



Geothermal Heat Pump Workforce Development Plan for Connecticut

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Contents

Executive Summary	2
1. Introduction and Background.....	4
1.1 Introduction to geothermal systems	4
1.2 Benefits of geothermal systems	5
1.3 Ulbrich Heights project.....	6
2. Data Collection	7
2.1 Workforce needs assessment	7
Methods	7
Findings summary	7
2.2 Workshops.....	8
Methods.....	8
Findings summary	9
3. Proposed Strategies for Developing Connecticut’s Geothermal Workforce.....	10
3.1 Incorporate equity through targeted outreach, clearly defined goals, and support for underrepresented communities	10
3.2 Recruiting and training new entrants	11
3.2.1 Generating awareness and interest in the industry	11
3.2.2 Reaching high school and college students.....	12
3.2.3 Reaching adults transitioning into the industry	12
3.3 Licensing.....	14
3.3.1 Licensing content	14
3.4 Drilling	15
3.4.1 Drilling: Recruitment and training.....	15
3.4.2 Drill rig availability	17
4. Conclusion	18
4.1 Next steps.....	20
4.1.1 Short-term actions	20
4.1.2 Medium-term actions	21
4.1.3 Long-term actions	21

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Executive Summary

This statewide workforce development plan was produced for the Connecticut Department of Energy and Environmental Protection (CT DEEP) project, District Geothermal Heating + Cooling Deployment in an Environmental Justice Community. This project is funded by the U.S. Department of Energy (DOE) and is centered on the design of a technically- and economically-feasible low-temperature geothermal heating and cooling system for a low-income community in Wallingford, Connecticut, that the Connecticut Office of Environmental Justice identified in 2022 as an [Environmental Justice Community](#). As part of the grant application to DOE, the project team proposed to create a workforce plan for the geothermal industry in Connecticut, based on a needs assessment. The project is being pursued by a coalition of partners, including the Connecticut Department of Energy and Environmental Protection (CT DEEP), Northeast Energy Efficiency Partnerships (NEEP), the University of Connecticut, LN Consulting, the Wallingford Housing Authority, and the Wallingford Electric Division. Construction of the Wallingford system is contingent on availability of funding, including a further award from DOE. Carrying out the recommendations outlined in this plan likewise is contingent on availability of funding but, regardless, the information in this plan will help advance the state’s clean energy economy. DEEP expects to explore multiple avenues for funding that may align with this report, including the New England Heat Pump Accelerator Coalition, for which the U.S. Environmental Protection Agency recently announced support.

To prepare this workforce development plan, the coalition completed the [Connecticut Geothermal Industry Workforce Needs Assessment](#), which focused on statewide and project-specific gaps in the geothermal workforce in Connecticut. The coalition then held a series of four workshops in May 2024 to inform the identification of programs and initiatives that can fill the gaps identified by the workforce needs assessment. The purpose of this plan is to recommend strategies for overcoming gaps in the state’s geothermal workforce that can be implemented within the next 30 months. A separate workforce plan specific to the project in Wallingford will also be developed as part of the DOE-funded project.

New financial incentives for geothermal projects in Connecticut from federal, state, and utility programs are likely to drive increased demand if incentives drive down the installation and operating costs for these systems. This demand could continue to rise as the technology matures and becomes more widespread, resulting in lower manufacturing and installation costs, increased competition among manufacturers and installers, and ongoing improvements in geothermal system efficiency and performance. As more geothermal systems are installed in the state, the geothermal workforce will need to grow apace. If Connecticut agencies and geothermal players can procure sufficient funding, the strategies proposed in this plan would facilitate the growth of Connecticut’s domestic geothermal workforce by reducing barriers to entry for workers with skills that are transferrable to the geothermal sector, individuals without prior geothermal experience who are interested in a career in the industry, and companies and technicians currently performing similar work in other states.



The recommendations are grouped into four main topic areas: equity, recruitment and training, licensing, and drilling.

Area of Need	Main Recommendation	Recommended Actions
Equity	Embed equity in workforce development programs through targeted outreach efforts, establish clearly defined equity related program goals, and use holistic approaches for recruiting and training individuals from underrepresented communities.	Invest a predetermined percentage of funding for recruitment in targeted communities. Establish equity centered goals for metrics, such as dollars spent on outreach, the number of individuals entering training programs, and successful candidate placements. Use strategies like wraparound services, soft-skill training, and subsidies for training programs and related expenses.
Recruitment and Training	Increase awareness of geothermal careers with marketing campaigns and accessible low-cost training opportunities.	Create a marketing campaign illustrating career pathways in geothermal. Provide scholarship opportunities for HVAC training courses. Prompt state funded energy efficiency programs, such as Energize CT’s Green STEP program, to include geothermal curricula in its trainings. Prompt Connecticut training centers and institutions to use new modularized trainings such as those offered by the International Ground Source Heat Pump Association.
Licensing	Clarify the applicability of heating, piping, and cooling licenses to facilitate the growth of businesses focused on heat pumps. Streamline entry into the field and licensure in Connecticut	Update the description of the limited cooling licenses on CT DCP’s website to clarify that they cover heat pump installation. Create informational resources about the licensing pathways available for geothermal professionals, including for those with out-of-state experience or licenses.
Drilling	Retrain existing drillers, entice drilling companies to diversify their businesses into geothermal drilling, and increase the availability of drill rig equipment.	Establish a hub where professionals in the drilling industry can share costly training equipment and resources. Support IUOE Local 478 in bringing a geothermal well driller apprenticeship program to CT. Discuss public ownership of drill rigs with local governments, councils of governments, and others.



