

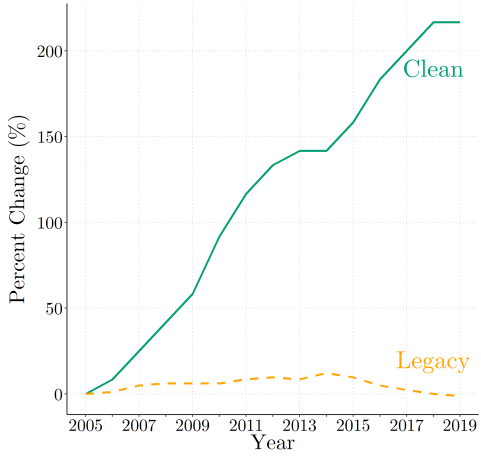
ENVIRONMENTAL INEQUALITY LAB

Aggregate trends in establishment counts and employment

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

Establishment Growth in Clean Sector Outpaces Legacy Sector

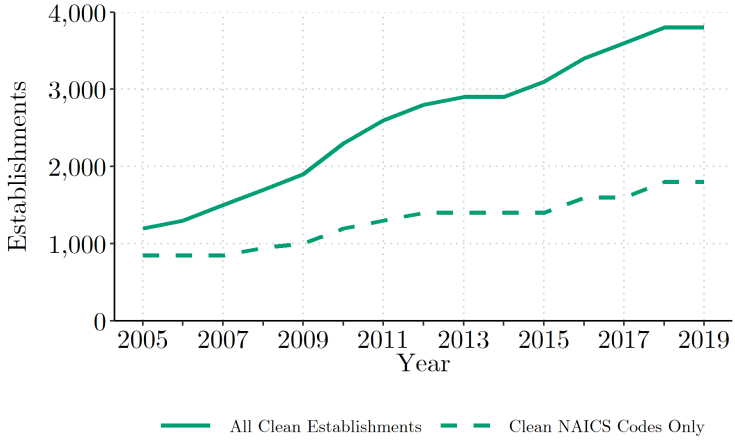


United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

Clean: 1.2K $\rightarrow$ 3.8K. Legacy: 41.5K $\rightarrow$ 41K

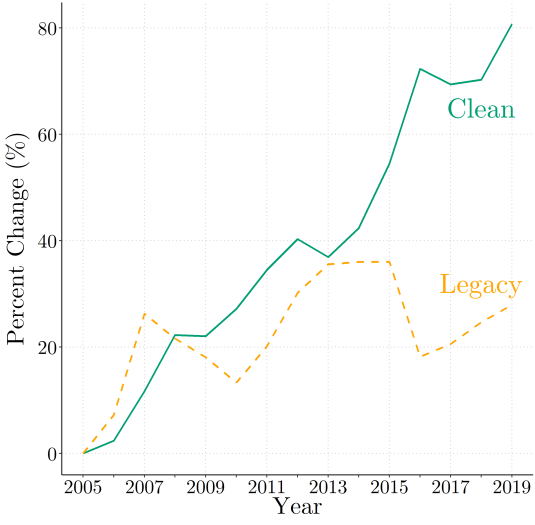
NAICS Codes Underestimate Clean Sector



United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

Employment Growth in Clean Sector Outpaces Legacy Sector



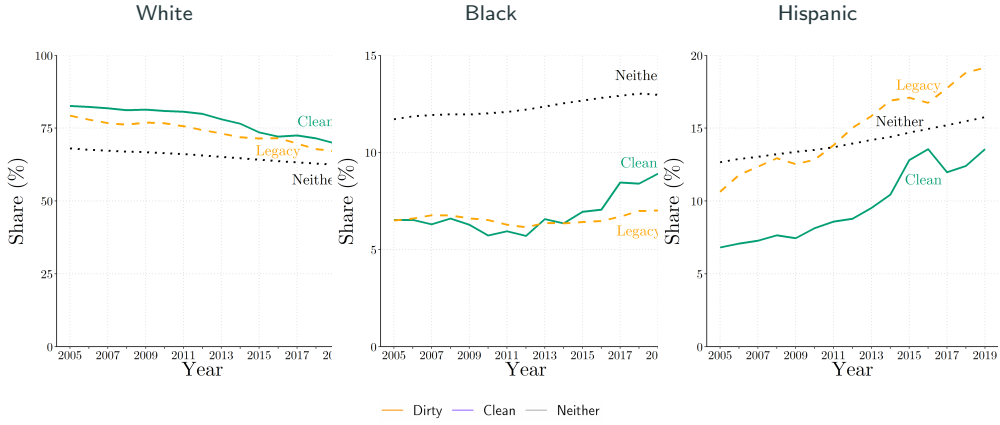
Clean: 79K $\rightarrow$ 143K. Legacy: 926K $\rightarrow$ 1.2M

Who works at clean and legacy establishments?

