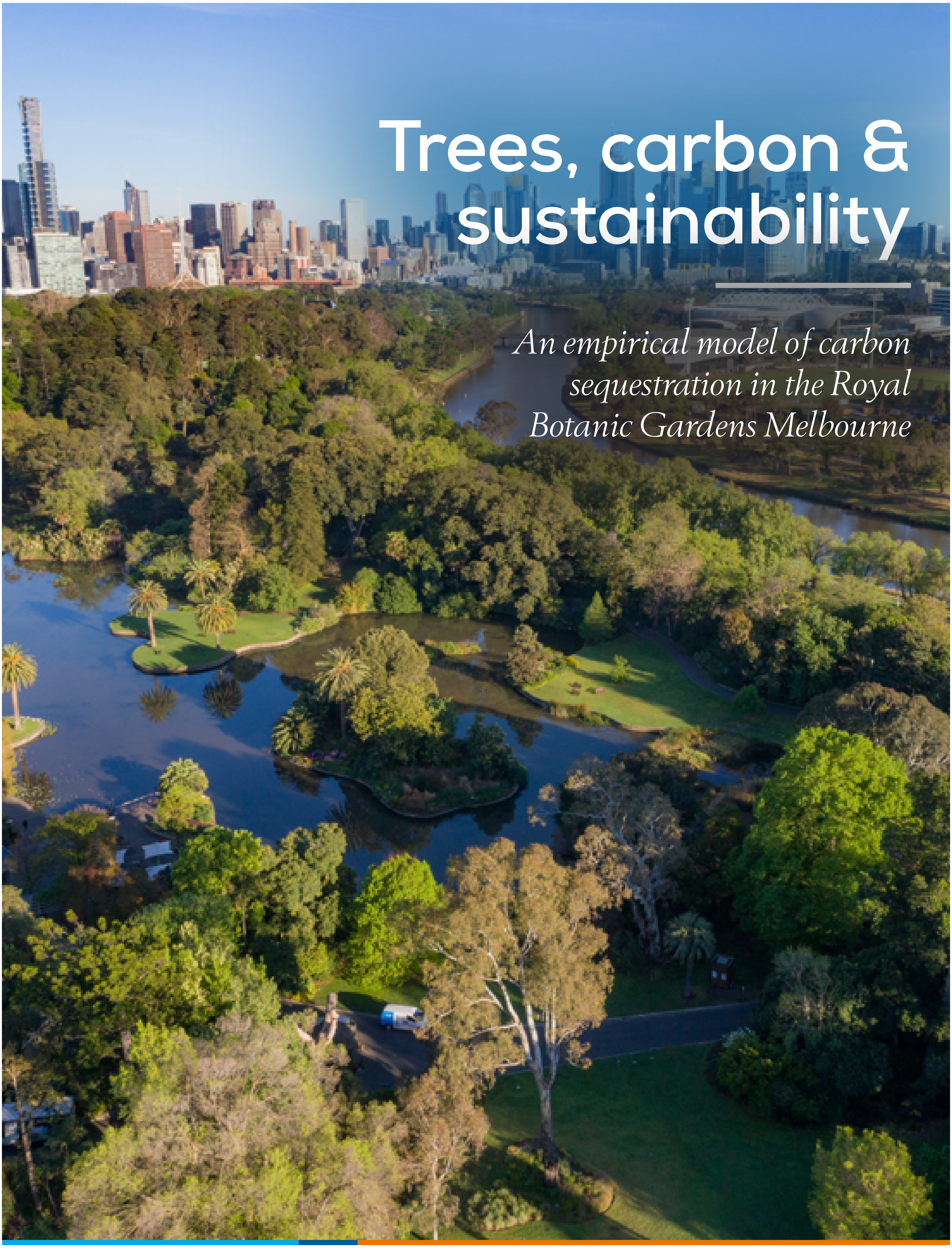

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Contents

» **Sustainability** – avoidance of the depletion of natural resources in order to maintain an ecological balance.

"The pursuit of global environmental sustainability"

Foreword

Karen McWilliams FCA
Business Reform Leader
Chartered Accountants Australia and New Zealand

Governments and businesses around the world are stepping up their response to the climate crisis and stating their intentions to become carbon neutral. Increasingly, large companies are reporting on their efforts to make their businesses sustainable.