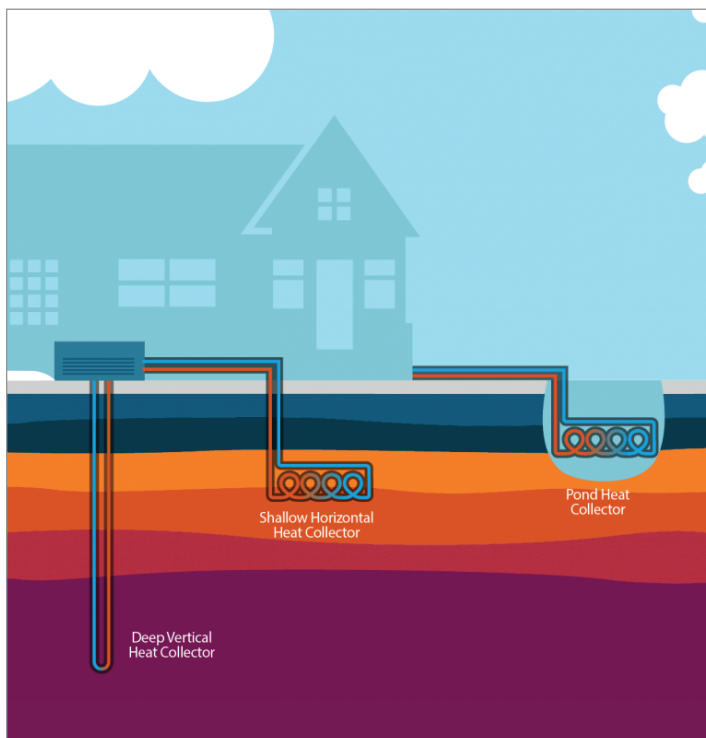
1. Introduction and Background

This section provides background information on geothermal systems and their benefits and a summary of the project and its location at Ulbrich Heights in Wallingford. The next section summarizes the data collection methods and findings of the workforce needs assessment, and the final section describes the recommended strategies for adoption.

1.1 Introduction to geothermal systems

Geothermal systems employ the ground's relatively constant temperature as a thermal resource to provide space heating and cooling for residential and commercial facilities. In Connecticut, temperatures at approximately ten feet below ground remain a [constant 50 degrees](#). When ambient air temperatures are warm, geothermal systems utilize the cool temperatures below ground to provide space cooling. When the ambient air is cold, geothermal systems use the warmer temperatures below ground to provide space heating. Temperature exchange occurs by circulating a heat-transfer fluid through a network of buried pipes known as a [ground loop](#) (see Figure 1).

Figure 1. Adapted from the [U.S. Department of Energy](#), showing configurations of ground loops



[Networked geothermal](#) is a highly energy efficient application of geothermal heating and cooling. A [networked geothermal system](#) connects multiple buildings to a large underground fluid distribution loop. [This configuration is often more efficient](#) than a single-building geothermal system due to reductions in thermal energy waste created when multiple buildings with different heating/cooling profiles are connected. Networked geothermal systems perform well in cold weather and are a proven technology with the potential to support community-scale heating and cooling [decarbonization](#). Multiple [colleges and universities, mixed-use commercial-residential properties, and multifamily residential properties](#) have installed or are developing [networked geothermal systems](#). Many other entities have also installed commercial-scale non-networked geothermal projects in Connecticut, such as those in [Manchester](#) and [Willimantic](#). See [CT DEEP's Geothermal Energy](#) webpage for more examples of geothermal projects across Connecticut.



Historically, one consistent barrier to networked geothermal uptake has been the relatively high up-front cost of system installation. As federal and state/utility incentives (both tax credits and rebates) have increased in recent years, the number of geothermal systems installed in Connecticut also has risen. [Geothermal system installations in Connecticut](#) increased by 192 percent from 2020 to 2021, by 52 percent from 2021 to 2022, and by 82 percent from 2022 to 2023.¹ With [federal](#) and [state/utility financial incentives](#) potentially available through 2034, this upward trend is likely to continue.

1.2 Benefits of geothermal systems

Increased uptake of geothermal systems is critical for Connecticut to achieve greenhouse gas (GHG) reduction targets while minimizing grid impacts of electrification. [Connecticut has set statewide goals](#) to reduce GHG emissions 45 percent below 2001 levels by 2030, and 80 percent below 2001 levels by 2050. To achieve these goals, Connecticut must decrease the use of fossil fuels for residential heating, which currently accounts for 21 percent of the state's total [greenhouse gas emissions](#). To bring the residential sector's emissions in line with the 2030 target, reductions must occur 6.9 times faster from 2022 through 2029 than they did between 2001 and 2022. The state must also reduce emissions from fossil fuels for heating commercial facilities. Commercial-sector combustion emissions did not decrease sufficiently between 2001 and 2022, and in fact increased slightly, so emissions reductions from 2023 onward will need to be even more aggressive than specified above to achieve 2030 and 2050 targets.²

Developing replicable and scalable models for energy efficiency and decarbonization projects in affordable housing communities is important for several reasons. Residential and commercial buildings account for [33 percent of GHG pollution in Connecticut](#). According to the Connecticut Housing Data [Hub](#), in 2022 there were 94,264 government-assisted rental units across the state. According to the [Connecticut Housing Assessment](#) research report by the Urban Institute from December 2020, there are nearly 2.2 million total housing units in the state, so government-assisted rental units make up roughly five percent of the housing stock. Reducing energy consumption in affordable housing communities will help Connecticut reach its GHG reduction goals.

Affordable housing energy efficiency programs help reduce utility costs for residents. Low-income households spend a disproportionate amount of household income on utility costs compared to higher-income households. Lower utility bills can free up needed resources and decrease housing cost burdens for low-income stakeholders. Energy efficiency programs improve comfort, health, and safety. Efficiency programs enhance indoor air quality and thermal comfort, improving overall well-being for residents. Energy efficiency programs can help [preserve affordable housing](#). Given that energy efficiency reduces operating costs and increases net income and property values, property owners are less likely to raise rents and have increased access to capital for repairs or renovations. Additionally, energy efficiency programs provide community economic benefits through the creation of local [jobs](#).

¹ From [Connecticut Energy Dashboard](#).

² Synapse analysis for CT DEEP using [Connecticut Greenhouse Gas Reduction Progress Reports](#).



1.3 Ulbrich Heights project

The DOE's Geothermal Technologies Office is investing millions of dollars in development of reliable and scalable networked geothermal models through the [Community Geothermal Heating and Cooling Design and Deployment program](#). This program is funding a project at Ulbrich Heights in Wallingford, Connecticut, that is led by CT DEEP in partnership with Northeast Energy Efficiency Partnerships (NEEP), the University of Connecticut, the Wallingford Housing Authority, the Wallingford Electric Division, and LN Consulting. The objective of the [Ulbrich Heights](#) project is to contribute to development of replicable models for affordable housing energy efficiency and decarbonization programs in Connecticut and beyond.

