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STATE CORPORATION COMMISSION

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December 1, 2024

The Honorable R. Creigh Deeds
Chair, Senate Committee on Commerce and Labor

The Honorable Jeion A. Ward
Chair, House Committee on Labor and Commerce

The Honorable Scott A Surovell
Chair, Commission on Electric Utility Regulation

Ladies and Gentlemen:

Please find enclosed the Virginia State Corporation Commission's report ("Geothermal Workgroup Report") on the findings and recommendations of the stakeholder workgroup convened to among others, "examine the feasibility of establishing renewable energy portfolio standard program ("RPS program") requirements under § 56-585.5 of the Code of Virginia, as amended by this act…." In summary, Enactment Clause 2 of Chapter 597 of the 2024 Acts of Assembly seeks to require each Phase I and Phase II Utility, as defined in subdivision A 1 of § 56-585.1 of the Code of Virginia, to procure and retire renewable energy certificates ("RECs") from certain defined geothermal heating and cooling systems, as a percentage of the number of RECs used for RPS program compliance purposes.

The Geothermal Workgroup Report includes findings regarding critical, currently missing factors that may need to be defined or configured in order to support the feasibility of a geothermal REC carve-out at this time. It also identifies challenges that would need to be overcome in order to enhance the feasibility of including a carve out for geothermal heating and cooling systems in the Virginia RPS program and offers ways to address those challenges.

Please let us know if we may be of further assistance.

Respectfully submitted,

David N. Essah

David N. Essah

Enclosure

VIRGINIA

State Corporation Commission's Geothermal Working Group: Final Report

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Executive Summary

The Virginia State Corporation Commission ("SCC") convened a Geothermal Working Group to evaluate the feasibility of implementing a Renewable Portfolio Standard ("RPS") program requirement for Phase I and Phase II utilities to procure and retire Renewable Energy Certificates ("RECs") from geothermal heating and cooling systems. This initiative, mandated by the 2024 Regular Session of the Virginia General Assembly, Acts of Assembly Chapter 597 (Senate Bill 508), sought to assess how a geothermal REC ("GREC") carve-out could be integrated within Virginia's existing RPS framework. The working group, consisting of representatives from the geothermal industry, utilities, government agencies, and advocacy organizations, held a series of meetings between July and September 2024 to gather input and identify critical factors impacting the feasibility of a GREC carve-out within the RPS program requirements.

The working group identified 14 feasibility factors, including GREC calculation methods, verification processes, affordability and equity concerns, supply chain and workforce considerations, and the growth potential of the geothermal market in Virginia. Their discussions highlighted the complex nature of implementing a GREC carve-out, revealing that while some factors currently support feasibility, others present significant challenges that must be addressed for successful program implementation.

Key findings include the need for a clearly defined GREC calculation and verification processes, concerns regarding the affordability and accessibility of geothermal technologies, and the necessity of establishing appropriate carve-out percentages and deficiency payment levels. Based on stakeholder feedback, the report outlines several recommendations aimed at enhancing program feasibility, including creating performance-based incentives, expanding the geothermal supply chain, and implementing equitable support mechanisms for residential and commercial installations.

The findings of the working group suggest that a number of critical factors are not currently defined or configured to support the feasibility of a GREC carve-out. Changes would be needed to overcome the challenges identified and enhance feasibility.

Statutory and Legislative Background

The SCC convened the Geothermal Working Group to examine the feasibility of establishing an RPS program requirement for Phase One and Phase Two Utilities to procure and retire RECs from geothermal heating and cooling systems. This initiative stems from the 2024 Regular Session Acts of Assembly Chapter 597 (Senate Bill 508), which mandates the SCC conduct this examination.

Specifically, the legislation directs that: *"the [SCC] shall convene a stakeholder work group to examine the feasibility of establishing renewable energy portfolio standard program (RPS program) requirements under § 56-585.5 of the Code of Virginia [("the Code")], as amended by this act, that require each Phase I and Phase II Utility, as defined in subdivision A 1 of § 56-585.1 of the Code of Virginia, to procure and retire renewable energy certificates (RECs) from geothermal heating and cooling systems, as defined in § 56-576 of the Code of Virginia, as amended by this act, placed in service after August 16, 2022, as a percentage of the number of RECs used for RPS program compliance. The work group shall include representatives from the geothermal industry, Phase I and Phase II Utilities, the Department of Energy, environmental advocacy organizations, environmental justice organizations, consumer advocates, and other interested stakeholders. The Commission shall report the findings and recommendations of the work group to the Chairmen of the Senate Committee on Commerce and Labor, the House Committee on Labor and Commerce, and the Commission on Electric Utility Regulation no later than December 1, 2024."*

To provide context for the work group's deliberation, the legislation also introduces a specific definition for "Geothermal heating and cooling system," which will take effect on January 1, 2025. This definition outlines five key criteria that a system must meet to qualify. A Geothermal heating and cooling system is a system that:

1. Exchanges thermal energy from groundwater or a shallow ground source to generate thermal energy through an electric geothermal heat pump or a system of electric geothermal heat pumps interconnected with any geothermal extraction facility that is (i) a closed loop or a series of closed-loop systems in which fluid is permanently confined within a pipe or tubing and does not come in contact with the outside environment or (ii) an open loop system in which ground or surface water is circulated in an environmentally safe manner directly into the facility and returned to the same aquifer or surface water source;
2. Meets or exceeds the current federal Energy Star product specification standards;
3. Replaces or displaces less efficient space or water heating systems, regardless of fuel type;
4. Replaces or displaces less efficient space cooling systems that do not meet federal Energy Star product specification standards; and
5. Does not feed electricity back to the grid.

Furthermore, the legislation amends Code §56-585.5 C 5, effective January 1, 2025. It states, "Energy from a geothermal heating and cooling system is eligible for inclusion in meeting the requirements of the RPS Program. RECs from a geothermal heating and cooling system are created based on the amount of energy, converted from BTUs to kilowatt-hours, that is generated by a geothermal heating and

cooling system for space heating and cooling or water heating. The Commission shall determine the form and manner in which such RECs are verified."

History of the Geothermal Working Group Meetings

The Geothermal Working Group held three meetings to gather perspectives and recommendations from stakeholders. Meetings were held on July 29, 2024, August 19, 2024, and September 9, 2024. This report details the proceedings and findings from these three meetings, along with a summary of recommendations for consideration. Full meeting summaries are included in Appendix A of this report, including agendas for each meeting, and a summary of presentations given. The body of this report focuses on the results of the discussions held, and the conclusions drawn.

Issues Identified: Factors Influencing Feasibility

Based on the working group discussions held, the following 14 factors were identified as having influence on the feasibility of a GREC carve-out within the RPS program. The table below lists the feasibility factors:

Feasibility Factors			
1	GREC Calculation Method	**8**	Supply Chain and Workforce Considerations
2	GREC Verification Process	**9**	Affordability and Equity
3	GREC Retirement Process	**10**	Initial Carve-Out Percentage
4	Performance-Based Incentives	**11**	Carve-Out Percentage Dynamics Over Time
5	Installed Base of Eligible Systems	**12**	Increasing RPS Requirements
6	Expected Geothermal Market Growth in Virginia	**13**	Initial Deficiency Payment Level
7	Legacy Geothermal Installations	**14**	Deficiency Payment Level Over Time

Below each feasibility factor is described and challenges associated with each factor are listed.

Factor 1:	**GREC Calculation Methods**
Description:	The method that will be used to determine the number of GRECs generated annually from eligible geothermal heating and cooling systems in Virginia.
Challenges:	Starting January 1, 2025, geothermal heating and cooling systems will be eligible for inclusion in the RPS program. However, the legislation that defines the method for calculating GRECs leaves uncertainty around the manner in which RECs will be generated from geothermal heating and cooling installations and additional clarity may be appropriate. Ensuring transparency, consistency, and accuracy in REC calculation methods for geothermal systems is a key challenge.

Factor 2:	**GREC Verification Process**

Description:	Code §56-585.1 C 5 states: "Energy from a geothermal heating and cooling system is eligible for inclusion in meeting the requirements of the RPS Program. RECs from a geothermal heating and cooling system are created based on the amount of energy, converted from BTUs to kilowatt-hours, that is generated by a geothermal heating and cooling system for space heating and cooling or water heating. *The Commission shall determine the form and manner in which such RECs are verified*."
Challenges:	Virginia does not currently have an established process for verifying GRECs. Verification is needed to ensure that geothermal systems are issued the appropriate RECs, and to verify ongoing system operation and REC creation over time. This poses challenges for older systems and those without modern monitoring capabilities. Participants stressed the need to balance verification accuracy with practical considerations to avoid excessive administrative burdens. It was noted that verification methods can differ for different customer classes (residential vs commercial vs industrial geothermal users).

Factor 3:	**GREC Retirement Process**
Description:	Retiring a REC removes the instrument from circulation or market use.
Challenges:	Utilities have expressed concerns about retiring source specific RECs in the PJM GATS (Generation Attribute Tracking System), which can be time consuming and complex. Minimizing burden and creating a process that works for everyone, including utilities and aggregators, will promote compliance and reduce implementation costs.

Factor 4:	**Performance-Based Incentives**
Description:	These incentives would promote improvements in the operating efficiency and effectiveness over time, of geothermal heating and cooling systems installed in Virginia.
Challenges:	Funding sources for incentivizing installations or performance upgrades and the implementation process of such incentives are not established in Virginia. Utilities and/or Virginia Energy may be potential participants in this process, but it is not clear what would be required to establish it. On-going performance incentives and improvements could also be useful but are not established.

Factor 5:	**Installed Base of Eligible Systems**
Description:	Geothermal heating and cooling systems located in the Commonwealth, placed in service after August 16, 2022.
Challenges:	The geothermal heat pump market in Virginia is currently small and predominantly residential. It is estimated that up to 30,000 geothermal heating and cooling systems may currently exist in Virginia, but a relatively small portion would be eligible to support a GREC carve-out, due to the service date requirement.

Factor 6:	**Expected Geothermal Market Growth in Virginia**
Description:	The rate at which geothermal heating and cooling system deployments are expected to grow in Virginia.
Challenges:	The geothermal heat pump market in Virginia is currently small and predominantly residential. The program's success will depend on market growth. Different growth dynamics are anticipated in the residential, commercial, and industrial sectors. Additionally, the in-service date requirements mean some portion of the existing market would not be eligible for participation in the carve-out as currently codified. In addition, overall electricity demand is increasing. As a result, a fixed percentage will require growth year-over-year to keep up with increasing demand.

Factor 7:	**Legacy Geothermal Installations**
Description:	Geothermal systems installed in Virginia prior to August 16, 2022
Challenges:	Systems installed before August 16, 2022 are not eligible for inclusion in the GREC carve-out of the RPS program (but could be eligible for inclusion in the general RPS requirement if their GRECs are retired by a participating utility). Approximately 30,000 systems may currently exist, which could account for up to 1.2 million annual RECs, effectively 30 times the expected number of GRECs to be generated annually. No process exists for handling legacy systems that perform upgrades.

Factor 8:	**Supply Chain and Workforce Considerations**
Description:	Availability of qualified manufacturers, suppliers, installers, maintenance and repair technicians, and aggregators in Virginia to support the geothermal heating and cooling market.
Challenges:	Expanding the geothermal market in Virginia will require a robust supply chain and skilled workforce.

Factor 9:	**Affordability and Equity**
Description:	The degree to which a program supports residents and businesses in purchasing geothermal systems, and ensures that all residents and businesses have equal access to technology and financing options.
Challenges:	High upfront costs were identified as a significant barrier to geothermal system adoption, particularly for low-to-moderate income (LMI) households. Incentives such as upfront REC payments, leveraging tax credits, or integrating REC value into financing options were recommended to address these costs. Participants stressed the importance of designing programs that ensure equitable access to the benefits of geothermal technology for all Virginians, including targeted support for multifamily properties and affordable housing.

Factor 10:	**Initial Carve-Out Percentage**
Description:	The initial percentage value set for a GREC carve-out within the RPS program.
Challenges:	Setting realistic carve-out percentages that match market supply and demand, is crucial to prevent excessive costs from spilling over to ratepayers. An initial carve-out percentage should appropriately reflect the installed base of geothermal systems eligible for GREC consideration (those installed after August 16, 2022, according to the Code requirement).

Factor 11:	**Carve-Out Percentage Dynamics Over Time**
Description:	The method by which the GREC carve-out percentage changes from the initially defined value.
Challenges:	Setting realistic carve-out percentages that match market supply and demand, is crucial to prevent excessive costs from spilling over to ratepayers. Over time, changes in the carve-out percentage should be realistic. Participants emphasized that these percentages should be flexible and tied to actual industry growth metrics, allowing adjustments as the market matures and more geothermal systems are installed.

Factor 12:	**Increasing RPS Requirements**
Description:	RPS requirements will increase over time, according to a schedule defined by the Code. If a GREC carve-out is defined as a fixed percentage of the overall RPS requirement, the total number of GRECs required for purchase will also increase according to the defined RPS schedule.
Challenges:	Virginia's RPS program mandates increasing percentages of renewable energy, with Appalachian Power required to reach 100% renewable energy by 2050 and Dominion Energy by 2045. Starting January 1, 2025, geothermal heating and cooling systems will be eligible for RPS compliance. A percentage carve-out for GRECs from units installed after August 16, 2022, would require growth of the geothermal industry at a rate that matches the mandated RPS increases. It is not clear whether the geothermal industry will be able to keep up.

Factor 13:	**Initial Deficiency Payment Level**
Description:	The initial price point at which the deficiency payment[1] is set, at the time when a carve-out requirement becomes active.

[1] Code Section 56-585.5 D 5 states, for the RPS program overall: "If, in any year, a Phase I or Phase II Utility is unable to meet the compliance obligation of the RPS Program requirements or if the cost of RECs necessary to comply with RPS Program requirements exceeds $45 per megawatt hour, such supplier shall be obligated to make a deficiency payment equal to $45 for each megawatt-hour shortfall for the year of noncompliance, except that the deficiency payment for any shortfall in procuring RECs for solar, wind, or anaerobic digesters located in the

Challenges:	Higher Deficiency Payment levels were suggested to drive market adoption, with comparisons to Maryland's approach where deficiency payments range from $90-$100. Participants highlighted the need for Virginia-specific analysis to set appropriate payment levels that would effectively stimulate market growth without disproportionately impacting ratepayers or creating unsustainable compliance costs for utilities.

Factor 14:	**Deficiency Payment Level Over Time**
Description:	The method by which the deficiency level payment amount changes from the initially defined value.
Challenges:	Higher Deficiency Payment levels were suggested to drive market adoption, with comparisons to Maryland's approach where deficiency payments range from $90-$100. Over time, stakeholders suggested that the deficiency payment could decrease as the GREC market increases.

Feasibility Assessment and Findings

An assessment was conducted to determine the criticality and feasibility of each factor identified. Working group members were presented with a set of questions regarding each factor, and their aggregate responses were analyzed for insights. This section reviews the findings and their implications.

Commonwealth shall be $75 per megawatts hour for resources one megawatt and lower. The amount of any deficiency payment shall increase by one percent annually after 2021."

Criticality: How Critical is Each Factor in Assessing Feasibility?

The working group evaluated the criticality of each feasibility factor in assessing the potential for implementing a GREC carve-out in Virginia's RPS program. Participants were asked to rate each factor as either "Highly Critical," "Moderately Critical," "Somewhat Important," or "Not Significant At All." The following table summarizes the responses, providing insight into which factors the group considered most crucial for the success of a potential GREC program. Each row indicates the percentage of responses received in each category and the total number of respondents for each question.

Criticality Factor	Label	Highly Critical	Moderately Critical	Somewhat Important	Not Significant At All	# of Respondents
1	GREC Calculation Method	75%	19%	6%	0%	16
2	GREC Verification Process	60%	20%	20%	0%	15
3	GREC Retirement Process	40%	47%	13%	0%	15
4	Create Performance-Based Incentives	33%	20%	20%	27%	15
5	Installed Base of Eligible Systems	13%	53%	27%	7%	15
6	Expected Geothermal Market Growth in Virginia	73%	27%	0%	0%	15
7	Handling Legacy Geothermal Installations	20%	20%	27%	33%	15
8	Supply Chain and Workforce Considerations	43%	29%	29%	0%	14
9	Affordability and Equity	60%	27%	13%	0%	15
10	Defining an Initial Carve-Out Percentage	83%	17%	0%	0%	12
11	Carve-Out Percentage Dynamics Over Time	40%	30%	30%	0%	10
12	Keeping Up with Increasing RPS Requirements	60%	20%	20%	0%	10
13	Defining an Initial Deficiency Payment Level	67%	8%	25%	0%	12
14	Setting the Deficiency Payment Level Over Time	20%	20%	60%	0%	10

Support for Success: Does the Current Definition or Status of Each Factor Support or Detract from Feasibility?

Participants were asked to evaluate whether each factor, as currently defined, supports or detracts from the potential success of of a GREC carve-out program. Responses were categorized as "Strongly Supports Success," "Moderately Supports Success," "Moderately Detracts from Success," or "Strongly Detracts from Success." The results, presented in the table below, offer a snapshot of which aspects of the current regulatory and market environment may facilitate or hinder the implementation of a GREC carve-out. Each row indicates the percentage of responses received in each category and the total number of respondents for each question.