An increase in adoption of the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) amongst organisations worldwide and recent commitments from New Zealand and the United Kingdom to mandate these disclosures for certain entities, suggest the appetite for sustainability reporting is gathering momentum.

Our February 2020 call to action explained the significant role the accountancy profession can play in achieving both climate change mitigation and adaptation at individual business, industry sector and economy-wide levels. Professional accountants can ensure transparency and appropriate disclosure around climate-related risks and opportunities, which in turn will help to maintain financial stability.

They can also support sustainable decision-making within the organisations they work for by allocating budgets and resources, and by developing high quality and timely information and insights through measurement and disclosure, built on robust and transparent accounting systems.

Chartered Accountants Australia and New Zealand is pleased to have partnered with the University of Melbourne and the Royal Botanic Gardens of Melbourne on the research project described in this document. As a multi-year project, funded by the Australian Research Council, it is excellent to see the results come through at such a critical time.

The insights from this research will provide important data to inform both the disclosure and the decision making which underpins it. For example, information on the carbon sequestration of trees by age and species can help organisations make better decisions as to the carbon benefit from their natural assets. The results can also influence urban design and planning as cities seek to grow sustainably.

As influential members of every sector of the economy, professional accountants are uniquely positioned to help affect meaningful and positive change in a collective effort. This project provides important data to help them play their crucial role in addressing climate change.

Introduction

As custodians of external reporting and central caretakers of governance practices in any organisation, accountants are increasingly playing a vital role in what was once unfamiliar territory – reporting on sustainability.

Accountants need new knowledge to apply their skills to work in increasingly technical areas, such as calculating an organisation's carbon footprint, and to open up their work to new opportunities for collaboration across diverse disciplines.

This document is the result of one such unique collaboration, involving researchers at the School of Ecosystem and Forest Science and the Department of Accounting at the University of Melbourne, as well as the Royal Botanic Gardens of Melbourne (RBGM).

Their research, the first comprehensive study of its kind in an Australian urban environment, focused on understanding how much carbon is sequestered by different tree species as they grow. Their goal was to help organisations, and more specifically, the RBGM, understand how to measure, manage and report on carbon sequestration.

As the climate crisis makes sustainability reporting more urgent, this research provides a model to accurately account for the quantity of carbon sequestered by a variety of tree species of different ages.

Trees are a vital store of carbon and their protection and growth can contribute to organisations reducing their carbon footprint and ultimately becoming carbon neutral.

This project also demonstrates the tangible benefits that can be achieved when accountants collaborate across disciplines. They can enhance their ability to report accurately on activities that tackle some of the world's biggest challenges.

Associate Professor Brad Potter CA, left, and Professor Ian Woodrow of the University of Melbourne

Sustainability reporting

Sustainability reporting involves providing an assessment of a company's economic, environmental and social impact as a result of its everyday activities.

Accountants can help companies measure, understand and communicate how sustainable their activities are. They can help organisations set targets to become more sustainable, and provide assurance that an organisation is meeting the standards adopted by governments, regulators or investors.

Sustainability reports can vary widely across companies, ranging from completely customised reports to others that strictly adhere to established reporting frameworks.

Comprehensive sustainability frameworks and accompanying guidelines have been developed by several international organisations.[1]

While there is currently no single, universally recognised "global" sustainability framework, the Global Reporting Initiative (GRI) has been implemented by organisations worldwide and is focused on providing sustainability information to a wide range of interested parties.

Other frameworks and approaches, such as Integrated Reporting and the TCFD recommendations are focused on specific stakeholder groups, in both cases, external providers of capital.

Notwithstanding, there is growing alignment across many of these frameworks. Additionally, the International Financial Reporting Standards (IFRS) Foundation Trustees have recently announced they are considering whether to establish a Sustainability Standards Board.

Why do sustainability reporting?

Historically, companies voluntarily publishing sustainability reports may have depended on the cost associated with reporting and anticipated reactions to the information disclosed.

But the voluntary nature of sustainability reporting is changing. Some countries have adopted a 'comply or explain' approach in which organisations need to disclose sustainability-related information or explain why they do not. The European Union, Australia, Canada, South Africa, and India have taken this approach.

Other countries, such as Japan, China, Indonesia, and Thailand, have now mandated this type of information disclosure but there is still significant variation in the exact nature and extent of these types of disclosures and there is no generally agreed reporting framework.