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

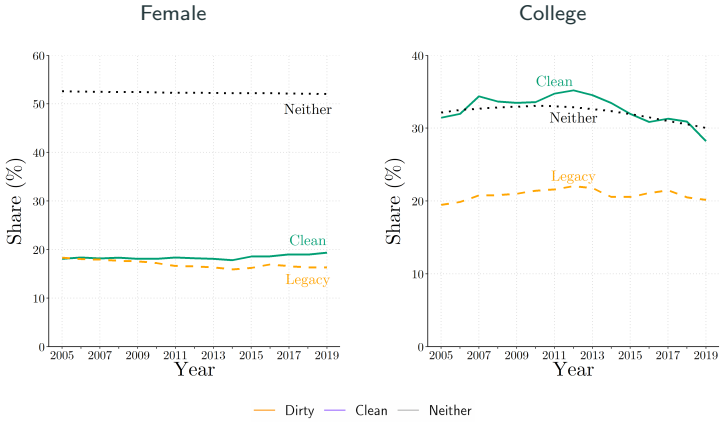
The Demographics at Clean and Legacy Establishments



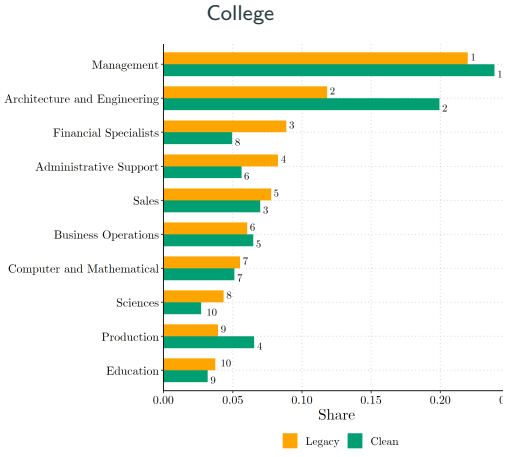
United States® Census Bureau

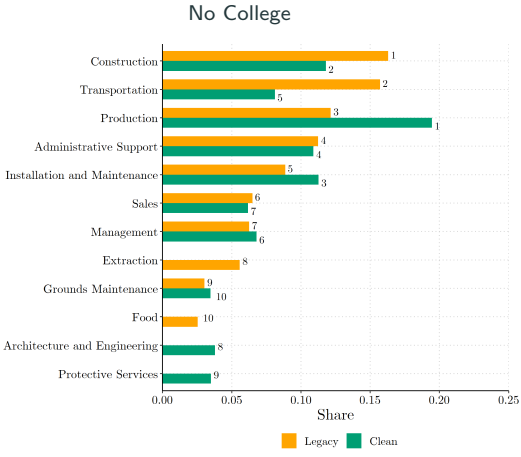
ENVIRONMENTAL INEQUALITY LAB

The Demographics at Clean and Legacy Establishments



The Occupations at Clean and Legacy Establishments





United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

How do Jobs at Clean and Legacy Establishments Compare?

