



**Eliminating Marketing Barriers to Support the Transition from Methyl Bromide Fumigation to Vacuum and Steam Treatment Technology: Feasibility and Site Selection Analysis**

**PREPARED BY THE VIRGINIA TECH CENTER FOR ECONOMIC AND COMMUNITY ENGAGEMENT**

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## Executive Summary

Virginia Tech Center for Economic and Community Engagement (CECE) faculty and staff conducted a feasibility study in partnership with the Virginia Tech Department of Sustainable Biomaterials to assess feasibility and identify potential locations for a novel steam and vacuum log treatment facility. The steam and vacuum log treatment process appears to confer cost-saving and ecological advantages over conventional methyl-bromide treatment.

CECE reviewed industry TPOs, or Timber Product Output surveys, to generate a sense of scale of the industry and develop a contact list of companies of relevance to the log export industry. The research team then surveyed and interviewed companies to determine business size, export trends, present treatment practices, and awareness and acceptance of the novel steam and vacuum treatment technology. CECE also interviewed industry representatives, regulatory officials, and companies relevant to the log export industry to generate insight regarding industry trends, challenges, and opportunities. Demand for log exports has historically been high in Asian markets, particularly China and India. Industry trends indicated that recent log trade has been increasingly concentrated in these high-demand regions, due to the European Union's ban of methyl-bromide-treated products. Though wood product export from the U.S. has seen some fluctuation, Port of Virginia representatives and several industry interviewees showed optimism for future international demand of logs and wood products when asked about projected wood trade trends. Particularly, the proposed novel treatment method has the potential to expand log exporters' reach to European markets.

To guide site selection, CECE also examined direct and indirect factors that would impact facility site selection. Direct factors included geographic concentrations of log industry activity and proximity to ports and transportation networks, tax structures and incentives, and regulatory conditions. Indirect factors included characteristics such as availability of labor, access to educational institutions to determine the most favorable potential site and/or prioritize potential sites.

Findings strongly suggest that an ideal treatment site would be located near a port, to facilitate export and reduce hassles associated with shipping, as well as in an area with strong highway infrastructure, to facilitate the truck-based transportation that companies report as being critical to sending logs for treatment. Though CECE looked across the states of Virginia, West Virginia, Pennsylvania, Maryland, North Carolina, and South Carolina in the mid-Atlantic region, the research team narrowed potential sites to the state of Virginia, based on its port access, strong concentration of companies, regulatory environment, and transportation infrastructure. Optimal facility size would range from 5-20 acres, to accommodate trailers of logs to be treated and to accommodate storage of logs post-treatment. Location in Southeastern Virginia would confer regulatory advantages, as quarantine restrictions are more easily met by firms sending logs to this region than by firms sending logs out of this region.

Based on the qualitative findings from interviews and engagement with industry stakeholders, log export experts, and regulatory agency representatives, CECE finds a potential market demand for a steam and vacuum log treatment facility. Countries across the world have been taking steps to decrease methyl bromide usage as a pesticide, including the European Union, which completely banned all imports of products treated with methyl bromide. The development of a steam-and-vacuum treatment facility would allow companies to access markets otherwise closed for wood trade due to such restrictions. Furthermore, industry survey results indicated some existing awareness and desire for an alternative treatment method for wood products among export companies. The vacuum chamber

required for the steam-and-vacuum treatment process has a high upfront cost, so a shared facility where multiple companies could access the technology for their products would help mitigate the cost to each individual company.

CECE's qualitative findings also helped inform the following ranking for top factors impacting site selection:

1. Proximity to a port for foreign export
2. Size of site (5-20 acres)
3. Water and sewer infrastructure present
4. Transportation access (highways, potentially rail)
5. Zoning (industrial uses permitted)
6. Regulatory factors particularly those regarding wood pest control and quarantine

Mapping of the key factors, including port access, transportation system access, and industry activity concentration yielded the Shenandoah Valley and Front Royal, Hampton Roads, and Greater Richmond region as best potential location. Site selection should be focused throughout the Southeastern portion of Virginia near Norfolk's Port of Virginia, near Richmond's strong highway system, or in proximity to infrastructure associated with Warren County's Virginia Inland Port. Using the VEDP Site Selection Database online tool, the research team used the identified site criteria to filter potential locations within the state of Virginia. Then, the research team identified one location per region that best matched the top criteria. All sites selected were zoned industrial, within the 5 to 20 acres range, served by water and sewer infrastructure, and access to both highway and rail systems. The selected sites were as follows:

1. **Front Royal Warren County Industrial Park, Front Royal VA (80 Acres):** This industrial site is located within 10 miles of the Inland Port of Front Royal and 3 hours away from the Port of Virginia in Hampton Roads. The available 80 acres are sub-dividable by 5-acre lots with the options of build-to-suit or sale. This would allow treatment facility developers flexibility in the amount of land needed.
2. **Tri Point Terminals, Chesapeake VA (8.4 Acres):** This pad-ready site in the Hampton Roads region is zoned industrial and is located 22 minutes from the Port of Virginia.
3. **2401 Bermuda Hundred Rd., Chester, VA (12 Acres):** This site, located 20 minutes from the Richmond Marine Terminal, is well served by highway and rail and is zoned for industrial use. Notably, the site also has potential to offer availability for redundant power which could be an advantage to provide reliable power to run treatment operations.<sup>1</sup>

Further evaluation is needed to finalize an optimal site, based on secondary and tertiary factors such as parcel cost and tax rates. The selected sites exemplify the ideal criteria for the future location of the potential steam-and-vacuum treatment facility.

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<sup>1</sup> Retrieved from VEDP Sites Database, <https://sites.vedp.org/virginia/propertyid/234209>



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## Introduction

The Center for Economic and Community Engagement at Virginia Tech, in partnership with the Virginia Tech Department of Sustainable Biomaterials, conducted a feasibility study to identify potential locations for a steam-and-vacuum treatment plant that would serve the log treatment needs of companies in Virginia, West Virginia, Pennsylvania, Maryland, North Carolina, and South Carolina. The facility would make use of a new vacuum and steam-based log treatment technology developed by a Virginia Tech research team with funding from a USDA Federal State Marketing Improvement Program, in partnership with the Virginia Tech College of Natural Resources and Environment. The new treatment method would help mitigate the environmental and health impacts of the current industry-standard methyl-bromide log treatment and allow access to markets that no longer accept methyl-bromide-treated logs.

The technology in question uses steam to treat logs for export, which confers environmental advantages over conventional methyl bromide. Incorporation of a vacuum to the treatment improves saturation efficiency. As it stands, heat sterilization of wood products, using steam or a dry kiln method, is an accepted treatment process that is codified in the International Standard for Phytosanitary Measures (ISPM) 15.<sup>2</sup> However, these methods do not include the use of vacuum technology; therefore, treatment takes a longer time to complete and logs have to be treated to the core.

For instance, China's current phytosanitary requirements for imported wood mandate that logs from South Carolina or Virginia be debarked with less than 5% remaining bark on the surface area, treated with bark on with methyl bromide, or heat treated with bark on at 71C for 75 minutes to the core.<sup>3</sup> European Union phytosanitary regulations allow incoming logs treated at 56C for 30 minutes to the core if the logs are debarked.<sup>4</sup>

Meanwhile, the proposed accelerated steam-and-vacuum treatment method allows logs to be treated at 56C for 30 minutes to the core without the need to remove the bark, adding protection and helping to preserve the treated wood. This method requires a specialized vacuum chamber, costing \$1,193,800.00<sup>5</sup>—an upfront cost that likely precludes companies from integrating the steam-and-vacuum treatment method in-house. Having an accessible shared facility would allow companies to share costs while taking advantage of the alternative treatment method.

Virginia Tech research faculty and developers of the new steam-and-vacuum treatment method previously completed a site selection factor comparison and analysis, with the results indicating the

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<sup>2</sup> International Standard for Phytosanitary Measures (ISPM) 15: Regulation of wood packaging material in international trade. Food and Agricultural Organization of the United Nations, 2018. Retrieved from <https://www.fao.org/3/mb160e/mb160e.pdf>

<sup>3</sup> USDA APHIS. (n.d.). General Requirements: China (2013). USDA Phytosanitary Certificate Issuance & Tracking System (PCIT): Phytosanitary Export Database (PExD). Retrieved January 9, 2023, from <https://pcit.aphis.usda.gov/PExD/faces/ViewPExD.jsf>

<sup>4</sup> USDA APHIS. (n.d.). Commodity Summaries: European Union (2020). USDA Phytosanitary Certificate Issuance & Tracking System (PCIT): Phytosanitary Export Database (PExD). Retrieved January 9, 2023, from <https://pcit.aphis.usda.gov/PExD/faces/ViewPExD.jsf>

<sup>5</sup> Evaluation of the New Vacuum-Steam Treatment Plant Location, Economic Analysis NIFA (2021). Virginia Tech College of Natural Resources and Environment.

