Original scientific article / Izvirni znanstveni članek

USE TO REUSE: MAPPING AND ASSESSING CHEMICALLY TREATED END-OF-LIFE TIMBER FOR CIRCULARITY IN AUSTRALIA
UPORABA ZA PONOVNO UPORABO: KARTIRANJE IN OCENJEVANJE KEMIČNO OBDELANEGA ODSLUŽENEGA LESA ZA KROŽNOST V AVSTRALIJI

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ABSTRACT

The current and projected availability of end-of-life treated-timber vineyard posts in Australia has been assessed and mapped to enhance timber recycling and reuse potential by improving the visibility of timber flows. While timber provides benefits such as low embodied carbon and renewability, chemically treated variants present significant challenges for reuse and recycling. This study addresses these barriers and aims to develop circular economy pathways for preservative-treated timber products in Australia, ultimately reducing the amount of timber sent to landfill. Data were collected through industry site visits, surveys, and publicly available sources. The inclusion of councils with existing circular economy strategies highlights regions that could develop into circular economy hubs, supporting new business opportunities. This map helps identify resource distribution, infrastructure, and regulatory constraints, enabling informed decision-making and fostering stakeholder collaboration.

Keywords: Resource recovery; Recycling; Reuse; Timber circularity; Treated wood; Preservative-treated wood; Treated timber; Preservative-treated timber; Vineyard post

IZVLEČEK

Ocenjena in kartirana je bila trenutna ter predvidena razpoložljivost impregniranih lesenih kolov za vinograde v Avstraliji, z namenom izboljšanja možnosti recikliranja in ponovne uporabe lesa prek večje preglednosti tokov lesa. Čeprav ima les prednost, kot so nizka vgrajena ogljična vrednost in obnovljivost, je les, tretiran z biocidnimi pripravki, velik izziv za ponovno uporabo in recikliranje. Ta študija obravnava te ovire in si prizadeva razviti poti krožnega gospodarstva za izdelke iz lesa, obdelanega s biocidi, v Avstraliji, s čimer se bo zmanjšala količina lesa, ki konča na odlagališčih. Podatki so bili zbrani med obiski industrijskih lokacij ter z anketami in javno dostopnimi viri. Vključitev občin z obstoječimi strategijami krožnega gospodarstva postavlja v ospredje regije, ki bi se lahko razvile v središča krožnega gospodarstva ter podpirale nove poslovne priložnosti. Ta zemljevid omogoča prepoznavanje, razporeditev virov, infrastrukturo in regulativne omejitve, kar omogoča sprejemanje informiranih odločitev ter spodbuja sodelovanje deležnikov.

Ključne besede: Obnovitev virov; Recikliranje; Ponovna uporaba; Krožnost lesa; Obdelan les; Les, obdelan z biocidi; Obdelan leseni material; Les, obdelan z zaščitnimi pripravki; Vinogradniški kol

GDK 813(292.91/.93)(045)=111
DOI 10.20315/ASetL.138.2

Prispelo / Received: 18. 07. 2025
Sprejeto / Accepted: 22. 10. 2025

1 INTRODUCTION UVOD
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Preservative-treated timber presents one of the most pressing circular economy challenges in Australia and globally (Augustsson et al., 2017; Klinge et al., 2019). While timber is valued for its renewable properties and low embodied carbon, chemical treatment, in particular chromated copper arsenate (CCA), creates significant barriers to reuse, recycling, and safe disposal. These challenges are especially acute in industries such as viticulture, where millions of treated timber vineyard posts reach end-of-life (EOL) annually, yet regulatory restrictions and costs leave growers with limited management options.

Timber preservatives, most notably CCA which was developed in 1934, have been shown to substantially extend the durability and service life of timber, with inground treated products demonstrating service lives up to and exceeding 50 years (Mohajerani, Vajna & Ellcock, 2018; Singh & Page, 2016). This not only decreases repair and replacement costs but also has environmental benefits by reducing pressure on new timber harvesting (Khademibami & Bobadilha, 2022). However, growing environmental and health concerns have led to restrictions or bans on the use of CCA in many countries. In Australia, CCA and other copper-based preservatives remain the only option for ground-contact uses (AS/NZS 1604) (Liu et al., 2019).

Despite regulatory restrictions, both nationally and internationally, the preservative-treated timber market remains a growing multi-billion-dollar global industry, with values estimated at USD 5–6 billion in 2023 and projected to reach USD 9–10 billion in the near future (Treated wood, 2025).

The millions of tonnes of preservative-treated timber currently in service globally represent a mounting waste management challenge as they will ultimately require reuse, repurposing, or carefully controlled disposal pathways (Mitchell et al., 2025). Regulatory constraints complicate efforts to recycle or repurpose chemically treated timber, both in Australia and internationally (Manage and dispose ..., 2024; NetRegs, s. a.). The National Centre for Timber Durability and Design Life (NCTDDL) at the University of the Sunshine Coast, Queensland, is leading the Timber Circularity Project to identify circular pathways for preservative-treated timber and engineered wood products (EWP) in Australia.