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

Clean Jobs are High Wage, but Conditional Clean-Legacy Wage Gap is much Smaller

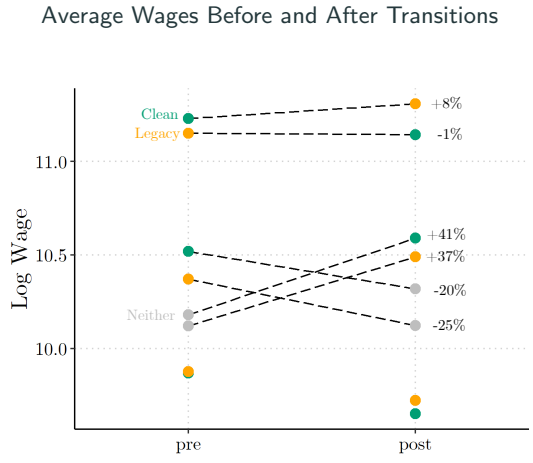
Regression of Log Wages

	(1)	(2)	(3)
Clean	0.162***	0.0296***	0.0247***
	(0.00405)	(0.00484)	(0.00448)
Neither	-0.617***	-0.584***	-0.309***
	(0.00172)	(0.00208)	(0.00140)
Observation	8,738,000	8,738,000	8,738,000
Year FEs	X	X	X
Individual Controls		X	X
Individual FEs			X

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

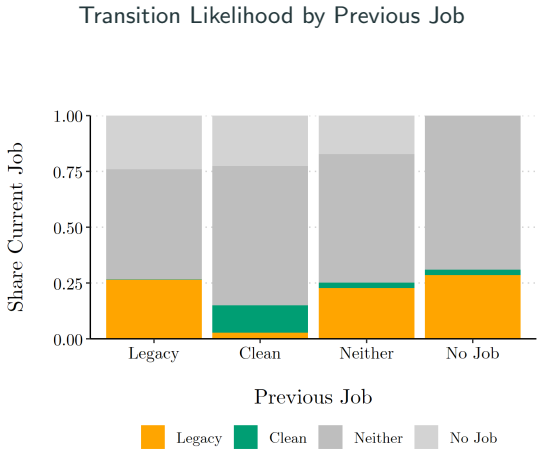
Transitions out of Clean or Legacy Employment are Costly



United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

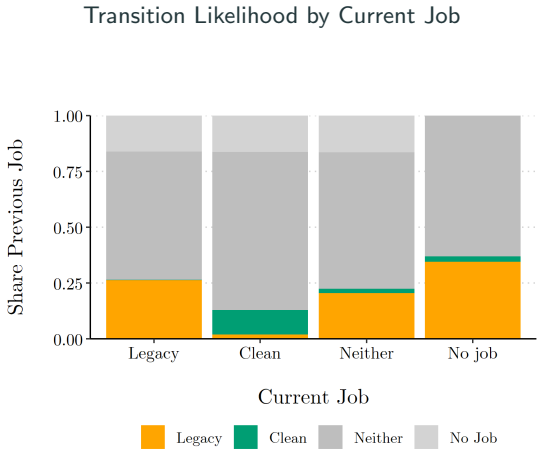
Transitions Between Clean and Legacy Employment are Rare



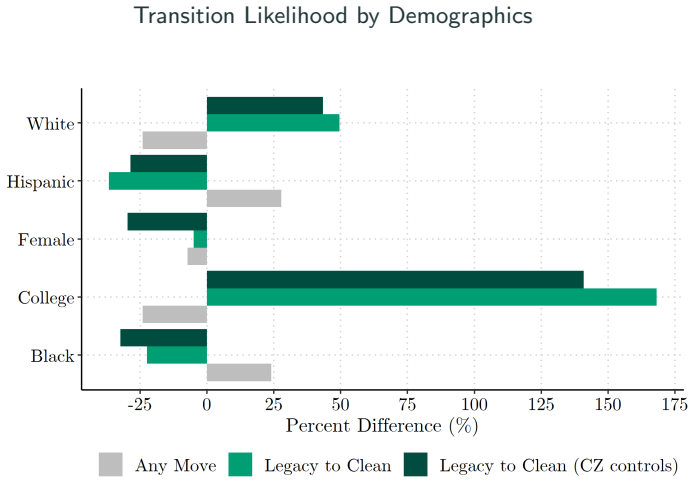
United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

Transitions Between Clean and Legacy Employment are Rare



Transitions Rates Vary by Demographics



United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

Taking Stock

- Clean Energy Jobs are high wage jobs, but not necessarily more so than legacy jobs (controlling for education)
- Transitions between legacy and clean jobs are rare
  - When they do occur, earnings stay $\approx$ the same, but transitions out of legacy to other sectors result in large earnings losses
  - More educated and white workers are more likely to transition from legacy to clean
- Additionally, occupational structure is quite different in Clean vs. Legacy establishments
- Together, these suggest the potential for large transitional costs as decarbonization proceeds

