CENTREPOLIS Accelerator
at Lawrence Technological University

Michigan Commercial & Industrial GEOTHERMAL Market Assets, Gaps & Recommendations

EGLE Michigan Clean Energy Assets Roadmap Program

September 2022

FINAL DRAFT

Thanks to Our Partners

EGLE

MICHIGAN GEOTHERMAL ENERGY ASSOCIATION

Institute for Energy Innovation

GLREA
GREAT LAKES RENEWABLE ENERGY ASSOCIATION

Introduction

In the fall of 2022, the Michigan Energy Office (MEO) within the EGLE commissioned a study to support Governor Whitmer's administration's MI Healthy Climate Plan to reduce greenhouse gas emissions by 2050 and "illuminate the existing assets and gaps Michigan has in its renewable energy policies and its supply and value chains that may impact the further adoption of these clean energy technologies."

This report focuses on identifying the supply-side assets/gaps and demand-side impediments of Michigan's commercial and industrial (C&I)* geothermal** markets, as well as provide recommendations to improve the adoption of C&I geothermal.

Our aim is "to provide information critically needed by EGLE that will enable it to address policy, workforce development and value chain gaps impeding the adoption of clean energy resources and prohibiting the growth of manufacturing, developing projects, installing and servicing these resources."

** For this study, the definition of the "Commercial and Industrial" (C&I) sector includes commercial, industrial, large scale residential/multi-residential, agricultural, institutional, and governmental.*

*** In this report we focus on ground-sourced and water-sourced heat pump technologies and do not address air-sourced heat pump technologies.*

Report Outline

- Methodology
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- Michigan C&I Geothermal Market - Supply & Value Chains
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  - Assets
  - Gaps
- Michigan C&I Geothermal Market – Growth
  - Threats of Lagging C&I Geothermal Adoption
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- Recommendations to EGLE to Increase C&I Geothermal Adoption and and Accelerate SMM Decarbonization
- Supplement: Moving Forward! Envisioning Success

Methodology

Methodology

- Information and data inputs to this report are drawn from four sources:
  - Independent research and project partners
  - Qualitative interviews with 9 geothermal industry leaders and suppliers (January – February 2022)
  - Online *C&I Geothermal Supplier Survey* of 31 geothermal suppliers (May-June 2022)
  - In-person *C&I Geothermal Adoption Forum* of more than 16 C&I geothermal leaders, suppliers and buyers (June 21, 2022)
- C&I Geothermal companies that contributed to this report include:

Advanced Energy Group	Esemay LLC	SmithGroup
Airtech Equipment Inc	Geothermal Innovations Inc.	State of Michigan
Airtech Equipment Inc	GMB	Strategic Energy Solutions
Ameresco	IGSHPA	Superior Heating & Cooling, Inc
BBI	Lansing Community College	The Energy Alliance Group
Catalyst partners	Lean & Green Michigan	Thumb Electric Cooperative
Clark Construction	Mahlon Mechanical Services	TowerPinkster
Consumers Energy	Midwest Geothermal	Waterfurnace
Dandelion Energy	Occupant Care, Inc.	Wellconnect
DTE Eenrgy	RW Mead & Sons	Williams Distributing
Enertech	Salas O'Brien	Zeven Element Design Institute PLLC

Michigan C&I Geothermal Market – Demand

Michigan C&I Geothermal Market – Demand

- Growth
  - Geothermal works well in Michigan
  - Geothermal works well for C&I
  - C&I geothermal opportunities in Michigan

Geothermal Works Well In Michigan

- Geothermal systems use heat pumps and loops to extract heat from the air or the ground depending on if heating or cooling is needed. Geothermal system benefits include:
  - Improves efficiencies by 5x or more compared to NG
  - Integrates separate heating/cooling into one system
  - Greater efficiencies → reduce summer peak load demand
  - Reduces/eliminates need for natural gas, propane, and fuel oil
  - Lowers overall carbon footprint + delivers carbon free heating/cooling when powered by solar or wind
- Michigan's four-season climate and ample water balance heating/cooling loads and reduce costs
- Michigan has a vibrant geothermal supply chain & support ecosystem
  - Michigan has ~40,000 geothermal installs (Source: Geothermal Exchange Organization)
  - Michigan early adopters include electric co-ops & "green" communities
  - Michigan's supply chain includes multiple experienced engineers, contractors and loop installers
  - The Michigan Geothermal Energy Association (MGEA) is a regional leader
    - Great Lakes Renewable Energy Association (GLREA) and Michigan Energy Innovation Business Council (Michigan EIBC) support Michigan's geothermal ecosystem as well
  - Compared to some other states, Michigan has reasonable state guidelines for loops & bore holes

Source: C&I Geothermal Supplier Interviews

Geothermal Works Well for C&I

- Geothermal opportunities for C&I are very significant
- For C&I, geothermal advantages include:
  - Delivers more efficient & less expensive cooling
    - Lower operational HVAC and life cycle costs, especially for cooling
      - Conventional cooling equipment like cooling towers more regular cleaning, treatment & maintenance
  - Reduces consumption of natural gas or propane costs used for heating and cooling
  - Increases comfort
  - Reduces peak demand loading in summer
  - Saves space as the heatpump integrates otherwise separate heating and cooling appliances
  - Geothermal provides a way to immediately reduce carbon footprint
  - Unlike conventional chiller systems, geothermal heat pumps have no harmful refrigerant chemicals
  - Expansion into water heating and other diverse heating/cool load applications
  - Practical invisibility
  - An energy solution that works 24/7/365 for 25 to 50+ years straight
  - Support by a robust geothermal supply chain and ecosystem

Source: C&I Geothermal Supplier Interviews

Geothermal Works Well for C&I

- Geothermal provides C&I users with significant lifecycle costs savings over time:
  - Geothermal systems can be sized to eliminate natural gas/propane for heating, and significantly reduce electrical costs for cooling
  - Geothermal systems have significantly lower HVAC maintenance/replacement costs compared to conventional HVAC systems
    - Geothermal loops last 25-50 years or longer, compared to ~15 years for conventional HVAC systems
    - Geothermal heat pumps are lower maintenance costs than conventional HVAC systems
  - Federal tax credits will increase to at least 30% in 2023 for most commercial buildings, significantly improving system ROI
    - Other incentives that C&I entities can apply for include the 179D tax credit
- Geothermal projects are often is most cost-effectively for C&I applications when the project:
  - Is new construction
  - Has ready access to land (ground source) or water (water sourced)
  - Is well designed with right-sized loops that effectively balance heating and cooling loads
  - Offsets significant natural gas/propane costs for cooling and heating
  - Benefits from tax credits, rebates and/or favorable electrical rates
  - Enables the C&I customer to lower demand charges, especially in the summer