Inland Port of Virginia as a potential region in which to develop a treatment facility. Other previous work conducted by the team included internal economic analysis of the steam-and-vacuum treatment method, including the costs to operate the vacuum treatment system, electricity and water consumptions, and more.

To supplement previous work completed, the CECE team examined a variety of direct and indirect factors that would impact facility site selection. Direct factors included geographic concentrations of log industry activity and proximity to ports and transportation networks, tax structures and incentives, and regulatory conditions. Indirect factors included characteristics such as availability of labor, access to educational institutions to determine the most favorable potential site and/or prioritize potential sites.

## Wood Product Industry Overview

Wood-and-wood-articles trade constitutes a \$135 Billion industry worldwide. Global trade of wood products is regulated through the International Standard for Phytosanitary Measures (ISPM) 15, which allows for two main wood treatment methods to eradicate pests: methyl bromide fumigation or heat treatment to certain temperatures to the core for a specific amount of time.

There has been some effort across the globe to eradicate methyl bromide usage and transition to alternative pest control methods. In 1992, countries party to the Montreal Protocol treaty identified methyl bromide as an ozone-depleting substance and established a phaseout schedule in 1997. Developed countries, including the United States, were required to reduce methyl bromide consumption by 100% by the year 2005.<sup>6</sup> However, a country can exempt uses deemed “critical”—use cases where a technically and economically feasible alternative is not available and/or a significant market disruption would occur without methyl bromide treatment.<sup>7</sup> Thus, quarantine and pre-shipment uses were qualified as exempt from the phaseout, though those uses were never formally defined and/or codified by temporal limits.

Some countries have since taken additional steps to phase out quarantine and pre-shipment usage of methyl bromide. The European Union banned all methyl bromide uses, including quarantine and pre-shipment purposes, in 2010.<sup>8</sup> The National Agency for Food and Drug Administration and Control (NAFDAC) of Nigeria banned the import and export of methyl bromide in 2015, prohibiting agricultural workers and exporters from using it as a pesticide.<sup>9</sup> More policies to decrease pre-shipment and quarantine methyl bromide uses have been proposed or are being explored, such as USDA Animal and Plant Health Inspection Service (APHIS) commodity import evaluation assessing alternative treatment

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<sup>6</sup> United Nation: Montreal Protocol on Substances that Deplete the Ozone Layer, 16 Sep 1987, C.N.468.1997.TREATIES-4/I, 5 Dec 1997

<sup>7</sup> United Nation: Montreal Protocol on Substances that Deplete the Ozone Layer, 16 Sep 1987, C.N.468.1997.TREATIES-4/I, 5 Dec 1997

<sup>8</sup> *Barriers details page | Access2Markets*. (2023, February 13). European Commission-Access2Markets. [https://trade.ec.europa.eu/access-to-markets/en/barriers/details?isSps=true&barrier\\_id=10709](https://trade.ec.europa.eu/access-to-markets/en/barriers/details?isSps=true&barrier_id=10709)

<sup>9</sup> Muanya, C. (2019, February 28). *Why NAFDAC banned use of methyl bromide as fumigant for pest control*. The Guardian Nigeria News - Nigeria and World News. <https://guardian.ng/features/why-nafdac-banned-use-of-methyl-bromide-as-fumigant-for-pest-control/>

options, including phytosanitary measures, for imported Chilean table grapes.<sup>10</sup> In 2020, a North Carolina Senator filed a bill to amend NC General Statute 143-443 to outlaw methyl bromide as a fumigant for whole logs, with the exception of operators with a temporary permit granted by the North Carolina Pesticide Board.<sup>11</sup> Though the bill did not pass, the introduction of such policy shows growing awareness and effort to continue phasing out all methyl bromide treatment.

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<sup>10</sup> *USDA Extends Comment Period for Proposed Importation of Chilean Table Grapes Under a Systems Approach or Irradiation.* (2022, December 13). *Animal and Plant Health Inspection Service-U.S. Department of Agriculture: Program Updates.* [https://www.aphis.usda.gov/aphis/newsroom/stakeholder-info/sa\\_by\\_date/sa-2022/chilean-table-grape-comment-period](https://www.aphis.usda.gov/aphis/newsroom/stakeholder-info/sa_by_date/sa-2022/chilean-table-grape-comment-period)

<sup>11</sup> *Bill Summaries: S737 (2019-2020 Session) | Legislative Reporting Service.* (2020, May 14). *Unc.edu.* <https://lrs.sog.unc.edu/bill-summaries-lookup/S/737/2019-2020%20Session/S737>



## Qualitative Analysis

The Virginia Tech Center for Economic and Community Engagement (VTCECE) research team conducted an industry survey and multiple interview with logging and export industry stakeholders to assess current conditions, opportunities, and barriers to alternative log treatment in relation to export. The following section provides key findings from the survey and interviews.

### Methodology

The Virginia Tech Center for Economic and Community Engagement (VTCECE) research team generated a preliminary list of wood product-related firms to determine geographic concentrations of wood-product related firms. The VTCECE research team did this by running a query in ESRI Business Analyst for businesses in the following designated North American Industry Classification System (NAICS) 6-digit codes:

- **113310 (Logging):** This industry comprises establishments primarily engaged in one or more of the following: (1) cutting timber; (2) cutting and transporting timber; and (3) producing wood chips in the field.
- **423310 (Lumber, Plywood, Millwork, and Wood Panel Merchant Wholesalers):** This industry comprises establishments primarily engaged in the merchant wholesale distribution of lumber; plywood; reconstituted wood fiber products; wood fencing; doors and windows and their frames (all materials); wood roofing and siding; and/or other wood or metal millwork.

These 6-digit codes expand into more detailed 8-digit codes, to facilitate further organization of businesses. Please see Appendix X for a detailed list of NAICS-based codes used.

The research team then narrowed the business inventory generated via ESRI Business Analyst by cross-referencing business inventory with information in the USDA Forest Service's Timber Product Output surveys (TPOs), which the Forest Service uses to estimate and track timber removal and its subsequent impacts on regional economies and forests. VT CECE interviewed state forestry representatives, industry association representatives, log export experts, and Port of Virginia representatives to verify and supplement the inventory of businesses engaging in timber processing, treatment, and export developed in the other research steps.

The VTCECE research team used QuestionPro survey software to survey the inventory of wood product companies on their business practices and potential willingness to use the alternative treatment method in question.

The research team additionally contacted companies via email, website, and phone, to ensure equitable survey access and representation and engaged in follow-up communication where appropriate.

### Survey Responses

#### Survey Meta-analysis

The survey contact list included approximately 450 firms. Companies on the broader contact list tended to be clustered towards the coast, with notable clusters observed in the vicinity of Richmond, VA and Wilmington, NC as well as Greensboro, NC and Durham, NC.

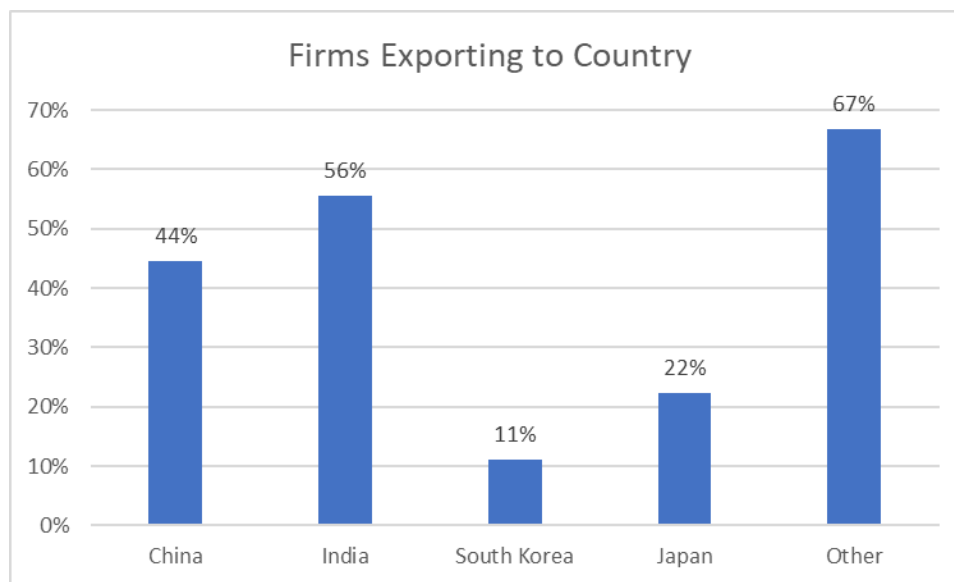
Overall, 223 respondents opened the survey, of which 46 engaged with the survey and 12 completed the survey. This translated to a 26.09% completion rate among those who engaged with the survey. The VTCECE research team was able to determine that nonparticipation was, in part, due to firms not being in the target region of study, not being engaged in log export, or not being presently engaged in business activity. With question-by-question participation varying, subsequent discussion of results is limited to responses provided for each given question.