In Australia, CCA-treated timber represents approximately 30% of all preservative-treated wood. Utility poles, landscaping timber, and vineyard posts are predominantly CCA-treated. In the Australian wine industry, approximately 80% of vineyard posts in service are preservative treated with CCA, with the remaining 20% treated with creosote (Mitchell et al., 2024). Vineyard posts may require replacement prior to the end of their service life due to breakage, predominantly from mechanical harvesting. This equates to up to 4.3 million posts each year (approximately 2–5% of installed posts) across Australia (Mitchell et al., 2025). The end-of-life management of these posts poses significant challenges due to the stringent regulatory restrictions on the transport, reuse, recycling, and disposal of treated timber in Australia. As a result, many vineyard growers stockpile used posts (Figure 1), concentrating hazardous materials in one location and posing environmental and health risks, particularly in bushfire-prone regions. Burning CCA-treated wood releases toxic arsenic gases, while the resulting ash contains high concentrations of heavy metals that require hazardous waste disposal at licensed sites (Jambeck et al., 2007).

The objective of this study was to develop practical, evidence-based pathways for managing EOL preservative-treated timber and engineered wood products (EWPs) within a circular economy framework in Australia. Focusing initially on CCA-treated vineyard posts, the study sought to:

- quantify current and projected volumes of end-of-life vineyard posts;
- evaluate the residual chemical profiles of vineyard posts and the potential for recycling or repurposing;
- analyse regulatory constraints across local, state, and federal levels that influence reuse and disposal;

Fig. 1: CCA-treated radiata pine posts stockpiled at an Australian vineyard, awaiting disposal.

Slika 1: S CCA impregnirani koli bora radiata, zloženi v avstralskem vinogradu, čakajo na odstranitev.

- map geographic resource flows, transport networks, and circular economy initiatives; and
- pilot viable reuse and recycling options for CCA-treated timber.

2 METHODS
2 METODE
2.1 Vineyard Post Volumes and Landfill Disposal Costs
2.1 Količine vinogradniških kolov in stroški odlaganja na odlagališču

To estimate the number of CCA- and creosote-treated posts currently in use and removed annually from Australian vineyards and their cost of disposal at landfill sites, multiple datasets were analysed to assess post quantities, dimensions, weights, volumes, and condition at regional, state, and national scales. The datasets included:

2.1.1 Wine Australia's National Vineyard Scan (NVS) (2019)
2.1.1 Nacionalni pregled vinogradov (NVS) organizacije Wine Australia (2019)

Wine Australia used satellite imagery to geolocate all winegrape vineyards in Australia for the National Vineyard Scan (NVS) in 2019. The NVS used a computer algorithm to scan satellite imagery and detect vineyards. Australia was scanned state by state using 836 satellite images from more than 16,934 areas of interest. The NVS was used as a check for the survey data (Section 2.1.3), as it provided greater detail on distances between posts and between rows, which was considered to be more accurate than the survey data.

2.1.2 Geospatial maps developed for Wine Australia using ArcGIS (2020)
2.1.2 Geoprostorske karte, razvite za Wine Australia z uporabo ArcGIS (2020)

The NVS data were used to develop geospatial maps, which are available at (Wine Australia – Open Data) on the Australian Wine Geographic Indications (GI) Map. The maps include the most accurate and up-to-date information available on locations and hectares for Australia's winegrape-growing vineyards in 2023. This information was used to extract vineyard areas on a state, zone, and regional basis. Vineyard areas by zone did not always correspond with regional areas (3.74% discrepancy overall). This was likely due to several factors:

- zones not completely overlapping regions
- table grapes potentially being misidentified as winegrape areas, although there was a degree of manual curation to remove data from known table grape regions

This small discrepancy was not considered to be an issue for the current study, as the industry is currently undergoing considerable change, with some regions removing large areas of vineyard and other areas increasing vineyard area.

2.1.3 Survey sent to Wine Australia members (2022)
2.1.3 Anketa, poslana članom organizacije Wine Australia (2022)

An online survey was conducted between May and June 2022 targeting winegrape growers. With permission from Wine Australia, the survey was distributed to all members (n=488), yielding a response rate of approximately 67% (n=327). The survey included a mix of closed and open-ended questions aimed at understanding the type, volume, and condition of the posts used and removed, the options available to manage treated timber waste, and attitudes to the end-of-life management of posts.

The raw data were cleaned to remove incomplete responses, duplicates, errors, and vineyards that did not use treated timber posts. The cleaned data used to determine the number of CCA-treated posts comprised 341 unique responses, representing 45 of the 65 officially recognised regions in Australia. This dataset was processed to allow extrapolated summaries to be tabled at a region, zone, and state level.

Response rates varied between regions, with some having a single respondent, more than ten regions having ten or more respondents, and one region having 90 unique responses.