Source: C&I Geothermal Supplier Interviews

C&I Geothermal Opportunities in Michigan

- C&I sectors using geothermal include …
  - Educational
  - Government/municipal
  - Large residential
  - Commercial
  - Industrial
  - Agricultural

- Commercial options include:
  - Auto dealerships
  - Hotels
  - Office buildings
  - Residential/multi-family developments
  - Big box stores
  - Data centers
  - Sports facilities
  - Medical centers
  - Houses of worship

- Industrials with heat & large cooling needs such as:
  - Dairies
  - Operations w/ metal treatment
  - Nurseries/greenhouses
  - Food processing
  - Power plants
  - Mines

Source: C&I Geothermal Supplier Interviews

C&I Geothermal Examples in Michigan

- Public Sector Examples:
  - State of Michigan Capitol
  - US 75 visitor centers
  - Lansing Community College – West Campus
  - Monroe Community College
  - University of Michigan
  - City of Wyandotte
  - East Lansing Schools
  - Midland City Jail
  - Ann Arbor Public Schools
- Private Sector Examples:
  - Meijer
  - Coveyou Farm Market
  - McDonalds (Westland)
  - Elzinga & Hoeksema Greenhouse (Portage)
  - La Fontaine Auto
  - NLB Pump (Wixom)

Source: C&I Geothermal Supplier Interviews; C&I Geothermal Adoption Forum

Michigan C&I Geothermal - Demand

- Impediments
  - Geothermal lacks effective education & promotion
  - Geothermal up-front economics can be challenging
  - Other challenges
  - Most significant barriers to growth (From C&I Geothermal Supplier Survey)
  - Most significant barriers to growth (From C&I Geothermal Adoption Forum)

Geothermal Lacks Effective Education & Promotion

- Geothermal is not effectively promoted in Michigan
  - Buyers/users cannot see geothermal, which can make it harder to promote
    - Geothermal is underground, putting it effectively ”out of sight - out of mind.”
  - The architecture, engineering and building markets are “undereducated” about geothermal
    - Only a handful of architects, engineers and contractors are familiar with, experienced with or certified for geothermal
  - Geothermal is easy for architects/owners to overlook
    - The overall geothermal market is very small (2% of building HVAC market
    - Geothermal’s reputation for some is tainted by instances of poorly designed/installed systems
    - The geothermal industry marketing is focused on homes, not the C&I market
  - In interviews, several contractors relayed stories when geothermal energy savings projections were discounted because building managers considered them to be “too good to be true”
- Geothermal systems are complex to engineer properly, and loops require training to install correctly
  - Designs must fit different needs in different conditions
  - Early new/retrofit design discussions usually do not include geothermal contractors
- Of note, geothermal is aggressively promoted in states such as New York and Massachusetts, which have natural gas infrastructures that are older and slowly failing

Source: C&I Geothermal Supplier Interviews

Geothermal Up-Front Economics Can Be Challenging

- Building owners ideally have a life cycle viewpoint that incorporates the long-term benefits of geothermal
  - Unlike solar, C&I geothermal is hard to fit into a “standard” financing model
- Upfront geothermal project costs are higher compared to conventional HVAC designs
  - While internal HVAC/Heat pump costs for geothermal systems are on par with conventional HVAC, upfront costs for the external geothermal loop add additional project costs
  - Geothermal project cost also increase as utilities charge additional fees to add new meters for heat pumps
- , Michigan financing options are limited
  - Michigan utilities do not provide incentives for installs that “switch” fuels away from natural gas (P.A. 342)
  - Michigan Saves commercial lending terms are not long enough, and PACE financing is cumbersome and costly

Source: C&I Geothermal Supplier Interviews

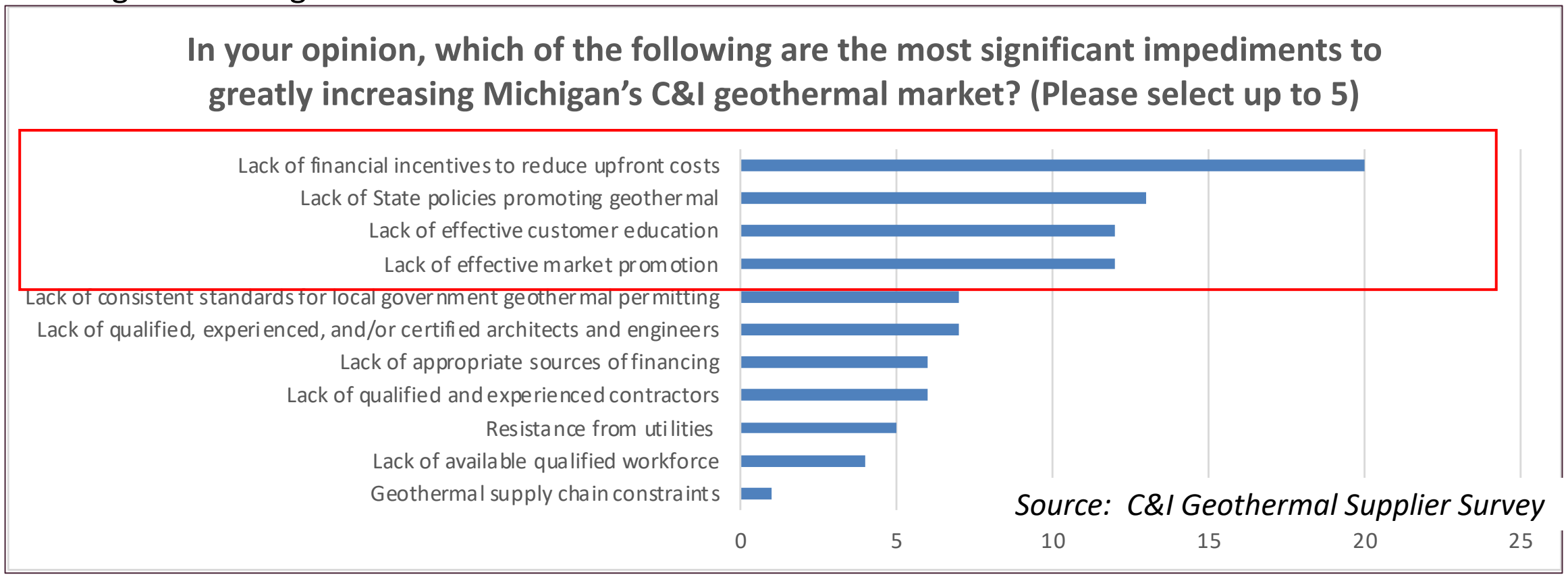
Other Challenges

- Michigan has a relatively small C&I new construction market and a large C&I retrofit market
  - Geothermal costs for new construction are often lower than for retrofit construction
- Local units of government can be inconsistent with local permitting procedures & costs
  - Several geothermal contractors reported that sometime localities, especially those with water table/aquifer concerns, require more analysis and need more time for permitting
- Utility reviews of geothermal projects can reportedly take a long time and be expensive
  - Utility reviews can take longer than necessary because they are based on older geothermal designs rather than newer more efficient geothermal system designs