Ulbrich Heights is a 132-unit affordable housing complex in a low-income community in Wallingford, Connecticut, that the Connecticut Office of Environmental Justice identified in 2022 as an [Environmental Justice Community](#).³ The Ulbrich Heights Community Geothermal Project includes community engagement activities and the design of a networked geothermal heating and cooling system that will serve at least 50 percent of the apartments at the property. Currently, natural gas boilers heat and window-mounted air conditioning units cool the apartments at Ulbrich Heights. Installation of a networked geothermal system in half of the units at Ulbrich Heights would eliminate 155 tons of annual CO₂ pollution, improve indoor and outdoor air quality, and enhance resident comfort and safety.

In addition to system design and community engagement activities, the Ulbrich Heights project also involves completion of a workforce needs assessment and a workforce development plan. The workforce needs assessment identified and analyzed gaps between current labor market capabilities and the workforce required to meet growing geothermal market demand. This statewide workforce development plan proposes initial systematic solutions to address barriers to entry and fill skill gaps, enabling CT DEEP to ensure the geothermal workforce scales up effectively and at the pace needed to meet Connecticut's GHG emission targets. This statewide workforce development will significantly inform a separate workforce plan specifically tailored to the Ulbrich Heights project.

NEEP derived the strategies outlined in this plan from recommendations and feedback that stakeholders provided during the research and outreach for the workforce needs assessment and workshop series. Stakeholders underscored the need for development at all career stages, from entry-level to mid- and late-career workers, to advance the geothermal workforce. In section 3, NEEP proposes that CT DEEP pursue the strategies described to bridge the current gaps and prepare for significant geothermal market growth.

³ In 2022, the census block group where Ulbrich Heights is located reported that 30 percent of the population was living below the federal poverty level. <https://geodata.ct.gov/datasets/CTDEEP::environmental-justice-2022-set/explore?layer=0&location=41.454345%2C-72.806161%2C13.00>.



2. Data Collection

A recent workforce needs assessment and a series of workshops inform this workforce development plan. This section describes the methods and findings of each of these efforts.

2.1 Workforce needs assessment

[The Connecticut Geothermal Workforce Needs Assessment](#) identified three major barriers to the uptake of geothermal projects in the state: inadequate awareness of and/or interest in geothermal careers, a tension between an uneven supply of workers and an increasing demand for projects, and high upfront costs that constrain geothermal uptake. This workforce development plan discusses these barriers as they relate to the growth of the geothermal workforce and makes suggestions for growing the geothermal workforce in Connecticut.

Methods

NEEP conducted a series of surveys and interviews with a wide range of experts and professionals in the geothermal industry between October 2023 and April 2024 to form the Connecticut Geothermal Industry Workforce Needs Assessment, published in June 2024.

Surveys were distributed to four stakeholder categories: Wallingford Housing Authority facilities managers; training centers; trade schools; and industry players such as drillers, engineering companies, and geothermal installers. NEEP received 11 survey responses. To get a deeper understanding of institutional barriers to licensing, prior workforce development initiatives, and expected industry changes, NEEP interviewed members of utilities, drilling companies, unions, installers, manufacturers, and the Connecticut Technical Education and Career System. In total, NEEP conducted 19 interviews.

NEEP supplemented this primary research with secondary research from online resources. For a more detailed description of the methodology and the data collected, please consult the needs assessment.

Findings summary

The NEEP team identified three major barriers to the growth of geothermal technology in Connecticut:

1. low awareness of and/or interest in geothermal careers;
2. tension between an uneven supply of workers and an increasing demand for geothermal projects; and
3. persistently high upfront costs for consumers, which constrain geothermal uptake and inhibit market indicators that the geothermal workforce needs to grow.



Despite the presence of high-paying and in-demand job opportunities, awareness of geothermal career paths lags, particularly in segments of the population that would presumably be attracted to these careers. It is critical that the geothermal industry in Connecticut adjust its marketing strategies for the types of positions that become available in a manner that is appealing and accessible to new entrants to scale up the industry.

Meanwhile, an inadequate supply of drillers and drill rigs has increasingly strained the rising demand for geothermal technology. NEEP found that drilling was particularly cost prohibitive to geothermal growth in Connecticut, with over 50 percent of total project costs attributed to drilling alone. An inadequate supply of drillers and drilling equipment compounds this situation. Although a few stakeholders said current demand is being met, the state needs to expand the workforce to accommodate accelerating demand for system installation and prepare the industry for future growth.

The high upfront costs associated with geothermal systems (especially for building retrofit projects) impedes market growth to drive geothermal deployment and employment. Expanded federal initiatives and tax incentives will likely increase demand and grow awareness of geothermal technology. Workers must be in place to address this demand. Currently, state HVAC licensing requirements, difficulties securing new workers and equipment for drilling, and barriers to attracting and training new entrants to geothermal careers all constrain workforce growth.

2.2 Workshops

Methods

After finalizing the needs assessment, NEEP hosted [four virtual geothermal workforce solutions workshops](#). Each workshop focused on one of four themes: licensing, training new entrants, drilling, and the workforce needs assessment (the latter in partnership with the [Connecticut Clean Economy Council](#)).⁴ NEEP held the workshops throughout May 2024 to share the workforce needs assessment results and provide a forum for stakeholders to provide their perspectives. Over the course of the four workshops, 45 individuals participated, represented utilities, trade unions such as the United Association of Plumbers and Pipefitters Local 777, drilling firms, state agencies such as the Connecticut Office of Workforce Strategy, and geothermal advocacy organizations such as HEET.⁵

Through the workshops, NEEP collected input and suggestions on how to address industry barriers to inform the workforce development plan.

⁴ The Connecticut Clean Economy Council (CCEC) is an advisory council bringing together state and industry leaders to work in collaboration to develop workforce training programs, advance economic justice, and deploy funding for sustainability, climate mitigation, and clean energy. <https://portal.ct.gov/gwc/connecticut-clean-economy-council>.

⁵ HEET is a nonprofit organization that works on transitioning gas utilities to thermal utilities. <https://www.heet.org/>.



Findings summary

These four workshops yielded critical first-hand research that informed this workforce development plan. During the licensing workshop, the stakeholders discussed the absence of, and desire for, a heat pump-specific license in Connecticut, and concerns regarding the pace of retirement for S-1 and S-2 unlimited heating, piping, and cooling license holders at small companies.⁶ Stakeholders also pointed to the need to market career opportunities to young people interested in clean energy careers, as well as to pair recruitment efforts with substantial training and educational offerings.