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

Aggregate trends in Clean and Legacy Business Formation

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

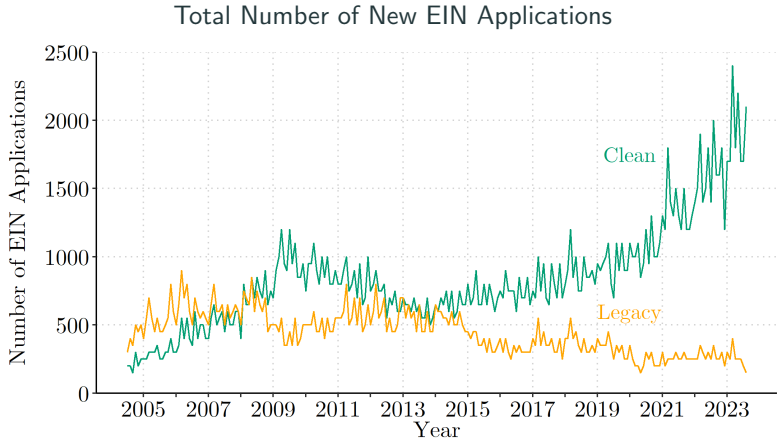
BFS Data

- Previous analysis is backward looking, but things are proceeding quickly now – what can Census data tell us in closer to real time?
- Census receives information on EIN applications from IRS (these underlying the Business Formation Statistics)
- Can we use these data to track new clean energy activity?
  - Need to be able to identify these firms, same NAICS code issues prevail
- We use similar text keyword analysis to identify clean energy EIN applications using their stated line of business description
- Since BFS is more frequent/current, we can also measure emerging activity
  - Important for industrial decarbonization: hydrogen, CCUS, etc

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

Applications for New Clean EINs are Growing

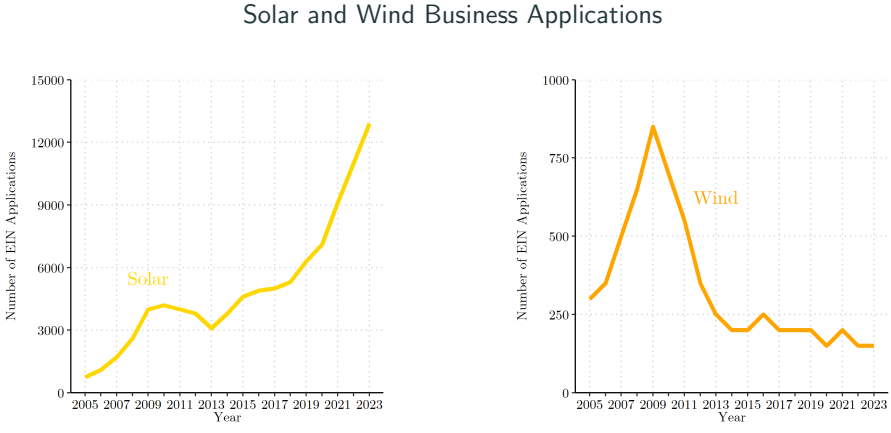


Source: Business Formation Statistics microdata

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

Solar Related Business Applications Have Soared, Wind Has Declined



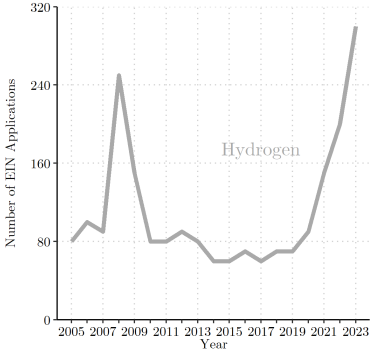
Source: Business Formation Statistics microdata

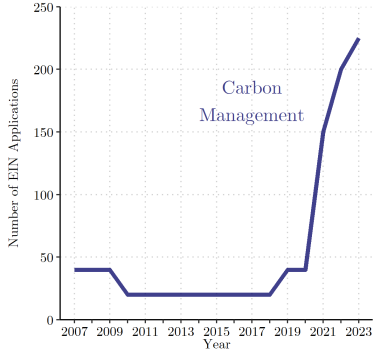
United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