Source: C&I Geothermal Supplier Interviews

Most Significant Barriers to C&I Geothermal Growth
(From Supplier Survey Rankings)*

- Lack of financial incentives, state policies, customer education & market promotion most constrain C&I geothermal growth



Most Significant Barriers to C&I Geothermal Growth
(From Supplier Forum Rankings)

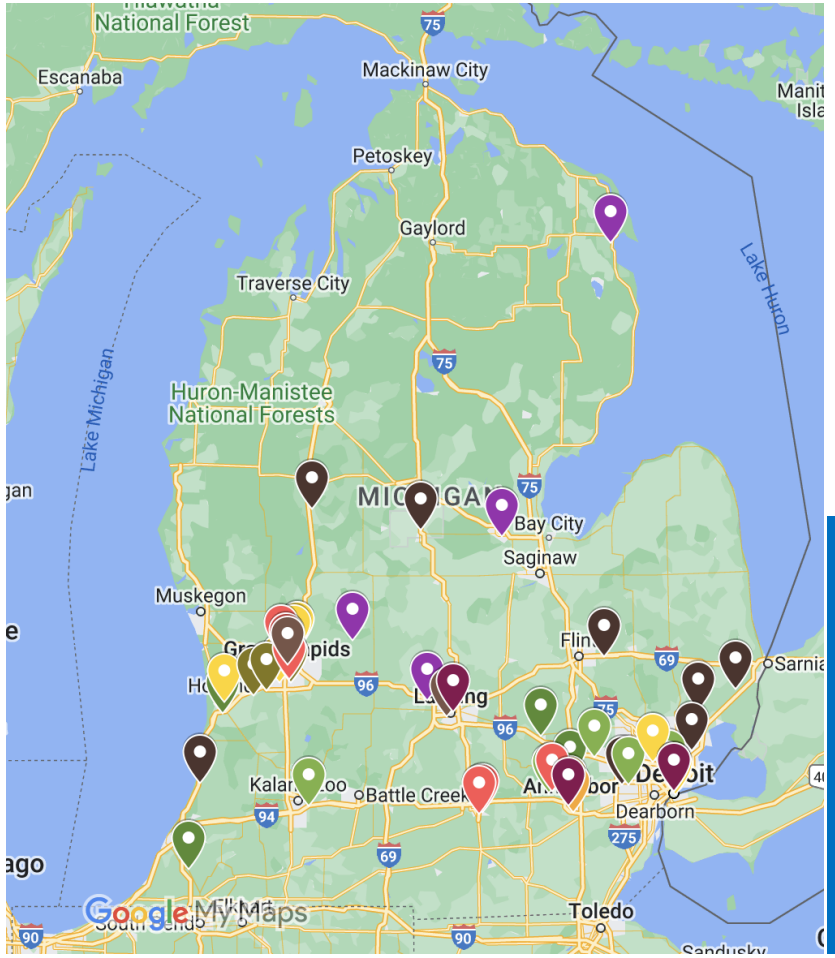
- Financing constraints, market awareness and state policies most constrain C&I Geothermal Growth
  - **Financing** Constraints (36 "votes")
    - Lack of financial incentives to reduce upfront costs
    - Lack of consistent knowledge about & recognized pay back model for geothermal
    - Existing financial models undervalue geothermal opportunities
    - Lack of appropriate sources of financing
    - Low natural gas prices in Michigan
  - **Market Awareness** Constraints (24 "votes")
    - Lack of effective customer education
    - Lack of effective market promotion
    - Lack of education about tax incentives
  - **State Policy** Constraints (19 "votes")
    - Lack of State policies promoting geo
    - Chemicals, fuel switching, energy codes
    - Resistance from utilities
    - Lack of consistent carbon pricing

Source: C&I Geothermal Adoption Forum

Michigan C&I Geothermal Market – Supply & Value Chains

- Assets
  - Geothermal Supply Chain - Manufacturing
  - C&I Solar Value Chain
- Gaps & Suggestions
  - Supply chain & value chain gaps
  - Suggestions to improve Michigan solar supply chain

Michigan C&I Geothermal Supply Chain



Michigan Manufacturers of Geothermal System Materials, Components & Systems

Dow Chemical	Chemicals	Midland
Geothermal Innovations	Geo systems	Auburn Hills
Michigan Poly Pipe	HDPE Pipes	Grand Ledge
Robroy Enclosures	Enclosures	Belding
Well Connect GEO	Water-based Geo	Alpena

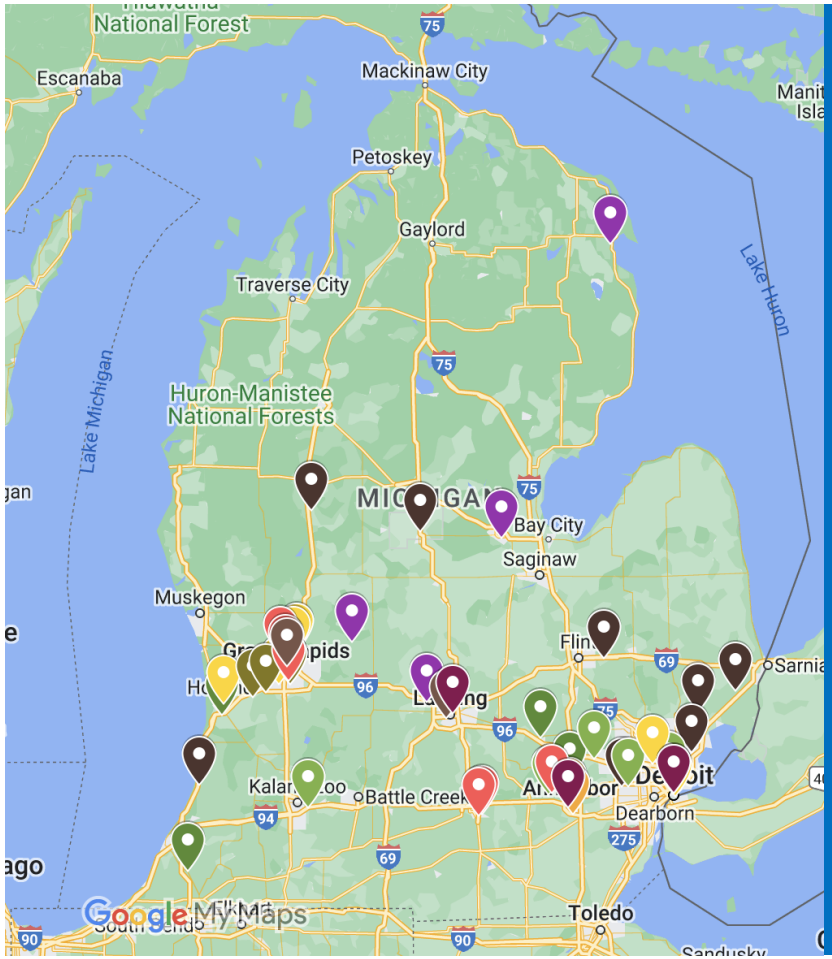
- Pipes
- Chemicals
- Enclosures
- Drillers