### Company Locations and Operations

Respondents reported being from four of the states, with approximately 43% from Virginia, 25% from North Carolina, 25% from South Carolina, and just over 7% from Pennsylvania.

The majority of respondents reported that their firm engaged in export. Results suggest that these firms may specialize heavily in export, rather than domestic production. When asked what portion of produced logs are exported, the majority of respondents — over 60%—reported exporting between 80-100% of logs produced. Companies reported exporting logs to a number of countries, as detailed in the figure below:

*Figure 1: Recipient countries of exported logs*



The research team did not exclude firms reporting “no export” from the final survey results since these firms may be potentially inclined to use a log treatment facility in their area in the future. Importantly, insight suggests that stateside adoption of the alternative log treatment technology may depend on whether recipient countries, particularly those in Asia and Southeast Asia, formally accept the alternative treatment method.

### Transportation Logistics

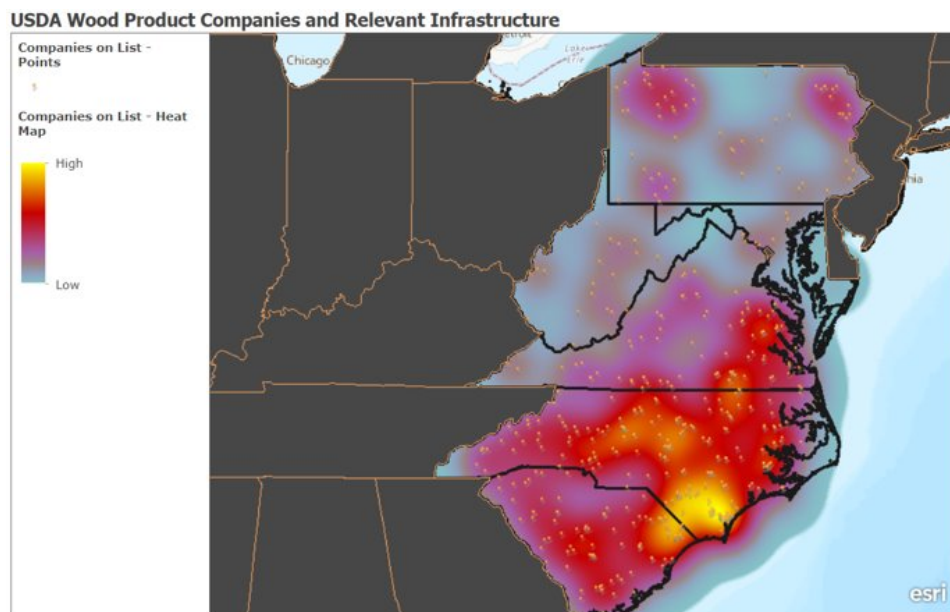
The survey asked respondents to report the locations in which they have their logs treated and the distances over which they send their logs for treatment. Responses showed that companies report treating logs in a variety of cities from South Carolina to New York. Suffolk, Virginia stood out, as it was a unique city mentioned multiple times by export companies. Responses suggest that companies may send logs up to 250 miles for treatment, though some conduct their own treatment on-site.

Companies sending logs for offsite treatment unanimously reported using trucks for product transportation. This means that proximity to highways and well-developed road infrastructure should be strongly considered in treatment facility site-selection.

Survey responses suggest that companies evaluate transportation costs differently, reporting costs on per-mile, per-container, and per-employee bases. Though this complicates efforts to generate standardized estimates of transport costs, it provides valuable insight into employers' cost analysis. For instance, employers may view overall costs as being fixed: once they have hired an employee to engage in transport, they may not consider additional variable (i.e. per mile or per container) costs associated with transporting logs for treatment.

Notably, companies in the contact list were heavily located near major highways and ports, consistent with the understanding that such infrastructure is vital to log exports. Major hubs of activity, by concentrations of companies, are located in the Richmond and Wilmington areas, among other larger cities and convergences of road systems. The figure below details these trends:

Figure 2: Multi-state presence of Companies in Contact Database

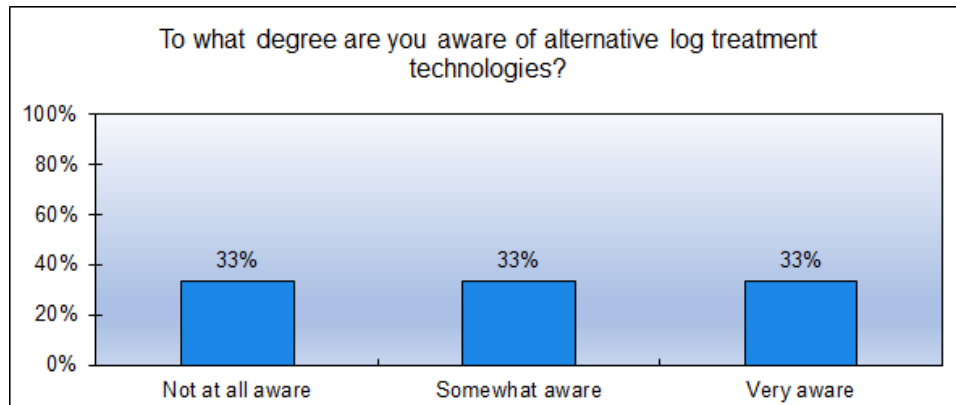


Note: The above plot includes all companies, rather than only those that responded to our survey, in the figure above to respect respondent privacy. Map Sources: see <https://virginatech.maps.arcgis.com/home/item.html?id=e4a78c50a91a4e579155753bbb98f85b>; layer references in appendix.

## Interest in Alternative Treatment Technologies

The figure below details participant awareness in alternative log treatment technologies:

*Figure 3: Participant awareness of alternative log treatment technologies*



Participants report with equal frequency that they are ‘Very Aware’, ‘Somewhat Aware’, and ‘Unaware’ of alternative log treatment technologies. The current scarcity of phytosanitary treatment facilities in the region surveyed may contribute to lower awareness of this treatment method among firms.

Companies report mixed willingness to use alternative log treatment. Half of respondents report unwillingness to use treatment technology, though this is affected by the fact that these respondents may not presently engage in log treatment (or export) in any form. Regardless, one third of respondents reported that they would be ‘extremely likely’ to use an alternative log treatment technology, while the rest detailed that they would be ‘somewhat likely’ to do so. Overall, this suggests that an alternative treatment facility could generate substantial, even if not universal, business participation.

The vast majority of companies engaging in export stated that they would be ‘somewhat’ to ‘extremely’ likely to implement an alternative log treatment technology. The sole exception cited transportation logistics, rather than the technology itself, as contributing to its unwillingness to use an alternative treatment facility; this supports the importance of proximity to highways and strong roadway infrastructure when selecting a site for the treatment facility. Regardless, review of general insights suggests that challenges to acceptance and use may include participant understanding of foreign regulations and logistic challenges related to transporting logs by truck.

## Interview Analysis

VTCECE conducted 10 formal interviews, supplemented by a number of informal conversations, with industry stakeholders and regulatory officials to better understand current market conditions, as well as emerging challenges and opportunities, related to timber processing and exporting. Organizations and groups interviewed included:

- U.S. Animal & Plant Health Inspection Service (APHIS)
- Virginia Department of Agriculture and Consumer Services (VDACS)
- Port of Virginia
- Virginia Loggers Association
- Virginia Department of Forestry
- North Carolina Department of Agriculture & Consumer Services
- IVP Forest Products, LLC.
- The Lyme Timber Company
- Meherrin River Forest Products
- International Wood Group of SC
- Phytovac

Interviews included discussions about factors that influence international timber export, treatment methods, regulatory factors influencing treatment and export, and perceptions of steam and vacuum wood treatment. Interviewees discussed opportunities, challenges, and potential considerations for siting for the alternative wood treatment process.

## Industry Trends

- Generally, there has been growing demand for timber products over time, both domestically and internationally. Demand fluctuated somewhat with regulatory changes, such as recent changes in phytosanitary certificate requirements or China, a large importer of timber product. Some interviewees shared an optimistic outlook for the wood exporting industry in the coming year (2022-2023).
- Meanwhile, export costs have risen, and while the demand for processed wood remains high, securing competitive international export rates and the empty containers needed to transport wood products has become a challenge. One interviewee remarked, “The shipping world is on its head right now.” Several industry experts emphasized these challenges of logistical issues and container shortages.
- Interviewees reported shifts in supply chain operations due to changing operational, wood processing, and transportation costs. Responses suggested trends toward vertical integration, though operations with prohibitively high upfront integration costs, such as debarking, may not be integrated into current operations.
- Political and economic conditions have some influence on the wood exporting industry. One participant mentioned some opportunity for companies that may have been focusing operations domestically to turn to export, as the nation faces a potential recession and a slowdown in domestic construction. Additionally, some participants mentioned the recent Russian embargo as a potential opportunity to open up new markets such as Europe due to the unmet demand.