The credibility associated with financial reports is largely due to the requirement that they be audited. The practice of independent verification or assurance of sustainability reports is still evolving.

Assurance reporting

Most of the world's 250 largest companies periodically produce assurance of sustainability reporting containing carbon information and also obtain assurance on these reports.[2] However, auditors continually face issues with the underlying quality of the information and this also affects the level of assurance they can provide.

The most common framework for providing assurance on sustainability reporting is through the International Standard on Assurance Engagements (ISAE) 3000 'Assurance Engagements Other than Audits or Reviews of Historical Financial Information'. This standard allows two options for assurance engagement and reporting:

- 'reasonable assurance engagement' where assurance is positive
- 'limited assurance engagement' where assurance is negative.

Carbon and trees

Trees make an invaluable contribution to reducing the rate of climate change by mitigating carbon dioxide accumulation in the atmosphere. Through photosynthesis, trees act as a carbon sink and absorb atmospheric carbon dioxide.

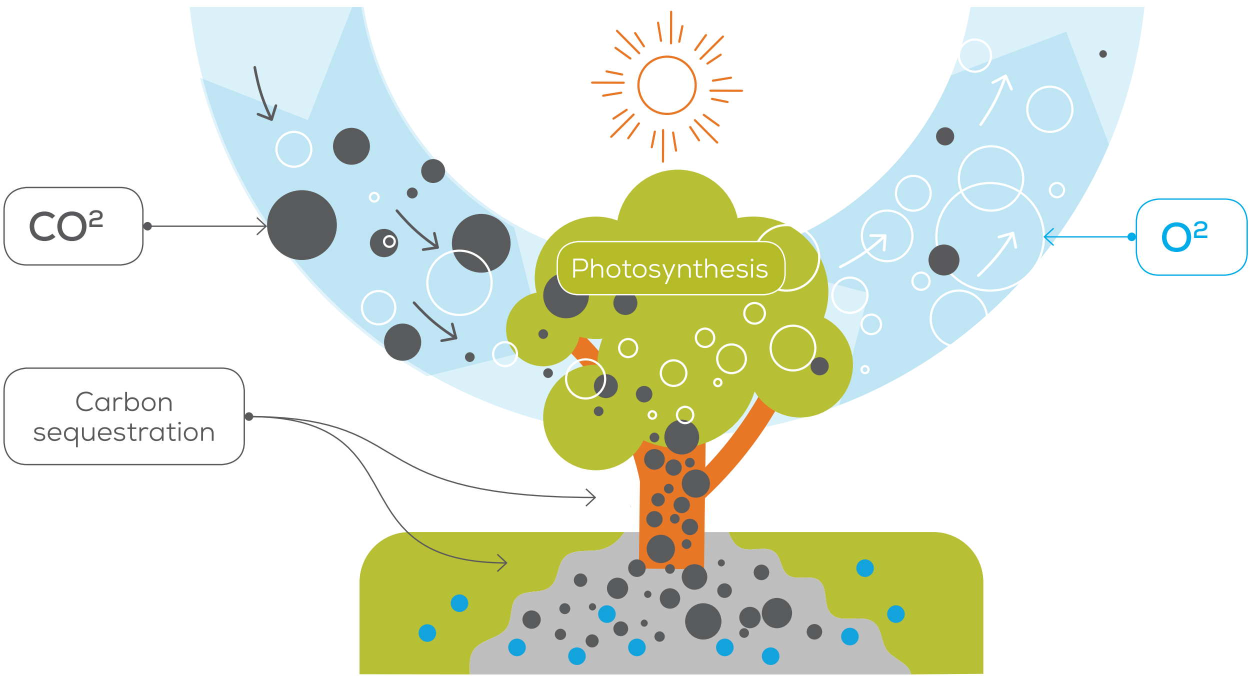
The process of trees absorbing carbon dioxide as a gas and storing it in solid or liquid form as a plant substance is called 'carbon sequestration'.

An estimated 45 per cent of the earth's carbon is stored in forests which cover 30 per cent of the Earth's land mass.[3] Deforestation is markedly reducing the capacity of forests to sequester carbon. This is offset to a certain degree by natural and plantation-based re-growth of trees.

Some of these trees are grown outside forests on agricultural land and in urban parks and gardens. Trees in an urban environment also reduce noise, improve air quality, moderate storm water damage and reduce air temperature.