Most problematic supply chain challenges *

- ✓ Long lead times
- ✓ Motors & VFDs
- ✓ Finding qualified drillers & geothermal system installers

* Based on Survey inputs to date

Michigan C&I Geothermal Value Chain



- Construction
- Contractors
- Distributors
- Drillers
- Engineers & Consultants
- Financiers

Michigan C&I Geothermal-Specific Include

Architects & Engineering

Architedtural Resource	Ann Arbor
DFD Architecture	Spring Lake
GMB	Grand Rapids
Comprehensive Engineering	Grand Rapids
Strategic Energy Solutions	Ferndale
Hooker DeJong AE	Grand Rapids
Progressive AE	Grand Rapids
E3M Engineering	Wyoming
Zedi Consulting	Grand Rapids
TowerPinkster	Grand Rapids
SmithGroup	Detroit
Catalyst Partners	Wyoming
Integrated Architecture	Grand Rapids

Construction

Clark Construction	Lansing
Christman Constructors	Detroit
Owen Ames Kimball	Grand Rapids

Distributors

Michign Pipe and Valve	jackson
Process Engineering & Equipment	Grand Rapids
CMR Mechanical	Dexter
Williams Distributing	Grand Rapids
Airtech Equipment	Wyoming
Heat Controller	Jackson

Drillers

Custom Trenching Inc.	Zeeland
Midwest Geothermal	Grand Rapids
StraightLine Directional Drilling	Hudsonville

Financing

Lean and Green Michigan	Detroit
Michigan Saves	Lansing
The Energy Alliance Group	Ann Arbor

Michigan C&I Geothermal Contactors Include

Geothermal Specialists

Geothermal Innovations	Howell
G.H.P. Systems Heating & Cooling	Holland
Michigan Energy Services	Whitmore Lake
WaterFurnace Michiana	Barrien Springs

Renewable Energy Specialists

Advanced Energy Group	Ann Arbor
New Energy Solutions, LLC	Milford
SUR Energy	Ann Arbor

HVAC Contractors

Cappy Heating and Air Conditioning	Livonia
Executive Heating & Cooling	Ray
Haven Heating and Air Conditioning	South Haven
Holland Heating and Cooling	Davison
R. W. Mead	Fraser
Stratz Heating & Cooling, Inc.	Big Rapids
Superior Heating & Cooling, Inc	Columbus
Walton Heating & Cooling, Inc.	Mount Pleasant

Mechanical Contractors

RW La Pine	Kalamazoo
Behler Young	Livonia
Haley Mechanical	Dexter
John E. Green	Highland Park
Mahlon Mechanical	Grand Rapids

C&I Geothermal Supplier Supply & Value Chain

Weaknesses & Gaps

- Problematic Perceptions
  - Customers … “unaware” and “too expensive”
  - Engineers … “reluctant to try something different”
  - Customers and engineers … “focused on short term paybacks”
- Supply constraints & long lead times
  - Pipe prices
  - Lack of resin
  - Freight costs
  - Delayed deliveries
- Unqualified installers
- Inconsistent codes
- Small market → few qualified & available contractors/drillers

Offered Solutions

- Foster more geothermal installation opportunities
- Promote geothermal case studies
  - Use trusted sources
- Greater state leadership in promoting geothermal
  - Look at New York
- Apply consistent standards ‘
  - ANSI, CSA, and IGSHPA standard C448
- Improve upfront geothermal project financing
- Promote centralized loops in high-density areas
- Promote private sector/municipal loop ownership

Source: Michigan C&I Geothermal Supplier Survey

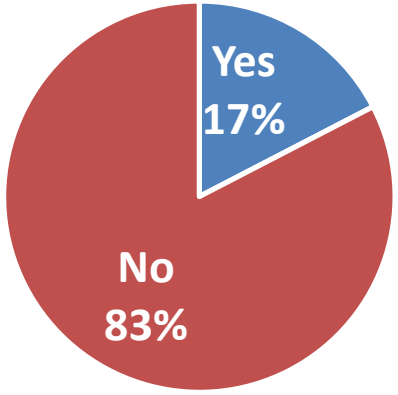
Michigan C&I Geothermal Market – Workforce

Michigan Geothermal Market - Workforce

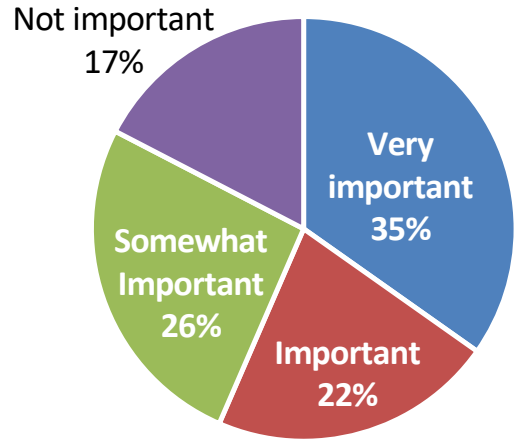
- Supplier Sentiments
- Michigan Schools providing solar workforce training
- Suggestions to improve Michigan's workforce infrastructure

Geothermal Supplier Sentiments

Are you aware of Michigan-based geothermal education and training resources for your employees? (n=23)



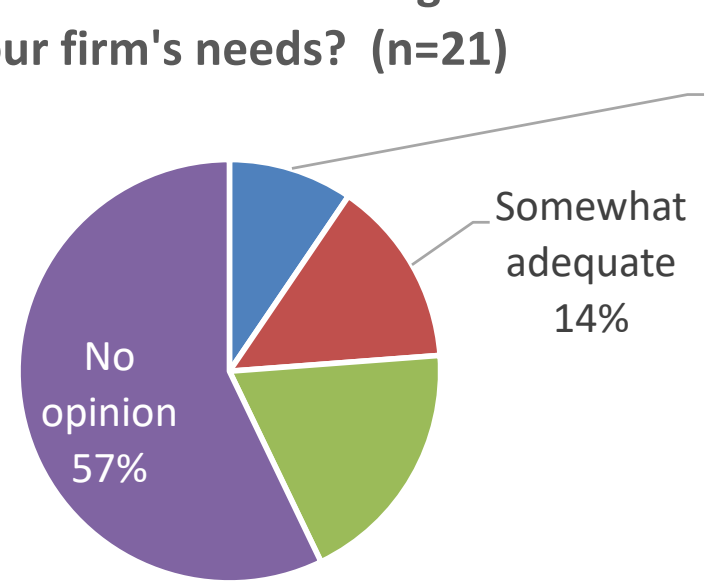
When hiring, how important is it for candidates to have relevant certificates or degrees? (n=23)