The workshop on training new entrants identified strategies such as expanding the International Ground Source Heat Pump Association's (IGSHPA) modularized curricula within Connecticut, providing wraparound services for students, and building up resources for technical schools such as training equipment and hands-on experience programs.⁷

During the workshop on drilling, NEEP gathered feedback on how to reduce costs and increase the number of drill operators within the state. Key takeaways included the potential impact of union apprenticeships on expanding the number of drillers, ways the Inflation Reduction Act (IRA) geothermal tax credit can reduce initial costs for commercial projects, and the opportunity for larger networked projects to increase the demand for drillers by driving the project pipeline.

Lastly, the needs assessment workshop held in partnership with the Connecticut Clean Economy Council reinforced the need to increase the availability and accessibility of geothermal careers and training. NEEP heard from stakeholders that this drive to increase visibility must be conducted with an equity focus to ensure that careers are marketed thoughtfully, wraparound services are provided, and trainings are flexible for students. Stakeholders also suggested increasing public awareness and trust in geothermal technologies more broadly, especially among existing HVAC contractors and non-geothermal drillers. Ideally, developers, contractors, and engineers would consider geothermal technologies as a conventional and accessible option for building design and construction.

⁶ Some heat pump companies have expressed a desire for a license that does not include fossil fuel equipment, because of the barrier it poses to them hosting apprentices with that full scope of work. S-1 and S-2 Unlimited Heating, Piping, and Cooling licenses are the most comprehensive, time-intensive heating, piping, and cooling licenses offered by the Connecticut Department of Consumer Protection.

⁷ The International Ground Source Heat Pump Association (IGSHPA) is a member organization composed of manufacturers, engineers, ground loop installers, drillers, as well as many others working to further the adoption of ground source heat pump technology. <https://igshpa.org/>.



3. Proposed Strategies for Developing Connecticut's Geothermal Workforce

Using data collected through the needs assessment and workshops, NEEP developed the following recommendations to address key workforce growth challenges.

3.1 Incorporate equity through targeted outreach, clearly defined goals, and support for underrepresented communities

Diversity, equity, inclusion, and access make up a “foundational pillar” described in the draft Connecticut Governor’s Workforce Strategic Plan; this pillar’s goal is creating a more inclusive economy that ensures workers have a seamless and supported pathway from education and training to successful careers.⁸ The [Connecticut Office of Workforce Strategy \(OWS\)](#) is leading an initiative to strengthen the workforce of select industries such as manufacturing and IT/data with a goal of training and placing 2,000 workers from historically underserved populations.⁹ However, the state has published no development or equity goals for the geothermal workforce in Connecticut. NEEP recommends that Connecticut use the workforce goals set for the aforementioned sectors as guidelines, set similar goals in the geothermal industry, and establish a goal of 40 percent of training program participants in the geothermal industry being members of [CT Environmental Justice Communities](#), to align with [Justice40](#). It could then use this equity-centered approach as a model for workforce development programs in the broader clean energy sector.

To increase diversity in the geothermal workforce, Connecticut should consider setting equity-centered goals for targeted outreach and recruitment of individuals currently in the HVAC workforce as well as new entrants. Connecticut should set a time-sensitive goal (e.g., by 2025) to source a designated percentage of geothermal recruitment from historically marginalized, low-income, and disadvantaged communities. NEEP recommends that Connecticut develop a corresponding outreach initiative that could target audiences such as recipients of government assistance for HUD Section 3 housing by dedicating a percentage of the time and money spent on marketing, communications materials, and training costs for those audiences. This initiative could include in-person open house events, flyers, targeted outreach in languages other than English, coordination with local community action agencies and other community centers, and coordination with local secondary and tertiary education providers. The state could then track demographic data on attendance at outreach events to measure success in meeting equity goals.

As geothermal education and awareness expands through intentional marketing and stakeholder outreach, the state could establish equity-centered goals. For example, the state could establish goals for the number of candidates entering training programs and receiving interviews, the number of job offers extended, and the number of successful placements. Connecticut could also set workforce development targets for the geothermal

⁸ Summary of Governor’s Workforce Strategic Plan, <https://portal.ct.gov/gwc/strategy>.

⁹ Strengthening Sectoral Partnerships Initiative (SSPI), Connecticut Office of Workforce Strategy, <https://www.eda.gov/sites/default/files/2022-08/Office-of-Workforce-Strategy-CT-Project-Narrative.pdf>.



heating and cooling workforce that reflect the state’s projected demographics in 2050, the year Connecticut is currently using as the target for its climate goals. These equity goals could be tracked and measured through periodic anonymized surveys of employers in the geothermal industry. While attrition will naturally occur between the recruitment, interviewing, and actual placement phases in the process, the demographic proportions at each stage should remain similar.

There are existing workforce development programs in Connecticut, such as [Career ConneCT](#), that take a holistic approach to workforce development, and some of the regional workforce development boards work on placing people in green jobs. CT DEEP has an opportunity to collaborate with existing workforce programs. Connecticut should consider holistic approaches to workforce development in the geothermal industry that meet the individual needs of potential entrants. Wraparound services can lower barriers for training. For example, providing technical skills training as well as soft skills training like time and finance management can support increased minority representation in the clean energy industry. Addressing housing, transportation, and childcare needs, which can present barriers to professional development, is also critical to equitable career access. Such barriers can prevent entry-level hires from joining smaller companies that cannot easily afford wraparound services. To increase access to new workers from disadvantaged communities, state workforce development efforts should incorporate funding for wraparound services, including but not limited to stipends for childcare and transportation, assistance in getting a driver’s license if required, training in general job readiness skills, and post-placement career supports. To support underrepresented communities in joining Connecticut’s geothermal workforce, the state can also address cost barriers to taking training courses and paying union dues. Connecticut could consider providing funding directly to training course participants, and grants to community-centered organizations with connections to those in need of funding for supporting program activities such as wraparound services and scholarships.

Connecticut could set up a publicly accessible database to track, report, and support progress toward these goals. By tracking program data, the state can tailor outreach strategies to specific community needs over time.