2.1.4 Post size and weight survey (2023/24)
2.1.4 Popis velikosti in teže vinogradniških kolov

Additional information on post size and weight was required to better understand the scale of the end-of-life vineyard post resource available due to its impact on logistics and recycling. A survey was undertaken with the support of Wine Australia, which was distributed via the AWRI webinar in December 2023 and via member communication channels. The surveyed growers were asked to randomly select 16 end-of-life posts from their stockpiles and measure and record the length, end diameter, and weight of each post (67 posts in total).

2.1.5 Site visits (2023/24)
2.1.5 Obiski lokacij (2023/24)

Additional information on post size and weight was obtained through site visits to vineyards, where log length, diameter, and weight measurements were recorded from randomly selected logs in stockpiles. The condition of the logs was noted, and photos were taken (142 posts in total). This provided benchmark figures to better understand the post dimension survey results. End-of-life posts obtained from a variety of vineyards for other testing in the current study were also measured and weighed for additional data. A total of 220 samples were measured, 20 of which were delivered from vineyards for strength testing.

2.1.5 Consultations with Wine Australia representatives and winegrape growers
2.1.5 Posvetovanja s predstavniki organizacije Wine Australia in pridelovalci grozdja

Weekly discussions with Wine Australia were held during 2023 and 2024 to confirm and clarify information. Discussions with growers and site visits to a variety of vineyards provided the research team with further opportunities to clarify details around post data and ensure the data were within reasonable limits.

Initially, site visits were conducted to understand the extent of the resource. Subsequent visits were then carried out to gain insight into specific details that were not accessible through other sources or where additional clarity was required for the data.

The integration of these data sources enabled a comprehensive understanding of vineyard post use and disposal across Australia.

2.1.6 Landfill disposal costs
2.1.6 Stroški odlaganja na odlagališču

The cost of disposal of CCA-treated vineyard posts at regional landfill sites across winegrowing regions was assessed through a combination of phone calls to landfill operators and obtaining cost information from landfill websites.

2.2 Post Chemical Analysis
2.2 Kemijska analiza kolov

A chemical analysis was undertaken on vineyard posts to determine the retention of CCA treatment over their service life to better understand their reuse potential. Forty-eight CCA-treated radiata pine vineyard posts were randomly selected from six vineyard stockpiles in two wine growing regions of South Australia, after service lives of between 18 and 26 years. Four discs were removed at varying points along each log, providing a total of 192 samples. The discs were sprayed with chrome azurol S to detect copper penetration. The methods and results are reported in Singh et al. (2024).

2.3 Geospatial Mapping
2.3 Geoprostorsko kartiranje

Geospatial data collected from the sources described above were mapped in collaboration with a geospatial service provider using ArcGIS, with end-user functionality as a primary consideration. A further key requirement was that, where possible, data could be added or updated by the Timber Circularity Project staff.

3 RESULTS
3 REZULTATI

Study results are presented in three parts. Section 3.1 reports findings from multiple datasets used to assess post quantities, dimensions, weights, volumes, and condition at regional, state, and national scales. Section 3.2 presents the results of the post chemical analysis, while Section 3.3 examines state-level regulations, which present challenges to the reuse, recycling, or disposal of preservative-treated timber posts. Together, these findings provide a comprehensive overview of the quantity, condition, and distribution of timber resources that could support timber circularity in Australia.

3.1 Vineyard Post Volumes and Cost of Disposal at Landfill Sites
3.1 Količine vinogradniških kolov in stroški odlaganja na odlagališčih

Based on the combined analysis of the datasets, it is estimated that more than 85.6 million posts are currently in service in Australian vineyards, and approximately 32.5 million posts are stockpiled across vineyards nationally (Mitchell et al., 2025). While vineyards exist in every state except the Northern Territory, the highest concentration is in three states, New South Wales, South Australia, and Victoria due to the suitability of their climatic conditions.

The expense of meeting regulatory requirements is pushing the viticulture industry to stockpile old posts and investigate alternative products including steel and plastic, which could potentially have a higher overall impact. The annual production of end-of-life vineyard posts has been quantified in terms of the number of posts, their sizes and volume, weight, quality, condition, and geographic distribution. The information has been collected through a series of surveys, site-visits,

Table 1: Summary of CCA-treated timber and creosote posts removed annually in Australian vineyards (assuming a 2-5% attrition rate). Tasmania is calculated using a 1-2% attrition rate based on data information from Wine Tasmania and the high level of hand-harvesting compared to other regions.

Preglednica 1: Povzetek količin s CCA in kreozotnim oljem obdelanega lesa, ki se vsako leto odstranijo iz avstralskih vinogradov (ob predpostavki stopnje obrabe 2–5 %). Za Tasmanijo je izračun narejen ob upoštevanju stopnje obrabe 1–2 %, na podlagi podatkov organizacije Wine Tasmania in zaradi visoke stopnje ročnega obiranja v primerjavi z drugimi regijami.