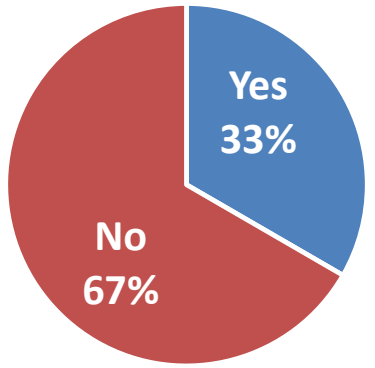
Source: Michigan C&I Solar Supplier Survey

Geothermal Supplier Sentiments

How adequate are Michigan's geothermal education and workforce training resources for your firm's needs? (n=21)



Do Michigan workforce education/training gaps or weaknesses hinder your firm's ability to provide more C&I geothermal solutions? (n=21)



Source: Michigan C&I Solar Supplier Survey

Workforce Infrastructure – MI Schools Providing Geothermal Workforce Training

Dorsey College
Ferris State*
Grand Rapids CC
Grand Valley State
Henry Ford CC
Jackson CC
Kirkland CC
Lansing CC
Macomb CC
MIAT College of Techn.
Michigan State Univ.
Michigan Tech Univ.
Mid-Michigan CC*
Monroe CC
Mott CC
Oakland CC
Oakland University
University of Michigan
Washtenaw CC
Wayne County CC
Wayne State University
Western Michigan Univ.

* Geo specific options

= Schools participants have worked with

Source: C&I Geothermal Adoption Forum

MI Schools: Geothermal Workforce Training

Dorsey College www.dorsey.edu	**HVAC Systems Technician training program** https://www.dorsey.edu/hvac/
Ferris State, Big Rapids www.ferris.edu	**Geothermal Energy for the Home Certification Program** Center for Certification Training & Testing cfc@ferris.edu
Grand Rapids Community College www.grcc.edu	**Heating, Ventilation, and Air Conditioning/Refrigeration Technology Certificate** https://catalog.grcc.edu/preview_degree_planner.php?catoid=18&poid=3275 (one relevant course)
Grand Valley State Univ www.gvsu.edu	Peter Wampler Professor, Geology wamplerp@gvsu.edu
Henry Ford Community College www.hfcc.edu	**Energy Technology - HVAC Associate in Applied Science** https://catalog.hfcc.edu/programs/energy-technology-hvac-aas (multiple relevant courses, possibly other programs)
Jackson Community College www.jccmi.edu	**Environmental Science – Certificate** https://www.jccmi.edu/degree/environmental-science-certificate/
Kirtland Community College www.kirtland.edu	**Facility And Energy Management Degrees** https://www.kirtland.edu/programs-we-offer/facility-and-energy-management-degrees/
Lansing Community College www.lcc.edu	**Study Energy Management at LCC** https://www.lcc.edu/academics/areas-of-study/computers-engineering-technology/hvac/study-energy-management.html **Heating, Ventilating and Air Conditioning Technology** https://www.lcc.edu/academics/areas-of-study/computers-engineering-technology/hvac/index.html
Macomb Community College www.macomb.edu/	**Renewable Energy Technology Certificate** https://www.macomb.edu/resources/viewbook/attachments/CT-Renewable-Energy-Technology.pdf
MIAT College of Technology www.miat.edu	**Energy Technology Programs** https://miat.edu/programs/energy/

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Michigan Technological Univ www.mtu.edu	Zhen Liu Associate Professor, Civil, Environmental, and Geospatial Engineering zhenl@mtu.edu 906-487-1826
Mid Michigan Community College www.midmich.edu	**Geothermal Technology Advanced Credential** https://www.midmich.edu/pathways/geothermal-technology/
Monroe County Community College www.monroeccc.edu	**Renewable Energy Technology** https://www.monroeccc.edu/programs/renewable-energy-technology
Mott Community College www.mcc.edu	**Introduction to Renewable Energy Tech. Technology** https://catalog.mcc.edu/preview_course_nopop.php?catoid=13&coid=56956
Oakland Community College www.oaklandcc.edu	**HVAC/R Systems Technology** http://catalog.oaklandcc.edu/programs/hvacr-systems-technology/ (some clean energy classes, but hard to find in site)
Oakland Univ www. oakland.edu	Jonathan Maisonneuve Assistant Professor, Mechanical Engineering maisonneuve@oakland.edu 248-370-2185
Univ of Michigan, Ann Arbor www.umich.edu	Gregory A. Keoleian Professor gregak@umich.edu
Washtenaw Community College	**Heating, Ventilation, Air Conditioning and Refrigeration (APHVCR)** https://catalog.wccnet.edu/current/programs/aphvcr.php
Wayne County Community College www.wcccd.edu	**Renewable Energy Technology program** https://www.wcccd.edu/academic/pdfs/programs/Renewable%20Energy.pdf
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Supplier Workforce/Educational Gaps That Hinder C&I Geothermal Success

- Lack of acceptance and promotion of geothermal
  - State level
  - Utility level
  - Among building owners
- Lack of knowledge about geothermal
  - What geothermal actually is
  - Geothermal costs and benefits
- Lack of training at key levels of the supply chain
  - Residential, C&I and mechanical contractors - on the benefits of geothermal
  - Code officials
  - Loop installers/drillers

Source: Michigan C&I Solar Supplier Survey

Suggestions for Michigan to Better Meet C&I Geothermal Workforce Needs

- Generate more demand for geothermal solutions
  - Commit at the state level to a long-term promotion of geothermal options
  - Provide easier access to geothermal projects for contractors to bid on
  - Require geothermal and energy load calculations for new and replacement construction and plan reviews
- Improve geothermal educational infrastructure and tools
  - Help geothermal system employers find more qualified, teachable employees
  - Partner with Community Colleges
  - Simplify education around geothermal technologies
  - Provide training programs and certifications through partnerships with MGEA and IGSHPA
  - Teach HVAC dealers to do energy costs via a Geo Designer program for accurate fossil fuel comparisons

Source: Michigan C&I Solar Supplier Survey

More Michigan C&I Geothermal Sales → More Jobs

Number of New Jobs If Your Firm's C&I Geothermal Sales Double*

No new jobs	25%
1-10 new jobs	62%
11-25 new jobs	13%
26-50 new jobs	- %
50+ new jobs	- %

* C&I Geothermal Adoption Forum ; n=28

Number of New Jobs If Your Firm's C&I Geothermal Sales Are 10 Times Greater Than Current Sales*

No new jobs	-
1-10 new jobs	55%
11-25 new jobs	11%
26-50 new jobs	34%
50-99 new jobs	- %
100+ new jobs	- %

* C&I Geothermal Adoption Forum; n=9

<u>More C&I Geothermal → More Jobs</u>

With more than 40 Michigan firms involved with C&I geothermal:

Doubling Michigan C&I geothermal may generate scores of new jobs.
Growing C&I geothermal demand by 10x could add hundreds more jobs.