3.2 Recruiting and training new entrants

3.2.1 Generating awareness and interest in the industry

A broad awareness campaign targeted at young people could benefit the geothermal industry. Research for the needs assessment showed that many companies have a difficult time finding new workers who are genuinely interested in staying in the field because many do not have a clear sense of the industry and available career pathways. CT DEEP could support the creation of marketing materials that illustrate geothermal career pathways, the main job functions, the character of the work, and the contributions that people in geothermal careers can make toward mitigating climate change. Connecticut could engage Local 777, the Connecticut Plumbers, Pipefitters, and HVAC-R union in this process, as they already offer a wide variety of licensing pathways and bring young members to career fairs to talk with students. Other labor unions and related nonprofits, such as the Connecticut Roundtable on Climate and Jobs, could also collaborate to create these materials.



3.2.2 Reaching high school and college students

To increase awareness of the geothermal industry and career pathways, Connecticut should consider a campaign to reach students in technical high school HVAC programs. While the needs assessment revealed a lack of consensus on the extent that geothermal curriculum is being covered in Connecticut Technical Education Career System (CTECS) high school HVAC programs, ample opportunity exists to enhance exposure to the career paths available. One way to do this would be for the Energize CT-sponsored Green Sustainability Technology Education Program ([Green STEP](#)) to begin including geothermal heat pump material in its curriculum. Green STEP also offers programming to public school students in the form of after-school or summer classes, so including geothermal in this program would expose a wide range of students to the opportunities within this career path. Green STEP regularly consults with energy efficiency and clean energy industry professionals to help shape the program's curriculum. This process should include members of the geothermal heating and cooling industry.

Geothermal system manufacturers can also raise awareness of the industry by donating or subsidizing the use of geothermal equipment for educational purposes. Access to equipment for training gives students the opportunity to gain hands-on experience with geothermal technologies. Early interventions that build awareness of geothermal technologies and provide high-quality educational opportunities can demonstrate to young people what careers in geothermal are like in practice. Programming could also include site visits, to give people the opportunity to see geothermal systems under construction or in operation first-hand.

Increasing the capacity of technical high school HVAC programs could help expand the pool of people with relevant skills and training. One participant in a workforce solution workshop noted that schools often have lengthy wait lists for technical high school HVAC programs, and a significant number of these students ultimately have no opportunity to participate. The subsequent lack of post-secondary opportunities for affordable geothermal training leaves many young people out of the pipeline to industry careers.

For students who are not in technical high schools, the state and industry should leverage existing career programming. Many schools in Connecticut already have career cluster initiatives and small learning academies targeted at specific industries, and geothermal could be included in those. This would also help address equity concerns with recruiting new entrants, because many of these programs are in schools in large urban areas, where students from disadvantaged communities may not have access to technical school education.

3.2.3 Reaching adults transitioning into the industry

For adults seeking HVAC training for a career in the geothermal industry, the price of training courses may be a serious barrier. The offerings outside of technical high school programs can cost thousands of dollars, likely deterring potential entrants who cannot afford the upfront cost. CT DEEP could explore ways to provide increased scholarship opportunities for members of disadvantaged communities to attend training programs that the CT Department of Consumer Protection accepts toward classroom hour requirements. Alternatively, the CT Department of Consumer Protection could allow heat pump dealer trainings and similar reduced-cost



training programs to count toward the classroom hour requirements for licenses. CT DEEP could also engage the state's regional workforce boards, which already have experience implementing workforce programs for job seekers in the clean energy industry. The [Northwest Regional Workforce Investment Board](#) has launched an Architecture, Engineering, and Construction partnership that could include geothermal careers, and the southwestern workforce board [WorkPlace](#) has recently launched the [Energy Works](#) program with funding from the U.S. Department of Labor. In the Energy Works program job seekers engage in short-term trainings for solar, weatherization, or utility line worker careers, using classroom instruction, hands-on practical exercises, and immersive virtual reality simulations.

Connecticut might also look to the [District of Columbia's Sustainable Energy Utility \(DCSEU\) workforce development program](#) as a model for encouraging businesses to offer more on-the-job training. The DCSEU program connects DC residents who are new to the workforce, between jobs, or looking for a career change with local contractors, businesses, municipal agencies, and other organizations in five month paid externships, across the clean energy sector. DCSEU pays wages with ratepayer funds because the SEU has mandatory workforce objectives. This funding allows employers to take on more hiring risk, and companies that host participants often hire program graduates.

The International Ground Source Heat Pump Association (IGSHPA) is developing and releasing new modularized training courses that correspond with the 14 job descriptions identified in a [2013 report by the Geothermal Heat Pump Consortium](#) on behalf of the U.S. Department of Energy. IGSHPA has already released training courses for service technicians and installers. Upcoming additional courses include those for advanced service technicians, residential design, commercial design, and inspection. IGSHPA plans to have all training program courses available by the end of 2025 and will pilot the programs in select community colleges, vocational and technical colleges, and other training facilities. CT DEEP could coordinate with interested colleges and training facilities to help bring these courses, or others like them that tie directly to one or more geothermal job descriptions, to Connecticut institutions and thereby give Connecticut students access to these new geothermal training opportunities and accreditations. To ensure that programs deliver comprehensive training that supports greenhouse gas emissions reductions, participants should be trained on how to mitigate refrigerant leaks as well.

Finally, Local 777, the Plumbers, Pipefitters, and HVAC-R union in the state, accepts 50 to 75 apprentices per year out of roughly 500 to 600 applications received. Local 777 stated that it will accept only the number of apprentices for which it believes it has job opportunities. As geothermal development expands in Connecticut, the state could work with Local 777 to identify opportunities to expand the number of apprentices it accepts and to encourage those not accepted to seek other career pathways in geothermal.



3.3 Licensing

3.3.1 Licensing content

In Connecticut, the [Department of Consumer Protection](#) (CT DCP) controls professional licensing. Currently available [heating, piping, and cooling licenses](#) include the S series limited and unlimited heating, piping, and cooling licenses, the OE-2 Operating Engineer Journeyman license, the G series for gas equipment, the D-3 and D-4 licenses for refrigeration-based equipment, the D-1 and D-2 limited warm air, cooling, and refrigeration licenses (which do not cover oil burners), and the B series for gas and oil burners. See Table 1 for information about the number of license holders in Connecticut for each of these heating, piping, and cooling licenses.