- Multiple interviewees indicated China and India as being prominent international destinations for treated wood; this notably aligns with trends in export destinations reported by companies in the survey. Some other export markets noted included Romania, Vietnam, India, the Middle East, North Africa, and South Korea.
- Virginia produces and exports a variety of wood products, including hardwoods and softwoods. Companies, such as IVP Forest Products LLC., export oak, beech, southern yellow pine, and more.
- Port of Virginia representatives indicated that approximately 75% of logs exported from the Port originate in the state of Virginia; the remainder of logs originate from out-of-state, particularly from North Carolina, South Carolina, Maryland, and West Virginia.

### **Regulatory Environment**

- Some participants discussed the fluctuations in regulatory conditions among wood-importing countries. For instance, some indicated hesitation and wariness from some countries importing American processed wood, primarily China. China had previously banned all wood exports from the U.S. due to inefficient processing and nematode infestation. The ban has been lifted, and wood processing regulations were bolstered as a response to the infestation.
- However, some industry stakeholders indicated experiences of inconsistent regulations and disparities in enforcement of wood treatment standards among importing countries, even within a single nation.
- Countries across the world are increasingly moving towards regulation that bans methyl bromide treatment. For instance, the European Union has banned import of all products treated with methyl bromide. Adoption of alternative effective treatment methods provides an opportunity to enter this market.
- One interviewee noted that additional regulations at the municipal level can affect timber product transportation logistics and cost, such as additional road weight limit restrictions at the local level which can lead log transporters to adjust travel to avoid these areas.
- Many interviewees indicated a need for more consistency and uniformity in regulation and enforcement at state, national, and international levels, with more clear information on any outlying regulatory standards.
- Interstate transport taxes may apply to logs transported across state borders; other taxes may pertain to export and shipping, but conversations with agencies do not suggest industry-specific taxes to be a major concern.

### **Site and Feasibility Factors**

- Interviewees indicated that companies interested in log export tend to prioritize access to shipping containers when selecting location sites. Companies often look for access to areas where logs can be put in containers and transported directly to ports for subsequent export as a way of minimizing costs.
- Interviewees mentioned an industry focus on rail clusters connected to ports and noted that the log transport methods companies use may vary by firm size, with smaller firms loading logs

directly at the timber site and subsequently transporting logs to port via truck, and larger companies loading logs at large lumber yards and subsequently transporting logs to port via rail or truck. Particularly, truck transportation and routes depend on truck weight limitation regulations.

- Some participants indicated Virginia, as compared to nearby states such as the Carolinas, as more suitable for timber transportation due to the regulatory environment as well as past exposure to and control of invasive pests. There is less risk of exposure to new invasive species.
- Several participants indicated the greater Richmond region or Hampton Roads as potentially favorable site locations for a steam-and-vacuum-treatment facility. The Richmond region is a centralized location with strong highway infrastructure, with access to the Richmond Marine Terminal (RMT), while Hampton Roads is also strategically located with access to the Port of Virginia.
- Interviewees indicated that a potential steam-and-vacuum-treatment facility would need to be close to port to minimize deterioration or infestation of the treated product, with 24/7 access, and sufficient room for container staging. A potential site might range anywhere from 5 to 20 acres.

## Wood Production and Export Trends

VTCECE analyzed data from the Timber Product Output survey (TPOs), a voluntary survey administered to the states by the USDA Forest Service, as well as other trade data from the Port of Virginia and the Observatory of Economic Complexity to better understand the concentration of logging activity across the state of Virginia and the nation. A potential steam treatment plant would need to locate in proximity to the geographic “hotspots” of log production activity to facilitate an effective supply chain and minimize transportation costs for companies in order to be feasible. Since TPO Surveys are optional for companies to complete, data collected does not capture all active companies within a state. Recent TPO data was available for the year 2021 for the following states: Virginia, North Carolina, and South Carolina. Completed TPO surveys were unavailable for the following states: West Virginia, Pennsylvania, and Maryland.

### State Trends

Port of Virginia data showed that Virginia exported 861,555 short tons of logs and lumber in 2021. The Hampton Roads port facilities accounted for 3,031 short tons of product exported, representing \$982.73 million of total cargo. The amount of logs and lumber exported has decreased over time, shrinking by 32.7% since 2017.

Port of Virginia Logs and Lumber Export by Year (Short Tons) <sup>12</sup>					
	2017	2018	2019	2020	2021
Logs and Lumber	1,280,448	1,703,765	784,436	696,838	861,555

\*This table includes both export and import data for all facilities that comprise the Port of Virginia, some of which are not owned or operated by the Authority. The Authority estimates that the VPA Facilities handle in excess of 95% of the general cargo transported through the Port of Virginia.

The USDA Animal and Plant Health Inspection Service (APHIS) recognizes three authorized treatment facilities in Virginia that use methyl bromide to fumigate logs: Caruso, Inc. (West Point), Royal Fumigation Co. (Suffolk), and Western Fumigation Co. (Suffolk).<sup>13</sup>

According to TPO survey data, state of Virginia produced a total of 550,970 MCF (thousand cubic feet) of roundwood product in 2021. Of total product produced, 2,013 MCF (thousand cubic feet), or 0.36%, of logs were exported internationally in 2021. TPO Survey data indicated that all roundwood products that were exported outside of the country were hardwood saw logs. This does not capture all production activity in the state, as interviewees and subject matter experts have indicated existing export trade for softwoods such as southern yellow pine wood.

### Industrial timber exports by timber product and major species group (MCF), Virginia 2021

<sup>12</sup> Virginia Port Authority 06 30 2022 Annual Comprehensive Financial Report. (2022). In *Port of Virginia*. <https://wp.portofvirginia.com/wp-content/uploads/2022/10/VPA-2022-Annual-Comprehensive-Financial-Report.pdf>

<sup>13</sup> Quesada, H. (2019, August 16). An alternative to methyl bromide log fumigation. *Wood Products*. <https://wood-products.extension.org/an-alternative-to-methyl-bromide-log-fumigation/#:~:text=Methyl%20bromide%20is%20most%20often,pest%20living%20in%20the%20wood>.

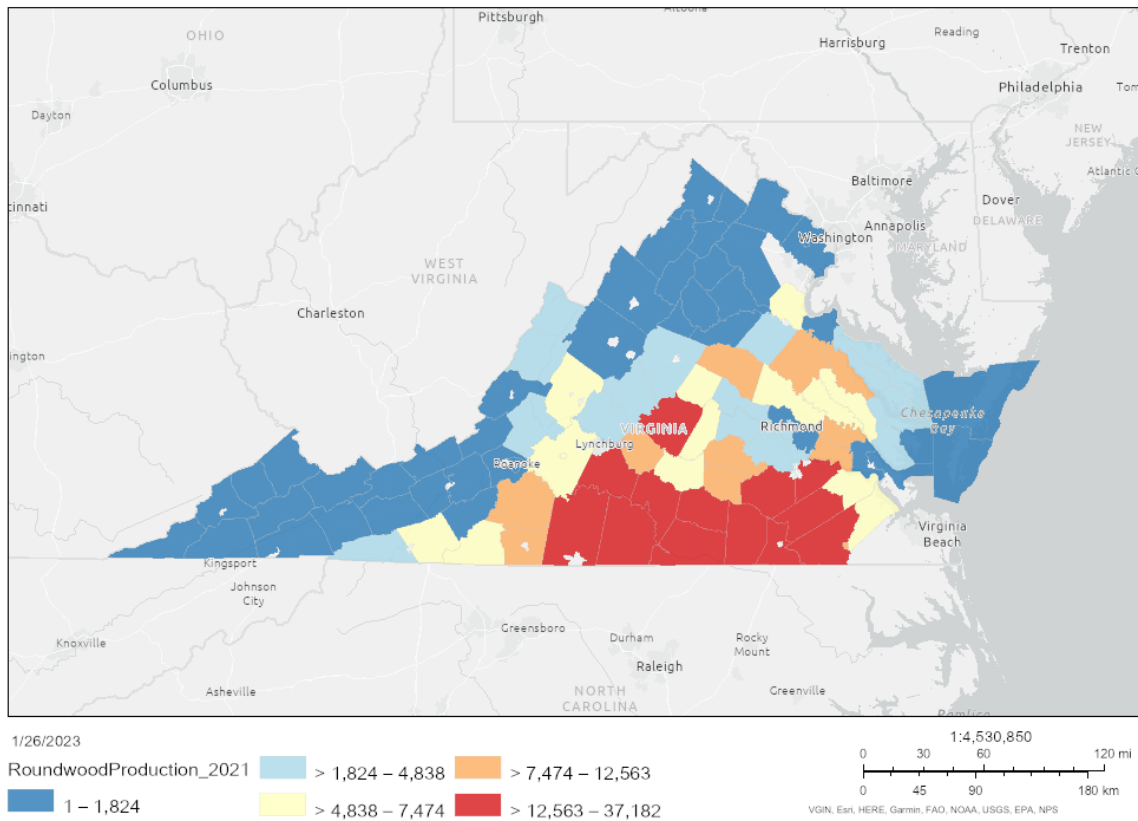


State Name	Species Class	Roundwood Meaning	Florida	North Carolina	South Carolina	Tennessee	Other non-U.S.	Grand Total
Virginia	Softwood	Bioenergy/Fuelwood		2,907				2,907
		Miscellaneous		7,767				7,767
		Pulpwood	110	20,285				20,395
		Saw logs		17,911		95		18,006
	Hardwood	Bioenergy/Fuelwood		6,104				6,104
		Miscellaneous		414				414
		Pulpwood			193			193
		Saw logs		1,276		574	2,013	3,862
Grand Total			110	56,663	193	669	2,013	59,647