Support for Success	Label	Strongly Supports Success	Moderately Supports Success	Moderately Detracts from Success	Strongly Detracts from Success	# of Respondents
1	GREC Calculation Method	15%	69%	8%	8%	13
2	GREC Verification Process	7%	27%	27%	40%	15
3	GREC Retirement Process	33%	47%	20%	0%	15
4	Create Performance-Based Incentives	0%	17%	50%	33%	12
5	Installed Base of Eligible Systems	33%	47%	13%	7%	15
6	Expected Geothermal Market Growth in Virginia	69%	15%	8%	8%	13
7	Handling Legacy Geothermal Installations	10%	40%	20%	30%	10
8	Supply Chain and Workforce Considerations	50%	21%	29%	0%	14
9	Affordability and Equity	7%	20%	40%	33%	15
10	Defining an Initial Carve-Out Percentage	0%	0%	33%	67%	9
11	Carve-Out Percentage Dynamics Over Time	0%	0%	44%	56%	9
12	Keeping Up with Increasing RPS Requirements	42%	8%	17%	33%	12
13	Defining an Initial Deficiency Payment Level	0%	33%	17%	50%	12
14	Setting the Deficiency Payment Level Over Time	0%	18%	36%	45%	11

Commentary and Conclusions Regarding Criticality and Support for Feasibility

The following table provides commentary and conclusions regarding the findings related to each factor.

	Label	Commentary	Conclusions
1	GREC Calculation Methods	Participants noted the uncertainty regarding the calculation method that will be used, but still indicated that the current definition supports success.	The findings show an apparent contradiction in working group member perspectives, which should be further explored and clarified.
2	GREC Verification Process	Participants noted high criticality and detraction from success.	This factor currently supports the overall infeasibility of a GREC carve-out.
3	GREC Retirement Process	Polling showed high criticality and support for success, despite the challenges raised by utilities regarding PJM GATS limitations.	This factor supports the overall feasibility of a GREC carve-out.
4	Performance-Based Incentives	This does not appear to be a critical factor in assessing the feasibility of a carve-out.	Incentives can support geothermal market growth, but are not critical in assessing the feasibility of a carve-out.
5	Installed Base of Eligible Systems	Participants view the current installed base as sufficient in supporting a carve-out, though the small total number of eligible systems is noted as a challenge.	This factor supports the overall feasibility of a GREC carve-out.
6	Expected Geothermal Market Growth in Virginia	Participants view market growth as a critical factor and hold a positive outlook for the industry.	This factor supports the overall feasibility of a GREC carve-out.
7	Legacy Geothermal Installations	This does not appear to be a critical factor in assessing the feasibility of a carve-out.	Though opportunities exist to monetize legacy systems, this is not critical in assessing the feasibility of a carve-out.
8	Supply Chain and Workforce Considerations	Participants have a positive perception of the local market and its current standing.	This factor supports the overall feasibility of a GREC carve-out.
9	Affordability and Equity	Participants see this factor as critical, and do not believe affordability and equity are adequately being addressed.	This factor currently supports the overall infeasibility of a GREC carve-out.
10	Initial Carve-Out Percentage	Participants see this factor as critical, but do not believe an appropriate initial carve-out level has been identified.	This factor currently supports the overall infeasibility of a GREC carve-out.
11	Carve-Out Percentage Dynamics Over Time	Participants noted challenges related to carve-out percentage dynamics,	The findings show an apparent contradiction in working group member perspectives, which

		but still indicated that the current definition supports success.	should be further explored and clarified.
12	Increasing RPS Requirements	Participants acknowledge this as a critical factor, but are split on whether changes are needed to address this.	Further exploration may be needed to understand the impact of this factor on the feasibility of a carve-out.
13	Initial Deficiency Payment Level	Participants believe the deficiency payment is a critical factor to program success, but it is not correctly structured to support the success of a carve-out.	This factor currently supports the overall infeasibility of a GREC carve-out.
14	Deficiency Payment Level Over Time	This does not appear to be a critical factor in assessing the feasibility of a carve-out.	This factor is not a critical determinant for feasibility.

Based on the stakeholder feedback received, the following conclusions can be drawn:

- Four factors currently support the feasibility of a GREC carve-out program in VA. These include:
  - The current GREC Retirement Process.
  - The current installed base of eligible geothermal systems in Virginia.
  - The current supply chain and geothermal workforce in Virginia. The expected geothermal market growth in Virginia.
- Four factors currently prevent a GREC carve-out program from being feasibly implemented in VA. These include:
  - The lack of a clearly defined and transparent process for verifying GRECs.
  - The affordability and equity of access to geothermal technologies by residents and businesses.
  - An insufficient conclusion concerning the initial carve-out percentage that would be most feasible for Virginia.
  - An insufficient conclusion regarding the best monetary value to assign to the deficiency payment level within a GREC carve-out program.
- Three factors should be further clarified, to better understand their impact on determining the feasibility of a carve-out. These factors include:
  - The GREC calculation method to be used in Virginia.
  - The dynamics by which the carve-out percentage changes over time.
  - The relationship between a GREC carve-out percentage and mandated increases in RPS requirements over time.
- Three factors initially identified through working group discussions do not appear to be critical considerations in assessing the feasibility of a carve-out program. These include:
  - Performance-based incentives for geothermal system upgrades and enhancements.
  - Incentivizing legacy geothermal systems to participate in the GREC carve-out program.
  - The method by which the deficiency level payment amount changes from the initially defined value.

The findings of the working group suggest that a number of critical factors are not currently defined or configured to support the feasibility of a GREC carve-out. Changes would be needed to overcome the challenges identified and enhance feasibility.

The following section of this report provides recommendations that can be pursued to overcome the challenges identified.

Recommendations for Enhancing Feasibility

Working group members were encouraged to provide additional recommendations for each feasibility factor. These suggestions offer valuable insights from diverse stakeholders and highlight potential areas for improvement or further consideration. The following sections compile these recommendations, organized by each of the 14 feasibility factors discussed by the working group. These comments provide a great source of ideas for policymakers and regulators to consider as they contemplate a GREC carve-out in Virginia.

Program Design

Factor 1: GREC Calculation Method

	Recommendations
1	Develop Standardized Calculation Methods: Establish state-approved, standardized methods for calculating GRECs, ensuring transparency, consistency, and accuracy across residential, commercial, and industrial applications. This approach should use public data and reflect actual system performance. Different methodologies may be needed for various system sizes, with more detailed approaches for larger installations.
2	Participants suggested using standardized state-maintained calculators rather than proprietary tools, emphasizing the need for transparent and public data. Important factors for calculations include the system's Coefficient of Performance ("COP"), local climate data, building characteristics, and the method of converting thermal energy into kilowatt-hours. Simplifying the calculation while ensuring it reflects actual performance was highlighted as essential for both residential and commercial applications.
3	If the geothermal system is replacing a system using grid provided electricity, the current methodology may overstate the RECs because grid-provided electricity is becoming greener and cleaner every year.
4	A commission-established calculation is likely needed to improve the verification process.
5	Care needs to be given in selecting variables (or allowing customer inputs) to accurately calculate GRECs created by geothermal systems, both pre-August 16, 2022, and those eligible for the carve-out (installed on or after August 16, 2022).
6	Some believe that a new energy savings calculator should be devised for Virginia “RPS eligible” GRECs. This calculator should prioritize transparency and reliable GREC generation. This calculator should be operated by a third-party or independent trade organization, and be auditable by industry, aggregators, SCC staff, and utilities alike.
7	Some think it’s important to use the same method for all systems to keep it simple. Too many unique site-specific adjustments would be difficult
8	Need neutral third party like International Ground Source Heat Pump Association to host an approved calculator based on Department of Energy-certified (Air Conditioning, Heating, and

	Refrigeration Institute) ratings. Transparency of calculation method is also necessary for credibility.
9	Recommend following the suggestions of the group which creates an industry standard method of energy savings and equipment performance based on COP and other metrics.
10	Establish a standard third-party calculator that should standardize the calculation and promote transparency and fairness in the market.
11	Clarification from the General Assembly on if the intent was the full heat content exhausted or adsorbed by the system, or just the efficiency gains between an air source heat pump and a geothermal heat pump.

Factor 2: GREC Verification Process

	Recommendations
1	Provide Simple Verification Processes for Residential Customers: Implement simplified verification processes to reduce administrative burdens, especially for residential systems. Options include using equipment serial numbers and installation photos for one-time calculations and self-certification.
2	Adopt Different Processes for Different Customer Types: For larger systems, consider more rigorous checks, such as periodic on-site inspections and leveraging existing energy management systems.
3	A Commission-established verification process is likely required to make it feasible for a carve-out.
4	Balance needs to be struck between accuracy and burden; however, ensuring REC creation is accurately tracked and verified (that the actual number of RECs claimed are being created and are available) is necessary to ensure that the program is providing the results that it claims.
5	Some participants recommend simplicity to keep the administrative burden low.
6	Auditors should obtain a statistically significant sample of measurable and verifiable data from Ground Source Heat Pumps ("GSHPs") at one year and 3 years. Commissioning data for a sample population could diminish the need for verification. Ground heat exchanger designs could be pre-approved to minimize variation and reduce verification. Contractor registration and demonstration of competency would assist in the same way. Finally, performance monitoring data from the GSHPs would be most valuable.
7	The recommendations to date are well conceived. Several participants stated that residential/light commercial systems below a certain size (i.e. 5 tons) should require a light verification process but commercial and industrial systems require more detailed verification.
8	Clearly defined requirements for system eligibility and the supporting documents necessary to verify should be industry standard documents, meaning they would be readily available.
9	Members of this stakeholder group would be recommended to provide comment in the next GATS Business Rules case that may address this issue.

Factor 3: GREC Retirement Process

	Recommendations
1	Explore using the PJM GATS system's capabilities for source-specific REC tracking and bulk retirement options to streamline the process. Develop new software capabilities as needed, in conjunction with impacted utilities, aggregators, and PJM.

2	A Commission order is required to confirm for PJM GATS how to process GRECs.
3	It may be appropriate for a balance to be struck to ensure that administrative burdens on utilities subject to any GREC carve-out are manageable. It appears that GATS is a suitable option for tracking and retiring GRECs, both for general RPS compliance and any possible GREC-specific carve-out; however, there may be costs associated with needing to transact small quantities of limited-availability GRECs that increase costs of compliance, which will ultimately be borne by utility customers.
4	This is a standardized process within GATS, similar to solar.
5	Ensure reporting is transparent and accessible.
6	Use the Solar GATS process.
7	This process already exists for solar and can be applied to geothermal.

Factor 4: Performance-Based Incentives

	Recommendations
1	Incorporate Performance-Based Incentives: Explore performance-based incentives to encourage ongoing system optimization and efficient operation, particularly for larger commercial and industrial systems. Options include tiered incentive levels based on measured performance or bonuses for systems that exceed expected efficiency levels. Care should be taken to balance the complexity of these incentives with the goal of promoting adoption.
2	There are only tax credit incentives that may not be fully helpful to supporting upfront costs; more incentives may be needed for upfront costs which requires legislative changes.
3	Participants represented that energy savings are certain for geothermal systems and don't change.
4	While performance-based incentives may allow for additional efficiency of the program (ensuring that geothermal systems are operating at or near maximum efficiency or encouraging improvements to increase performance [and the availability of GRECs]), it does not seem that performance-based incentives beyond a customer receiving the maximum number of RECs his/her system is capable of producing is necessary for consideration of a GREC carve-out. Verification of RECs created seems to be a more directly necessary part of the equation.
5	Reward installers for desired outcomes. Provide consumer targeted marketing materials.
6	Recommend following current industry standard performance methodologies such as American Society of Heating, Refrigeration, and Air Conditioning Engineers 90.1. Recommend mandating certain industry standard programs to be used for geo calculations.
7	Additional incentives can/should be made available. Overcomplicating a new REC incentive could make it more difficult for utilities to adopt.
8	This would require a change in the statute to implement and should include where the funds are coming from.

Domestic Market Considerations

Factor 5: Installed Base of Eligible Systems

	Recommendations
1	Allow inclusion of older geothermal systems in the possible carve-out, perhaps at a lower tier REC level.

2	Set the carve-out percentage at a very low level, to reflect the actual quantity of eligible GRECs expected in the market.
3	Incentivize geothermal market growth in Virginia and lower barriers to adoption.
4	Analyze the current installed base of eligible systems (those installed after August 16, 2022) to develop more accurate estimates.
5	Only two years of installations will be eligible for the carve-out, which may not be enough for a base.
6	To the extent that a percentage carve-out is sized to existing eligible systems (those installed on or after August 16, 2022) in Virginia while escalating at a rate that is achievable for new systems to be installed on an annual basis, the carve-out may be appropriate. However, if a percentage carve-out is set too high or increases too rapidly, it may mean that the number of installed units necessary to comply with the carve-out may not exist and may be substantially behind any carve-out, making compliance unnecessarily difficult or practically impossible.
7	Any eligibility for systems installed prior to August 16, 2022 would likely require legislative changes.
8	Appropriate studies of available systems in Virginia installed between August 16, 2022, and the study date would be a vital piece of information to ensure appropriate setting of a carve-out percentage.
9	Many "older" systems are high performance GSHPs providing more GRECs than newer, marginally qualified systems. At the same time, many of these older systems have performance monitoring installed and operating to prove high performance operation. Recommendation is to award GRECs based on performance, not a fairly randomized age vs. performance assumption.
10	The registration process and eligibility must be attainable for systems that are already installed post 2022.

Factor 6: Expected Geothermal Market Growth In Virginia

	Recommendations
1	Conduct Further Market Analysis: Perform detailed studies of geothermal potential in Virginia, including market size, current system adoption, and future growth projections. Utilize modeling tools such as NREL's ResStock model to inform program design and identify the most effective strategies for encouraging geothermal adoption across the state.
2	It was unclear if market growth would increase significantly without additional and sizeable incentives.
3	Geothermal growth isn't strong enough to support the projected PJM electric load growth. The market would not function in this environment, prices will be at max cap.
4	Some participants think market potential is large, but cost of systems is a huge factor which will determine the amount of the theoretical market that can be converted to actual growth.
5	Accurate expectation-setting regarding large capital investments, especially for residential geothermal systems, is a critical part of feasibility of any GREC carve-out. To the extent projections of system adoption are higher than actual experience and the GREC carve-out percentage is based on those percentages, it is possible that a higher carve-out is set than can be complied with, increasing costs for RPS compliance to utilities and, ultimately, to utility customers. It may be appropriate to err on the side of caution in establishing initial targets to avoid unnecessary costs; alternatively, it may be appropriate to create higher percentage carve-outs to drive installation, assuming such installation expectations can reasonably be met.

6	To the extent possible, barriers to GSHP installation in VA should be reduced or eliminated. This includes extraordinary permitting processes and fees, sales tax, and any other non-value added requirements.
7	Some project that over 1 million megawatt-hour ("MWh") of geothermal would be online by 2025, including both systems eligible to participate in the GREC carve-out (those installed after August 16, 2022) and those not currently eligible for such participation. GREC volume-per-system is significant. For example, a 2,500 square-foot residence in Virginia could house a 3-ton GSHP system. That same sized home could feasibly house a 7 kilowatt Direct Current rooftop solar system. While the solar system would generate around 8 RECs per year, the GSHP system would generate around 36 GRECs per year. That is a 400% increase in “RPS eligible” REC supply as compared to rooftop solar for a comparable home.
8	Estimated growth rates reported by both installers and manufacturers support a rate which can meet a 1% carve-out which would meet goals to increase the adoption of geothermal.

Factor 7: Legacy Geothermal Installations

Recommendations	
1	Incentivize upgrades so that older systems can then qualify for GREC program inclusion.
2	Allow older systems to participate in the GREC carve-out of the RPS program at a lower-tier REC-level, compared to newer systems.
3	A larger base of installations is going to help with a carve-out requirement for the utilities.
4	Each legacy installation owner is a huge advocate to future installs.
5	Some think we should focus on incremental systems rather than giving legacy systems credit unless it keeps them going longer
6	This would be, in some participants' understanding, a bit of a policy question – if the law is intended to incent adoption of new geothermal systems, prohibiting systems prior to a date (currently August 16, 2022) from participation would encourage new participants to install new geothermal systems; however, allowing legacy geothermal systems to participate in a GREC carve-out may facilitate higher carve-out percentages as there is a larger number of eligible participants in any such program. As to the question of upgrading an existing system and whether that upgraded system would qualify as a "new" unit, more study may be warranted as to what types of upgrades may merit such "new" designation.
7	Submission of older systems might include a requirement to submit January and/or February electric bills to ensure systems are functioning and not just heating with resistance heat. Submission of performance data would be an even better confirmation.
8	Systems prior to 8/16/2022 should qualify as a Virginia Tier 1 (GREC carve-out) resource.
9	Legacy systems do not affect the carve-out as they would not be eligible. They should be allowed as a Tier 1 resource.

Factor 8: Supply Chain and Workforce Considerations

Recommendations	
1	Invest in workforce training and certification programs, such as those offered by the International Ground Source Heat Pump Association (IGSHPA), to build a robust installer base and address potential bottlenecks in the supply chain.

2	Encourage partnerships with educational institutions for training initiatives, and support business development for companies expanding into geothermal technology.
3	Create business development resources for companies looking to enter or expand in the geothermal sector.
4	Ensure a sufficient number of qualified installers and addressing potential bottlenecks, such as the availability of drillers. Current workforce and supply chain is limited in this sector, but future opportunity looks optimistic with new federal incentives building.
5	Ensure a large, diverse supply chain (with companies of various sizes) to provide resiliency in times of supply chain challenges.
6	Coordinate with Virginia Works and Virginia Energy to maximize opportunity with the "Training Residential Energy Contractors" U.S. Department of Energy federal grant, among other workforce training opportunities. Consider state tax credits to encourage manufacturing or distribution within Virginia to help address supply chain considerations.
7	More workforce training support is needed.
8	Recommendations are very valuable to expand this workforce. The workforce exists and can grow. These are good paying jobs and appeal to folks in the oil and gas industries.
9	If GREC carve-out percentages are established at a relatively higher percentage, it seems necessary that a substantial increase in workforce to allow larger quantities of installations to occur more quickly would be necessary and appropriate. To the extent public/private partnerships could be leveraged, it may be appropriate to endeavor to foster such relationships. Conversely, if significant lags in workforce development and supply-chain issues were to occur, it may prevent achievement of any specific GREC carve-out.
10	Historically, the market is far more capable of installing capacity than the incentivizing agency is at supporting them. New York state installers were crippled by extremely slow payouts from both New York State Energy Research and Development Authority and then the utility companies.
11	An increase in residential GSHP adoption will lead to significant job creation in Virginia for drillers and installers, as well as in the broader U.S. for domestic manufacturers.
12	Increase in geothermal adoption will lead to more jobs within the industry especially with more education around all incentives available. Industry leaders should/would also support the carve-out.