Data on urban trees in Australia has been lacking. Most research into tree carbon is US-centric, and research in Australia and New Zealand has typically focused on plantations.

By understanding the total ecosystem in terms of tonnes of carbon dioxide absorbed on a continuous basis as a basic measure, environmental economists could consider valuing and monetising this impact. The usefulness of this information comes from the fact that it can be integrated with costs and other benefits on operating an entity to derive the total impact on an economy.



Royal Botanic Gardens Melbourne

In a unique collaboration, researchers from the University of Melbourne's departments of eco-system and forest science and accounting worked with the Royal Botanic Gardens Melbourne (RBGM) to understand how to capture, manage and report on carbon storage and sequestration.

The Melbourne Gardens, one of two botanic gardens managed by Royal Botanic Gardens of Victoria, were established in 1846 on a 38 hectare site on the south side of the Yarra River.

The Gardens have 11 main lawns with grass and garden beds taking up a significant area. It also includes five hectares of ornamental lakes. About 6,000 trees are clustered within groups and some are scattered in lawn areas. About 40 per cent of tree species are native.

The total pool of carbon in the Gardens consists of trees, the garden beds with associated plants and mulch, the lakes (including wetlands), and the lawns. Underlying all of these is a layer of soil and sediment in which carbon is stored through decomposition and root activities.

Photo by Malin on Unsplash

Research approach and results

Measurement of the total carbon pool

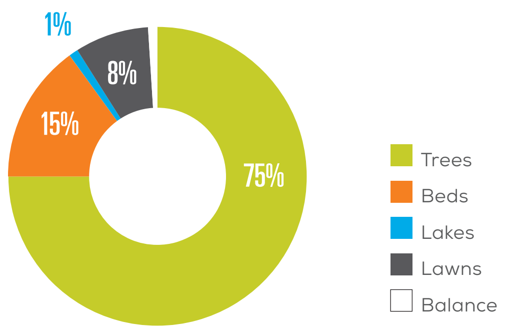
Researchers estimated the carbon content of the major repositories of carbon in the RBGM and discovered trees were by far the most important contributing 75 per cent. Garden beds contributed 15 per cent, lawns 8 per cent and lakes 1.4 per cent respectively.

Next, the researchers focused on which species of trees sequestered the most carbon so they chose a representative sample of all the trees in the RBGM.

Using surveys conducted in 1991 and 2014, researchers applied allometric growth models to each tree group to determine carbon accumulation, including:

- Conifers (native and non-native)
- Rainforest trees (native and non-native)
- Australian evergreens (native)
- Deciduous trees (largely non-native)
- Palms (native and non-native)

The four major components to the total carbon pool at RBGM



Measurement of the trees

Students from the University of Melbourne's School of Botany took contemporary tree measurements. They measured trunk diameter at breast height (DBH) 1.37 m above ground level and tree height (H), using a specialised tape to estimate the DBH and a TruPulse 360 laser rangefinder to measure the height of the trees.

Researchers from both accounting and botany departments analysed the data. Their first step was to compute the above-ground mass of trees using allometric equations and models.

- For trees in the deciduous, evergreen and conifer groups, the researchers used volumetric equations developed for 15 species of Californian street trees.[4]
- For trees in the rainforest group, they used a dry rainforest biomass regression[5] because most of the trees belonging to this group in the RBGM were in relatively dense stands. However, as those dense stands are not as dense as in a typical rainforest, a factor of dilution of 0.8 was applied.
- Researchers assumed palms stems were cylindrical to compute the palm mass.[6]

Having estimated the trees' volumes, the researchers then used wood densities to convert volume to mass. Species-specific wood density values or a genus average wood density were obtained from two wood density databases.[7]

Research approach and results (continued)

Total tree mass

The total biomass of each tree was then divided into three components, considering ground level as the dividing point. Total tree biomass = leaf mass + trunk/branch mass + below-ground (root) mass. Different proportions were obtained from published values for each of the five different types of trees.