Hydrogen and CCUS Business Applications Increased Dramatically After 2020

Hydrogen and Carbon Management Related Business Applications





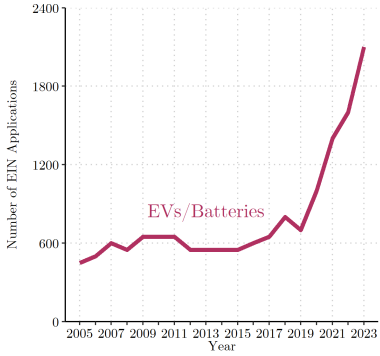
Source: Business Formation Statistics microdata

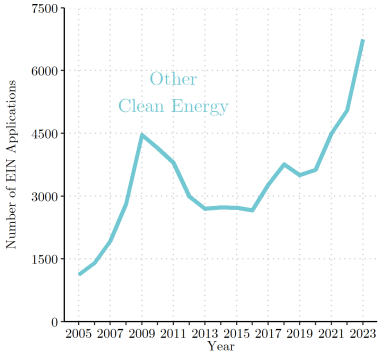
United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

EVs, Batteries and Other Clean Energy Applications Also Increased

EV/Batteries and Other Clean Energy Business Applications



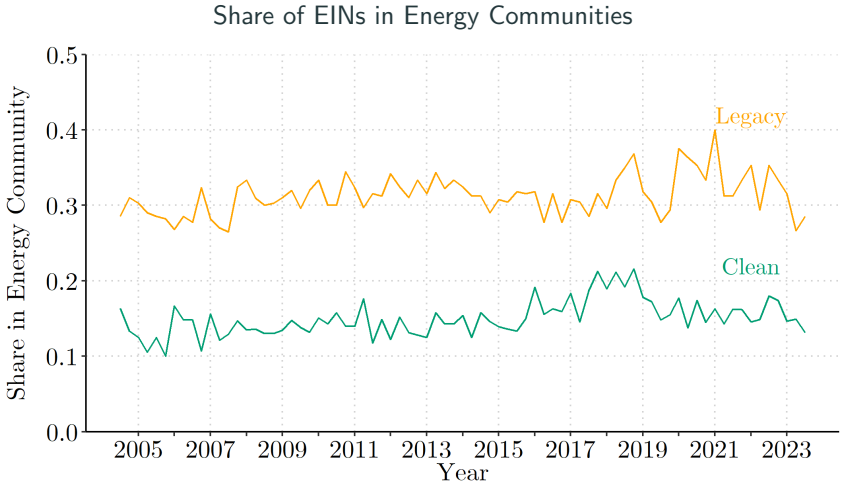


Source: Business Formation Statistics microdata

United States® Census Bureau

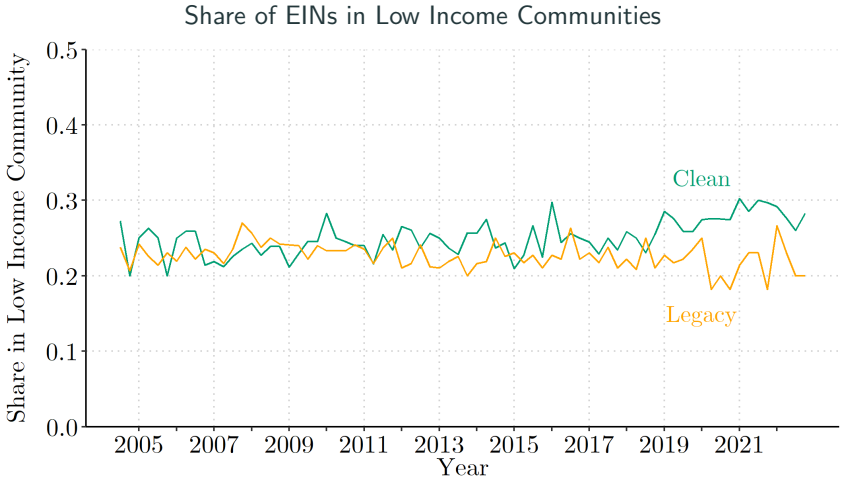
ENVIRONMENTAL INEQUALITY LAB

Legacy EINs are Disproportionately Likely to Locate in Energy Communities



Source: Business Formation Statistics microdata.