Factor 9: Affordability and Equity

Recommendations	
1	Support Affordability and Equity: Address the high upfront costs of geothermal systems through targeted incentives like upfront REC payments, on-bill financing, and state-level tax credits (some of which may require legislative changes). Special attention should be given to supporting low-to-moderate income households and multifamily properties, potentially through additional rebates or higher REC values. Ensure that program benefits are accessible to all Virginians, including those in rural areas or lower-income brackets.
2	Engage in Consumer Education: Increase consumer awareness of geothermal technology through educational campaigns that highlight the benefits, long-term cost savings, and available incentives. Develop materials for homeowners, businesses, and real estate professionals to promote understanding and adoption. Use case studies and showcase successful installations to demonstrate the value of geothermal systems.

3	Virginia Energy's Home Energy Rebates for low- and moderate-income households will support affordability for residential geothermal heat pumps, if included in final rebate program design; Virginia's Commercial Property Assessed Clean Energy program can also support success. State could consider other incentives or programs if desired (e.g., state level tax credits, workforce training grants, coordinated educational outreach,).
4	There is very minimal support for affordability in VA right now and legislative changes will be needed to make that happen.
5	Tax credits at the state level could help incentivize builds.
6	If affordability and equity are a primary concern, care needs to be given to the development of incentives for low- to moderate-income residential customers or small businesses. The high up-front costs of geothermal systems may mean that GREC revenues alone are not sufficient to spur investment in the technology and that other incentive structures (direct payments, decreased tax liability, etc.) may be necessary or appropriate. Care should be given to consider tiered structuring to target incentives to customers more in need of such incentives to reduce the potential for free-ridership (those who intended to install a geothermal system without any incentive beyond GREC value but will gladly accept additional funds for an action they already intended to take).
7	Identify "preferred partners" for drilling and installation-based training and certifications, then just let them work.
8	The purpose of a GREC carve-out is to help establish pricing parity between GSHPs and air source heat pumps by dramatically lowering upfront costs for homeowners. Without a carve-out, the current affordability and equity options are insufficient.
9	Additional incentives for low-to-moderate income should be established with the carve-out. Current policies do not promote equity.

Implementation Challenges

Factor 10: Initial Carve-Out Percentage

	Recommendations
1	Suggestions for geothermal carve-out percentages within the broader RPS program ranged from 1-1.5%, reflecting the need to balance ambitious adoption targets with realistic market conditions.
2	Based on the expected number of systems added annually, participants estimated that 37,500 new GRECs would be created in Virginia every year. This represents 0.0375% of the overall Virginia REC market size in 2023.
3	Without accurate data on the installed base, we cannot set an appropriate percentage for this carve-out. Setting it too high will cost ratepayers additional money to subsidize this type of resource for others.
4	1.5% seems like it may be logical and in line with other state programs already in place (Maryland)
5	Some feel like the carve-out should be linked to Demand Side Management targets (§ 56-596.2) which are percentage based and track load and type of resource.
6	Some advocate for a GREC carve-out of 1% of the RPS Program Requirement. They believe a carve-out can supercharge residential GSHP adoption in Virginia. An increase in residential GSHP adoption will lead to significant consumer savings, increased grid resilience through peak avoidance, job creation in Virginia for drillers and installers, as well as in the broader U.S. for

	domestic manufacturers. These economic and infrastructural gains are in addition to the inherent climate benefits of GSHPs. Furthermore, there is also a supply-demand value in increasing the supply of "RPS eligible" GRECs over the coming decades. Their analysis projects that geothermal growth would meet the 1% carve-out by 2029.
7	Some advocate for a 1% carve-out to increase incentives for adoption of geothermal and to create an obtainable demand.
8	The carve-out should be aggressive to drive market response. 1% seems appropriate. There will be a brief, but critical administrative ramp-up period at launch and SCC expectations should reflect that.
9	Establishing the percentage carve-out for GRECs is one of the most critical pieces of the implementation of any such program. Further Virginia-specific studies would be advised to ensure an appropriate percentage, based on an understanding of existing eligible systems (installed on or after Aug. 16, 2022) as well as realistic expectations of sector growth, especially given current economic uncertainty. A carve-out set too high may mean that it can only be reached many years in the future (and if joined with a high deficiency payment could lead to significantly increased costs to utility ratepayers) while a carve-out set too low may not incent the increased adoption that may be a policy goal.

Factor 11: Carve-Out Percentage Dynamics Over Time

Recommendations	
1	Adjustable Carve-Out Percentages: Consider flexible carve-out percentages that are responsive to actual industry growth and market conditions. This approach allows for periodic adjustments to the carve-out requirements based on installation data, market metrics, and industry feedback, ensuring the program remains realistic and achievable.
2	Changes to the carve-out would have to be made legislatively and it is not clear how they should increase over time at this stage.
3	Some think picking a percentage change is difficult until you find out what the adoption rates will be.
4	Some advocate that a carve-out percent should ideally scale up with geothermal growth. However, due to the requirements of legislative change to enact such a flexible percentage, they do not believe a flexible factor should be a priority in the establishment of an initial GREC carve-out.
5	An analysis should be done every 3-5 years to ensure the program is in line with goals. Our internal analysis is that a 1% carve-out could be met by 2029 at which time changes to increase the percentage would be necessary.
6	The percentage measurement is useful to utilities only. Implementers need GREC goals that can be expressed in terms of "How many systems?" or "How much tonnage?" needs to be aggregated. This is how to drive market response. Clear goals for clear action.
7	If percentage carve-outs are meant to increase (or decrease) over time, care must be taken to establishing the rate of such change. If rapid increases to the GREC requirement were established, it is possible that the installation rate may not be able to keep up, resulting in increased deficiency payments and raising costs to utilities and, ultimately, ratepayers. If a dynamic carve-out is found to be appropriate, additional study should examine realistic current penetration and growth rates (ideally with sensitivities to account for lower and higher rates of adoption) as well as periodic (3- or 5-year check-ins to review how reality matches the targets, allowing for adjustment going forward.

Factor 12: Keeping Up With Increasing RPS Requirements

	Recommendations
1	Do not tie GREC percentage requirements to the overall RPS requirement.
2	GREC production through 2050 is not likely to keep up with increases in RPS requirements.
3	GREC targets should be tied to a more appropriate metric in the domestic economy.
4	Without more data on the current installed base and the market growth over time, we don't know if it is feasible to have this amount increase in the same manner as the RPS increases.
5	Given the unique attributes of geothermal, some recommend setting a parallel, but separate, growth goal for Geothermal.
6	Some think tracking load is a good way to do it right now given the pace of load growth.
7	Some advocate that the 1% GREC carve-out should be tethered to the RPS Program Requirement. Their calculations suggest that geothermal growth will keep pace with the scaling RPS Program Requirement. Furthermore, this also limits complexity. Having the carve-out dependent on the RPS requirements is a simple widely adopted way to work a carve-out with success. Other methods could add additional complexity.
8	Virginia is poised to lead the nation in REC generation through GRECs. The geophysical characteristics, installers, citizenry, and even the economy in Virginia are well suited to rapid growth. A 1% carve-out will have long lasting and strong impact on several sectors of the Virginia trades and supply industry.
9	Similar to prior comments, if the carve-out is pegged as a percentage of overall RPS requirements, which are expanding up to 100%, it is possible that a scenario unfolds where the geothermal system market is unable to produce sufficient GRECs. This is a particular concern as load growth forecasts for utilities are anticipating explosive growth in demand in the not-too-distant future.

Factor 13: Initial Deficiency Payment Level

	Recommendations
1	Set Appropriate Deficiency Payment Levels: Establish higher deficiency payment levels to stimulate market growth, ensuring these payments are sufficient to create a viable market for GRECs without unduly burdening ratepayers. Virginia-specific analysis should guide the setting of these levels, considering local market conditions and expected growth trajectories. Set a deficiency payment level that differs for GRECs, compared to other sources.
2	Industry participants think it should be set at $100, any cost above market cost of RPS eligible RECs is going to increase costs to the general body of ratepayers.
3	$100 per credit would be a more helpful number to drive implementation.
4	Upon concerted analysis, some advocates recommend a $100.00 deficiency payment for a GREC carve-out. The objective should be to institute the lowest deficiency payment possible that would still spur GSHP adoption in Virginia. They are sensitive to concerns voiced by utilities who, rightfully so, do not wish to be locked into buying the deficiency payment in perpetuity if GSHP adoption cannot keep pace. Their analysis does not indicate that this scenario would occur. Based on our preliminary calculations, GSHP adoption would overtake the deficiency payment in 2029, thus negating the need for the payment of the deficiency payment. Furthermore, there is also a supply-demand value in increasing the supply of GRECs over the

	coming decades. Virginia RPS demand is likely going to hit a supply squeeze, beginning in 2025, due to Code § 56-585.5 "RPS eligible" REC qualification criteria greatly increasing in stringency. This increase in "RPS eligible" stringency will thus limit the supply of "RPS eligible" RECs available for compliance. Among the various eligibility specifications required as of 2025, Dominion's ability to procure out-of-state RECs will be limited to 25% of its total electric energy calculation, further increasing the need for in-state "RPS eligible" RECs. From their perspective, a GREC carve-out would only serve to increase the supply of in-state "RPS eligible" RECs over time, potentially shaving price hikes at both the RPS procurement and retail levels (ratepayers).
5	After in depth analysis it is the recommendation of some advocates for a $100 deficiency payment to encourage adoption of geothermal. This should also help mitigate potential REC shortfalls for the overall RPS.
6	Behavioral economics indicates that a market response requires stimulus that is both noticeable and impactful. Therefore, the GREC deficiency payment should be reflective of Virginia income levels and Consumer Price Index. A deficiency payment of $100 like Maryland is likely appropriate. Keep in mind however, very few people (even within the industry) are even aware of how this works and why. Public Relations is critical.
7	To the extent that a deficiency payment is established at a high rate, and there are not sufficient GRECs from qualifying units available in a market, costs of RPS compliance will be higher for customers than otherwise would be. Additionally, it may be appropriate to consider existing carve-outs for resources currently in the Code of Virginia (e.g., the $75 [increasing at 1% annually] deficiency payment for RPS-eligible resources sized 1 megawatt or lower).

Factor 14: Deficiency Payment Level Over Time

	Recommendations
1	Participants highlighted the need for Virginia-specific analysis to set appropriate payment levels that would effectively stimulate market growth without disproportionately impacting ratepayers or creating unsustainable compliance costs for utilities.
2	It would need to be established legislatively and may need to be updated legislatively over time after actual experience with the market.
3	If economic changes occur, it could be necessary to revisit.
4	Declining payments in any economic stimulus provoke an even higher level of declining interest. The GSHP industry previously experienced this phenomenon with declining tax credits. Some stated that 2017's federal tax credit debacle drove a 50% decline in installations nationwide. Some also said that drillers, installers, manufacturers, trainers, advocates, and many others need more clarity on how to calculate their investment and return on investment.
5	Again, higher deficiency payments may spur investment, which may be a policy goal of the Commonwealth. Alternatively, these higher deficiency payments may increase costs for ratepayers.

Concluding Remarks

The Virginia Geothermal Working Group's final report marks a pivotal step in evaluating the potential for integrating geothermal heating and cooling systems into the state's RPS program. Through extensive

stakeholder engagement, the working group identified critical factors influencing the feasibility of a GREC carve-out and developed a series of recommendations to address the challenges presented.

The report concludes that while a GREC carve-out presents promising opportunities for Virginia to diversify its renewable energy portfolio and support the growth of the geothermal industry, there are significant barriers that must be overcome. These include establishing a transparent GREC calculation and verification process, addressing affordability and equity concerns, and establishing effective values for a GREC carve-out percentage and a deficiency payment amount.

The working group recommends that the Virginia SCC further refine program design elements, such as initial carve-out percentages and deficiency payment levels and continue to engage stakeholders in defining the program's framework. Additional studies and legislative actions may be necessary to align the geothermal carve-out with Virginia's broader clean energy goals and to ensure that the program can be implemented effectively and equitably.

As Virginia moves forward in its clean energy transition, the insights gained from this working group will serve as a valuable resource in shaping the future of its geothermal industry.

The conclusion of this working group marks a crucial step in Virginia's efforts to diversify its renewable energy portfolio and potentially create new market opportunities for geothermal energy. The thorough process undertaken by the group, combining quantitative assessments with qualitative insights from industry stakeholders, provides a solid foundation for informed decision-making at the legislative level.

As the process moves forward, continued engagement from stakeholders will be vital to ensure that any potential GREC program is designed to effectively balance market growth, consumer affordability, and Virginia's broader renewable energy goals.

Appendix A: VA SCC Geothermal Working Group Registrants and Meeting Attendance

Presenters:

Emmanuel Taylor, Senior Clean Energy Consultant, Beam Reach Consulting Group
Allison Samuel, Deputy Director for the Division of Public Utility Regulation, Virginia SCC
Dave Voss, Energy Transition Consultant, Energetics
David Dalton, Public Utility Regulation Manager, Virginia SCC
Greg Clendenning, NMR Group, Inc.
Matthew Unger, Senior Renewable Energy Analyst, Virginia SCC
Brandon McBride, Executive Director, American Electric Power Company
John Leimann, Dominion Energy

VA SCC Staff:

Allison Samuel, Deputy Director for the Division of Public Utility Regulation
David Dalton, Public Utility Regulation Manager
Arlen Bolstad, Deputy General Counsel for Utilities
David Essah, Director of Public Utility Regulation
Matthew Unger, Senior Renewable Energy Analyst
William Chambliss, General Counsel

Beam Reach Staff & Partners:

Emmanuel Taylor, Senior Clean Energy Consultant
Dominic Ligon, Technical Writer
Maria Smith, Data Management Analyst
Denisse Parada, Data Management Analyst
Laura Beeman, Managing Consultant
Jimmy Ly, Information Assurance Specialist
Dave Voss, Energy Transition Consultant, Energetics

Breakout Room Facilitators:

Emmanuel Taylor, Senior Clean Energy Consultant, Beam Reach Consulting Group
Dave Voss, Energy Transition Consultant, Energetics

Working Group Members:

First Name	Last Name	Affiliation	7/29	8/19	9/16
Abigail	Thompson	Gentry Locke	Yes	No	No
Amelia	Letvin	Geothermal Rising	No	No	No
Ashely	Besic	Building Decarbonization Coalition	No	Yes	Yes
Brandon	McBride	American Electric Power	No	Yes	Yes
Brian	Urlaub	Salas O'Brien	Yes	Yes	Yes
Carrie	Hearne	Virginia Commission on Electric Utility Regulation	Yes	Yes	Yes

Carter	Hutchinson	The Office of Senator Scott Surovell	No	Yes	Yes
Daniel	Sadik	Carbon Solutions Group	Yes	Yes	Yes
Gavin	Dillingham	SLB (Schlumberger Limited)	No	No	No
Heather	Deese	Dandelion Energy	Yes	Yes	Yes
Jack	Wallace	Carbon Solutions Group	Yes	Yes	Yes
Jackie	Taylor	Christian and Barton	Yes	Yes	Yes
Jason	Ascher	Mid-Atlantic Pipe Trades Association	No	No	No
Jay	Egg	Egg Geo, LLC	Yes	No	No
John (Jack)	DiEnna	Geothermal National & International Initiative	Yes	No	No
Joshua	Soble	Celsius Energy	Yes	No	No
Kelcy	Kline	Carbon Solutions Group LLC	Yes	Yes	Yes
Kevin	Cross	Dominion Energy	Yes	Yes	Yes
Kris	Newman	Dominion Energy	Yes	No	No
Kyle	Allwine	Northern Neck Electric Cooperative	No	No	No
Laura	Gonzalez	Clean Virginia	Yes	No	No
Max	Feeman	Ballinger	Yes	Yes	Yes
Michael	Daley	Carbon Solutions Group (CSG)	No	Yes	Yes
Mimi	N/A	N/A	Yes	No	No
Richard	Lay	North American Geothermal	Yes	Yes	Yes
Robert	Riley	Chester Solar	No	No	No
Ron	White	Southside Electric Cooperative	Yes	No	No
Ryan	Dougherty	GeoExchange	Yes	Yes	Yes
Steve	Weitzel	Enertech Global	Yes	Yes	Yes
Wade	Sewell	ClearPath Renewables	Yes	No	No
Will	Castle	Appalachian Power	Yes	No	No
Willem	Lange	WaterFurnace International	No	Yes	Yes

Appendix B: Meeting Summaries

Meeting One:

Meeting Agenda:

1st Working Group Meeting (July 29th, 2024)			
Time	**Duration**	**Description**	**Presenter**
9:00 AM	0:05	Welcome and Overview	**Emmanuel Taylor, BRCG**
9:05 AM	0:10	Introduction - Background and Purpose	**Allison Samuel, VA SCC**
9:15 AM	0:15	Overview of Existing VA RPS Program	**Allison Samuel, VA SCC**
9:30 AM	0:25	SME Presentation: Geothermal Technology and what's feasible for VA	**Dave Voss, Energetics**
9:55 AM	0:15	Q&A Session 1	**Emmanuel Taylor, BRCG**
10:10 AM	0:10	**Break**	
10:20 AM	0:10	Ground Rules, Instructions	**Emmanuel Taylor, BRCG**
10:30 AM	1:15	Facilitated Discussion on Technology, Availability, and Local Supply Chain	**Emmanuel Taylor, BRCG**
11:45 AM	0:45	**Lunch Break**	
12:30 PM	0:15	Current State of the Geothermal REC Markets in PJM	**Matthew Unger, VA SCC**
12:45 PM	0:15	Overview of Geothermal Programs Beyond PJM	**Dave Voss, Energetics**
1:00 PM	0:15	Q&A Session 2	**Emmanuel Taylor, BRCG**
1:15 PM	1:15	Facilitated Discussion on VA Geothermal Program Considerations	**Emmanuel Taylor, BRCG**
2:30 PM	0:10	**Break**	
2:40 PM	0:15	Utility 1 Presentation	**Brandon McBride, Appalachian Power**
2:55 PM	0:15	Utility 2 Presentation	**John Leimann, Dominion Virginia Power**
3:10 PM	0:20	Utility Q&A	**Emmanuel Taylor, BRCG**
3:30 PM	1:00	Broader Group discussion	**Emmanuel Taylor, BRCG**

4:30 PM	**0:15**	**Next Steps/wrap up/ concluding remarks**	**VA SCC**

Meeting Summary:

The SCC convened the first meeting of its Geothermal Working Group on July 29, 2024. This working group aimed to examine the feasibility of establishing a RPS program requirement for Phase I and Phase II utilities to procure and retire RECs from geothermal heating and cooling systems.