Carbon absorption

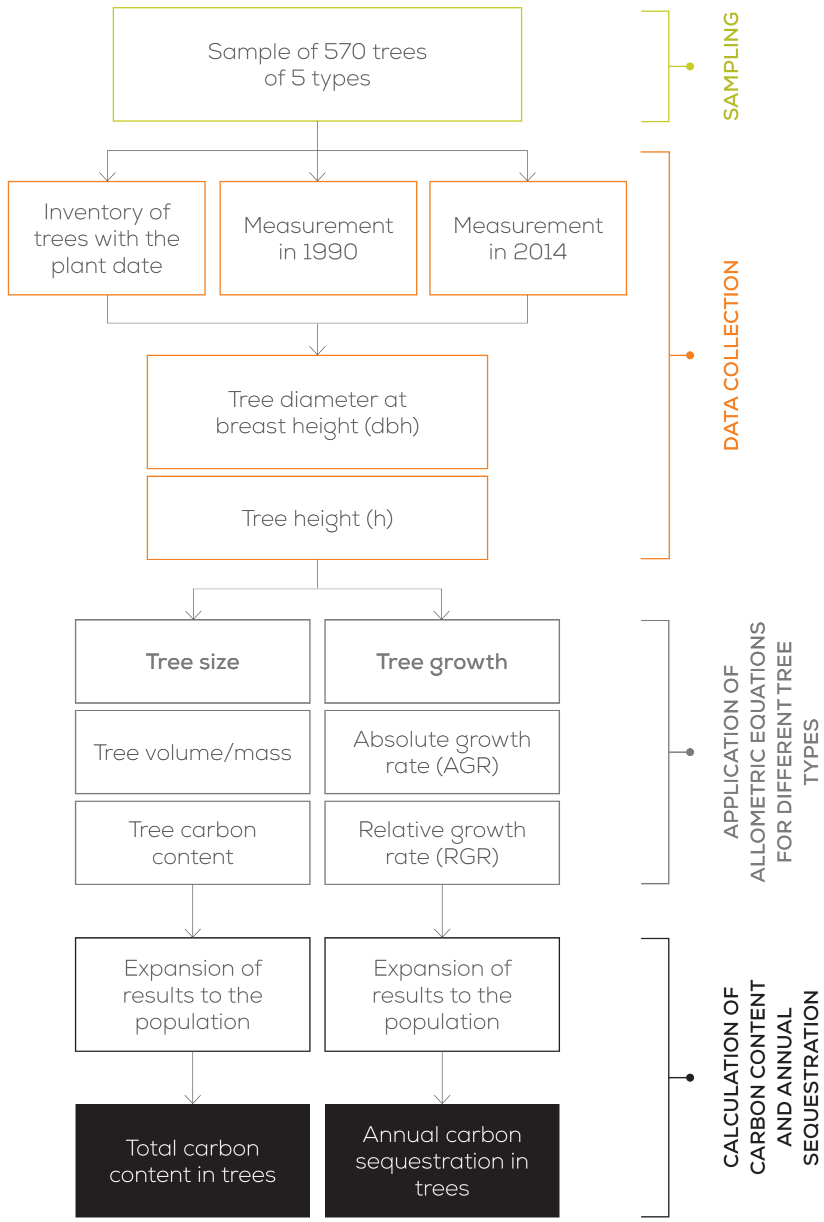
The next step was to evaluate how much carbon each tree had absorbed during its growth. The amount of carbon in all trees is taken as 50 per cent of its mass, based on a comprehensive study conducted covering several tree categories.[8]