	ATTRITION RATE	CCA POSTS REMOVED	CREOSOTE POSTS REMOVED	TOTAL POSTS REMOVED
NEW SOUTH WALES	2-5%	304,695 – 761,738	111,691 – 279,228	416,386 – 1,040,966
QUEENSLAND	2-5%	6,016 – 15,041	1,145 – 13,611	7,161 – 28,652
SOUTH AUSTRALIA	2-5%	719s,479 – 1,798,697	194,315 – 485,788	913,794 – 2,284,485
TASMANIA	1-2%	10,319 – 20,638	0	10,319 – 20,638
VICTORIA	2-5%	229,858 – 574,644	32,599 – 81,498	262,457 – 656,142
WESTERN AUSTRALIA	2-5%	91,827 – 229,567	0	91,827 – 229,567
NATIONAL	1-5%	1,362,194 – 3,400,325	339,750 – 860,125	1,701,944 – 4,260,450

discussions with wine associations, growers and post suppliers, geospatial data, recorded documents, and durability analysis.

A conservative estimate of post numbers based on a 2% attrition rate has been calculated at state and national levels (Table 1). It has been determined that a large proportion of the timber posts in use are CCA-treated (80%), with creosote-treated posts making up the remainder. In total, the number of treated timber posts removed from vineyards annually in Australia is over 1.7 million. This number is thought to be very conservative as it does not take into consideration aging posts and wine over-supply which in some cases has resulted in the removal of entire vineyards. An average of 3% to 5% may be a more accurate estimate which equates up to 4.2 million posts nationally. Tasmania's data has been calculated at 1-2% attrition rate based on data information provided by Wine Tasmania and several Tasmanian vineyards stating they hand-harvested a high proportion of their crop compared to other regions, resulting in less damage to the posts.

The 2022 survey responses (Section 2.1.3) provided information about what vineyards are currently doing with their removed posts. Responses for this question varied significantly. Table 2 summarises these responses.

Survey results allowed for stockpile percentages to be calculated by state (Table 3). This does not account for existing post stockpiles which have accumulated over many years and could potentially be many times the number of posts coming out of the vineyards annually. A 2003 South Australian Wine Industry Association report suggested breakages ranged up to 12%, which indicates the annual contribution to stockpiles at that point could have been much greater, even if some posts were reused in applications such as farm fencing.

The average cost for disposal of CCA treated vineyard posts at regional landfill sites in wine growing areas was A$298/tonne This excludes transport costs to the landfill site, which can be considerable.

Table 2: Survey responses asking vineyards to specify their current method of end-of-life posts from a selection including: taking to licenced landfill; giving away; selling; stockpiling; burning/burying, or other.

Preglednica 2: Odgovori na anketo, v kateri so bili vinogradniki pozvani, naj navedejo svoj trenutni način ravnanja z odsluženimi koli izmed naslednjih možnosti: odvoz na licencirano odlagališče; podarjanje; prodaja; skladiščenje; sežiganje/zakopavanje ali drugo.

Number of respondants out of total (n=327)	Current method of managing end-of-life posts
9	Send 100% to licenced landfill. Many others send a proportion of their posts.
12	Giveaway 100% of the posts, but many others said they give away a small percentage.
3	Sell 70 – 80%, but very few others used this method.
112	Stockpile 100% of removed posts onsite, while many others responded with stockpiling a large percentage.
4	Burn or bury 100% of their removed posts, but very few others use this method.
66	Said 'other', with most saying they reuse the posts onsite as fencing and landscaping materials.

Table 3: Summary of preservative-treated timber posts stockpiled in Australian vineyards (assuming a 2-5% attrition rate). Tasmania

Preglednica 3: Povzetek količin z zaščitnimi pripravki obdelanega lesa, ki je skladiščen v avstralskih vinogradih (ob predpostavki stopnje obrabe 2–5 %). Tasmanija

STATE	PERCENTAGE STOCKPILED	TOTAL NO. POSTS REMOVED ANNUALLY (2%)	STOCKPILED ANNUALLY
NSW	71.60%	416,387	298,133
QLD	71.60%	7,461	5,342
SA	76.36%	913,794	697,773
TAS (1%)	20%	10,319	2,063
VIC	49.63%	262,457	130,257
WA	55.42%	91,827	50,890
NATIONAL TOTAL		1,702,245	1,184,458

3.2 Post Chemical Analysis
3.2 Kemijska analiza kolov

The results of the analysis of end of life CCA treated vineyard posts showed relatively minimal loss of preservative components from the posts over their 18- to 26-year service life, with little evidence of changes in the ratios of copper, chromium, or arsenic in most samples (Table 4). The findings also suggest that the majority of posts could be reused in soil contact applications to provide additional service life (Singh et al., 2024).