The meeting provided an overview of the current RPS program in Virginia, geothermal technologies, and the current market and regulatory landscape. Utility representatives presented their perspectives on implementing a geothermal REC program. Facilitated discussions explored technology availability, local supply chain considerations, and program design elements.

Key outcomes included identifying challenges related to REC calculation methods, measurement and verification strategies, and potential impacts on ratepayers. The group recognized the need for further analysis on market potential, incentive structures, and integration with existing energy programs.

Summary of Presentations Given:

This appendix provides a summary of the key presentations given during the Geothermal Working Group Meeting One. The presentations offered valuable insights from various stakeholders, including regulatory bodies, utilities, and industry experts, regarding the implementation and potential impacts of GRECs in Virginia.

Allison Samuel, Deputy Director for the Division of Public Utility Regulation with the SCC, presented an overview of Virginia's RPS program. The RPS establishes mandatory requirements for utilities to purchase and retire RECs as a percentage of their overall electricity generation portfolio. The Code defines eligible resources and sets targets as a percentage of total non-nuclear electric energy sold, with requirements increasing over time to reach 100% for Dominion by 2045 and for Appalachian Power by 2050. Utilities must file annual compliance plans and petitions for approval of new solar/wind development. Eligible resources include solar, wind, falling water, waste/landfill gas, biomass, and (starting in 2025) geothermal heating and cooling systems located in Virginia. Utilities can use RECs from owned or contracted resources in Virginia or PJM, verified through PJM's tracking system. There is a deficiency payment of $45/MWh if utilities cannot meet requirements or if REC costs exceed $45/MWh. Utilities can recover RPS compliance costs through a non-bypassable charge on customer bills. The SCC staff reviews utility compliance plans, modeling, REC procurement, retirements, and other aspects as part of the annual review process. The presentation aimed to provide baseline context on the current RPS program as geothermal is considered for inclusion, outlining the key parameters and requirements of Virginia's existing RPS program to set the stage for discussing how geothermal may fit into this framework going forward.

Matthew Unger, a Senior Renewable Energy Analyst with the SCC, offered an overview of the current GREC markets in PJM. He explained that these RECs are classified as Maryland Tier 1, DC Tier 1, or Virginia renewable, with the majority originating from Maryland. Unger noted a significant increase in GRECs in PJM in 2021 following Maryland's introduction of a residential geothermal carve-out. He also discussed the Intercontinental Exchange (ICE) futures market for Maryland Tier 1 RECs, which includes

geothermal, providing recent pricing data that showed these RECs trading around $35 for 2024 and $26 for 2028.

Brandon McBride, from American Electric Power expressed concerns about implementing a specific carve-out for GRECs. He pointed out the limited availability of GRECs, even in states with existing carve-outs, and worried that setting requirements too high could result in merely paying compliance payments. McBride also highlighted the potential administrative costs and burdens associated with managing a source specific carve-out, suggesting careful consideration when setting percentage requirements and compliance payment prices if such a carve-out is implemented.

John Leimann, of Dominion Energy Virginia provided insights from a utility perspective on RPS compliance and REC transactions. He explained the administrative challenges of managing numerous small REC transactions for compliance, noting that Dominion's 2024 RPS requirement is estimated to be around 12.5 million RECs. Leimann described how utilities typically acquire RECs through over-the-counter transactions with various counterparties and expressed concerns about the potential administrative difficulties of a geothermal carve-out. He suggested that such a carve-out could drive prices up close to the compliance payment level.

Meeting Two:

Meeting Agenda:

2nd Working Group Meeting (August 19th, 2024)				
Time	**Duration**	**Item**	**Discussion Theme**	**Presenter**
9:00 AM	0:15	Introduction	- Background - Purpose - Recap of First Meting - Agenda	David Dalton, VA-SCC
9:15 AM	0:15	Plenary Presentation	PA Geothermal Efficiency Program	Greg Clendenning, NMR Group, Inc.
9:30 AM	0:05	Plenary Q&A		
9:35 AM	0:10	Topic 1: Recap of First Meeting	Program Design - Summary of Findings - Recommendations Made	David Dalton, VA-SCC
9:45 AM	1:00	Topic 1: Facilitated Discussion	Program Design - Addressing Gaps and Outstanding Questions	Parallel Sessions: - Emmanuel Taylor, BRCG - Dave Voss, Energetics
10:45 AM	0:10	**Break**		
10:55 AM	0:10	Topic 2: Recap of First Meeting	Domestic Economy - Summary of Findings - Recommendations Made	Dave Voss, Energetics

11:05 AM	1:00	Topic 2: Facilitated Discussion	Domestic Economy - Addressing Gaps and Outstanding Questions	Parallel Sessions: - Emmanuel Taylor, BRCG - Dave Voss, Energetics
12:05 PM	0:45	**Lunch**		
12:50 PM	0:10	Topic 3: Recap of First Meeting	Implementation Challenges - Summary of Findings - Recommendations Made	Allison Samuel, VA-SCC
1:00 PM	1:00	Topic 3: Facilitated Discussion	Implementation Challenges - Addressing Gaps and Outstanding Questions	Parallel Sessions: - Emmanuel Taylor, BRCG - Dave Voss, Energetics
2:00 PM	0:10	Break		
2:10 PM	0:45	Open Discussion and Feedback		Plenary Session: - Emmanuel Taylor, BRCG
2:55 PM	0:05	Next Steps and Closing Remarks		Allison Samuel, VA-SCC
3:00 PM		Adjourn		

Meeting Summary:

The SCC convened the second meeting of its Geothermal Working Group on August 19, 2024. This meeting continued the examination of establishing a RPS program requirement for utilities to procure and retire RECs from geothermal heating and cooling systems.

The meeting included a plenary presentation on Pennsylvania's geothermal efficiency program, followed by facilitated discussions on program design, market considerations, and implementation challenges. Key topics included REC calculation methods, verification processes, handling older systems, performance-based incentives, alternative compliance payments, carve-out percentages, affordability considerations, administrative burdens on utilities, and supply chain and workforce development.

Participants explored various approaches to program design, debated appropriate incentive levels and market structures, and discussed strategies to ensure equitable access to geothermal technology benefits. The discussions revealed both significant potential and complex challenges in implementing a GREC carve-out within RPS in Virginia.

Conclusions drawn from the meeting included a closing plenary discussion that synthesized key insights and identified areas requiring further research and analysis. Participants emphasized the need for a carefully designed, data-driven approach that balances ambitious climate goals with practical implementation concerns.

Summary of Presentations Given:

This appendix provides a summary of the key presentations given during the Virginia Geothermal Working Group Meeting Two. During the meeting, Greg Clendenning from NMR Group, Inc. delivered a plenary presentation on Pennsylvania's approach to incentivizing geothermal systems. Clendenning provided an overview of Pennsylvania's Act 129 electric energy efficiency programs, which are overseen by the Pennsylvania Public Utility Commission for the seven largest electric distribution companies. While GSHPs are eligible measures under these programs, they are not commonly installed, with only one utility currently offering a modest $650 rebate. Clendenning highlighted several challenges limiting GSHP adoption in Pennsylvania, including a 15-year statutory limit on measure life for cost-effectiveness testing and a prohibition on fuel switching from fossil fuels to electric. Despite these challenges, historical GSHP installations in Pennsylvania have demonstrated significant energy savings, with average first-year savings of over 1800 kilowatt-hours compared to replaced systems. The presentation also touched on Pennsylvania's use of a technical reference manual for calculating savings, which considers factors such as system COP, baseline system efficiency, climate data, and building characteristics. Following the presentation, a Q&A session addressed various topics, including the impact of the 15-year measure life limit, differences between residential and commercial calculations, verification processes, and potential improvements to savings estimates. This presentation provided valuable insights and a useful point of comparison for the Virginia working group as they consider designing their own geothermal REC program.

Meeting Three:

Meeting Agenda:

3rd Wrap-Up Meeting (September 9th)			
Time	**Duration**	**Item**	**Presenter**
9:00 AM	0:10	Introduction -Background and Purpose	Allison Samuel, VA SCC
9:10 AM	1:00	Topic 1 - Program Design - Discussion and Evaluation	Emmanuel Taylor, BRCG
10:10 AM	0:10	Break	
10:20 AM	1:00	Topic 2 - Domestic Market - Discussion and Evaluation	Emmanuel Taylor, BRCG
11:20 AM	0:10	Break	
11:30 AM	1:00	Topic 3 - Implementation Challenges - Discussion and Evaluation	Emmanuel Taylor, BRCG
12:30 PM	0:10	Break	
12:40 PM	0:15	Open Discussion	Emmanuel Taylor, BRCG
12:55 PM	0:05	Closing Remarks	Allison Samuel, VA SCC

1:00 PM		Adjourn	

Meeting Summary:

The SCC convened the third and final meeting of its Geothermal Working Group on September 9, 2024. This meeting marked a significant milestone in the state's exploration of integrating GRECs into its RPS program.

The group assessed 14 critical factors across program design, domestic market conditions, and implementation challenges. Through digital surveys and open discussions, participants provided valuable insights and recommendations for each factor. Initial analysis revealed which factors were considered most critical and how current definitions and conditions may support or hinder GREC feasibility.

Key outcomes included a comprehensive evaluation of feasibility factors, collection of stakeholder input, preliminary insights on critical issues, and identification of areas needing further study. Next steps involve data analysis and report preparation, with a final report to be submitted to the Virginia General Assembly by December 1, 2024. Conclusions drawn from the meeting included the working group's formal discussions, setting the stage for potential legislative action based on the report's findings and recommendations.

Summary of Presentations Given:

No presentations were given during the course of this meeting.

Appendix C: Guiding Documents, References, and Resources

Below is an aggregate list of references and documents offered for consideration by members of the geothermal working group.

1. Maryland Public Service Commission. (n.d.). Geothermal Renewable Energy Credit (GREC) Program. (Mentioned as a reference point several times for program design and pricing.)
2. Pennsylvania Public Utility Commission. (n.d.). Act 129 Energy Efficiency and Conservation Program. (Presented as an example of how geothermal systems are incentivized in another state program.)
3. Pennsylvania Public Utility Commission. (n.d.). Technical Reference Manual (TRM). (Referenced as a source for calculation methodologies.)
4. Northeast Energy Efficiency Partnerships (NEEP). (n.d.). Mid-Atlantic Technical Reference Manual (TRM). (Mentioned as a reference document).
5. Illinois Commerce Commission. (n.d.). Illinois Statewide Technical Reference Manual for Energy Efficiency. (Mentioned as reference document)
6. Regional Technical Forum. (n.d.). Pacific Northwest Energy Efficiency Planning (Mentioned as a reference)
7. California Public Utilities Commission. (n.d.). Electronic Technical Reference Manual (eTRM). (Mentioned as reference).
8. ENERGY STAR. (n.d.). Product Finder Database. (Suggested as potential data source for calculations)
9. HEAT (Home Energy Advanced Technology). (n.d.). Technical Resources on Thermal Energy Networks. (Suggested as resource for heating systems)
10. Geothermal Heat Pump Manufacturers Association. (n.d.). Installation Data Compilation. (Offered to be compiled and shared)
11. PJM Environmental Information Services. (n.d.). Generation Attribute Tracking System (GATS) Public Reports. (Mentioned as a data source on recs)
12. Internal Revenue Service. (n.d.). Statistics on Geothermal Tax Credit Claims. (Referenced for tax eligibility)
13. National Renewable Energy Laboratory (NREL). (n.d.). Residential Demand System Model (ResDSM) and ResStock. (Suggested for market analysis)
14. Zillow Group. (n.d.). Zillow API Documentation. (Mentioned as part of a system for tracking home ownership changes)
15. ClimateMaster. (n.d.). Geothermal Savings Calculator.
16. New York State Department of Public Service. (n.d.). Rate Case Studies on Geothermal System Benefits.
17. Internal Revenue Service. (n.d.). Energy Communities Map for Tax Credit Eligibility.
18. Renewable Thermal Collaborative. (n.d.). Factsheet: Renewable Thermal in Renewable Portfolio Standards. https://www.renewablethermal.org/wp-content/uploads/2018/12/RTC-Factsheet-Renewable-Thermal-in-RPSs_12_13_18.pdf

19. Clean Energy States Alliance. July 2018. Renewable Thermal In State Renewable Portfolio Standards. https://www.cesa.org/wp-content/uploads/Renewable-Thermal-RPS.pdf

Various State Studies (on geothermal system performance and economics):

20. New York State Energy Research and Development Authority (NYSERDA). (n.d.). Geothermal Heat Pump Program.
21. Oklahoma State University. (n.d.). International Ground Source Heat Pump Association Research.
22. Massachusetts Clean Energy Center. (n.d.). Ground-Source Heat Pump Program.
23. Efficiency Maine. (n.d.). Heat Pump Incentive Program.

Appendix D: Presentation Slides

The following slides were displayed by presenters during the working group meetings, as described in the agendas and summaries included in Appendix B.

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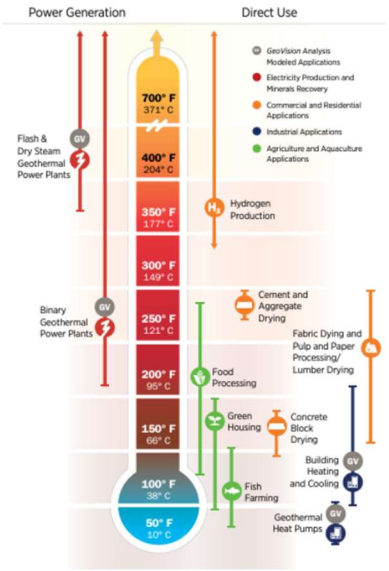
Geothermal Technology and Virginia Applicability

Outline

- Types of Geothermal Applications
  - Power Generation
  - Heating and Cooling
- Geothermal Heat Pumps
- Geothermal in Virginia

Types of Geothermal Applications



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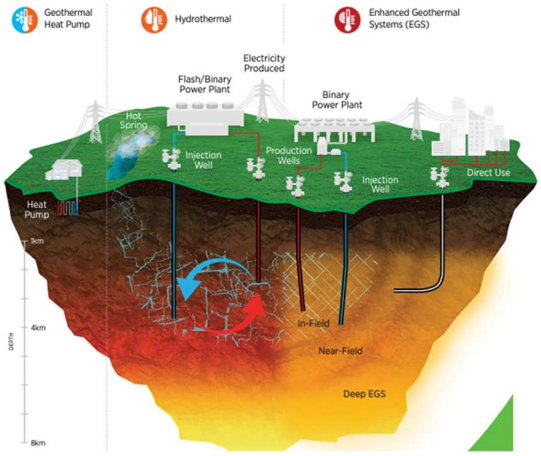
Types of Geothermal Applications

Power Generation

- Hydrothermal - direct
- Binary – uses bottoming cycle to utilize lower temperature resource
- Enhanced Geothermal Systems (using hydraulic fracturing and water injection)
- Thermal Energy Storage



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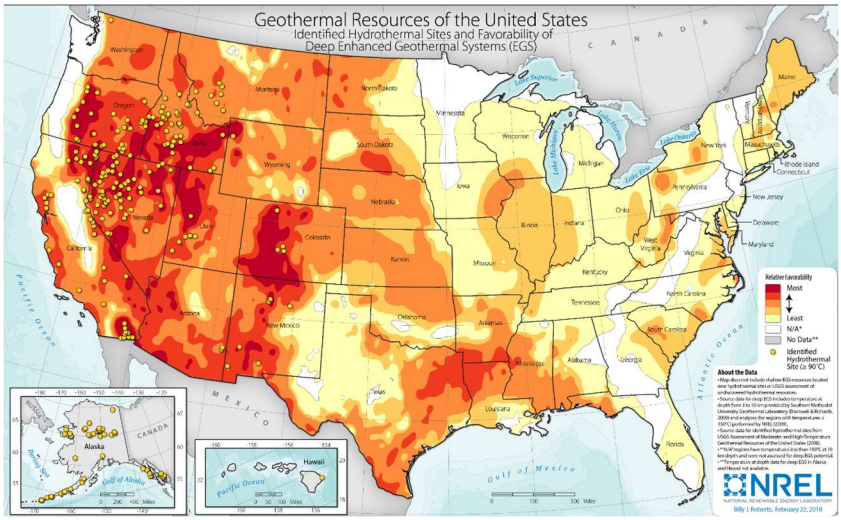
Types of Geothermal Applications