Legacy and Clean EINs are Equally Likely to Locate in Low Income Communities



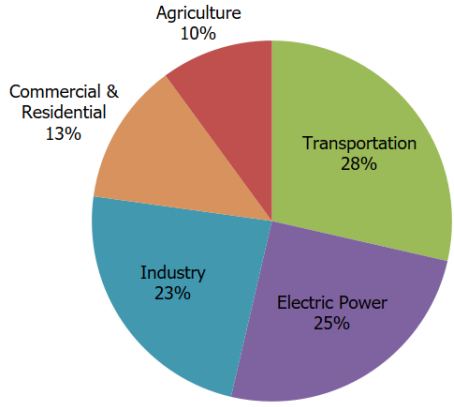
United States Census Bureau

ENVIRONMENTAL INEQUALITY LAB

Source: Business Formation Statistics microdata.
LIC definition from Vibrant Clean Energy (2022)

Where do we go from here?

- Our main approach using LBD/BR can capture most pathways for decarbonizing electricity generation
- Transportation can be partially captured (there is a NAICS code for battery manufacturing)
- What about harder to decarbonize sectors?
- Probably need more data + alternative approaches

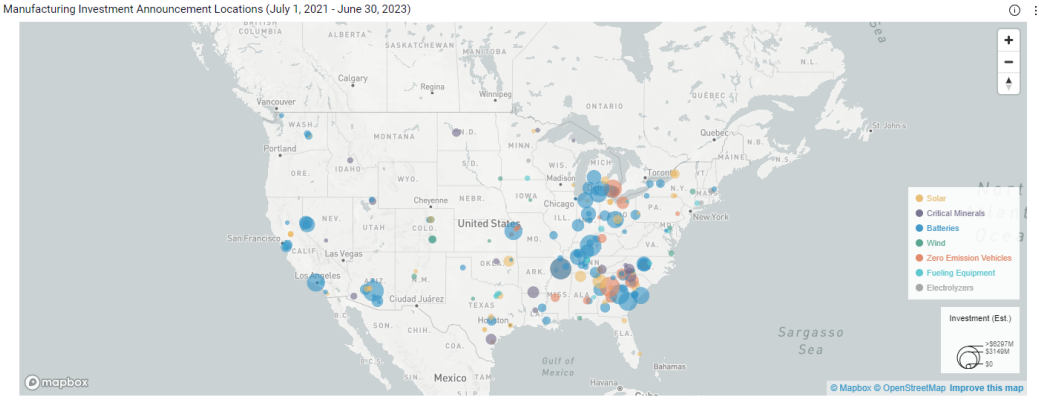


Source: EPA

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

Approach 1: Leverage Public Data Collection



Clean Investment Monitor Mapping from Rhodium Group and MIT CEEPR

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

Approach 2: New Data Collections or Acquisitions

- We broadly understand the potential pathways for decarbonizing industry + buildings
  - For buildings: electrify heating, cooling, cooking and water heating (e.g. heat pumps)
  - For industry: carbon capture, electrification, fuel/feedstock switching (e.g. using hydrogen)
- Could add content to, e.g. the Economic Census + annuals (ABS or AIES) on these decarbonization activities (on HH, ACS/AHS)
- The IRA and IIJA provide incentives through the tax code for many of these pathways
  - If we can get the administrative records related to these programs, can identify firms utilizing carbon capture (45Q credits), hydrogen (45V credits) as well as manufacturing of heat pumps and electrolyzers
- On HH side: permit data (or better information from third party housing data providers)?

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

Thanks!

Contact information: john.l.voorheis@census.gov

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB

Backup Material

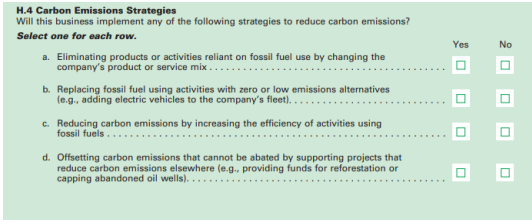
Legacy and Clean Energy Sector Classification