Source: USDA Forest Service Forest Inventory & Analysis TPO Data Reporting Tool

Therefore, the research team examined the production of hardwood sawlogs, specifically, by county to better understand the concentration of activity that contributes to export of hardwood roundwood product that would need to be treated in compliance with international regulations prior to exporting. The following figure shows the annual production of hardwood sawlogs by county for 2020.

Figure 4: Log Production by County, Virginia, 2021



Source: USDA Forest Service TPO\_Virginia.xlsx, 2021

\*Gray-shaded areas signifies counties for which TPO survey data was not available

The figure demonstrates that production of roundwood is highly concentrated within the Southside region of the state, with a few counties near the Richmond metropolitan area contributing to roundwood production.

Brunswick County was the highest producing county in 2021, with 37,182 MCF of roundwood produced. Halifax County and Charlotte County followed, with 24,773 MCF and 24,557 MCF produced in 2021, respectively.

Fairfax County, Accomack County, and Frederick County produced the least roundwood in 2021, at 1 MCF each, respectively.

VTCECE also analyzed most recent TPO survey data available for North Carolina and South Carolina to better understand wood production for export on a broader regional level.

In 2021, North Carolina produced a total of 796,806 MCF of roundwood, and South Carolina produced 883,657 MCF. Both North and South Carolina exported a variety of roundwood products internationally as of 2021. North Carolina exported 19,883 MCF of total roundwood product in 2021, and South Carolina exported 9,646 MCF.<sup>14</sup> Softwood sawlogs were the greatest export for both North Carolina and South Carolina, with 18,722 MCF and 9,144 MCF exported in 2021, respectively.<sup>15</sup>

#### National and Global Trends

To contextualize the wood trade industry and export trends on a larger scale, the research team examined product-level international trade data from the Observatory of Economic Complexity (OEC)<sup>16</sup> and other sources.

According to the U.S. Census Bureau, logs and lumber contributed \$6.2 billion in international trade in 2022, a decrease of \$184 million since 2021.

U.S. Exports of Goods by End-Use Category and Commodity (Seasonally Adjusted)						
Item	Year-to-Date (2021)	November 2022	October 2022	Monthly Change	Year-to-Date (2022)	Year-to-Date Change
Logs and lumber	\$6,420M	\$437M	\$492M	\$55M	\$6,209M	(\$212M)

<sup>14</sup> Retrieved from: <https://public.tableau.com/views/TPOREPORTINGTOOL/MakeSelection?%3AshowVizHome=no>

<sup>15</sup> Retrieved from: <https://public.tableau.com/views/TPOREPORTINGTOOL/MakeSelection?%3AshowVizHome=no>

<sup>16</sup> AJG Simoes, CA Hidalgo. The Economic Complexity Observatory: An Analytical Tool for Understanding the Dynamics of Economic Development. Workshops at the Twenty-Fifth AAAI Conference on Artificial Intelligence. (2011). Retrieved from: <https://oec.world/en/profile/hs/rough-wood?countryComparisonFlowSelector=Exports&countryComparisonGeoSelector=na&countryComparisonMeasureSelector=Trade%20Value>

Source: U.S. Census Bureau<sup>17</sup>

According to OEC, the United States was the fifth largest exporter of wood, wood articles, and charcoal, which includes rough wood, lumber, and logs, accounting for \$7.76 billion, or 5.7%, of annual wood trade in 2020. From 2010 to 2020, United States export of wood products increased at an annualized rate of 1.25%. However, export trade of rough wood, which includes most types of logs, has declined slightly, at an annualized rate of 0.24%. The top importer of wood articles was the United States (representing 16.4% of imports), followed by China and Germany, with 12.5% and 6.3% respectively. The top importer of rough wood in 2020 was China, accounting for 50.6%, or \$6.7B, of rough wood imports, followed by Austria (\$648M) and India (\$589M).

Coniferous lumber represented the largest portion of global wood article trade value, at \$27.8B in 2020. Coniferous untreated logs accounted for \$7.52B of trade value.

For the United States, non-coniferous lumber contributed \$963M in trade value in 2020, untreated logs contributed \$946M, and oak logs contributed \$204M.

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<sup>17</sup> U.S. INTERNATIONAL TRADE IN GOODS AND SERVICES, DECEMBER AND ANNUAL 2022 (Release Number: CB 23-17, BEA 23-05). (2023). In *United States Census Bureau*. [https://www.census.gov/foreign-trade/Press-Release/current\\_press\\_release/ft900.pdf](https://www.census.gov/foreign-trade/Press-Release/current_press_release/ft900.pdf)

## Site Factors

Using existing research conducted by VT College of Natural Resources and Environment (CNRE) faculty and additional input from key faculty and log export industry experts, the research team determined the following site characteristics that will need to be factored to choose a suitable site for a potential steam and vacuum treatment facility.

### Facility Size and Operations

Based on specifications for the vacuum treatment system<sup>18</sup>, developed in 2017 in partnership with VT faculty, Phytovac and Welker Vakuum GmbH, a potential site will need to have sufficient room for the chamber, which can accommodate shipping containers up to 40 ft in length.

Figure 5: Representation of Treatment unit.

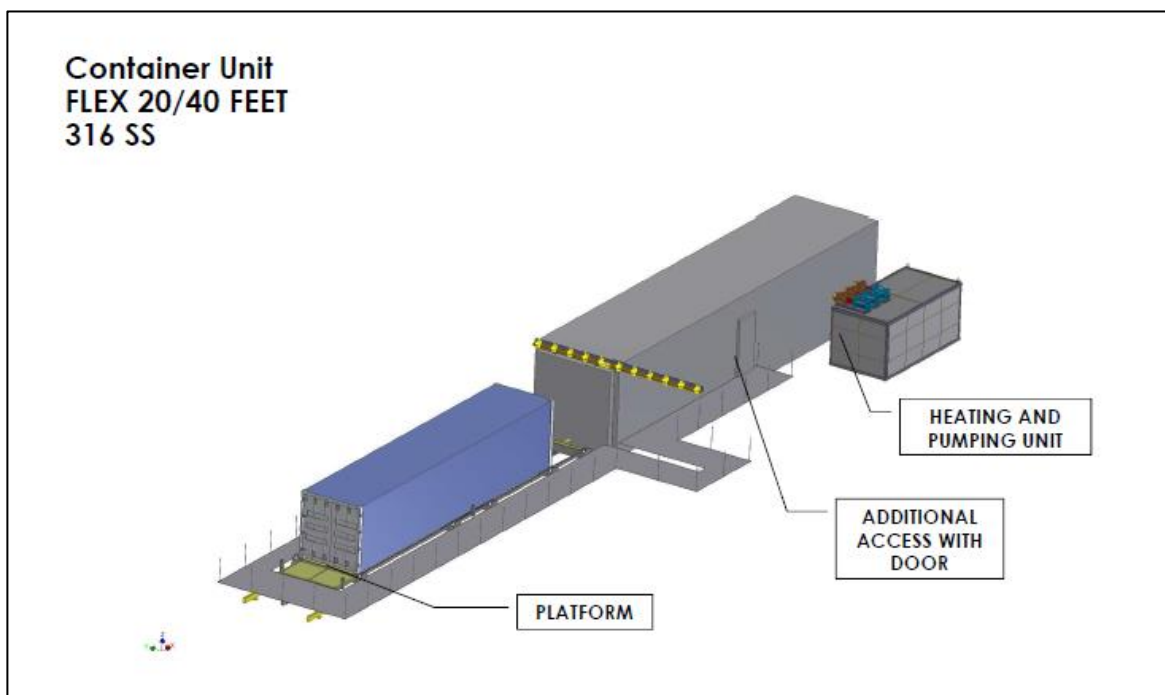


Image source: Quesada 2021.<sup>19</sup>

Figure 6: Image of Treatment Unit onsite.