Power Generation – Minimal resources in VA



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Types of Geothermal Applications

Heating and Cooling

- Residential and Commercial Heat Pumps
- District Heating
- Industrial Heating

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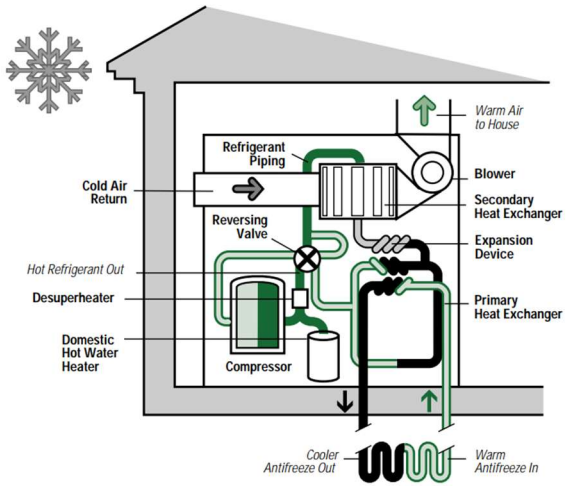
Geothermal Heat Pumps

- Entire US suitable for GHPs
- Constant temperature year-round; varies by location
  - US: 40 -70 °F
  - VA: 55 - 57 °F
- System flow reverses between heating and cooling
- System sized for local conditions
  - Local temperature
  - Thermal characteristics of soil
  - Configuration of loops vs. space constraints



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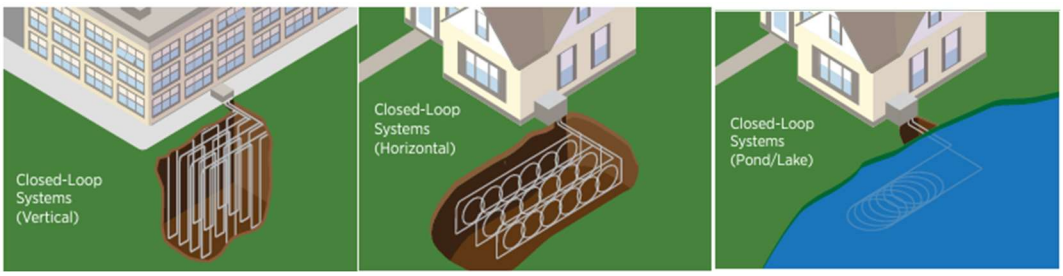
Geothermal Heat Pumps

Closed Loop Systems

- Heat Transfer Fluid
  - Primary refrigerant used in Heat Pump
  - Secondary HTF with heat exchanger: water, antifreeze solution
- Configurations: horizontal, vertical, body of water



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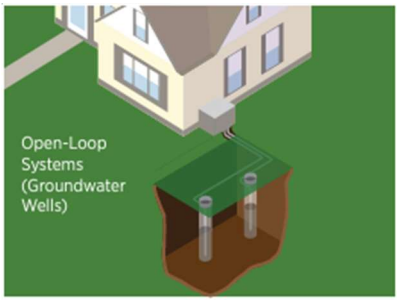
Geothermal Heat Pumps

Open Loop Systems

- Heat Transfer Fluid
  - Ground water / acquifer
  - Reclaimed water
  - Surface water
  - Mine water



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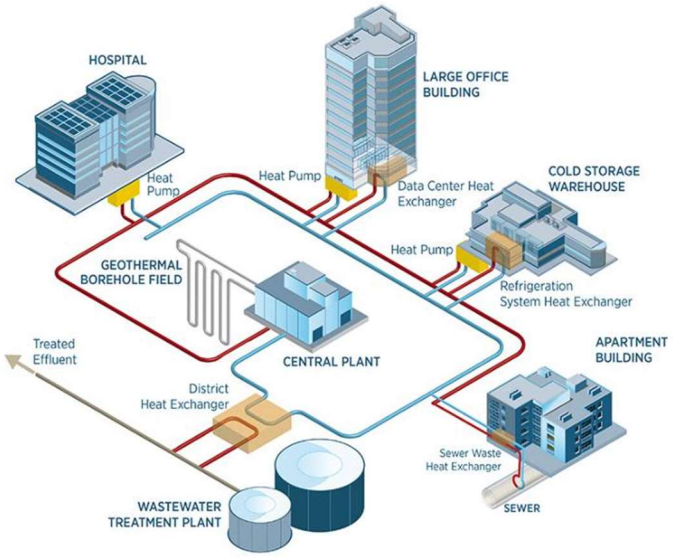
District Heating

- Geothermal boreholes drilled 10 – 500 feet



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Industrial Heating

- Example applications
  - Greenhouses
  - Aquaculture
  - Food processing (breweries, agricultural drying)
  - Process heat (pulp and paper processing, material drying)
  - Industrial heat pumps (electrification of combustion furnaces)
  - Gas turbine inlet cooling (using absorption chillers)
  - Desalination of sea water

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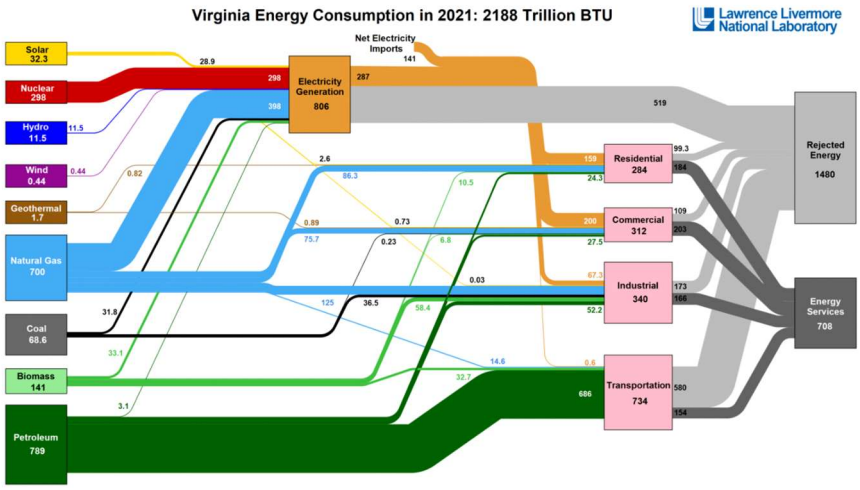
Energy Flows – Virginia (2021)

Geothermal 0.08% of overall consumption



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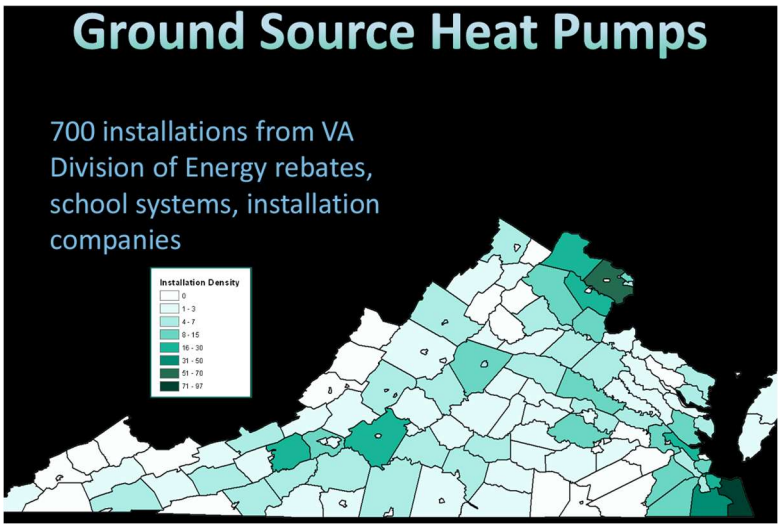
Heat Pump distribution in Virginia (2013)

Presentation by Virginia Department of Mines, Minerals, and Energy, 9/11/2013



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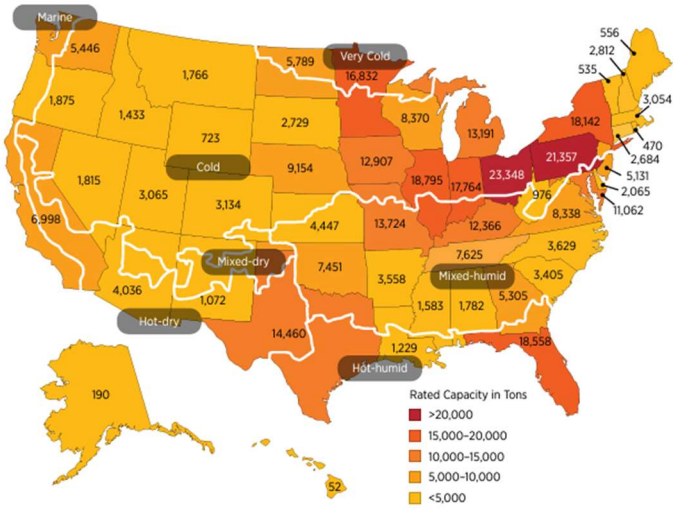
Geothermal HP shipments (2009)

U.S. geothermal heat-pump shipments (rated capacity in cooling tons) in 2009



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Summary

- Geothermal HPs are much more efficient than air source HPs
- Geothermal heat pumps can be installed anywhere in Virginia
- Constraints will be site-specific

Questions?

GEOTHERMAL
WORK GROUP

DISCLAIMER: THE STATE CORPORATION COMMISSION HAS ESTABLISHED THIS PROCEEDING AND DIRECTED THIS STAKEHOLDER MEETING TO INFORM STAFF'S REPORT. THE VIEWS EXPRESSED DURING THIS STAKEHOLDER MEETING DO NOT STATE OR REFLECT THOSE OF THE COMMISSION. THIS IS CONSIDERED AN "OPEN MEETING" AND WE ASK THAT EVERYONE ONLY DISCUSS INFORMATION THAT IS PUBLIC. THIS MEETING WILL BE RECORDED AND USED SOLELY FOR NOTE TAKING PURPOSES AND WILL NOT BE OTHERWISE SHARED. WHILE GATHERING INFORMATION FOR THE REPORT TO BE SUBMITTED TO THE COMMISSION, WE WILL NOT SPECIFICALLY REFER TO INDIVIDUALS BY NAME IN THE REPORT BUT RATHER GENERALLY TO THE IDEAS OR POSITIONS OF EITHER THE GROUP OR THEIR ORGANIZATION.

2024 ACTS OF ASSEMBLY, CHAPTER 597

2. That the State Corporation Commission (the Commission) **shall convene a stakeholder work group to examine the feasibility of establishing renewable energy portfolio standard program (RPS program) requirements** under § 56-585.5 of the Code of Virginia, as amended by this act, that require each Phase I and Phase II Utility, as defined in subdivision A 1 of § 56-585.1 of the Code of Virginia, **to procure and retire renewable energy certificates (RECs) from geothermal heating and cooling systems**, as defined in § 56-576 of the Code of Virginia, as amended by this act, placed in service after August 16, 2022, **as a percentage of the number of RECs used for RPS program compliance**. The work group shall include representatives from the geothermal industry, Phase I and Phase II Utilities, the Department of Energy, environmental advocacy organizations, environmental justice organizations, consumer advocates, and other interested stakeholders. The Commission shall report the findings and recommendations of the work group to the Chairmen of the Senate Committee on Commerce and Labor, the House Committee on Labor and Commerce, and the Commission on Electric Utility Regulation no later than December 1, 2024.

2024 ACTS OF ASSEMBLY, CHAPTER 597

As of January 1, 2025:

"**Geothermal heating and cooling system**" means a system that:

1. Exchanges thermal energy from groundwater or a shallow ground source to generate thermal energy through an electric geothermal heat pump or a system of electric geothermal heat pumps interconnected with any geothermal extraction facility that is (i) a closed loop or a series of closed loop systems in which fluid is permanently confined within a pipe or tubing and does not come in contact with the outside environment or (ii) an open loop system in which ground or surface water is circulated in an environmentally safe manner directly into the facility and returned to the same aquifer or surface water source;

2. Meets or exceeds the current federal Energy Star product specification standards;

3. Replaces or displaces less efficient space or water heating systems, regardless of fuel type;

4. Replaces or displaces less efficient space cooling systems that do not meet federal Energy Star product specification standards; and

5. Does not feed electricity back to the grid.

2024 ACTS OF ASSEMBLY, CHAPTER 597

As of January 1, 2025:

56-585.5 C 5.: Energy from a geothermal heating and cooling system is eligible for inclusion in meeting the requirements of the RPS Program. **RECs from a geothermal heating and cooling system are created based on the amount of energy, converted from BTUs to kilowatt-hours**, that is generated by a geothermal heating and cooling system for space heating and cooling or water heating. The Commission shall determine the form and manner in which such RECs are verified.

56-576 DEFINITIONS

"Renewable energy" means energy derived from sunlight, wind, falling water, biomass, sustainable or otherwise, (the definitions of which shall be liberally construed), energy from waste, landfill gas, municipal solid waste, wave motion, tides, **and geothermal power**, and does not include energy derived from coal, oil, natural gas, or nuclear power. "Renewable energy" also includes the proportion of the thermal or electric energy from a facility that results from the co-firing of biomass. "Renewable energy" does not include waste heat from fossil-fired facilities or electricity generated from pumped storage but includes run-of-river generation from a combined pumped-storage and run-of-river facility.

"Renewable thermal energy equivalent" means the electrical equivalent in megawatt hours of renewable thermal energy calculated by dividing (i) the heat content, measured in British thermal units (BTUs), of the renewable thermal energy at the point of transfer to a residential, commercial, institutional, or industrial process by (ii) the **standard conversion factor of 3.413 million BTUs per megawatt hour**.

RENEWABLE PORTFOLIO STANDARD PROCEEDING

RELEVANT CODE SECTIONS

§ 56-585.5 C:

(i) establishes a mandatory RPS Program and establishes annual requirements for the sale of renewable energy through the use and retirement of renewable energy certificates ("RECs");

(iii) defines the types of resources eligible for RPS Program compliance;

and (iv) sets targets as a percentage of a utility's total non-nuclear electric energy sold which must come from RPS-eligible generating resources.

8

RELEVANT CODE SECTIONS

§ 56-585.5 D:

requires Phase I and Phase II Utilities to annually **file a plan** for compliance with the mandatory RPS Program and petition for approval for the development of new solar and onshore wind generation capacity (pursuant to Code § 56-580 D 1 for a Phase I Utility, Code § 56-580 D 2 for a Phase II Utility). Code § 56-585.5 D 4 also requires the Commission to issue its Final Order regarding utility petitions and associated requests no more than **six (6) months** after the date of filing for such petition.

9

RELEVANT CODE SECTIONS

§ 56-585.5 E:

establishes requirements for Phase I and Phase II Utilities to petition the Commission for the development of **energy storage resources**

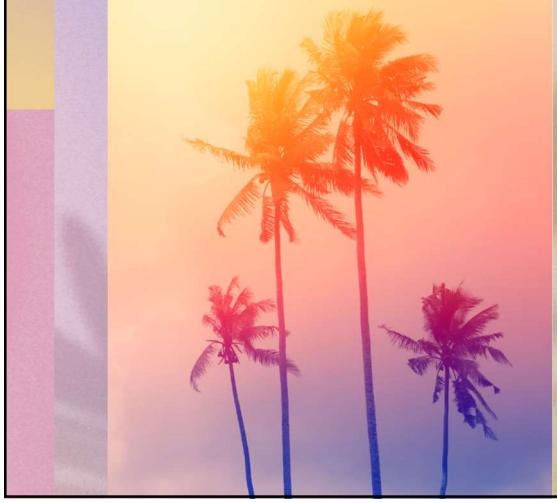
10

RELEVANT CODE SECTIONS

§ 56-585.5 F:

permits for the recovery of the costs of compliance with the Mandatory RPS Program as **a non-bypassable charge** from all customers, regardless of generation supply of such customer, except as provided in Code § 56-585.5 G (accelerated renewable energy buyers, also referred to as "ARBs") or as provided in Code § 56-585.1:11 C 3.

11



RPS REQUIREMENTS

12

PERCENTAGE REQUIREMENTS

The RPS Program requirements shall be **a percentage of the total electric energy sold** in the previous calendar year and shall be implemented in accordance with the following schedule:

Phase I Utilities	RPS Program Requirement	Phase II Utilities[1]	RPS Program Requirement
2024	10%	2024	23%
2025	14%	2025	26%
2049	96%	2044	95%
2050	100%	2045	100%

[1] Beginning with the 2025 compliance year and thereafter, at least 75 percent of all RECs used by a Phase II Utility in a compliance period shall come from RPS eligible resources located in the Commonwealth.