Source: C&I Geothermal Adoption Forum

Michigan C&I Geothermal Market – Growth

Michigan C&I Geothermal Market – Growth

- Threats of Lagging C&I Geothermal Adoption
  - Michigan loses its geothermal supplier ecosystem
  - Slower geothermal adoption further strains grid and decarbonization goals

Michigan Loses Its Geothermal Suppler Ecosystem

- Geothermal markets are taking off elsewhere …
  - New England, New York, and New Jersey
    - Deteriorating gas infrastructure → Significant rebates, serious policies and even moratoriums to reduce gas usage and gas line extensions
  - Texas: Selling geothermal as “Free Cooling”
  - Canada: Serious regulations, standards, incentives and financing
  - Seattle: Climate goals → Has banned natural gas for new buildings
- … Michigan talent/capabilities is pulled to other states
  - Michigan’s C&I geothermal companies are doing more and more work outside of Michigan

Source: C&I Geothermal Supplier Interviews

Slower Adoption Further Strains Grid & Decarbonization Goals

- Michigan's grid is increasingly under strain
  - Michigan's utilities have higher costs/more outages than comparable Midwest utilities
  - EV's will further increase stress on Michigan's grid, further increasing outages and upgrade costs
    - Note: Widespread adoption of air-sourced heat pumps rather than ground/water sourced systems will also increase grid strain
- Geothermal is grid-friendly
  - Geothermal improves HVAC efficiencies
    - Electrified geothermal can provide 5x and greater heating efficiencies compared to natural gas or propane
    - Results in lower electric facility chilling costs
      - Creates a flatter electrical load that reduces peak demand, especially during the summer
- Slower adoption forgoes very significant opportunities to offset C&I natural gas carbon emissions
  - The C&I sector consumes ~33% of Michigan's natural gas consumption (US Energy Information Agency)
    - Note: The residential and power sectors also each consume ~1/3 of natural gas usage in Michigan in 2020
  - Michigan policies and utility IRPs do not currently envision a significant role for geothermal

Source: C&I Geothermal Supplier Interviews

Michigan C&I Geothermal Market – Growth

- Growth Paths
  - Most significant geothermal supplier needs
  - Ranked suggestions to spur C&I geothermal market growth
  - Recommendations to EGLE to increase C&* geothermal adoption

Firm's Biggest Need Today for More C&I Solar Success?

Question: Your geothermal firm's biggest need today for more C&I geothermal success?

C&I Geothermal Adoption Survey (n=27)

More …	Rank
▪ Customers	1
▪ Marketing	2
▪ Qualified employees	3
▪ Partners	3
▪ Energy Industry Connections	4
▪ Capital	6

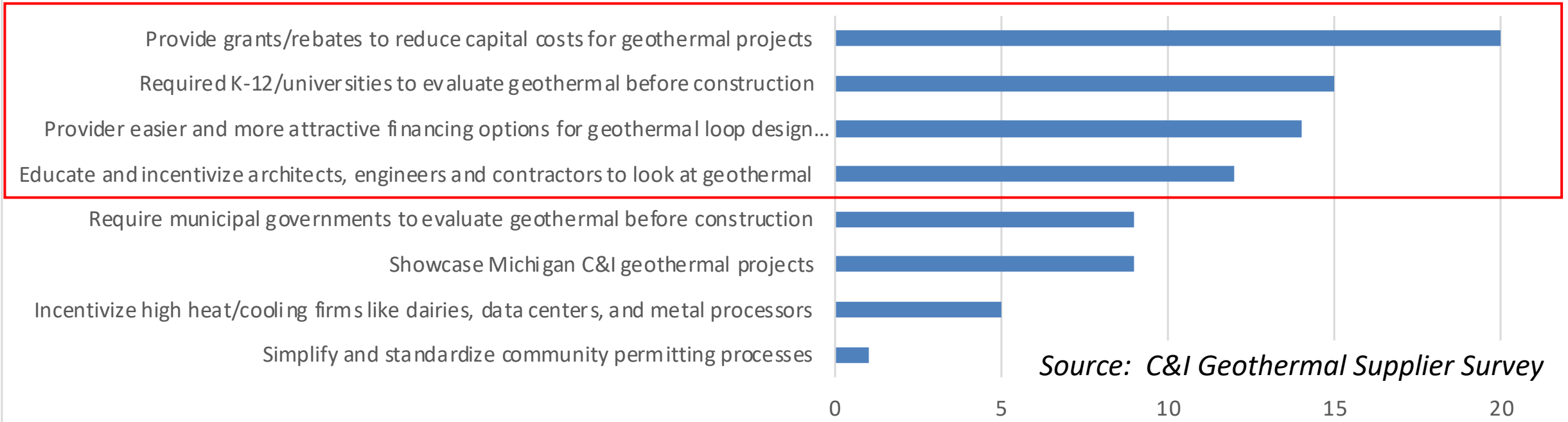
C&I Geothermal Convening

Better/More …	%
▪ Customers	75%
▪ Better tax incentives	25%
▪ Customers	-
▪ Suppliers	-
▪ Energy Industry Connections	-
▪ Partners	-
▪ Capital	-

Financing incentives, favorable state policies, and architect/engineers/contractor education and incentives would most boost C&I Geothermal Growth

(Supplier Survey Rankings)*

Which of the following suggestions would you most urge the State to consider to boost C&I geothermal adoption in Michigan? (Select four).