<sup>18</sup> <https://www.welker.de/files/PDF/plastics/condimat/14-%20PLAS%20WELKER%20CONDIMAT%20ENG2-rev%20comp.pdf>

<sup>19</sup> Retrieved from "Eliminating marketing barriers to support the transition from methyl bromide fumigation to vacuum and steam treatment technology: The Case for Export Logs." Grant proposal, Henry J. Quesada. 2021.



Image Sources: Welker Vakuum GmbH, Condimat<sup>20</sup>

Additionally, the potential site will need to have enough space for trucks transporting containers to enter, load, and unload containers and logs. Furthermore, the site will need sufficient storage space where logs that have been treated and are waiting to be transported to ship can be stored in a protected manner to prevent re-infestation.

Therefore, the potential site for the steam-and-vacuum treatment facility will need to be **at least 5 to 20 acres in size.**

### Zoning

Permitted uses for any given site are determined by a locality's zoning ordinance. Though there is some variation between various local ordinances, the research team found that forestry and wood product manufacturing and/or processing typically corresponded to light industrial or traditional/heavy industrial classifications. For instance, the City of Richmond includes wood and paper products, including shipping container uses, as permitted uses in its light industrial (M1) districts.<sup>21</sup> In the City of Suffolk, sawmills are permitted with conditional use permit in light industrial districts (M1) and by right in heavy industrial districts (M2).<sup>22</sup>

Therefore, the potential site would have to be zoned for light or heavy industrial uses and/or be designated by the locality's ordinance future land use map as a light or heavy industrial district.

<sup>20</sup> <https://www.welker.de/files/PDF/plastics/condimat/14-%20PLAS%20WELKER%20CONDIMAT%20ENG2-rev%20comp.pdf>

<sup>21</sup> RICHMOND, VA, CODE OF THE CITY OF RICHMOND, VIRGINIA. ch. 30, Div. 28 § Sec. 30-452.1. (2020).

<sup>22</sup> SUFFOLK, VA, UNIFIED DEVELOPMENT ORDINANCE, TABLE 406-1: Principal Uses Permitted in Zoning Districts. (2022)

### Power/Water/Utility needs

Vacuum treatment requires approximately half the energy of treatment at atmospheric pressure, so energy needs for a vacuum-steam treatment facility will not restrict site selection more than those of conventional methyl bromide treatment.

The steam-and-vacuum treatment method is water-intensive due to the generation of steam that increases the efficiency of the method. Each treatment cycle per container uses 187.5 gallons of water.<sup>23</sup> Thus, the potential site will require dependable access to water infrastructure.

An industrial site served by electric power, water, and sewer would be sufficient for the potential steam-and-vacuum treatment facility. Treatment experts indicated that the boiler used to treat the wood will require either electric or natural gas power sources.

### Transportation and Port Access

Interviewees consistently emphasized the importance of proximity and access to ports and to highway infrastructure, given that logging companies typically use trucks to transport logs to be treated. Niche local road weight limits and regulations have the capacity to reduce companies' demand for services in regions, so final site selection may verify that local regulations do not impart additional restrictions or fees on top of those generally imparted by state agencies.

Proximity to shipping ports is a major consideration. Log exporters and treatment experts indicated the need to get treated logs to ports as efficiently and quickly as possible to avoid re-infestation and degradation. Therefore, efficient and timely transport is key and depends on proximity to port locations and access to highways. Ports outside Virginia that may be of interest include those in Charleston and Baltimore, though interstate transport taxes may reduce Virginia loggers' demand for treatment services, should a site be located out of state. Norfolk, Virginia's port is also a logical area of interest, as is the Inland Port.

Furthermore, stakeholders of the proposed facility are exploring opportunities to supplement the wood vacuum and steam treatment services provided with additional services such as quarantine treatment of other imported non-wood goods. If a port received contaminated product containers, the quarantined container can either be treated or needs to be disposed of. Providing treatment and disposal services to ports could help diversify revenue streams for the proposed facility, as log trade can be somewhat seasonal.

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<sup>23</sup> Retrieved from economic analysis documentation by Dr. Marshall White and Dr. Zhangjing Chen, 2021.

## Indirect Factors

### Workforce

Interviewees indicated that wood treatment operations are often less labor-intensive than sawmills, or timber harvesting operators in the upstream supply chain. Some suggested that availability of workforce was not a top priority when considering a potential site, as compared to other factors.

Job postings data for the Virginia logging industry from Lightcast showed that 43% of jobs posted in the last 5 years had a required minimum education level of high school or GED equivalent. In comparison, 15% required at least a Bachelor's degree.<sup>24</sup> Proximity to a higher education situation may be an additional advantage but is not a primary factor for consideration.

Notably, the steam-and-vacuum treatment method is in the early stages of adoption. Therefore, there may be limited availability of specialists with experience in operating, maintaining, and repairing the chamber and specialized machinery. Some industry stakeholders indicated this as a concern to possible adoption. Selecting a site for the treatment facility should factor in proximity of companies or contractors qualified to work with the specialized technology, including the treatment process innovators at Virginia Tech in Blacksburg, VA.

### Tax environment

Tax structure of the community of a potential site may play as a secondary or tertiary factor when comparing potential sites. Lower property tax rates would save development costs for a potential facility.

Additionally, pricing of services for a potential facility will need to factor in the fact that logging companies and their drivers will bear the cost of transportation, including interstate transport taxes. This tax cost could apply to companies transporting logs for treatment from states outside of Virginia.

### Regulatory factors

Traditional treatment methods such as methyl bromide are regulated by federal and state regulations for outputs and waste generated. However, the proposed treatment technology results in no waste products other than steam, so regulations pertaining to discharge of atmospheric or other pollutants are not applicable. Nonetheless, site selection will need to consider local regulation of water run-off permits require for condensate control, as the steam generated is captured as condensation as a result of the treatment process. Most Virginia localities' ordinances require an operator to maintain a stormwater management plan. For instance, Richmond, Virginia Code of Ordinances Chapter 14, Article V describes the components of stormwater managements plans that all permittees or operators of developed land are required to submit and maintain.<sup>25</sup>

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<sup>24</sup> Retrieved from Lightcast Job Postings Analytics for Logging (NAICS 113310), 2017-2022.

<sup>25</sup> RICHMOND, VA., CODE OF ORDINANCES ch. 14, § 14-327 (2015).

Like with any industrial site, operators of the steam-and-vacuum treatment plant will need to adhere to federal, state, and local regulations on proper garbage disposal and similar statutes. For instance, the Code of Virginia forbids disposal of any waste products into bodies of water within the state.<sup>26</sup>

Additional regulatory factors include federal and state regulations of wood infestation and pests, such as the gypsy moth, emerald ash borer, and spotted lanternfly, and thousand-canker disease. Industry experts indicated that there are advantages to operating the site in of Virginia, as compared to some neighboring states, as areas in the state have already been infected by the gypsy moth and quarantined; therefore, bringing logs into a quarantine zone for treatment is lower-risk than exporting logs from the quarantine zone to areas not presently under quarantine.

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<sup>26</sup> CODE OF VIRGINIA, Section § 62.1-194.



## Site Inventory: Feasibility and Siting Recommendations

CECE used the previous key findings and ranked site selection factors derived from the interviews with stakeholders, regulatory agencies, and technology developers (VT CNRE faculty) to filter available vacant sites using the Virginia Economic Development Partnership’s site selection database and tool.<sup>27</sup>

### Key Findings

- Port of Virginia representatives indicated that approximately 75% of logs exported from the Port originate in the state of Virginia; the remainder of logs originate from out-of-state, particularly from North Carolina, South Carolina, Maryland, and West Virginia.
- Some participants indicated Virginia, as compared to nearby states such as the Carolinas, as more suitable for timber transportation due to the regulatory environment as well as past exposure to and control of invasive pests. There is less risk of exposure to new invasive species.
- Interviewees indicated that a potential steam-and-vacuum-treatment facility would need to be close to port to minimize deterioration or infestation of the treated product, with 24/7 access, and sufficient room for container staging. A potential site might range anywhere from 5 to 20 acres.
- Overall, site selection should focus on locations within Virginia, given the preceding findings that Virginia log exports predominantly make use of logs originating from within the state and that pest quarantine rules make transporting logs into Virginia easier than into other states.