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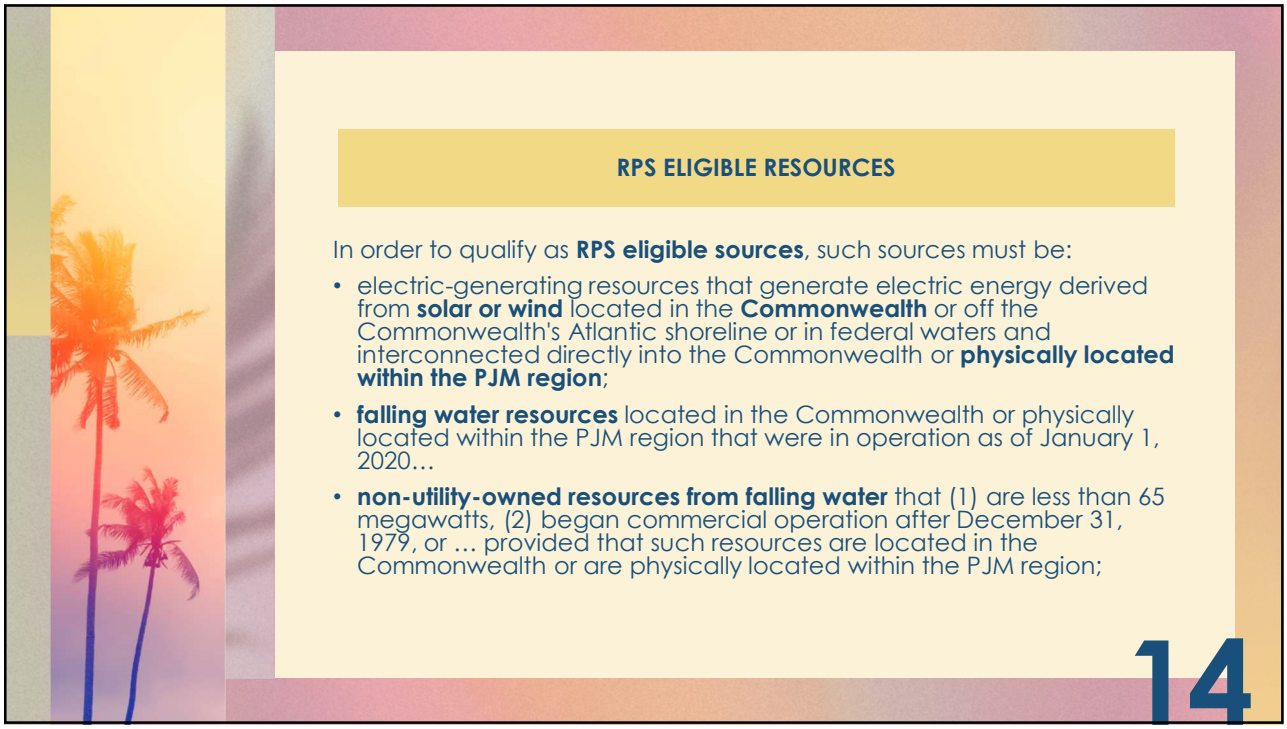

RPS ELIGIBLE RESOURCES

In order to qualify as **RPS eligible sources**, such sources must be:

- electric-generating resources that generate electric energy derived from **solar or wind** located in the **Commonwealth** or off the Commonwealth's Atlantic shoreline or in federal waters and interconnected directly into the Commonwealth or **physically located within the PJM region**;
- **falling water resources** located in the Commonwealth or physically located within the PJM region that were in operation as of January 1, 2020…
- **non-utility-owned resources from falling water** that (1) are less than 65 megawatts, (2) began commercial operation after December 31, 1979, or … provided that such resources are located in the Commonwealth or are physically located within the PJM region;

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RPS ELIGIBLE RESOURCES

In order to qualify as **RPS eligible sources**, such sources must be:

- **waste-to-energy or landfill gas-fired generating resources** located in the Commonwealth and in operation as of January 1, 2020, provided that such resources do not use waste heat from fossil fuel combustion
- **biomass-fired facilities** in operation in the Commonwealth and in operation as of January 1, 2023, that (1) supply no more than 10 percent of their annual net electrical generation to the electric grid or no more than 15 percent of their annual total useful energy to any entity other than the manufacturing facility to which the generating source is interconnected and are fueled by forest-product manufacturing residuals…(2) are owned by a Phase I or Phase II Utility, have less than 52 megawatts capacity, and are fueled by forest-product manufacturing residuals, biowastes, or biomass.…
- **As of January 1, 2025: geothermal heating and cooling systems located in the Commonwealth**

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RPS COMPLIANCE

In order to comply with the RPS Program, each Phase I and Phase II Utility **may use and retire the environmental attributes associated with any existing owned or contracted** solar, wind, falling water, or biomass electric generating resources in operation, or proposed for operation, in the Commonwealth or solar, wind, or falling water resources physically located within the PJM region, with such resource qualifying as a Commonwealth-located resource for purposes of this subsection, as of January 1, 2020, **provided that such renewable attributes are verified as RECs consistent with the PJM-EIS Generation Attribute Tracking System**.

Any Phase I or Phase II Utility may apply renewable energy sales achieved or RECs **acquired in excess of the sales requirement** for that RPS Program to the sales requirements for RPS Program requirements in the year in which it was generated **and the five calendar years after the renewable energy was generated** or the RECs were created. To the extent that a Phase I or Phase II Utility procures RECs for RPS Program compliance from resources the utility does not own, the utility shall be entitled to recover the costs of such certificates at its election pursuant to § 56-249.6 or subdivision A 5 d of § 56-585.1.

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SECTION 56-585.5 D – PHASE I UTILITIES

Shall petition the SCC for approvals of 600 MW of solar or onshore wind	
By 12//31/2023	At least 200 MW (35% PPA)
By 12/31/2027	At least 200 MW additional (35% PPA)
By 12/31/2030	At least 200 MW additional (35% PPA)

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SECTION 56-585.5 D – PHASE II UTILITIES

Shall petition the SCC for approvals of 16,100 MW of solar or onshore wind by 12/31/2035[1]	
By 12//31/2024	At least 3,000 MW (35% PPA)
By 12/31/2027	At least 3,000 MW additional (35% PPA)
By 12/31/2030	At least 4,000 MW additional (35% PPA)
By 12/31/2035	At least 6,100 MW additional (35% PPA)

[1]1,100 MW shall be solar with a nameplate capacity not to exceed 3 MW per project & 35% PPAs. At least 200 MW of the 16, 100 MW shall be on previously developed project sites

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SECTION 56-585.5 E – ENERGY STORAGE

Shall petition the SCC for approvals of energy storage resources	
By 12/31/2035	Phase I Utility shall petition for 400 MW
By 12/31/2035	Phase II Utility shall petition for 2,700 MW

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DEFICIENCY PAYMENTS

§ 56-585.5 D 5:

If, in any year, a Phase I or Phase II Utility is **unable to meet the compliance obligation** of the RPS Program requirements or if the cost of RECs necessary to comply with RPS Program requirements exceeds $45 per megawatt hour, such supplier shall be obligated to make **a deficiency payment equal to $45 for each megawatt-hour shortfall** for the year of noncompliance, except that the deficiency payment for any shortfall in procuring RECs for solar, wind, or anaerobic digesters located in the Commonwealth shall be $75 per megawatts hour for resources one megawatt and lower. The amount of any deficiency payment **shall increase by one percent annually after 2021**. A Phase I or Phase II Utility shall be **entitled to recover the costs of such payments** as a cost of compliance with the requirements of this subsection pursuant to subdivision A 5 d of § 56-585.1.

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CASE RESPONSIBILITIES

PUR STAFF

PUR STAFF CASE RESPONSIBILITIES

PUR Staff is generally responsible for reviewing and filing testimony addressing the following aspects of the utility's proposal:

- The **modeling inputs and assumptions** utilized, including forecasts for Energy, Capacity, and REC prices, commodity prices including fuel and environmental compliance costs, the specific operating characteristics of both existing resources and those made available for model selection;
- The modeling assumptions made regarding **energy efficiency** and demand response programs and the savings the Company anticipates receiving from their implementation;

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PUR STAFF CASE RESPONSIBILITIES

PUR Staff is generally responsible for reviewing and filing testimony addressing the following aspects of the utility's proposal:

- The **modeling outputs** resulting from the modeling process, including the resources selected, the costs associated with modeled portfolios, and each portfolio's compliance with the various utility needs (Energy, Capacity, and RECs) and statutory requirements;
- **Retirement analyses**, if applicable;
- The **Request for Proposal** ("RFP") process;

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PUR STAFF CASE RESPONSIBILITIES

PUR Staff is generally responsible for reviewing and filing testimony addressing the following aspects of the utility's proposal:

- Specific **resource requests** submitted by the Company;
- **Environmental Justice**:
  - For proposed resources, ensure compliance with Code §§ 2.2-234, 2.2-235, 56-576, 56-585.1 A 6, 45.2-1706 1, and Enactment Clause 7 of the VCEA.

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PUR STAFF CASE RESPONSIBILITIES

PUR Staff is generally responsible for reviewing and filing testimony addressing the following aspects of the utility's proposal:

- **Compliance Report**; and
- **Rate Analysis.**

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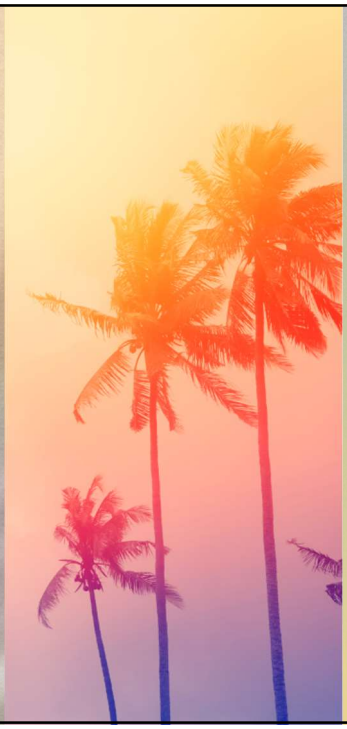
HISTORICAL **TIMELINE**



PROCEEDING TIMELINE

- **Phase I utility:**
  - Filed May 1
  - Procedural schedule within 2 weeks
  - Staff Testimony due within 8 weeks
  - Rebuttal due within 10 weeks
  - Hearing 12 weeks from filing date
  - Final Order due November 1
- **Phase II utility:**
  - Filed October 1
  - Procedural schedule within 2 weeks
  - Staff Testimony due within 8 weeks
  - Rebuttal due within 10 weeks
  - Hearing 12 weeks from filing date
  - Final Order due April 1

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QUESTIONS?

THANK YOU

Allison.Samuel@scc.virginia.gov

Confidential

Geothermal Working Group Meeting #2

Monday, August 19, 2024

Organized by the Virginia State Corporation Commission

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Recording Notice

The State Corporation Commission has established this proceeding and directed this Stakeholder meeting to inform Staff's report. The views expressed during this Stakeholder meeting do not state or reflect those of the Commission. This is considered an "open meeting" and we ask that everyone only discuss information that is public. This meeting will be recorded and used solely by Staff for note taking purposes and will not be otherwise shared. While gathering information for the report to be submitted to the Commission, we will not specifically refer to individuals by name in the report but rather generally to the ideas or positions of either the group or their organization.

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Welcome

Allison Samuel
Deputy Director
Division of Public Utility Regulation
Virginia State Corporation Commission

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2024 ACTS OF ASSEMBLY, CHAPTER 597

2. That the State Corporation Commission (the Commission) **shall convene a stakeholder work group to examine the feasibility of establishing renewable energy portfolio standard program (RPS program) requirements** under § 56-585.5 of the Code of Virginia, as amended by this act, that require each Phase I and Phase II Utility, as defined in subdivision A 1 of § 56-585.1 of the Code of Virginia, **to procure and retire renewable energy certificates (RECs) from geothermal heating and cooling systems**, as defined in § 56-576 of the Code of Virginia, as amended by this act, placed in service after August 16, 2022, **as a percentage of the number of RECs used for RPS program compliance.** The work group shall include representatives from the geothermal industry, Phase I and Phase II Utilities, the Department of Energy, environmental advocacy organizations, environmental justice organizations, consumer advocates, and other interested stakeholders. The Commission shall report the findings and recommendations of the work group to the Chairmen of the Senate Committee on Commerce and Labor, the House Committee on Labor and Commerce, and the Commission on Electric Utility Regulation no later than December 1, 2024.

2024 ACTS OF ASSEMBLY, CHAPTER 597

As of January 1, 2025:

"**Geothermal heating and cooling system**" means a system that:

1. Exchanges thermal energy from groundwater or a shallow ground source to generate thermal energy through an electric geothermal heat pump or a system of electric geothermal heat pumps interconnected with any geothermal extraction facility that is (i) a closed loop or a series of closed loop systems in which fluid is permanently confined within a pipe or tubing and does not come in contact with the outside environment or (ii) an open loop system in which ground or surface water is circulated in an environmentally safe manner directly into the facility and returned to the same aquifer or surface water source;

2. Meets or exceeds the current federal Energy Star product specification standards;

3. Replaces or displaces less efficient space or water heating systems, regardless of fuel type;

4. Replaces or displaces less efficient space cooling systems that do not meet federal Energy Star product specification standards; and

5. Does not feed electricity back to the grid.

2024 ACTS OF ASSEMBLY, CHAPTER 597

As of January 1, 2025:

56-585.5 C 5.: Energy from a geothermal heating and cooling system is eligible for inclusion in meeting the requirements of the RPS Program. **RECs from a geothermal heating and cooling system are created based on the amount of energy, converted from BTUs to kilowatt-hours**, that is generated by a geothermal heating and cooling system for space heating and cooling or water heating. The Commission shall determine the form and manner in which such RECs are verified.

56-576 DEFINITIONS

"Renewable energy" means energy derived from sunlight, wind, falling water, biomass, sustainable or otherwise, (the definitions of which shall be liberally construed), energy from waste, landfill gas, municipal solid waste, wave motion, tides, **and geothermal power**, and does not include energy derived from coal, oil, natural gas, or nuclear power. "Renewable energy" also includes the proportion of the thermal or electric energy from a facility that results from the co-firing of biomass. "Renewable energy" does not include waste heat from fossil-fired facilities or electricity generated from pumped storage but includes run-of-river generation from a combined pumped-storage and run-of-river facility.

"Renewable thermal energy equivalent" means the electrical equivalent in megawatt hours of renewable thermal energy calculated by dividing (i) the heat content, measured in British thermal units (BTUs), of the renewable thermal energy at the point of transfer to a residential, commercial, institutional, or industrial process by (ii) the **standard conversion factor of 3.413 million BTUs per megawatt hour**.

Meeting Purpose

- Support the VA-SCC in its analysis of geothermal use within the state.
- Explore considerations for designing geothermal REC programs.
- Better understand the current state of geothermal activities in Virginia.
- Discuss challenges for geothermal program implementation.
- Develop recommendations for the SCC to consider.

Agenda

9:00 AM	Introduction
9:15 AM	Plenary Presentation 1
9:30 AM	Plenary Q&A
9:35 AM	Topic 1: Program Design - Recap of First Meeting
9:45 AM	Topic 1: Program Design - Facilitated Discussion
10:45 AM	**Break**
10:55 AM	Topic 2: Market Considerations- Recap of First Meeting
11:05 AM	Topic 2: Market Considerations- Facilitated Discussion
12:05 PM	**Lunch**
12:50 PM	Topic 3: Implementation Challenges.- Recap of First Meeting
1:00 PM	Topic 3: Implementation Challenges - Facilitated Discussion
2:00 PM	Break
2:10 PM	Open Discussion and Feedback
2:55 PM	Next Steps and Closing Remarks
3:00 PM	Adjourn

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MD Geothermal REC Program

TBD

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PA Geothermal Efficiency Program

Greg Clendenning
Director
NMR Group, Inc.

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Pennsylvania's Act 129 Energy Efficiency Programs & Ground Source Heat Pumps

Statewide Evaluator to the Pennsylvania Public Utility Commission

Greg Clendenning, NMR Group; Jesse Smith and Steve Morris, Demand Side Analytics

August 19, 2024

NMR Group, Inc.

NMR Group, Inc.