Table 1. Heating, Piping, and Cooling Licenses, Uses, and Holders in Connecticut.

License Type	Main Uses	Number of License Holders in CT
B Series	Gas and oil burners	1,012
D-1 and D-2	Limited warm air, cooling, and refrigeration *Covers decommissioning fossil fuel systems	2,428
D-3 and D-4	Limited cooling (refrigeration-based equipment) *Does not cover decommissioning fossil fuel systems	94
G Series	Gas equipment	670
S-1 and S-2	Unlimited heating, piping, and cooling	4,838
Other S Series	Limited heating, piping, and cooling	1,488

Source: the CT DCP, accessed June 2024

Some industry stakeholders note that the current requirements for heating, piping, and cooling licenses are not conducive to heat pump-only businesses, which are likely to play an increasingly important role as Connecticut pursues its decarbonization goals. Currently, few heat pump-only businesses exist in the state. Reforming licensing requirements might facilitate more in-state geothermal business development or incentivize out-of-state companies to expand operations into Connecticut.

One major topic of disagreement among stakeholders is the amount of training that should be required on equipment for contractors who simply decommission fossil fuel systems and replace them with heat pumps. The general understanding among heat pump contractors in Connecticut seems to be that the lowest-barrier licenses that allow for this work are the D-1 and D-2 Limited Warm Air, Air Conditioning, and Refrigeration Contractor and Journeyman licenses, respectively. The D-2 license requires approximately 750 hours of training on fossil fuel systems and dedicates 10 of 60 questions to fossil gas systems.¹⁰ The D-3 and D-4 Limited Cooling Contractor and

¹⁰ Connecticut Department of Consumer Protection Occupational Licensing Heating, Piping and Cooling Trades Candidate Information Bulletin 2023. https://candidate.psiexams.com/bulletin/display_bulletin.jsp?ro=yes&actionname=83&bulletinid=59&bulletinurl=.pdf.



Journeyman licenses allow for installation, repair, replacement, maintenance, or alteration of all refrigeration systems and would likely cover the installation of air-source heat pumps without any training on fossil fuel systems. Identifying the lowest-barrier license that allows for the installation of water-source heat pumps will require more conversation and coordination between CT DEEP and CT DCP.

3.3.2 Licensing accessibility

In addition to identifying curriculum and training considerations for Connecticut licenses, NEEP also identified concerns about the barriers some potential candidates face in obtaining a license. Improving clarity on licensing rules and increasing accessibility to the licensing process could foster further growth of the workforce.

Conversations with the CT DCP and industry stakeholders suggest that the workforce needs greater clarity about licensing pathways. A primer on licensing pathways would be useful to ground-source heat pump installers, those interested in transitioning to ground-source heat pump installation, and new industry entrants. This primer could illustrate training requirements and the scope of work each license permits and outline viable paths to obtaining licenses needed for each stage of geothermal installation (drilling, loop fabrication, heat pump installation, etc.).

A gap may also exist between CT DCP's intention to allow workers to apply out-of-state experience toward their Connecticut on-the-job training requirements and worker access to this training exception. While CT DCP does not have reciprocity with any other jurisdictions for licenses, it does have established equivalencies with some states' licensing programs and considers transcripts from other states for recommendation to an internal review board. While workers with licenses from other jurisdictions may obtain waivers for on-the-job training (OJT) requirements relatively easily, those working without a license in other states find it more difficult to petition for a waiver of OJT requirements for a Connecticut license. NEEP recommends that CT DEEP work with CT DCP to do targeted outreach to industry stakeholders to address knowledge gaps and misconceptions about how to apply out-of-state experience to Connecticut licensing pathways and address any outstanding questions or concerns related to this process. CT DCP could also waive OJT requirements if the applicant has a proven track record of two years of geothermal heat pump business ownership in another state, as recommended by one stakeholder.

3.4 Drilling

3.4.1 Drilling: Recruitment and training

Many observers point to drilling as a major bottleneck for the geothermal industry. Increasing the number of trained, licensed drillers is critical to making geothermal projects easier for contractors to implement, which would help minimize project delays. See Table 2 for a description of the relevant [drilling licenses](#) in Connecticut, which are separate from the heating, piping, and cooling licenses discussed above. A driller need not start in a registered apprenticeship but must be a driller trainee for one year (in most cases) before taking the written exams and obtaining a license.



Table 2. Well Drilling License Types and Scopes of Work in Connecticut.

License Type	This registration permits the registrant to ...
W-1 Unlimited Well Driller Contractor	Engage in well construction.
W-2 Unlimited Well Driller	Construct a well, including the installation, repair and maintenance of pumps, pump motors, pump piping, valves, wiring, electric controls, and tanks, while in the direct and regular employment of a contractor registered for this work.
W-3 Limited Non-Water-Supply Contractor	Construct a non-water-supply well, including the installation, repair and maintenance of pumps, pump motors, pump piping, valves, wiring, electric controls, and tanks.
W-4 Limited Non-Water-Supply Driller	Perform the scope of W-3 license while in the direct and regular employment of a contractor registered for this work.
W-5 Limited Well Casing Extension Contractor	Perform well casing extension, repair, and maintenance work.
W-6 Limited Well Casing Extension Journeyman	Perform the scope of W-5 license while in the employ of a contractor licensed for this work.
W-7 Limited Geothermal Contractor	Construct a geothermal bore hole or geothermal system, up to and including the manifold connection, including the installation, repair, and maintenance of piping, casing, heat transfer media, pumps, pump motors, and valves. This registration excludes work on direct exchange systems.
W-8 Limited Geothermal Driller	Perform the scope of W-7 license while in the employ of a contractor licensed for this work.
W-9 Limited Direct Exchange Geothermal Contractor	Construct a geothermal bore hole or geothermal system, up to and including the manifold connection, but limited to those geothermal bore holes employing direct exchange or direct expansion technology, including drilling associated with the installation of copper or other piping containing a direct exchange heat transfer medium, the installation, repair, and maintenance of piping, casing, and heat transfer media.
W-10 Limited Direct Exchange Geothermal Driller	Perform the scope of W-9 license while in the employ of a contractor licensed for this work.
Driller Trainee	Perform the work for which they are being trained, only while in the presence and under the supervision of a registered contractor driller. Such driller trainee may also perform minimal cleaning work while not in the presence of such supervising contractor or driller.