3.3 Regulatory Requirements
3.3 Regulativne zahteve

In general, CCA treated timber in Australia is considered controlled or priority waste. Transport may require licensing and controlled waste tracking, and disposal must be at an appropriately licensed facility with advanced leachate management systems, both of which incur significantly higher disposal costs than general waste. Undetermined volumes of treated timber are delivered to resource recovery operations mixed with other material (Figure 3). While efforts are made to separate out treated timber, a small proportion ends up in material or energy recovery systems, contrary to current regulations.

State regulations are the most significant barrier to the circularity of treated timber in Australia. In most Australian states, regulatory provisions either do not allow alternatives to landfill disposal of treated timber or do not adequately support the potential reuse and recovery of treated timber within a circular economy,

Table 4: Relative amounts of copper, chromium, and arsenic in radiata pine vineyard posts from six different vineyards across South Australia (Note: Values represent means of four locations along 7 or 8 posts per vineyard. Balance is calculated as the % of each element in the total retention for that vineyard.) (Singh et al 2024).

Preglednica 4: Relativne količine bakra, kroma in arzena v vinogradniških kolih iz bora radiata iz šestih različnih vinogradov v južni Avstraliji. (Opomba: vrednosti ponazarjajo povprečja štirih lokacij vzdolž 7 ali 8 kolov na vinograd. Povprečje je izračunano kot odstotek vsakega elementa v skupni zadržani količini za posamezni vinograd.) (Singh et al., 2024).

REGION	VINEYARD	YEAR		Average Retention by Element (%)			
				Cu	Cr	As	Total
Langhorne Creek	A	1997	%	0.17	0.25	0.21	0.64
			Balance	0.27	0.39	0.34	
	B	1997	%	0.14	0.20	0.18	0.51
			Balance	0.27	0.38	0.35	
	C	2002	%	0.16	0.23	0.21	0.61
			Balance	0.27	0.38	0.35	
Adelaide Hills	D	1997	%	0.19	0.30	0.23	0.72
			Balance	0.26	0.42	0.32	
	E	2003	%	0.24	0.35	0.12	0.70
			Balance	0.34	0.49	0.17	
	F	2007	%	0.19	0.26	0.25	0.71
			Balance	0.27	0.37	0.36	
AS/NZS 1604		Balance Standard		**23-25**	**38-45**	**30-37**	**100**

Fig. 3: Mixed end-of-life timber at a resource recovery facility in South Australia.

Slika 2: Mešani odsluženi les na objektu za predelavo virov v Južni Avstraliji

an approach that could help address climate change while also supporting economic development. As part of this project, a comparison of state-by-state regulations relating to treated timber has been conducted, with key findings presented in Table 5.

A report containing findings and recommendations is forthcoming to enable further exploration of the circularity of preservative-treated timber and EWPs and to help support the way forward. The report will include some of the key findings, which have been summarised in Table 6.

3.4 Geospatial Mapping

3.4 Geoprostorsko kartiranje

The regulatory information outlined in Section 3.3 was included in the newly developed geospatial timber circularity resource map, which has been designed as a complete reference for an Australian timber circular economy. The map displays resources available, potential solutions and available support and infrastructure. Councils with circular economy or zero waste strategies, and landfills and transfer stations which are licenced to accept treated timber are displayed for their potential to support recycling infrastructure in the future. The resources currently mapped include vineyard posts, frame and truss offcuts, engineered wood products and CCA treated timber utility poles. All resources, solutions and infrastructure facilities are mapped by icons which are clickable with pop-ups providing relevant information (Figure 4a).

The CCA treated timber vineyard posts can be searched by region, zone, or state-based annual post-attrition numbers. Information provided includes, the area of vineyard planted, and the number, volume and wei-

Table 5: Comparison of Key Regulatory Aspects by Jurisdiction

Preglednica 5: Primerjava ključnih regulativnih vidikov po regijah

KEY ASPECTS	NSW	QLD	SA	TAS	VIC	WA
CCA treated timber classed as a controlled, special or priority waste (terms vary by state) subject to specific jurisdiction requirements.	√		√		√	√
Waste transport requirements apply for CCA treated timber.		√*			√	√
Intra- and interstate waste tracking requirements apply to CCA treated timber, consistent with the agreed national reporting framework.	√	√	√	√	√	√
Recovered CCA treated timber not allowed in land applications.	√	√	√	√	√	√
End of Waste (EOW) provisions currently in effect allowing classification other than as 'waste' if certain actions are taken.	√	√	√		√	
EOW provisions to be implemented or reformed.	√	√				√
Stated willingness to consult on specific proposals for alternatives to landfill for CCA treated timber, including pyrolysis and gasification as well as potential regulatory approaches necessary to implement.	√		√		√	√

* For transport of over 250kg of waste treated timber

Table 6: Key findings based on the review of the state regulations.