Act 129 & Pennsylvania EDC's Electric Energy Efficiency Programs

- Legislation enacted in 2008
- PA Public Utility Commission (PUC) oversees Energy Efficiency and Conservation (EE&C) programs for the 7 largest electric distribution companies (EDCs) in Pennsylvania
  - PECO
  - PPL
  - Duquesne Light
  - 4 FirstEnergy Companies (Met-Ed, Penelec, PennPower and West Penn Power
- PUC establishes savings targets for the EDCs for multi-year phases
- Currently in Phase IV, a 5-year phase
  - June 1, 2021 through May 31, 2026 (Program Years (PY) 13 through 17)
  - EDCs are currently implementing PY16 (June 1, 2024 to May 31, 2025)

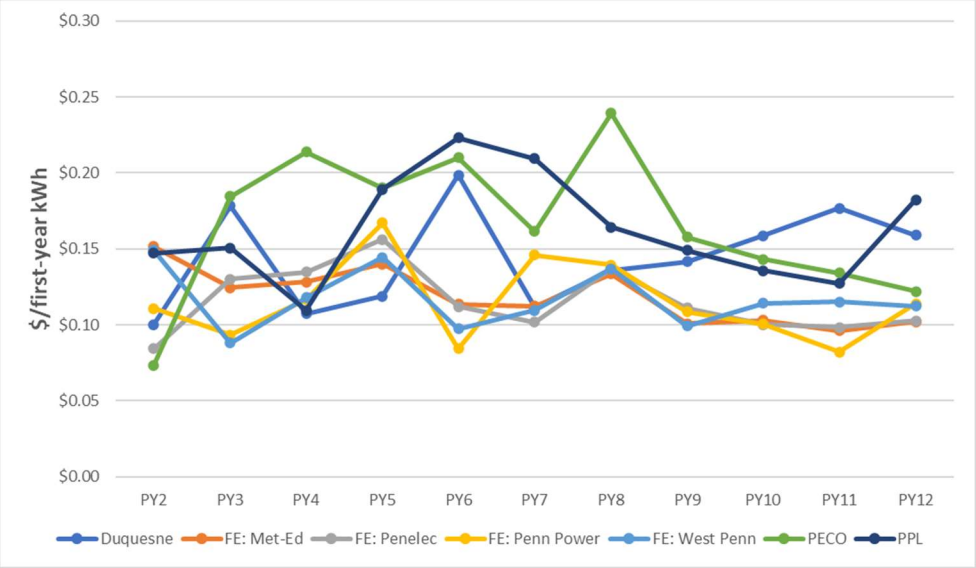
GSHP Also Eligible for PA's Alternative Energy Portfolio Standard (AEPS)

- Alternative Energy Portfolio Standards Act of 2004
- EDCs and electric generation suppliers must include a specific percentage of electricity from alternative resources in the generation that they sell to Pennsylvania customers
  - Requirement increases according to a fifteen year schedule
  - Minimum thresholds must be met for Tier I , Tier II, and solar photovoltaic resources
- Tier 2 includes Energy Efficiency measures
  - Credited based on the savings that may be calculated using the Act 129 Technical Reference Manual (TRM)
  - GSHP eligible for AEPS credits even without Act 129 rebates
  - Tier II credits current value on the spot market: ~ $30
    - One credit = one MWh of EE savings (or renewable generation)

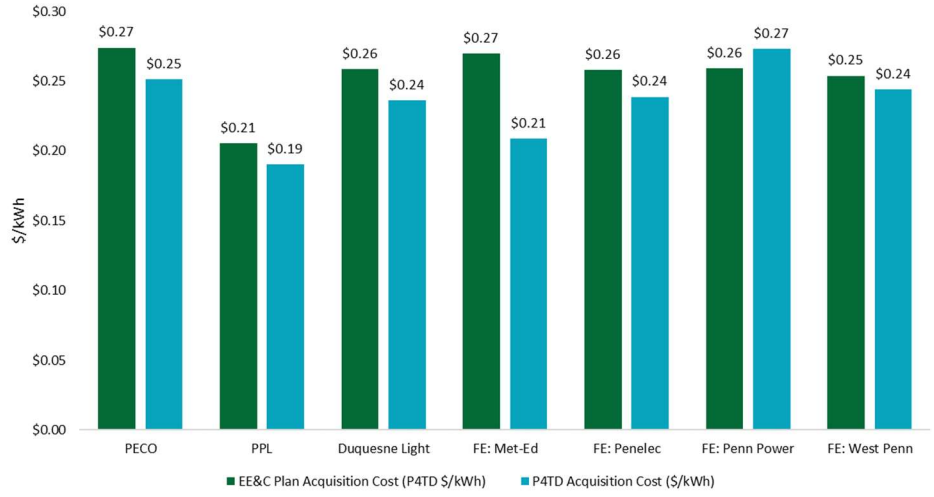
Act 129 Programs – Challenges for GSHPs

- 15-year statutory limitation to the measure life in the Total Resource Cost Test for Act 129
  - Affects all long-lived measures
  - Social Cost of Carbon not included in TRC test
- Prohibition on fossil → electric fuel switching
- Historically, low acquisition costs for kWh savings → relatively low rebates available

EDC Portfolio Acquisition Costs, PY2 through PY12



EDC Portfolio Acquisition Costs, PY14 (Current Phase)



GSHP Rebates Available

1. FirstEnergy Companies: $650 per system
   a) https://rebates.energysavepa.com/geothermal-hp-rebate
2. PECO, PPL and Duquesne Light: no rebates advertised on websites

Measure	Minimum Requirements		Manufacturer	Model No.	Serial No.	AHRI Reference No.	Rebate Amount
Geothermal Heat Pump	Must be Energy Star certified. Must meet full load efficiencies based on system configuration	Water-to-Water Closed Loop: EER ≥ 16.1 and COP ≥ 3.1					$650
		Water-to-Water Open Loop: 20.1 EER and 3.5 COP					$650
		Water-to-Air Closed Loop: EER ≥ 17.1 and COP ≥ 3.6					$650
		Water-to-Air Open Loop: 21.1 EER and 4.1 COP					$650

Residential GSHP Systems Rebated, Phase III & Phase IV

- Residential GSHP systems limited to the 4 FirstEnergy EDCs

	Phase III					Phase IV to date			Grand Total
	PY8 (6/1/16 – 5/31/17)	PY9 (6/1/17 – 5/31/18)	PY10 (6/1/18 – 5/31/19)	PY11 (6/1/19 – 5/31/20)	PY12 (6/1/20 – 5/31/21)	PY13 (6/1/21 – 5/31/22)	PY14 (6/1/22 – 5/31/23)	PY15 (6/1/23 – 5/31/24)	
Residential GSHPs	**GSHP**	**GSHP**	**GSHP**	**GSHP**	**GSHP**	**GSHP**	**GSHP**	**GSHP**	
FE: Met-Ed	96	47	72	85	56	34	36	83	**509**
FE: Penelec	21	16	28	30	27	14	83	19	**238**
FE: Penn Power	17	7	13	16	20	8	11	13	**105**
FE: West Penn Power	69	48	48	71	51	25	40	31	**383**
Grand Total	**203**	**118**	**161**	**202**	**154**	**81**	**170**	**146**	**1,235**

Residential GSHP Systems Rebated, Phase III & Phase IV

- Average EDC reported savings: 1,840.7 kWh per year (first year savings)

ALGORITHMS

This algorithm is used for the installation of new high efficiency air conditioners or heat pumps.

$$\Delta kWh = \Delta kWh_{cool} + \Delta kWh_{heat} + \Delta kWh_{DSF}$$

$$\Delta kWh_{cool} = CAPY_{cool} \times \left(\frac{OF_{cool}}{SEER_{base}} - \frac{1}{SEER_{ee}}\right) \times EFLH_{cool}$$

$$\Delta kWh_{heat} = CAPY_{heat} \times \left(\frac{OF_{heat}}{HSPF_{base}} - \frac{1}{HSPF_{ee}}\right) \times EFLH_{heat}$$

Table 2-8: Default Baseline Equipment Efficiency for High Efficiency Equipment

	Early Replacement			Replace on Burnout / New Construction		
Baseline Equip.	$SEER_{base}$	EER_{base}	$HSPF_{base}$	$SEER_{base}$	EER_{base}	$HSPF_{base}$
ASHP	13.5	11.4	8.2	14	12.0	8.2
CAC	12.1	10.6[a]	–	13	11.3	8.2
GSHP	15.0	16.6[a]	10.9	14	12.0	8.2
Elec. Baseboard	–	–	3.412	–	–	–
Elec. Furnace[13]	–	–	3.241	–	–	–
Space Heaters	–	–	3.412	–	–	–
PTAC[14,15,16]	$EER_{base} = 10.9 - (0.213 \times CAPY_{cool})$		–	$EER_{base} = 14.0 - (0.3 \times CAPY_{cool})$		–
PTHP[15,16,17]	$EER_{base} = 10.8 - (0.213 \times CAPY_{cool})$		$3.412 \frac{Btu}{W_2} \times (2.9 - 0.026 \times CAPY_{cool})$	$EER_{base} = 14.0 - (0.3 \times CAPY_{cool})$		$3.412 \frac{Btu}{W_2} \times (3.7 - 0.052 \times CAPY_{cool})$

Table 1-8: Residential HVAC Equivalent Full Load Hour and Coincidence Factor Assumptions

Climate Region	Reference City	CF	$EFLH_{cool}$		$EFLH_{heat}$		
			CAC & HP	Room AC	Non-HP	Primary HP	Secondary HP[25]
C	Allentown	0.354	575	178	906	1,235	845
A	Binghamton, NY	0.265	333	103	1,152	1,494	1,060
G	Bradford	0.218	206	64	1,347	1,672	1,218
I	Erie	0.265	468	145	1,054	1,422	1,004
E	Harrisburg	0.451	731	227	997	1,319	940
D	Philadelphia	0.424	781	242	761	1,084	727
H	Pittsburgh	0.369	544	169	942	1,269	876
B	Scranton	0.326	474	147	1,000	1,346	939
F	Williamsport	0.391	559	173	935	1,280	890

Non-Residential GSHP Systems Rebated, Phase III

- Non-Residential GSHP systems limited to PECO in Phase III

Program Year	C&I GSHP systems	PECO
PY8	GSHP Desuperheater	47
	Water Cooled Heat Pump - C&I (tons)	27
PY9	GSHP Desuperheater	6
	Water Cooled Heat Pump - C&I (tons)	725
PY10	GSHP Desuperheater	20
	Water Cooled Heat Pump - C&I (tons)	848
PY11	GSHP Desuperheater	10
	Water Cooled Heat Pump - C&I (tons)	82
PY12	GSHP Desuperheater	5
	Water Cooled Heat Pump - C&I (tons)	1,652
Total	**GSHP Desuperheater**	**88**
	Water Cooled Heat Pump - C&I (tons)	**3,334**

Thank You

Greg Clendenning

✉ gclendenning@nmrgroupinc.com
☎ 617-284-6230 ext. 2011

Questions and Answer Session

Intro to Facilitated Discussions

Expectations

- Active discussion
- All voices welcome
- High engagement

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Guiding Rules for Collaboration

- Respect: Community of peers
- Inclusion: All voices are invited and welcome
- Diversity: We all benefit from differing perspectives
- Timeliness: We only have so much time together
- Limitations: We won't solve every problem today
- Follow Up: Let's keep the conversation going!

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Roles and Responsibilities

Facilitation Team	Working Group Participants	VA-SCC
✓ Explain and manage the process	✓ Contribute thoughts and ideas	✓ Ensure we stay within our scope
✓ Keep the group on target	✓ Think openly	✓ As needed, helps to steer the conversation to achieve the working group goals
✓ Keep the group on time	✓ Think creatively	
✓ Ensure everyone gets to participate	✓ Think cooperatively	
✓ Document findings	✓ Take ownership for outcomes	

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Ground Rules for Discussion

- Be respectful
- Reserve judgment (no criticism)
- One idea at a time
- One minute rule
- One person speaks at a time
- It is okay to build on the ideas of others
- Clarifying questions are okay

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Recap of WGM1 Findings: System Attributes and Implementation Challenges

Summary of WGM1 Findings: Technology Availability and Supply Chain

Typical System Characteristics	
• Residential heat pumps, vertical loop systems	• Equal use in providing heating and cooling across seasons
• 1.25" pipe requires 150 feet of depth per ton of system capacity – 450 ft average loop length	• More labor-intensive than electric heat pumps
• Water used as the most common heat transfer fluid, followed by propylene glycol.	• Retrofits vs new construction; mix varies from 30 - 70%, depending on mortgage and housing market
• Properties are similar to those in VA systems and other NE US states.	• Disturbed land areas; over 2,500 sf of space required.
• Bigger part of VA is rural; and can take advantage of horizontal loops;	• grading plans limit $ feasibility; • County-by-county determination

Summary of WGM1 Findings: Technology Availability and Supply Chain

Factors Impacting Deployment	
Cost:	• The high upfront cost remains a significant barrier, especially for lower-income households.
Consumer awareness:	• There has been a significant increase in awareness over the past decade.
Installer expertise:	• The complexity of geothermal installations requires specialized skills.
Regulatory environment:	• Municipal regulations can affect the feasibility and cost of installations.
Energy prices:	• Cost savings are influenced by local energy prices.
Building characteristics:	• Suitability varies based on factors like home size, age, and existing HVAC systems.

Recap of WGM1 Findings: Program Design

Summary of WGM1 Findings: Geothermal REC Program Design

gREC Calculation Methods	
• Displacement/avoidance method vs. system performance/thermal energy used based method	• Tradeoffs between simplicity and accuracy in carbon reduction tracking
• Commercial REC generation calculators exist, but VA State should not depend on commercial solutions tied to particular vendors	• Existing system age and fuel; more rec credits for replacing 'dirtier' systems; least credits for replacing an electric (air-source) heat pump;
• Quantify of RECs generated per year dependent on system replaced; price depends on market value;	• VA statutory language seems to indicate REC generation basis, system displacement.

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Summary of WGM1 Findings: Geothermal REC Program Design

Measurement and Verification	
• Residential auditing should minimize burden and cost.	• Detailed commissioning and modeling could be used for commercial systems pursuing LEED certification or other incentives.
• Newer systems have real-time monitoring capabilities, but older systems would require retrofits.	• Digital twins represent an approach for large-scale geothermal system validation.
• Weather dependence; more RECs during extreme weather conditions? Not happening – one time calculation based on averages.	• Solar comparison: 8760 – differences between modeled systems vs actual performance; very different in solar, could be the same for geothermal;
• No re-calculation at future date; Even if higher efficiency equipped is installed at a future date;	• Re-calculations often happen when more square footage is added to a home; more displacement yields more credits; this is an existing allowance;
• Outside of PJM (in a different tracking system, green e-market) annual verification is performed; could be useful where active monitoring is not available (older systems);	

Make the most of your resources.

Breakout Rooms

- Will be opened momentarily.
- You will receive a pop-up notification on your screen, inviting you to move to a breakout room.
- Please acknowledge the pop-up.
- We will be randomly divided into groups.
- We will discuss the same topics.
- Groups are being divided to allow everyone more chances to actively contribute to the discussion.

Breakout Session #1: Program Design

We are on Break
We will return at 10:55 am ET

Recap of WGM1 Findings: Market Considerations

Summary of WGM1 Findings: Market Considerations

Costs and Drivers	
• 10x growth in installations within the last decade	• Average costs near $45,000; • ~$40,000 per compressor; residential systems typically have 1 or 2 compressors.
• Retrofits vs new construction; mix varies from 30 - 70%, depending on mortgage and housing market	• More labor-intensive than electric heat pumps • 16 man-days vs. 1 for a standard HVAC system
• Triple the cost of a standard HVAC system; federal incentives bring cost down to double;	• Higher value RECs drive more consumer participation
• ~ 2/3 customers using financing; many from green bank sources; more people financing recently;	• Upfront costs are still a deterrent for the VA market.
• Tax credits (30%) are now available for residential, commercial, and non-tax-paying entities.	• 5 to 10 year payback is generally acceptable to most customers;

Summary of WGM1 Findings: Market Considerations

Prices and Set-Asides	
• Deficiency payments in VA: legislation caps value at $45; will that be too low?	• MD price at $90 is pushing consumer behavior. • Anything is better than nothing;
• If a percentage requirement is instituted, but market volume is unavailable, deficiency payments could drive price increases for ratepayers.	• MD utility energy efficiency rebates, and federal tax credits together help in lowering first costs for systems; • MD state credits ~$3k/year; • MD utilities can provide financial incentives for fuel switching; Statutes in Virginia would prohibit that.
• In MD, geothermal REC price is still close to ACP, indicating low volume;	• Alternative compliance payment was $100 last year in MD; steps down every year; target $65/REC credit in 10 years;
• Qualifying geothermal systems in VA represent too little capacity to support	

Breakout Session #2: Pricing Considerations

Breakout Rooms

- Will be opened momentarily.
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- Please acknowledge the pop-up.
- We will be randomly divided into groups.
- We will discuss the same topics.
- Groups are being divided to allow everyone more chances to actively contribute to the discussion.

We are on Break for Lunch
We will return at
12:50 pm ET

Recap of WGM1 Findings: Implementation Challenges

Summary of WGM1 Findings: Implementation Challenges

Summary of Challenges Identified	
Administrative Burden:	• Utility representatives expressed concerns about the potential administrative burden of managing a separate carve-out for geothermal RECs, given the the PJM/GATS process for retiring RECs.
Available Capacity:	• VA may not have enough qualifying geothermal systems to produce sufficient gRECs for utility compliance with a percentage mandate.
Cost Impacts on Ratepayers:	• Utility representatives emphasized the need to carefully consider the percentage requirement and ACP level to avoid unintended consequences for ratepayers.
Operation Verification:	• The group discussed challenges related to verifying ongoing system operation, especially for older installations without modern monitoring capabilities.
Ownership Transfers:	• Participants raised questions about how RECs would be handled when properties with geothermal systems change ownership.

Summary of WGM1 Findings: Implementation Challenges

Local Supply Chain and Workforce	
• Most system components are manufactured in the USA.	• VA has a sufficient supply of manufacturers, offering reasonable pricing and lead times.
• While installers are available, qualified drillers can be difficult to source.	• It may be possible to retrain/utilize water well drillers from rural areas for work in the geothermal industry.
• in terms of equipment, similarities between ground source and air source; technicians can relatively easily work on both types.	• Workforce, always an industry in HVAC in general; aging workforce; any training / schooling assistance would be helpful; • Could be tied to renewable energy programs

Breakout Rooms

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Breakout Session #3: Implementation Challenges

We will now return to the main room for closing remarks!

We are on Break
We will return at
2:20 pm ET

Open Discussion

Open Discussion

• Affordability of geothermal systems vs traditional systems.	• Geothermal offers lowest ongoing heating and cooling bills compared to other systems. • Upfront costs just need to be offset. • "Everyone is going to pay for a GSHP, only some will buy one.'
• Carve out / economics	• 1,000 individual systems vs one centralized • What priority do we hold regarding the economics?
• REC/RPS strategy motivation	• Driving up volume and lowering costs
• Why subsidize if the tech has benefits?	• Distributed benefits; addressing RED supply squeeze;
• Ratepayer representation	• Need to consider all perspectives. • Rate case records show benefit for all utility customers.

Open Discussion

• Grid impacts of heat pumps	• Nationwide increase in energy costs • Larger consumers may not need incentives • Preparing consumers for electrification shift, and expected energy price increases
• Load forecasts	• Demand growth from other industries like datacenters and industrial electrification • Balancing that with expanding residential electric heat pump growth.
• Equipment load profile differences	• Geothermal heat pumps provide unique benefits to the grid and other ratepayers • Peak load 3 – 4x lower in winter, compared to air-source heat pump; more compared to resistive heating, which dominates in VA.
• Market studies	• Understanding market share for different heating sources in VA; can shape understanding of the benefits.

Open Discussion

• GSHP	• While numbers may be small; sizing; • 10kW solar vs 3 ton GSHP • Solar may generate 10 RECs, while GSHP can generate up to 35; • Adder for geothermal can help to backfill REC needs.
• Aggregator role	• Reduce administrative burden for other market stakeholders.
• Calculator	• Need a transparent and seamless product.
• Install audits	• Bipartisan technology; half of customers in it for money savings; half motivated by sustainability. • Many older individuals investing in systems.