Source: C&I Geothermal Supplier Survey

Ranked Suggestions to Spur C&I Geothermal Growth

- **Make State Policies More Geo-Friendly** (35 "votes")
  - Build geothermal readiness into commercial building codes
  - Incentivize end-users to decarbonize heating/cooling
  - Required K-12/universities to evaluate geothermal before construction
  - Incentivize high heat/cooling industrial firms such as dairies, data centers, and metal processors to look at geothermal
  - Simplify and standardize community permitting processes
  - Require municipal governments to evaluate geothermal before construction
- **Reduce Financial Hurdles** (30)
  - Promote contracts, firms and utilities that "utilitize" geo loops to build district scale loops and/or get to positive cash flow (through PPAs and equivalents)
  - Provider easier & more attractive financing options for geothermal loop design and installation
  - Standardize geothermal contracts/models so they are recognized by institutions
  - Provide grants/rebates to reduce capital costs for geothermal projects
- **Increase & Improve Geo Education/Marketing** (26)
  - Educate State of Michigan about geothermal
  - Educate consumers about how/why geo works (and heat pumps too)… "eco-bling"
  - Educate and incentivize architects, engineers and contractors to look at geothermal
  - Showcase Michigan C&I geothermal projects

Source: C&I Geothermal Adoption Forum

Recommendations to EGLE to Increase C&I Geothermal Adoption and Accelerate SMM Decarbonization

Recommendations for EGLE to Increase C&I Geothermal Adoption

- Promote geothermal!
  - Elevate geothermal at EGLE/State government as a proven carbon-reducing heating/cooling technology
    - Integrate into the MI Healthy Climate plan and relevant state office directives
    - Provide comparable levels of exposure to solar; include geothermal with other electrification solutions
  - Require K-12, universities, state/municipal governments to evaluate geothermal before construction
  - Support efforts by Michigan Geothermal Energy Association and Great Lakes Renewable Energy Association to raise awareness about and highlight the benefits of geothermal among:
    - General public
    - Architects, engineers and contractors
    - Building owners and managers
    - Market sectors with high heating/cooling loads
  - Showcase State of Michigan geothermal projects
  - Help municipalities and townships simplify and standardize geothermal project permitting
  - Encourage the adoption of “geothermal readiness” into building codes
  - Seek supplier feedback for EGLE about future C&I geothermal priorities, funding, and programs
- Encourage and incentivize geothermal and building energy engineering firms partner to integrate energy efficiency steps to reduce overall HVAC load along with geothermal projects
  - Promote EE + geothermal C&I success stories

Recommendations for EGLE to Increase C&I Geothermal Adoption

- Advocate for Michigan utilities to increase/broaden financial incentives for geothermal projects
  - Advocate for clarifying language (P.A. 342) to ensure utilities are eligible for energy waste reduction incentives for switching from gas/propane to heat pumps (geothermal or air-source)
- Reduce financing hurdles
  - Review/share geothermal market financing “best practices” in leading solar states
  - Facilitate and expand funding options/incentives/grants for C&I firms to purchase geothermal solutions
    - Help industry take full advantage of funding and benefits from IIJA, IRA, & CHIPS
    - Target geothermal pilots at high heat/cooling industrial firms such as dairies, data centers, and metal processors
  - Increase financial incentives for projects that:
    - Use Michigan content
    - Serve underserved/distressed/rural communities
  - Provide easier & more attractive financing options for geothermal loop design and installation
    - Reduce upfront costs for loop installations
    - Promote innovative contracting for firms and utilities that “utilitize” district geo loops
  - Encourage contractors and builders to develop and use standardized geothermal contracts/models

Recommendations for EGLE to Increase C&I Geothermal Adoption

- Plan C&I geothermal market and supply chain scale up
  - Model how C&I geothermal installations can help meet aggressive Michigan carbon reduction goals
    - Incorporate supply chain impacts and additional workforce needs
  - Convene additional solar industry surveys and forums to update solar industry acceleration recommendations, especially given recent passage of the IRA
  - Assess opportunities to build new geothermal-related manufacturing in Michigan
- Support geothermal innovation
  - Support R&D by Michigan companies and universities for next generation geothermal innovations

Additional Recommendations for EGLE to Accelerate SMM Decarbonization

Michigan small and medium-sized manufacturers (SMMs) have **tremendous potential** to reduce energy consumption and greenhouse gas emissions in their facilities and processes.

- Decarbonizing strategies include:
  - Consume more solar, wind, geothermal and other cleaner renewable energy sources
  - Electrify equipment and processes that currently use natural gas or propane
  - Fuel switch to replace natural gas and propane fuels with carbon neutral biogas or zero-carbon hydrogen
  - Adopt more energy efficient equipment and processes
  - Adopt Industry 4.0 technologies which improve process performance, reduce resource wastage, or better manage idle equipment, for example

Additional Recommendations for EGLE to Accelerate SMM Decarbonization

Leaders of small and medium-sized manufacturers (SMM) in Michigan have a growing interest in different decarbonizing strategies, but Michigan SMMs **face significant decarbonization challenges.**

- Decarbonizing challenges for SMMs including:
  - Lack of internal knowledge, capacity, or skills to navigate the:
    - Range of decarbonization options available and developing a sound decarbonization roadmap
    - Potential resources available to them
    - Decarbonization implementation process
    - Relevant regulatory environment
  - Lack of internal relevant expertise to identify, evaluate, or pursue decarbonization strategies, and the extra "bandwidth" and knowledgeable work force onsite to implement attractive decarbonization strategies
  - Lack financial strength and lower risk tolerance given overall market uncertainties and current economic pressures such as high inflation, rising interest rates, and workforce recruitment challenges

SMMs need independent and objective programs that help them 1) achieve their carbon reduction goals, 2) navigate contractors, incentives and regulations, and 3) not weaken their financial position.

Additional Recommendations for EGLE to Accelerate SMM Decarbonization

Based on years of experience and many interviews with SMM leaders, Centrepolis offers EGLE a range of integrated and self-reinforcing **recommendations to accelerate SMM decarbonization**.

- Recommendations to accelerate SMM decarbonization can be organized into four themes:
  1. Educate
  2. Demonstrate
  3. Help SMMs implement
  4. Take additional steps

Additional Recommendations for EGLE to Accelerate SMM Decarbonization

Theme #1: **EDUCATE** Michigan SMMs about clean energy technologies, energy efficiency, and other decarbonization strategies, and guide SMMs through onsite clean energy technology adoption. Education steps include:

- Hold multiple SMM decarbonization events throughout Michigan to educate C&I building owners and SMMs on decarbonization options, strategies, resources and success stories. Include:
  - Educate SMMs on available clean energy / energy efficiency assessments and implementation programs
  - Present and work with SMMs to develop decarbonization "recipes," roadmaps and resources tailored to accelerate decarbonization for different C&I market segments
  - Present case studies of SMM decarbonization success stories
- Work with relevant trade and professional associations to establish industry-specific decarbonization standards and decarbonization roadmaps that align the MI Clean Climate Plan and DOE goals

Additional Recommendations for EGLE to Accelerate SMM Decarbonization

Theme #2: **DEMONSTRATE** that SMM decarbonization is doable in Michigan, and that ELGE wants demonstration to happen in Michigan. Demonstration steps include:

- Aggressively showcase and appreciate Michigan C&I decarbonization success stories
  - Set up industry-specific decarbonization competitions (e.g. DOE's "Battle of the Buildings")
- Augment, accelerate and expanded decarbonization innovation RD&D programs to more fully leverage federal resources, Michigan's universities, and Michigan's many decarbonization solution providers
- Encourage SMMs to pilot test and help evaluate new technologies
  - Many new clean energy / energy efficiency technologies are proven, but not yet widely adopted
  - At the same time, many SMMs are willing to pilot and test out newer technologies.
  - Develop a decarbonization pilot and demonstration program that intentionally encourages Michigan SMMs to help evaluate promising, new and next generation clean energy / energy efficiency solutions

Additional Recommendations for EGLE to Accelerate SMM Decarbonization

Theme #3: **HELP SMMs IMPLEMENT.** It is critical that clean energy / energy efficiency project implementation support be part of resource support for SMMs. As stated previously, Michigan SMMs do not have capacity or expertise to begin or implement onsite clean energy transitions.. SMMs need both external expertise as well as grants to help offset the cost of clean energy / energy efficiency implementations.