Preglednica 6: Ključne ugotovitve na podlagi pregleda državnih predpisov

A robust and objective evidence base is required to address regulatory and end-use market concerns regarding alternatives to disposal of treated timber.
Key concerns include the concentrations and bioavailability of metals and related substances, potential air quality impacts, the presence of contaminants, industry accountability, and the suitability of end-use products for their intended purpose.
While regulators are open to exploring alternatives to disposal for treated timber, they lack sufficiently detailed proposals to fully understand industry needs and to make informed consultation and decision-making processes.
A consistent proposal and analytical framework would support more effective consultations with regulators in the development, refinement, and implementation of demonstration projects, including the proposed Timber Circularity projects(s).
Aligned industry sectors, such as water, forestry, agriculture, resource recovery, and biochar are facing similar challenges and exploring comparable alternatives and end-use markets to those considered under the Timber Circularity project, making them strong candidates for potential collaboration.
Some aligned industry sectors have undertaken initiatives that complement the objectives of the Timber Circularity project and offer opportunities for collaboration, particularly around potential co-feedstocks for pyrolysis and gasification. For example, the New South Wales timber industry has developed stewardship approaches for forestry residues, while the Water Services Association of Australia and the Intelligent Water Network have created a technology assessment framework that could be leveraged to support circularity outcomes.

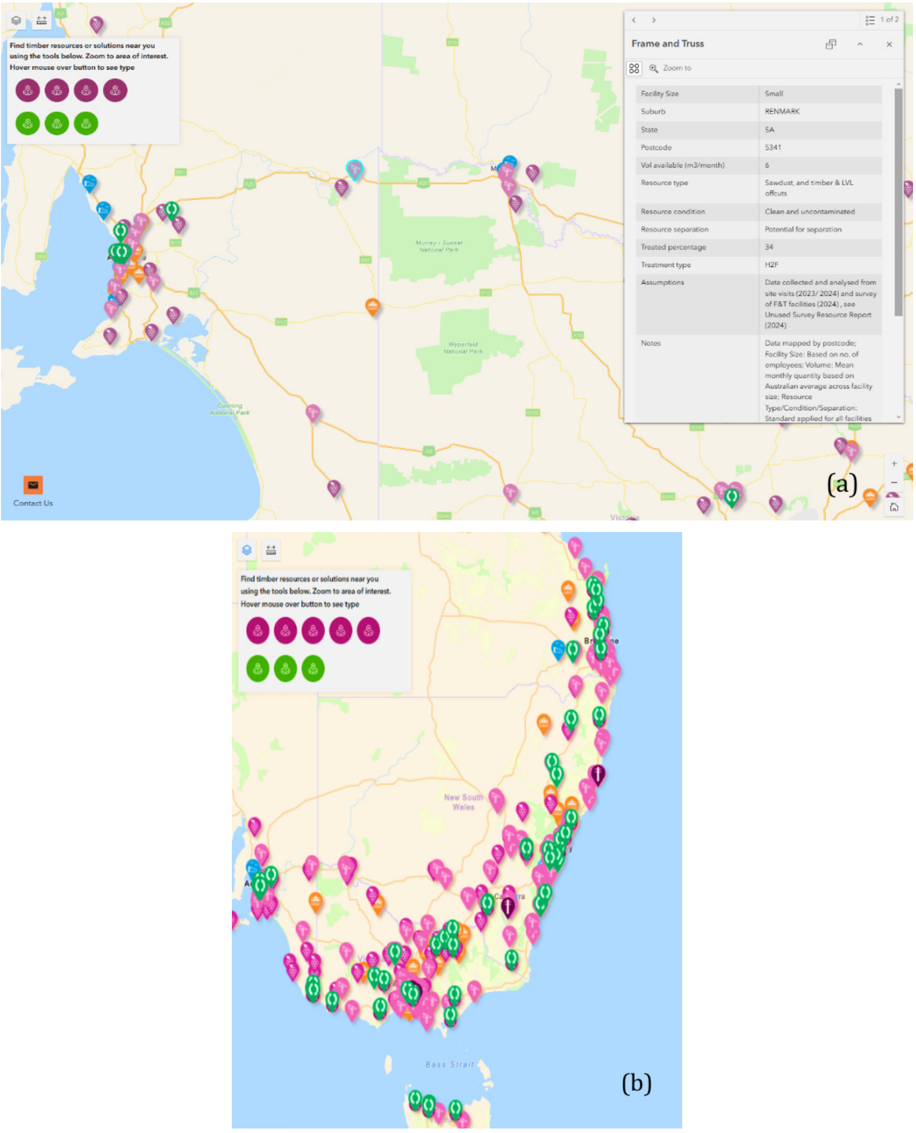

Fig. 4: (a) Gespatial timber resource map with each facility type represented with an icon. Data that has been collected appears in a pop up box as you select an icon. (b) The map includes useful tools, such as a user-defined radius and downloadable results.