Source: <https://portal.ct.gov/dcp/licensing/generate-a-roster-of-licenses-permits-registrations>, accessed June 2024



Geothermal drilling involves a skill set similar to that of other types of drilling, such as well-water, oil, and natural gas drilling. This transferability of skills creates opportunities to retrain drillers from other industries to work on geothermal projects. IGSHPA gears its geothermal drilling training toward existing drillers. Connecticut could implement this approach at in-state training institutions to increase retraining opportunities for drillers already working in the state. Because demand is more consistent for well-water or other kinds of drilling work, the industry may need a marketing campaign to entice drillers to work on geothermal. This campaign would need to demonstrate the viability of geothermal drilling as a business and convince workers that the demand for geothermal careers will become more and more stable. Connecticut state agencies could collaborate to support a marketing campaign aimed at retraining existing drillers.

Local 478, the Connecticut chapter of the International Union of Operating Engineers (IUOE), is planning to bring a geothermal drilling apprenticeship to its training facility in Meriden. Local 478 is developing this program with guidance from IUOE Local 150 in the Chicago area, which has been offering a geothermal drilling apprenticeship since 2009. Local 478's geothermal training program is currently awaiting approval from the Connecticut Department of Labor. Because it has already been successfully implemented elsewhere, the training director at Local 478 expects the program to be approved.

3.4.2 Drill rig availability

Sustainable Westchester has proposed the purchase of a publicly owned drill rig for the county, which the county or another public entity would lease out for geothermal drilling work. It also aims to provide workforce development opportunities, potentially in partnership with Westchester Community College and the Union of Operating Engineers. Sustainable Westchester has collaborated with the Westchester County Director of Economic Development on a concept paper proposal for this model with a request for funding from the County Board of Legislators.

One potential solution for increasing drill rig availability and driller training opportunities is public ownership of drilling rigs. [Sustainable Westchester](#), in Westchester County, NY, is a municipal member-based organization, comprising 44 of the county's 45 municipalities.¹¹ A representative of Sustainable Westchester suggested that a public entity in Connecticut could own and lease out a drilling rig and could potentially use it both for drilling within the community and for workforce training. CT DEEP could gauge interest in and assess the feasibility of this approach through coordination with local municipal groups and help identify funding, financing, and payback timelines.

The Geothermal Market Capacity Coalition, a national group with a focus on the Northeast, developed the idea of Geothermal Drilling Centers of Excellence to address

¹¹ Sustainable Westchester is a municipally led shared service provider working towards achieving a clean energy transition in New York State and strengthening the communities of Westchester County. <https://sustainablewestchester.org/>.



the need for an increased geothermal drilling workforce.¹² The coalition is composed of leading ground source heat pump manufacturers, contractors, geothermal drillers, trade groups, and educational, environmental, and advocacy organizations. The four main objectives of Geothermal Drilling Centers of Excellence are to provide geothermal training with wraparound services for drillers and other workers, develop innovative drill rig leasing programs, spur domestic drill rig manufacturing, and identify other opportunities for driving industry growth. The Geothermal Market Capacity Coalition has not yet secured funding for the Centers of Excellence but continues to pursue the concept as a means of supporting geothermal drilling growth. CT DEEP is currently an active member of this coalition and should continue to support the coalition’s pursuit of funding for the Centers of Excellence as a pathway to provide geothermal workforce training.

Another potential solution for the lack of drill rig availability is decreasing the need for drill rigs. The strategic use of other thermal resources can offset the need for boreholes and help reduce the cost and time required for drilling. Leveraging nearby sources of waste heat can increase system efficiency and reduce first costs for geothermal systems. Examples of waste heat include heat released from commercial refrigeration during winter and excess heat in a building’s wastewater. [A networked geothermal system in Vancouver](#) distributes waste heat from an ice rink to homes and buildings nearby for heat and hot water, and many other examples exist across the continent. Increasing mechanical, electrical, and plumbing firms’ capacity to leverage alternative thermal resources would benefit the industry as networked geothermal systems gain popularity, and the state could achieve this do via webinars, working groups, conferences, etc.

4. Conclusion

Based on extensive conversations with knowledgeable industry stakeholders and research on the current geothermal landscape, this report provides a tailored and specific selection of recommendations to best meet Connecticut’s geothermal workforce development needs and support both new and transitioning workers to the industry. In light of the previously published assessment of the current geothermal landscape and workforce in Connecticut, NEEP identified four main topic areas to be addressed in this plan: equity, recruiting and training new entrants, licensing, and drilling.

Equity—Incorporating equity measures in geothermal workforce development will align with support a diverse geothermal workforce, and provide economic benefits to historically-underrepresented communities in Connecticut. While the state has workforce equity goals for some industries, it has no established goals for geothermal heating and cooling workforce development. The state can embed equity in workforce development programs through targeted outreach efforts, by establishing clearly defined equity-related program goals, and by using holistic approaches to recruiting and training for individuals from underrepresented communities. By

¹² The Geothermal Market Capacity Coalition consists of leading ground source heat pump manufacturers; contractors and geothermal drillers; trades groups; and educational, environmental, and advocacy organizations working to relieve supply chain, labor, and capacity shortages. “A National Network of Geothermal Drilling Centers of Excellence,” Geothermal Market Capacity Coalition, [666c99a5c7b42cb43c15fe6c_GMCC-Geo-Drilling-CoE-White-Paper.pdf](#) (webflow.com).



investing a predetermined percentage of funding for recruitment in targeted communities, the state can bolster diversity in the workforce. Establishing equity-centered goals and metrics such as dollars spent on outreach, the number of individuals entering training programs, and successful candidate placements will allow the state to measure the effectiveness of its outreach strategies. By incorporating a holistic approach into program design through strategies like wraparound services, soft-skill training, and subsidies for training programs and related expenses, the state can reduce barriers to entry into the geothermal industry for individuals from underserved communities.

Recruiting and Training—To increase worker awareness of the geothermal industry and attract new workers, marketing campaigns and accessible low-cost training opportunities are crucial. To encourage new entrants into the field, the state of Connecticut could create a marketing campaign illustrating career pathways in geothermal; support Connecticut training centers and institutions to use new modularized trainings such as those offered by the IGSHPA; provide more scholarship opportunities for HVAC training courses; prompt state-funded energy efficiency programs, such as Energize CT’s Green STEP program, to include geothermal curriculum in their trainings; and increase the capacity of technical high school HVAC programs.