Based on the qualitative findings from interviews and engagement with industry stakeholders, log export experts, and regulatory agency representatives, the CECE team suggested the following ranking for top factors impacting site selection:

1. Proximity to a port for foreign export
2. Size of site
3. Water and sewer infrastructure present
4. Transportation access (highways, potentially rail)
5. Zoning (industrial uses permitted)
6. Regulatory factors particularly those regarding wood pest control and quarantine

*Table 1: Site Selection Criteria*

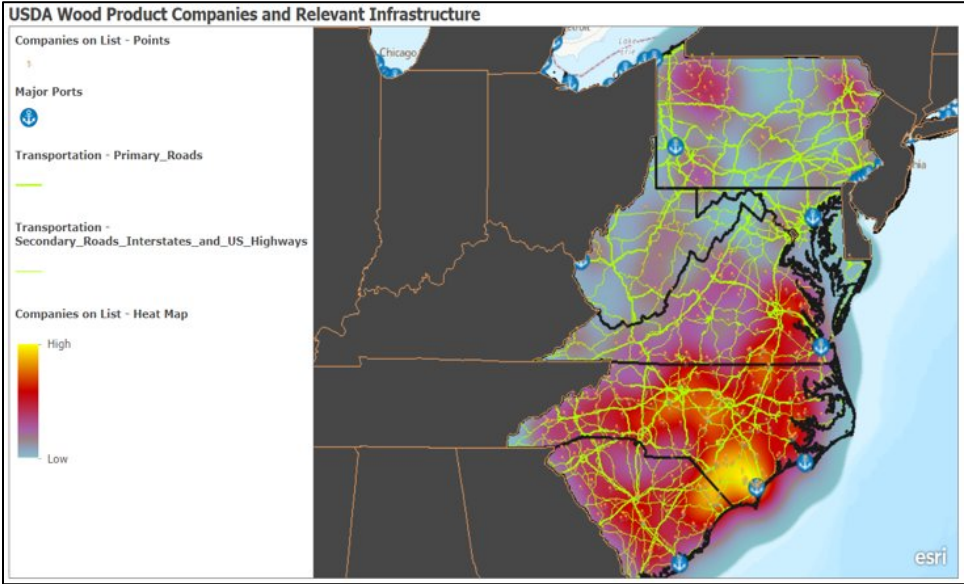
Consideration	Logic
Property Type: Sites and Land	The technology requires space for log laydown, etc., but not strictly office space.

<sup>27</sup> [Sites & Buildings Search \(vedp.org\)](https://vedp.org/Sites-Buildings-Search)

Minimum size: 5 acres	Conversations with CNRE faculty and other parties estimated this to be the minimum feasible size.
Distance to a major highway: <5 miles	Firms use trucks to transport logs; selection unchanged by relaxing constraint to <10 and <30 miles, maintaining other constraints.
Water and sewer access	Power source may be flexible, but the technology relies on water.
Rail Access	Firms may use rails to transport logs for export.
Located in Hampton Roads, Greater Richmond, or Warren County, VA.	Hampton Roads contains an ocean port; Greater Richmond is a central location with rail access; and Warren County contains the Virginia Inland Port. These areas are all well served by critical highway infrastructure. Hampton Roads and Greater Richmond are also sites with heavy log export firm presence. See Figure XXX.

The following figure illustrates the overlay of transportation infrastructure, location of Ports, and concentrations of logging industry companies. Significant concentrations of logging near the central and southeastern parts of the state (Greater Richmond region and Hampton Roads region) activity align with proximity to the Ports. Additionally, the Greater Richmond region and southeastern region of the state also show junctions of highway infrastructure and some rail.

Figure 7: Tentative Figure of Layers, Infrastructure, etc.



Note: The above plot includes all companies, rather than only respondents, in the figure above to respect respondent privacy. Map Sources: see <https://virginatech.maps.arcgis.com/home/item.html?id=e4a78c50a91a4e579155753bbb98f85b>; layer references in appendix.

Under these criteria, CECE found 5 sites in the Greater Richmond region, 5 sites in Hampton Roads, and 4 sites in proximity to the Inland Port, in Warren County, VA. Sites ranged from approximately 8 acres to 270 acres; CECE then excluded ‘mega sites’, defined as those greater than 100 acres, out of concern that negotiating for portions of these sites may be infeasible. As sites scale, the transaction costs associated with negotiation may increase, so CECE advises focusing on sites of a size as close to the necessary size as possible. The following table provides available site results:

*Table 2: Potential Sites in Regions of Interest*

Region	Site name	Acreage	Time to Port (hr/min)	Rail Access (Y/N)	Infrastructure/ Utilities	Link
Greater Richmond	West Site (U.S. 360)	51 Acres	15 min. to RMT 1 hr. 13 min. to Port of Virginia	Yes	has electric, natural gas, water, sewer, and fiber/broadband.	<a href="https://sites.vedp.org/virginia/propertyid/234353">https://sites.vedp.org/virginia/propertyid/234353</a>
Hampton Roads	York River Commerce Park	43 Acres	28 min. to Port of Virginia	Yes	has electric, natural gas, water, sewer, and fiber/broadband.	<a href="https://sites.vedp.org/virginia/propertyid/233923">https://sites.vedp.org/virginia/propertyid/233923</a>
	Southampton Commerce and Logistics Center	40 Acres	50 min. to Port of Virginia	Yes	has electric, natural gas, water, sewer, and fiber/broadband.	<a href="https://sites.vedp.org/virginia/propertyid/233924">https://sites.vedp.org/virginia/propertyid/233924</a>
	Suffolk Industrial Park*	51.19 Acres	29 min. to Port of Virginia	Yes	has electric, natural gas, water, sewer, and fiber/broadband.	<a href="https://sites.vedp.org/virginia/propertyid/234000">https://sites.vedp.org/virginia/propertyid/234000</a>
	Tri Point Terminals	8.4 Acres	22 min. to Port of Virginia	Yes	has electric, natural gas, water, sewer, and fiber/broadband.	<a href="https://sites.vedp.org/virginia/propertyid/288723">https://sites.vedp.org/virginia/propertyid/288723</a>
Northern Shenandoah Valley (Front Royal, Winchester)	Front Royal Warren County Industrial Park	80 Acres	14 min. to Inland Port 3 hr. 3 min. to Port of Virginia	Yes	has electric, natural gas, water, sewer, and fiber/broadband.	<a href="https://sites.vedp.org/virginia/propertyid/233306">https://sites.vedp.org/virginia/propertyid/233306</a>
	Stephens Industrial Park	85.2 Acres	5 min. to Inland Port 3 hr. 8 min. to Port of Virginia	Yes	has electric, natural gas, water, sewer, and fiber/broadband.	<a href="https://sites.vedp.org/virginia/propertyid/233385">https://sites.vedp.org/virginia/propertyid/233385</a>

*\*This site is located in Suffolk, VA; insight from interviews suggests Suffolk’s regulatory environment may be more complicated than that of other locations; this should be balanced against findings suggesting dense log industry activity in proximity to*

*Suffolk. Site availability is subject to change; in the event a particular site is no longer available, CECE advises consideration of an alternative site with similar characteristics.*

Should these sites prove infeasible, CECE recommends relaxing the Rail access constraint; doing so more rapidly expands marginal inclusion of sites than relaxing highway proximity constraints. Please see Appendix B for additional potential sites without rail access.

From the site inventory, the research team identified one top site per region that best matched the siting criteria. They are as follows:

4. **Front Royal Warren County Industrial Park, Front Royal VA (80 Acres):** This industrial site is located within 10 miles of the Inland Port of Front Royal and 3 hours away from the Port of Virginia in Hampton Roads. The available 80 acres are sub-dividable by 5-acre lots with the options of build-to-suit or sale.<sup>28</sup> This would allow treatment facility developers flexibility in the amount of land needed.
5. **Tri Point Terminals, Chesapeake VA (8.4 Acres):** This pad-ready site in the Hampton Roads region is zoned industrial and is located 22 minutes from the Port of Virginia.
6. **West Site (U.S. 360) (51 Acres):** This site, located 15 minutes from the Richmond Marine Terminal, is well served by highway and rail and is zoned for industrial use. Notably, the site also has potential to offer availability for redundant power which could be an advantage to provide reliable power to run treatment operations.<sup>29</sup>

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<sup>28</sup> Retrieved from VEDP Sites Database, <https://sites.vedp.org/virginia/propertyid/233306>

<sup>29</sup> Retrieved from VEDP Sites Database, <https://sites.vedp.org/virginia/propertyid/234353>

## Conclusions

Overall, research indicated that methyl bromide treatment is being rapidly phased out. Markets within the U.S. and abroad are already taking steps to outlaw methyl bromide treatment and close their doors to wood products treated with methyl bromide. Alternative and effective wood treatment methods will become inevitably necessary. Companies and logging industry representatives generally indicated some interest and acceptance of the potential steam-and-vacuum treatment method, with positive feedback in regards to the comparatively low environmental and health impacts.