Legacy Activities		Clean Activities		Potentially Clean Activities	
Industry	Description	Industry	Description	Industry	Description
211120	Crude Petroleum Extraction	221111	Hydroelectric Power Generation	236118	Residential Remodelers
211130	Natural Gas Extraction	221113	Nuclear Electric Power Generation	237130	Power and Communication Line and Related Structures Construction
212111	Bituminous Coal and Lignite Surface Mining	221114	Electric Power Generation, Solar	238160	Roofing Contractors
212112	Bituminous Coal Underground Mining	221115	Electric Power Generation, Wind	238210	Electrical Contractors and Other Wiring Installation Contractors
212113	Anthracite Mining	221116	Geothermal Electric Power Generation	238220	Plumbing, Heating, and Air-Conditioning Contractors
213111	Drilling Oil and Gas Wells	221117	Biomass Electric Power Generation	238990	All Other Specialty Trade Contractors
213112	Support Activities for Oil and Gas Operations	335911	Storage Battery Manufacturing	334413	Semiconductor and Related Device Manufacturing
213113	Support Activities for Coal Mining			333611	Turbine and Turbine Generator Set Units Manufacturing
221112	Fossil Fuel Electric Power Generation			423690	Other Electronic Parts and Equipment Merchant Wholesalers
221210	Natural Gas Distribution			423720	Plumbing and Heating Equipment and Supplies
237120	Oil and Gas Pipeline and Related Structures Construction				(Hydronics) Merchant Wholesalers
324110	Petroleum Refineries			423730	Warm Air Heating and Air-Conditioning Equipment
423520	Coal and Other Mineral and Ore Merchant Wholesalers				and Supplies Merchant Wholesalers
424710	Petroleum Bulk Stations and Terminals			444190	Other Building Material Dealers
424720	Petroleum and Petroleum Products Merchant Wholesalers			454390	Other Direct Selling Establishments
454310	Fuel Dealers			541330	Engineering Services
486110	Pipeline Transportation of Crude Oil			541690	Other Scientific and Technical Consulting Services
486210	Pipeline Transportation of Natural Gas			811310	Commercial and Industrial Machinery and Equipment
486910	Pipeline Transportation of Refined Petroleum Products				(except Automotive and Electronic) Repair and Maintenance

United States® Census Bureau

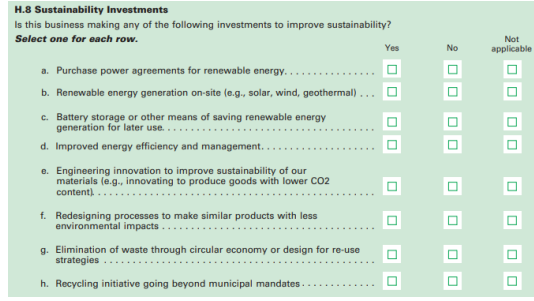
ENVIRONMENTAL INEQUALITY LAB

Example: Sustainability Content in the 2023 ABS



H.4 Carbon Emissions Strategies
Will this business implement any of the following strategies to reduce carbon emissions?
Select one for each row.

	Yes	No
a. Eliminating products or activities reliant on fossil fuel use by changing the company's product or service mix	☐	☐
b. Replacing fossil fuel using activities with zero or low emissions alternatives (e.g., adding electric vehicles to the company's fleet)	☐	☐
c. Reducing carbon emissions by increasing the efficiency of activities using fossil fuels	☐	☐
d. Offsetting carbon emissions that cannot be abated by supporting projects that reduce carbon emissions elsewhere (e.g., providing funds for reforestation or capping abandoned oil wells)	☐	☐



H.8 Sustainability Investments
Is this business making any of the following investments to improve sustainability?
Select one for each row.

	Yes	No	Not applicable
a. Purchase power agreements for renewable energy	☐	☐	☐
b. Renewable energy generation on-site (e.g., solar, wind, geothermal)	☐	☐	☐
c. Battery storage or other means of saving renewable energy generation for later use	☐	☐	☐
d. Improved energy efficiency and management	☐	☐	☐
e. Engineering innovation to improve sustainability of our materials (e.g., innovating to produce goods with lower CO2 content)	☐	☐	☐
f. Redesigning processes to make similar products with less environmental impacts	☐	☐	☐
g. Elimination of waste through circular economy or design for re-use strategies	☐	☐	☐
h. Recycling initiative going beyond municipal mandates	☐	☐	☐

Figure 4: Example Content from the 2023 Annual Business Survey

United States® Census Bureau

ENVIRONMENTAL INEQUALITY LAB