In addition, it is important to equitably distribute implementation resources and other additional support to less-resourced companies. Special consideration for implementation support should be given to Michigan SMMs that are located in:

- Historically disadvantaged, distressed or underserved communities
- Rural communities, and
- Communities where fossil fuel power generation systems are closed or have planned retirements and additional assistance is needed to decarbonize from a legacy of GHG impacts.

Additional Recommendations for EGLE to Accelerate SMM Decarbonization

- We recommend EGLE consider supporting a range of State Energy programs to help Michigan SMMS accelerate decarbonization implementation. The aim would be to help SMMs to:
  - Quickly and wholistically assess their opportunities to reduce energy usage, fuel switch to cleaner energy sources, and integrate decarbonization principles into product development
  - Identify, evaluate and adopt additional onsite clean energy and energy efficiency solutions
  - Expedite access to financing tools that reduce ROI
- Implementation support program options include:
  - Energy audits to improve manufacturing process energy efficiency and lower GHG emissions
  - Industry 4.0 technology opportunity audits and road mapping
  - Assessments of fuel switching to electric production processes
  - Provide expedited access to financial analysis tools and financing options
  - Offer specific funding for SMMs to electrify processes for facilities and production lines

Additional Recommendations for EGLE to Accelerate SMM Decarbonization

Theme #4: **TAKE ADDITIONAL STEPS.** Significant decarbonization will not be easy or quick for many SMMs. There are important additional steps, however, that will positively impact Michigan's journey, including:

- Accelerate workforce development to support SMM decarbonization.
  - The Inflation Reduction Act incentives will spur demand for a much larger pool of skilled labor that Michigan currently has for clean energy/energy efficiency assessments and SMMs future decarbonization implementation projects.
  - There will be a need to certify hundreds of new clean energy / energy efficiency assessment and implementation professionals. A program option includes:
    - Internship programs that pair experienced engineers with clean energy / energy efficiency expertise with students to educate the future workforce. These students could be paired with experienced engineers and assigned to work directly with Michigan SMM's to carry out implementation projects in their production facilities. The intent is to prepare these students for careers in clean energy on both the supply and demand side of the industrial sector.

Additional Recommendations for EGLE to Accelerate SMM Decarbonization

- Promote Michigan content.
  - Incentivize Michigan SMMs to have more Michigan content in products and service providers.
  - For competitive bid projects to the State, ensure higher value scoring criteria for those clean energy / energy efficiency projects that can demonstrate more Michigan content.
  - For projects where grant or incentives are offered directly to the SMMs, provide a higher project value or higher tax incentive for clean energy / energy efficiency projects that can demonstrate more Michigan content.
- Promote more SMM decarbonization in disadvantage communities.
  - For competitive bid projects to the State, place a higher value scoring criteria for SMM decarbonization projects located in disadvantaged communities.
  - For projects where grant or incentives are offered directly to SMMs, provide a higher project value or higher tax incentive for decarbonization projects that located in disadvantaged communities.
- Promote integration of energy storage and electrification
  - Incentivize integration of energy storage for decarbonization projects, such as those with solar, wind and EVs.
- Promote Michigan SMM decarbonization innovation
  - Augment, accelerate and expand decarbonization innovation RD&D programs to more fully leverage federal resources, Michigan's universities, and Michigan's many decarbonization solution providers

Supplement:
Moving Forward! Envisioning Success

- Improved State Policies Recommendation
- Improved Financing Recommendation
- Improved Education/Marketing Recommendation

Included in this supplement are outcomes from three visioning exercises were produced by participants of the C&I Geothermal Adoption Forum. Each exercised asked participants to put themselves into a future state and then:

1) envision key elements of what future success looks like, and

2) provide imagined retrospective reflections on how such future success was achieved.

Moving Forward! Envisioning Success

IMPROVED STATE POLICIES Recommendation: Positioning the State of Michigan to say YES-and-MORE to geothermal!	
What future success "looks" like! • MI, like other states, has gone ZERO CARBON on new HVAC systems • Utility- and commercial- scale loops are everywhere • Decarbonization incentives are in place & fuel switching is not an issue • PFAS and PFOs are no longer in HVAC systems	**Looking back, how we achieved success!** • Lobbyists had been significantly and successfully engaged • Michigan had drawn from the helpful experiences, tools, regulations and programs from other states • Geo became easy for politicians and policy makers to say "yes" to • Utilities also wanted a lot more geo • Political clarity and will were found!

Moving Forward! Envisioning Success

IMPROVED FINANCING Recommendation: Making geo affordable and simple to finance	

What future success "looks" like!
• <u>Affordable</u>
  • Millions of $ in incentives
  • Geo → self-perpetuating value
• <u>Simple to Finance</u>
  • No huddle to finance geo needed
  • Simple, consistent and solidly energy-based cot models
  • Banks recognize models & reward geo assets
	Looking back, how we achieved success!
	• $1B in kickstart investments/incentives
	• Accumulated many financial success stories
	• Growing recognition and acceptance of geo's multiple value propositions
	• Built a low cost, simple financing model that is operated by a trusted 3rd party
	• Very long-term financing (25 to 100 years)

Moving Forward! Envisioning Success

IMPROVED EDUCATION/MARKETING Recommendation: Offering consistent “grass roots” marketing support for geo promoters	

What future success “looks” like!
• 9 out of 10 people in MI know what geothermal is
• 7 out of 10 people have geo in their building
	Looking back, how we achieved success!
	• Educated HVAC and mechanical contractors about WHY to install geo (and that they will be OK when they do).
	  • Challenged OEMs to educate contractors/market!
	• Leveraged economies of scale with 3rd party and utility financing
	• Started geo education in K-12
	  • Earth Day → Geo Day
	• Tech schools and Community Colleges included geo education/drilling/fusion
	• Utilities sent consistent ”benefit” messaging (Similar to “safe gas” commercials).

Thank You To Our Partners

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