Next Steps and Concluding Remarks

Allison Samuel
Deputy Director
Division of Public Utility Regulation
Virginia State Corporation Commission

Future Meeting Dates and Reporting

- Working Group Meeting #3: Monday, September 9. 2024
  - Summary of recommendations and feedback
  - Evaluation of feasibility for recommendations drafted
- A summary from meeting 1 will be posted on the working group SharePoint site, and an email will be sent once available.
- A summary report will be developed, based on the discussions held today.

Thank you!

Geothermal Working Group Wrap-Up Session

Monday, September 9, 2024

Organized by the Virginia State Corporation Commission

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Welcome

Allison Samuel
Deputy Director
Division of Public Utility Regulation
Virginia State Corporation Commission

Working Group Purpose

- Support the VA-SCC in its analysis of geothermal use within the state.
- Explore considerations for designing geothermal REC programs.
- Better understand the current state of geothermal activities in Virginia.
- Discuss challenges for geothermal program implementation.
- Develop recommendations for the SCC to consider.

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As of January 1, 2025:

"**Geothermal heating and cooling system**" means a system that:

1. Exchanges thermal energy from groundwater or a shallow ground source to generate thermal energy through an electric geothermal heat pump or a system of electric geothermal heat pumps interconnected with any geothermal extraction facility that is (i) a closed loop or a series of closed loop systems in which fluid is permanently confined within a pipe or tubing and does not come in contact with the outside environment or (ii) an open loop system in which ground or surface water is circulated in an environmentally safe manner directly into the facility and returned to the same aquifer or surface water source;

2. Meets or exceeds the current federal Energy Star product specification standards;

3. Replaces or displaces less efficient space or water heating systems, regardless of fuel type;

4. Replaces or displaces less efficient space cooling systems that do not meet federal Energy Star product specification standards; and

5. Does not feed electricity back to the grid.

2024 ACTS OF ASSEMBLY, CHAPTER 597

As of January 1, 2025:

56-585.5 C 5.: Energy from a geothermal heating and cooling system is eligible for inclusion in meeting the requirements of the RPS Program. **RECs from a geothermal heating and cooling system are created based on the amount of energy, converted from BTUs to kilowatt-hours**, that is generated by a geothermal heating and cooling system for space heating and cooling or water heating. The Commission shall determine the form and manner in which such RECs are verified.

56-576 DEFINITIONS

"Renewable energy" means energy derived from sunlight, wind, falling water, biomass, sustainable or otherwise, (the definitions of which shall be liberally construed), energy from waste, landfill gas, municipal solid waste, wave motion, tides, **and geothermal power**, and does not include energy derived from coal, oil, natural gas, or nuclear power. "Renewable energy" also includes the proportion of the thermal or electric energy from a facility that results from the co-firing of biomass. "Renewable energy" does not include waste heat from fossil-fired facilities or electricity generated from pumped storage but includes run-of-river generation from a combined pumped-storage and run-of-river facility.

"Renewable thermal energy equivalent" means the electrical equivalent in megawatt hours of renewable thermal energy calculated by dividing (i) the heat content, measured in British thermal units (BTUs), of the renewable thermal energy at the point of transfer to a residential, commercial, institutional, or industrial process by (ii) the **standard conversion factor of 3.413 million BTUs per megawatt hour**.

Outcomes for Today's Meeting

- Review factors that influence the feasibility of a G-REC carve out in the VA RPS program.
- Review recommendations received that pertain to each feasibility factor.
- Conduct a live evaluation of feasibility for each factor.
- Discuss additional recommendations.
- Review next steps for the working group.

Overview of Feasibility Factors

1	G-REC Calculation Method	8	Supply Chain and Workforce Considerations
2	G-REC Verification Process	9	Affordability and Equity
3	G-REC Retirement Process	10	Defining an Initial Carve-Out Percentage
4	Create Performance-Based Incentives	11	Carve-Out Percentage Dynamics Over Time
5	Installed Base of Eligible Systems	12	Keeping Up With Increasing RPS Requirements
6	Expected Geothermal Market Growth in Virginia	13	Defining an Initial Deficiency Payment Level
7	Handling Legacy Geothermal Installations	14	Setting the Deficiency Payment Level Over Time

Intro to Facilitated Discussions

Expectations

- Active discussion
- All voices welcome
- High engagement

Guiding Rules for Collaboration

- Respect: Community of peers
- Inclusion: All voices are invited and welcome
- Diversity: We all benefit from differing perspectives
- Timeliness: We only have so much time together
- Limitations: We won't solve every problem today
- Follow Up: Let's keep the conversation going!

Roles and Responsibilities

Facilitation Team	Working Group Participants	VA-SCC
✓ Explain and manage the process	✓ Contribute thoughts and ideas	✓ Ensure we stay within our scope
✓ Keep the group on target	✓ Think openly	✓ As needed, helps to steer the conversation to achieve the working group goals
✓ Keep the group on time	✓ Think creatively	
✓ Ensure everyone gets to participate	✓ Think cooperatively	
✓ Document findings	✓ Take ownership for outcomes	

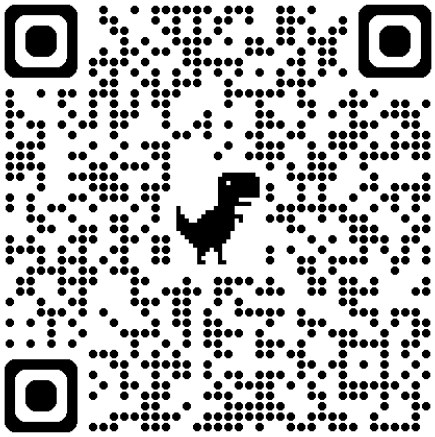
Ground Rules for Discussion

- Be respectful
- Reserve judgment (no criticism)
- One idea at a time
- One minute rule
- One person speaks at a time
- It is okay to build on the ideas of others
- Clarifying questions are okay

Discussion Session #1: Program Design

Program Design Evaluation Form

- Scan the QR code to access the form.
- Or, click the link provided in the chat.
- We ask that you provide your name, so we can follow up with questions, if needed.
- No attribution will be used in any reporting as a result of this working group.
- Your name and affiliation will NOT be used in any reports or publications.



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Factor 1: G-REC Calculation Methods

Challenges:	Recommendations to Date:
Starting January 1, 2025, geothermal heating and cooling systems will be eligible for inclusion in the VA RPS program. However, the VA legislation that defines the method for calculating G-RECs leaves uncertainty around the manner in which RECs will be generated from geothermal heating and cooling installations and additional clarity may be appropriate. Ensuring transparency, consistency, and accuracy in REC calculation methods for geothermal systems is a key challenge.	Establish state-approved, standardized methods for calculating geothermal RECs, ensuring transparency, consistency, and accuracy across residential, commercial, and industrial applications. This approach should use public data and reflect actual system performance. Different methodologies may be needed for various system sizes, with more detailed approaches for larger installations. Use standardized state-approved calculators rather than proprietary tools, emphasizing the need for transparent and public data. Important factors for calculations include the system's Coefficient of Performance (COP), local climate data, building characteristics, and the method of converting thermal energy into kilowatt-hours.

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Factor 2: G-REC Verification Process

Challenges:	Recommendations to Date:
The State of Virginia does not have an established process for verifying G-RECs. Verification is needed to ensure that geothermal systems are issued the appropriate RECs, and to verify ongoing system operation and REC creation over time. This poses challenges for older systems and those without modern monitoring capabilities. Participants stressed the need to balance verification accuracy with practical considerations to avoid excessive administrative burdens. It was noted that verification methods can differ for different customer classes (residential vs commercial vs industrial geothermal users).	Provide Simple Verification Processes for Residential Customers: Implement simplified verification processes to reduce administrative burdens, especially for residential systems. Options include using equipment serial numbers and installation photos for one-time calculations and self-certification. Adopt Different Processes for Different Customer Types: For larger systems , consider more rigorous checks, such as periodic on-site inspections and leveraging existing energy management systems.

Factor 3: G-REC Retirement Process

Challenges:	Recommendations to Date:
Utilities have expressed concerns about retiring source specific RECs in the PJM GATS system. Minimizing burden and creating a process that works for everyone, including utilities and aggregators, will promote compliance and reduce implementation costs.	Explore using the PJM GATS system's capabilities for source-specific REC tracking and bulk retirement options to streamline the process. Develop new software capabilities as needed, in conjunction with impacted utilities, aggregators, and PJM.

Factor 4: Performance-Based Incentives

Challenges:	Recommendations to Date:
• Funding and Implementation • Verification of performance improvements • Utility participation • Virginia Energy/state participation	Explore performance-based incentives to encourage ongoing system optimization and efficient operation, particularly for larger commercial and industrial systems. Options include tiered incentive levels based on measured performance or bonuses for systems that exceed expected efficiency levels. Care should be taken to balance the complexity of these incentives with the goal of promoting adoption.

We are on Break
We will return at 10:20 am ET

Discussion Session #2: Domestic Market

Domestic Market Evaluation Form

- Scan the QR code to access the form.
- Or, click the link provided in the chat.
- We ask that you provide your name, so we can follow up with questions, if needed.
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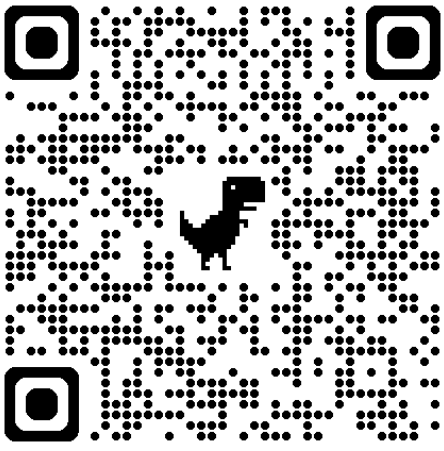

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Factor 5: Installed Base of Eligible Systems

Challenges:	Recommendations to Date:
The geothermal heat pump market in Virginia is currently small and predominantly residential. It is estimated that up to 30,000 geothermal heating and cooling systems may currently exist in Virginia, but a relatively small portion would be eligible to support a G-REC carve out, due to the service date requirement.	• Allow inclusion of older geothermal systems in the possible carveout, perhaps at a lower tier REC level. • Set the carve out percentage at a very low level, to reflect the actual quantity of eligible G-RECs expected in the market. • Incentivize geothermal market growth in Virginia and lower barriers to adoption. • Analyze the current installed base to develop more accurate estimates.

Factor 6: Expected Geothermal Market Growth in Virginia

Challenges:	Recommendations to Date:
The geothermal heat pump market in Virginia is currently small and predominantly residential. The program's success will depend on market growth. Different growth dynamics are anticipated in the residential, commercial, and industrial sectors. Additionally, the in-service date requirements mean some portion of the existing market would not be eligible for participation in the carveout as currently codified.	Conduct Further Market Analysis: Perform detailed studies of geothermal potential in Virginia, including market size, current system adoption, and future growth projections. Utilize modeling tools such as NREL's ResStock model to inform program design and identify the most effective strategies for encouraging geothermal adoption across the state.

Factor 7: Legacy Geothermal Installations

Challenges:	Recommendations to Date:
• Systems installed before August 16, 2022 are not eligible for inclusion in the G-REC carve out of the RPS program. • Approximately 30,000 systems currently exist, which could account for up to 1.2 million annual RECs, effectively 30 times the expected number of G-RECs to be generated annually. • No process exists for handling legacy systems that perform upgrades.	• Incentivize upgrades so that older systems can then qualify for G-REC program inclusion. • Allow older systems to participate in the G-REC carve out of the RPS program at a lower-tier REC-level, compared to newer systems.

Factor 8: Supply Chain and Workforce Considerations

Challenges:	Recommendations to Date:
Expanding the geothermal market in Virginia will require a robust supply chain and skilled workforce.	Workforce and Supply Chain Development: Invest in workforce training and certification programs, such as those offered by the International Ground Source Heat Pump Association (IGSHPA), to build a robust installer base and address potential bottlenecks in the supply chain. Encourage partnerships with educational institutions for training initiatives, and support business development for companies expanding into geothermal technology. Create business development resources for companies looking to enter or expand in the geothermal sector. Ensure a sufficient number of qualified installers and addressing potential bottlenecks, such as the availability of drillers. Ensure a large, diverse supply chain (with companies of various sizes) to provide resiliency in times of supply chain challenges.

Factor 9: Affordability and Equity

Challenges:	Recommendations to Date:
Supporting VA residents and businesses in purchasing geothermal systems, and ensuring that all residents and businesses have equal access to technology and financing options.	High upfront costs were identified as a significant barrier to geothermal system adoption, particularly for low-to-moderate income (LMI) households. Addressing these costs through incentives such as upfront REC payments, leveraging tax credits, or integrating REC value into financing options was recommended. Participants stressed the importance of designing programs that ensure equitable access to the benefits of geothermal technology for all Virginians, including targeted support for multifamily properties and affordable housing.

We are on Break
We will return at 10:05 am ET

Discussion Session #3: Implementation Challenges

Implementation Challenges Evaluation Form

- Scan the QR code to access the form.
- Or, click the link provided in the chat.
- We ask that you provide your name, so we can follow up with questions, if needed.
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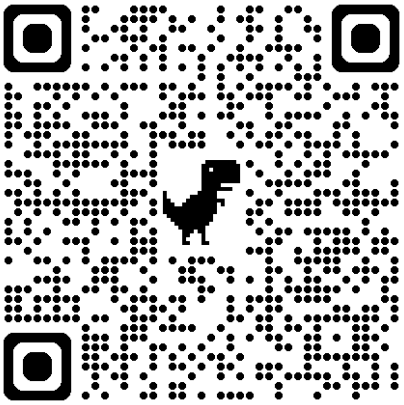

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Factor 10: Initial Carve-Out Percentage

Challenges:	Recommendations to Date:
Setting realistic carve-out percentages that match market supply and demand, is crucial to prevent excessive costs from spilling over to ratepayers. An initial carve-out percentage should appropriately reflect the installed base of geothermal systems eligible for G-REC consideration (those installed after August 16, 2022, according to the VA Code requirement).	Suggestions for geothermal carve-out percentages within the broader RPS program ranged from 1-1.5%, reflecting the need to balance ambitious adoption targets with realistic market conditions. Based on the expected number of systems added annually, participants estimated that 37,500 new G-RECs would be created in VA every year. This represents 0.0375% of the overall VA REC market size in 2023.

Factor 11: Carve-Out Percentage Dynamics Over Time

Challenges:	Recommendations to Date:
Setting realistic carve-out percentages that match market supply and demand, is crucial to prevent excessive costs from spilling over to ratepayers. Over time, changes in the carve-out percentage should be realistic. Participants emphasized that these percentages should be flexible and tied to actual industry growth metrics, allowing adjustments as the market matures and more geothermal systems are installed.	Adjustable Carve-Out Percentages: Consider flexible carve-out percentages that are responsive to actual industry growth and market conditions. This approach allows for periodic adjustments to the carve-out requirements based on installation data, market metrics, and industry feedback, ensuring the program remains realistic and achievable.

Factor 12: Increasing RPS Requirements

Challenges:	Recommendations to Date:
Virginia's Renewable Portfolio Standard (RPS) program mandates increasing percentages of renewable energy, with Appalachian Power required to reach 100% renewable energy by 2050 and Dominion Energy by 2045. Starting January 1, 2025, geothermal heating and cooling systems will be eligible for RPS compliance. A percentage carve-out for geothermal RECs from units installed after August 16, 2022, would require growth of the geothermal industry at a rate that matches the mandated RPS increases. It is not clear whether the geothermal industry will be able to keep up.	• Do not tie G-REC percentage requirements to the overall RPS requirement. • G-REC production through 2050 is not likely to keep up with increases in RPS requirements. • G-REC targets should be tied to a more appropriate metric in the domestic economy.

Factor 13: Initial Deficiency Payment Level

Challenges:	Recommendations to Date:
Establishing appropriate Deficiency Payment levels. Higher Deficiency Payment levels was suggested to drive market adoption, with comparisons to Maryland's approach where deficiency payments range from $90-$100. Participants highlighted the need for Virginia-specific analysis to set appropriate payment levels that would effectively stimulate market growth without disproportionately impacting ratepayers or creating unsustainable compliance costs for utilities.	Set Appropriate Deficiency Payment Levels: Establish higher deficiency payment levels to stimulate market growth, ensuring these payments are sufficient to create a viable market for geothermal RECs without unduly burdening ratepayers. Virginia-specific analysis should guide the setting of these levels, considering local market conditions and expected growth trajectories. Set a deficiency payment level that differs for G-RECs, compared to other sources.

Factor 14: Deficiency Payment Level Over Time

Challenges:	Recommendations to Date:
Establishing appropriate Deficiency Payment levels over time. Higher Deficiency Payment levels were suggested to drive market adoption, with comparisons to Maryland's approach where deficiency payments range from $90-$100.	Participants highlighted the need for Virginia-specific analysis to set appropriate deficiency payment levels that would effectively stimulate market growth without disproportionately impacting ratepayers or creating unsustainable compliance costs for utilities.

We are on Break
We will return at 12:40 pm ET

Open Discussion

Open Discussion

• Geothermal growth: preliminary calculations shared with the SCC. • Feedback and refinement	• Legislative change vs not from recommendations • Procedure for implementation?

Open Discussion

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Open Discussion

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Next Steps and Concluding Remarks

Allison Samuel
Deputy Director
Division of Public Utility Regulation
Virginia State Corporation Commission

Future Activities and Reporting

- A summary from meeting 1 has been posted on the working group SharePoint site.
- A summary from meeting 2 will be posted on the working group SharePoint site, and an email will be sent once available.
- A report detailing all recommendations will be developed, based on today's discussions and evaluation.
- This report is expected to be published by November 1, 2024.

Thank you!