Slika 4: (a) Geoprostorski zemljevid virov lesa, kjer je vsaka vrsta objekta predstavljena z ikono. Podatki, ki so bili zbrani, se prikažejo v pojavnem oknu, ko izberete ikono. b) Zemljevid vključuje uporabna orodja, kot sta uporabniško določen radij in možnost prenosa rezultatov.

ght of posts removed annually. Assumptions and notes are provided to understand the basis for the numbers, for example a 2% attrition rate as well as likely future attrition rates based on wine over-supply are acknowledged in the pop-up notes.

Frame and truss facilities are mapped according to their size - small, medium, large and extra-large based on employee numbers - and approximate offcut volumes based on facility size averaged nationally are provided. Resource type, condition, ability to separate, percent of wood resource treated, and the treatment type are also provided.

EWP facilities have been mapped as both resource and solution provider as many EWP facilities utilise their own unused resources for energy and/or steam production. Some also accept offcuts or wood chips for use in products including glulam beams or particleboard. Other avenues for timber waste recycling are also provided on a solutions layer on the map. Regulatory information around use of treated timber in products is included for all solution providers and is provided on a state-by state basis. Only councils with circular economy or zero waste initiatives have been mapped and the initiative is identified with details about plans or strategies. Landfill and transfer station pop-ups include current costs of disposal, including waste levies, and notes on acceptance of treated timber.

Each resource, solution and infrastructure facility are mapped on a separate layer, so although all layers are switched on by default, individual layers can be switched off in order to focus on a specific resource. There are additional built-in features within the map to help with a timber circular economy, including tools to search for resources or solutions within a user-defined radius, and download spreadsheets of resources in a specified location (Figure 4b). This feature helps drill down into amounts of resource, location, or distances. Features that will be added in the future include a 'heat-map' style tool which will visually depict the amount of timber resource available in any one region, which will further aid the understanding of timber resources available. It is hoped that the timber circularity geospatial map will become the circular economy reference point for the whole of the Australian timber industry in the future.

4 DISCUSSION AND CONCLUSIONS

4 RAZPRAVA IN ZAKLJUČKI

Alternatives to landfill for EOL treated timber, in particular that treated with CCA, has been an ongoing area of research for many decades overseas and more recently in Australia (Solo-Gabriele & Townsend 1999; Taylor et al. 2009). Key to identifying and assessing potential landfill alternatives for EOL treated timber is the information that has been collected over the course of the project on the quantities, location and condition of the EOL treated timber. While the project has identified that large quantities of EOL CCA treated timber vineyard posts are produced each year, with further quantities already stockpiled, the posts were also found to be widely spatially distributed, increasing transport costs to aggregate the posts in a single location. This information allows landfill alternatives to be assessed on the basis of their minimum viable quantities, the condition of the EOL treated timber they require to operate and the establishment and operating costs of each alternative. For an alternative to be viable, logically its costs must not exceed those of landfill disposal.

Uncertainty of supply is another issue that would determine the viability of a business providing an alternative to landfill disposal for CCA treated posts. In addition to the range of annual attrition rates noted above, there is also ongoing vineyard removals with some regions being more affected than others. Wine regions that are considered to have over-supply, including Langhorne Creek and Riverland in South Australia, may consider retiring entire vineyards over the next year. Alternatives to the use of CCA treated posts in vineyards, such as steel, concrete, plastic coated untreated posts and durable eucalypt species are being trialled in some regions, but these options are often cost-prohibitive (Hall & Sargent 2021).

The use of the geospatial map allows suitable sites to be identified for the establishment of businesses providing an alternative to landfill disposal. This analysis could include identifying synergies with other businesses that could provide additional treated timber input material or could be a potential purchaser of any saleable outputs from the processing of the posts.

4.2 Further Research

4.2 Nadaljnje raziskave

The timber circularity project is currently in its final year of a three-year timeline. Remaining tasks to include a review of potential alternative solutions to landfill and the implementation of a pilot project. Identified solutions are being compiled into a decision matrix, with each option evaluated based on cost, availability, technical feasibility, ecological impact, scalability, mobility, and regulatory considerations. This matrix will support the identification of context-specific solutions tailored to the type, quantity, and location of available resources. In addition, a summit will be held to engage global solution providers in identifying suitable reuse and recycling strategies for the Australian context.

The project will culminate in a pilot project trialling a small-scale reuse/recycling initiative, focused on EOL treated timber vineyard post. This pilot will which will incorporate models developed to estimate transport costs for specific products across the region. It will serve to assess the feasibility of the proposed approach and to identify logistical hurdles that may impact timber circularity more broadly at the national level.

5 SUMMARY

5 POVZETEK

Projekt krožnosti lesa si prizadeva obravnavati vse večji izziv upravljanja lesa, obdelanega z biocidnimi pripravki, in izdelkov iz tehnično predelanega lesa (EWP), ko dosežejo konec življenjske dobe v Avstraliji. Čeprav je les obnovljiv material z nizkim ogljičnim odtisom, ponovna uporaba in recikliranje obdelanega lesa z zaščitnimi pripravki, zlasti izdelkov, obdelanih s krom-baker-arzenovimi (CCA) spojinami, naletita na regulativne, okoljske in logistične ovire.