Licensing—The state should clarify the lowest-barrier heating, piping, and cooling licenses that cover the installation of water-source heat pumps in their scope with the CT DCP to facilitate the growth of businesses seeking to focus on heat pumps rather than fossil fuel equipment. To streamline entry into the field and licensure in Connecticut, the state could create informational resources about the pathways available for geothermal professionals. This would make it easier for geothermal professionals to transfer out-of-state work experience, help applicants meet on-the-job training requirements, and make training programs more accessible.

Drilling—The state can address the drilling bottleneck evident in the industry with three strategies: retraining existing drillers, enticing drilling companies to diversify their businesses into geothermal drilling, and increasing the availability of drill rig equipment. Establishing hubs where professionals in the drilling industry can share costly training equipment and resources could enhance the training and retraining of geothermal well drillers. Another idea proposed by the team involves a public entity, like a council of governments, owning and leasing drill rigs. This approach could reduce entry barriers, accelerate geothermal projects by making rigs more readily available, and offer training opportunities for workers. Additionally, bringing existing geothermal well driller apprenticeship programs to Connecticut, potentially supported by state subsidies to encourage companies to take on new hires, would further boost the supply of new drillers entering the industry.

Based on the needs of the consulted stakeholders and the data collected, CT DEEP, its sister agencies, and other geothermal actors in the state should work to establish an equity-centered approach to support every aspect of geothermal workforce development. NEEP recognizes that most of the work outlined in this plan is contingent on the availability of funding, sources of which have not been identified. If funded, however, the strategies outlined in this plan can help Connecticut as it seeks to develop a geothermal workforce at the scale needed to fulfill *Connecticut’s climate and grid-management goals*.



4.1 Next steps

NEEP recommends that Connecticut agencies and other geothermal players, contingent on availability of funds, implement short-, medium-, and long-term actions to fill gaps and address inadequacies to support successful scale-up of the geothermal workforce.

4.1.1 Short-term actions

Over the next 12 months, Connecticut should focus on actions that will both address the urgent needs of the current workforce and position the geothermal workforce for future success.

Based on the needs assessment and conversations with industry stakeholders, NEEP recommends collaboration between relevant Connecticut agencies such as CT DEEP, OWS, DCP, Department of Labor, Department of Economic and Community Development, and others as necessary to achieve the following objectives:

- Obtain any available, relevant demographic data that was beyond NEEP's scope during the research for the workforce needs assessment and workforce development plan (this could include demographic data collection from various government agencies or requests for data from entities that do not post publicly, including data on demographics in existing recruitment, interview, and hiring pools); begin to track and measure this data to assess equity-related themes and trends;
- Set equity-centered goals aligning with Justice40 for geothermal workforce outreach, recruitment, and hiring;
- Improve clarity of licensing rules and regulations by creating a primer for industry stakeholders on various licensing pathways for geothermal careers; include additional resources for those already in the industry and willing to transfer into Connecticut's market;
- Identify the lowest-barrier license that covers the installation of water-source heat pumps in its scope of work;
- Connect with heat pump manufacturers, technical high schools, and labor unions to begin planning a campaign to raise awareness of geothermal career pathways for young people (marketing activities could include tabling at career fairs, hosting informational sessions at vocational schools, partnering with community-based organizations for career fairs or construction project site visits, and/or coordinating with industry stakeholders to donate or subsidize the use of HVAC equipment for educational use);
- In consultation with industry representatives, work to include geothermal training topics as part of Green STEP's curriculum and in public schools' career cluster initiatives;
- Coordinate with IGSHPA to bring its new modularized curricula into vocational and technical schools and community colleges in accordance with IGSHPA's plans;
- Promote training on mitigating and handling refrigerant leaks; and
- Establish a working group to direct, facilitate, and continuously evaluate the impact of actions and overall success in developing Connecticut's geothermal workforce (this could be part of a regional sector partnership established by the Office of Workforce Strategy).



4.1.2 Medium-term actions

NEEP recommends that over the next 18 to 30 months Connecticut agencies work to ease pathways of professional development through the following actions:

- Enhance scholarship opportunities for members of disadvantaged and/or environmental justice communities to take geothermal training courses, enroll in technical schools, and join geothermal pre-apprenticeship programs;
- Work with existing training programs to increase the capacity of vocational and technical schools to take on more students;
- Consider creating grants for small businesses to subsidize OJT for targeted candidates in apprenticeships related to geothermal, thereby encouraging companies to take on some hiring risk;
- Support the Department of Labor's approval of geothermal apprenticeship programs such as the geothermal drilling program proposed by Local 478;
- Address misconceptions in the geothermal industry about transferring out-of-state licenses or work experience with targeted outreach and education;
- Explore opportunities to provide accessible wraparound services for students, including stipends for childcare, housing, and transportation, especially for those undergoing training programs (CT DEEP could also develop training and communications packages targeted toward language-isolated communities); and
- Undertake strategic outreach and develop tools for architects and engineers to become more aware of geothermal heating and cooling as an ideal option for designing and retrofitting HVAC systems and to bolster these professionals' willingness and capacity to deploy it.

4.1.3 Long-term actions

NEEP recommends that by the end of the 30-month period, Connecticut should seek to make significant progress on the following actions:

- Institute a formal process of collecting and responsibly storing detailed demographic data for the geothermal workforce through follow-up with participants of various training programs and collaboration with government agencies and private companies; consider ways to share this data in a publicly accessible database;
- Create a portfolio of affordable options for geothermal training that is publicly and easily accessible through existing training programs and on CT DEEP's web pages (such a portfolio can ease barriers to entry for industry entrants);
- Collaborate with the Geothermal Market Capacity Coalition to build a network of geothermal professionals in and around Connecticut to evaluate and begin developing a Center of Excellence for the geothermal industry in the region; and
- Encourage municipalities, councils of government, and/or private and nonprofit entities to establish a nonprofit drilling organization that can provide geothermal services to low-income focused projects; consider public ownership of expensive equipment such as a drill rig; explore supporting such a nonprofit through grants or financing.