Feasibility of a potential treatment facility depends on the rate of adoption among companies that are the target consumers of the facility's services. This, in turn, depends wholly on the pending federal regulatory approval of the steam-and-vacuum treatment protocol. In addition, foreign countries' adoption of trade laws that approve import of steam-and-vacuum treated wood products will also impact feasibility to marketing the service. The prognosis of the technology's adoption relies on success in these efforts to achieve regulatory approval from countries receiving logs from exporters within the region in question. Trading partners will need to adopt the proposed species-targeted vacuum-and-steam 56C/30 min. sapwood treatment for logs with bark. Companies express frustration with current regulatory standards imposed by importing companies; they perceive standards to shift and/or be arbitrarily enforced. Securing explicit regulatory approval will reduce exporting firms' hesitations to adopting the technology in question.

In general, the prognosis for the alternative steam and log treatment is positive. Firms seem generally accepting and the technology is promising and competitive should regulatory requirements allow for treatment of logs with bark on, rather than de-barked.

However, there are a number of threats to success and barriers to adoption that have the potential to jeopardize project success.

The steam and vacuum treatment technology has been proven to be as effective as other treatment methods.<sup>30</sup> If standards change to allow treatment of logs with bark on, which has been found to have similar efficacy as treatment of de-barked logs, it will shorten the required treatment time and protect logs in transport, likely saving companies some costs. However, until regulatory requirements shift, firms may be hesitant to invest in the alternative treatment technology themselves. Furthermore, there has been concern that limited options for facility maintenance could preclude widespread adoption by firms within the industry. In and of itself, this should not preclude an independent facility from attracting business of logging companies, but it does signal that there may be a degree of skepticism regarding the advantages of the technology within the industry.

Furthermore, there is some resistance to the export trade from some logging companies. Some firms cited moral concerns related to sending domestic resources overseas, particularly to China, but firms generally have engaged in export in either a past or present capacity, suggesting economic considerations may override. In their export activity, in general, firms may have developed successful

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<sup>30</sup> Zhangjing Chen, Marshall S. White and W.H. Robinson. 2004. Commercial Feasibility of Vacuum to Control Insects in Raw Wood Packaging Materials. Report submitted to Limestone Bluffs Resource Conservation and Development.

niches and business relationships and be hesitant to change. This presents an additional threat to technology adoption.

Firms report that currency exchange rates between countries (i.e. the strength of the dollar) have led to a slowdown of export in recent history. Firms also report volatile demand for logs by other countries and difficulty securing shipping containers to export logs. While present economic conditions have led to the return of export activity in companies' strategies, shipping difficulties remain a common issue for exporting firms. These difficulties have the potential to complicate export activity and, in turn, reduce demand for the alternative treatment technology.

Pending approval of the accelerated treatment protocol, site selection factors indicate opportunity for a potential treatment facility in Virginia, serving as a centralized location in proximity to concentrations of companies as well as major East Coast port access. Given size, utilities, regulations, and other considerations, sites in the proximity of the Hampton Roads region, Greater Richmond Region, and Inland Port region would be most appropriate.

## Appendix A

Table XX: NAICSs-Based Codes, Logging Business Inventory.

8-Digit NAICS- Based Code	NAICS Description
11331003	Logging Companies (Mfrs)
42331002	Building Materials - Wholesale
42331004	Cabinet Makers Equipment and Supplies - Wholesale
42331005	Cabinets - Wholesale
42331007	Cedar Products - Wholesale
42331009	Composite Materials - Wholesale
42331010	Counter Tops - Wholesale
42331011	Door Frames - Wholesale
42331012	Doors and Frames, Commercial and Industrial - Wholesale
42331013	Doors - Wholesale
42331014	Doors - Wood - Wholesale
42331016	Furniture Frames - Wholesale
42331018	Hardwoods - Wholesale
42331020	Kitchen Cabinets - Wholesale
42331023	Log Buyers - Wholesale
42331025	Louvers - Wholesale
42331026	Lumber Mill Representatives - Wholesale
42331027	Lumber - Drying - Wholesale
42331028	Lumber Exporters and Importers - Wholesale
42331029	Lumber - Wholesale
42331030	Millwork - Wholesale
42331031	Moldings - Wholesale
42331032	Pallets and Skids - Wholesale
42331035	Plywoods and Veneers - Wholesale
42331036	Poles - Wholesale
42331038	Railroad Ties - Wholesale
42331041	Shutters - Wholesale
42331043	Stakes - Wholesale
42331044	Storm Windows and Doors - Wholesale
42331046	Timber and Timberland Companies - Wholesale
42331049	Windows - Wholesale
42331051	Garage Cabinets and Organizers - Wholesale
42331032	Pallets and Skids - Wholesale

Source: Esri Business Analyst Business Search Tool



## Appendix B

Region	Site name	Acreage	Time to Port (hr/min)	Rail Access (Y/N)	Link
Greater Richmond	7710 Fort Darling Road-Richmond	18 Acres	11 min. to RMT 1 hr. 17 min. to Port of Virginia	No	<a href="https://sites.vedp.org/virginia/propertyid/234822">https://sites.vedp.org/virginia/propertyid/234822</a>
	Castlewood & Cardwell Road	16.8 Acres	10 min. to RMT 1 hr. 16 min. to Port of Virginia	No	<a href="https://sites.vedp.org/virginia/propertyid/285522">https://sites.vedp.org/virginia/propertyid/285522</a>
Northern Shenandoah Valley (Front Royal, Winchester)	220 Park Center Drive- Winchester	5 Acres	23 min. to Inland Port 3 hr. 23 min. to Port of Virginia	No	<a href="https://sites.vedp.org/virginia/propertyid/286752">https://sites.vedp.org/virginia/propertyid/286752</a>
	Annandale Industrial Park- Lot 6 Frogale Ct	9.1 Acres	19 min. to Inland Port 3 hr. 19 min. to Port of Virginia	No	<a href="https://sites.vedp.org/virginia/propertyid/235247">https://sites.vedp.org/virginia/propertyid/235247</a>
	Virginia Inland Port Services Industrial Park	30 Acres	2 min. to Inland Port 3 hr. 6 min. to Port of Virginia	No	<a href="https://sites.vedp.org/virginia/propertyid/240701">https://sites.vedp.org/virginia/propertyid/240701</a>

Map Layers:

2012 National Highway System of South Carolina. 30 October 2018. Gallowayra\_SCDOT.

<https://virginiatech.maps.arcgis.com/home/item.html?id=4948483186d24ea3a0506d5ab4f01b22>

Chesapeake Bay Watershed Boundary. 24 November 2015. CBF\_GIS.

<https://virginiatech.maps.arcgis.com/home/item.html?id=a505276362d6415a92e13b6ae21b63c1>

Company locations developed using ArcGIS Esri Business Analyst.

Elevation/World\_Hillshade (MapServer).

[https://services.arcgisonline.com/arcgis/rest/services/Elevation/World\\_Hillshade/MapServer](https://services.arcgisonline.com/arcgis/rest/services/Elevation/World_Hillshade/MapServer)

Major Ports. 11 September 2022. Esri\_US\_Federal\_Data.

<https://virginiatech.maps.arcgis.com/home/item.html?id=a8311108e2964dcb4a7c1fedb5763ff>

MDOT SHA Roadway National Highway System (NHS). 7 November 2022.

<https://virginiatech.maps.arcgis.com/home/item.html?id=c9790b35a015411b81c3db4b2abd11dd>

National Highway System(NHS). 19 April 2022. WVDOT\_Publisher.

<https://virginiatech.maps.arcgis.com/home/item.html?id=aa41072c7e1d47419b35e32d47273c93>

NCDOT NHS. 9 May 2022. NCDOT.GOV.

<https://virginiatech.maps.arcgis.com/home/item.html?id=b5e4863550324ed38890e802410fae77>

North American Rail Lines. 8 December 2022. Esri\_US\_Federal\_Data.

<https://virginiatech.maps.arcgis.com/home/item.html?id=b12706a22fbc47cdac131596d858388e>

Rail Lines. 9 March 2022. Oipi.admin.

<https://virginiatech.maps.arcgis.com/home/item.html?id=10ec8f2798b64e9d950a92352ab9b5c9>

Transportation. 25 January 2022. Esri\_US\_Federal\_Data.

<https://virginiatech.maps.arcgis.com/home/item.html?id=f42ecc08a3634182b8678514af35fac3>

US State Borders. 1 March 2020. Mribant\_GeographyDept.

<https://virginiatech.maps.arcgis.com/home/item.html?id=5f3cf3598dcf4be6869aad1378e5cec1>

USA States (Generalized). 20 September 2022. Esri\_dm.

<https://virginiatech.maps.arcgis.com/home/item.html?id=99fd67933e754a1181cc755146be21ca>

World Topographic Map. 22 November 2022. Esri\_vector.

<https://virginiatech.maps.arcgis.com/home/item.html?id=7dc6cea0b1764a1f9af2e679f642f0f5>