Cilji projekta so bili:

- kvantificirati trenutne in prihodnje količine lesa in EWP, obdelanih z zaščitnimi pripravki, ko dosežejo konec življenjske dobe v Avstraliji,
- oceniti stanje virov, vključno s količino preostalih kemikalij in možnostjo recikliranja,
- kartirati geografsko porazdelitev virov, infrastrukture in regulativnih omejitev,
- pregledati ustrezne politike, ki vplivajo na ponovno uporabo in predelavo,
- razviti matriko rešitev, ki opredeljuje izvedljive poti za recikliranje in ponovno uporabo,
- uresničiti pilotni demonstracijski projekt za testiranje in potrjevanje krožnih rešitev.

Glavni poudarek je na široki uporabi CCA-obdelanih vinogradniških kolov, ki dosegajo približno 30 % lesa, obdelanega z zaščitnimi pripravki v Avstraliji. Vinogradniki se spoprijemajo z visokimi stroški odstranjevanja in regulativnimi omejitvami, kar vodi do obsežnega kopičenja, ki je okoljsko in požarno tveganje. Lesa, obdelanega s CCA, ni mogoče varno sežigati zaradi strupenih emisij arzena.

Metode zbiranja podatkov so vključevale ankete in obiske lokacij pri pridelovalcih, dobaviteljih in industrijskih skupinah, analizo trajnosti in kemijske sestave uporabljenih kolov ter pregled zakonodaje.

Ključne ugotovitve projekta do zdaj kažejo, da se letno zamenja približno 1,7 milijona kolov ob 2-odstotni stopnji izpada, kar bi se lahko povečalo na 4,2 milijona ob drugačnih stopnjah izpada, pri čemer je južnoavstralska regija ena izmed tistih, ki k temu prispeva največ. Preostale zaloge lahko močno presegajo letne stopnje odstranjevanja.

Analiza 48 starih kolov (18–26 let v uporabi) iz šestih vinogradov je pokazala, da je večina v dobrem stanju. Poškodbe so bile večinoma posledica mehanskih poškodb in ne trohnobe. Preostale ravni CCA so ostale blizu prvotnih specifikacij, kar kaže na nizko izpiranje in visoko kemično stabilnost, kar nakazuje možnost varne ponovne uporabe ob upoštevanju regulativnih dovoljenj.

Les, obdelan z zaščitnimi pripravki, je v večini regij razvrščen kot nadzorovan ali prednosten odpadek. Njegov transport, sledenje in odstranjevanje so strogo regulirani in dragi. Nekatere zvezne države ponujajo možnosti »End-of-Waste« pod strogimi pogoji, vendar pomanjkanje nacionalno usklajenih okvirov prinaša izzive, hkrati pa obstajajo priložnosti za povezovanje s sektorji, kot sta kmetijstvo in bioenergija.

Eden glavnih rezultatov projekta je razvoj geoprostorskega kartiranja virov lesa in infrastrukture, ki je digitalna platforma za podporo krožnosti lesa. Kartirajo se količine vinogradniških kolov in napovedi izpada, lokacije in količine ostankov in EWP ter občine z uvedenimi pobudami krožnega gospodarstva. Uporabniki lahko iščejo po radiju oddaljenosti, prenesejo podatke, identificirajo pilotne točke in poiščejo partnerje za ponovno uporabo/recikliranje.

V zadnjem letu bo projekt dokončal matriko rešitev za ponovno uporabo/recikliranje na podlagi stroškov, skladnosti in možnosti razširitve, gostil globalni vrh za privabljanje rešitev in naložb ter izvedel pilotni demonstracijski projekt, osredotočen na ponovno uporabo vinogradniških kolov.

Ta pionirski nacionalni projekt poudarja obseg in nujnost obravnavanja lesa, obdelanega s CCA, ob koncu njegove življenjske dobe. Prve ugotovitve kažejo, da je ponovna uporaba morda izvedljiva zaradi nizkega izpiranja kemikalij, vendar so potrebne zakonodajne spremembe. Projekt zagotavlja pomembne podatke, zakonodajne vpoglede in geoprostorska orodja za podporo prehodu v krožno gospodarstvo ter ponuja razširljiv model za upravljanje in recikliranje tudi drugih dragocenih virov.

DATA AVAILABILITY

DOSTOPNOST RAZISKOVALNIH PODATKOV

Research data are property of National Centre for Timber Durability and Design Life. Contact the authors for more information. No research data created in any Slovenian public research organization were used.

ACKNOWLEDGEMENTS
ZAHVALA

The authors sincerely acknowledge the organisations that provided financial support for this work: Forest & Wood Products Australia, the Australian Forest Products Association, Wine Australia, the Frame & Truss Manufacturing Association, the Engineered Wood Products Association of Australasia, Azelis, Hexion, and Koppers, as well as the National Centre for Timber Durability and Design Life.

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