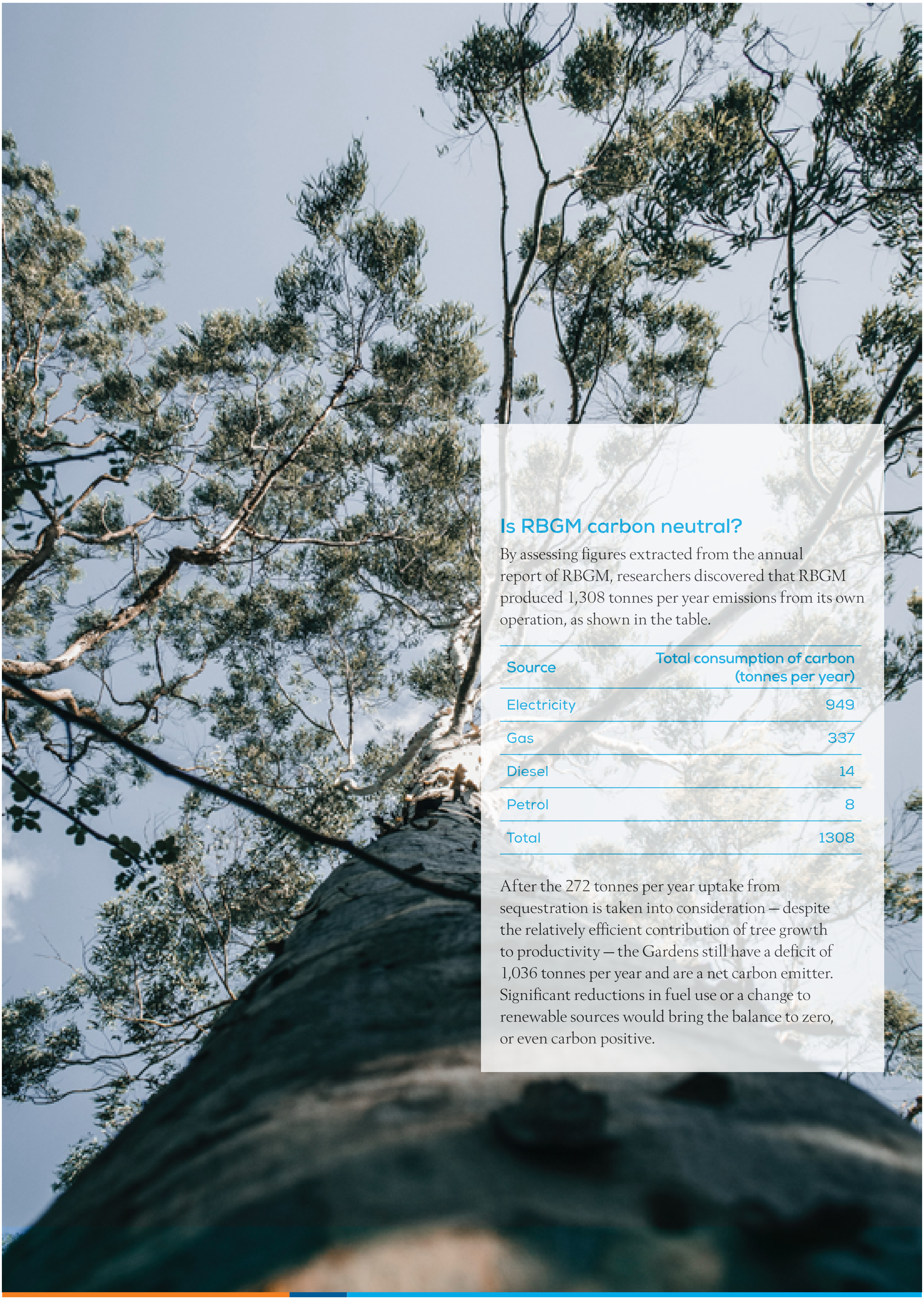
Knowing the mass of trees at two fixed points, namely in 1991 and 2014, as derived from the above calculations, the mean absolute growth rate (AGR) and relative growth rate (RGR) of trees could be estimated, as follows:

$$AGR = \frac{M_{2014} - M_{1991}}{(2014-1991)}$$

$$RGR = \frac{(\ln [M2014] - \ln [M1991])}{(2014-1991)}$$

Given that carbon is about half of tree biomass, the average rate of carbon accumulation by trees will be half of the AGR. The average relative carbon accumulation rate, however, will be equal to RGR.





Is RBGM carbon neutral?

By assessing figures extracted from the annual report of RBGM, researchers discovered that RBGM produced 1,308 tonnes per year emissions from its own operation, as shown in the table.

Source	Total consumption of carbon (tonnes per year)
Electricity	949
Gas	337
Diesel	14
Petrol	8
Total	1308

After the 272 tonnes per year uptake from sequestration is taken into consideration – despite the relatively efficient contribution of tree growth to productivity – the Gardens still have a deficit of 1,036 tonnes per year and are a net carbon emitter. Significant reductions in fuel use or a change to renewable sources would bring the balance to zero, or even carbon positive.

Photo by Carlos Costa on Unsplash

Model for accountants

Expanding the results of the sample to the population

The calculations of the carbon accumulation rate for a number of trees within each of the five categories allows a reliable estimate to be made for the entire tree population in the RBGM, assuming that the sub-samples in the five groups used here are indicative of the larger population.

The validity of this assumption is difficult to judge with absolute certainty because the Gardens didn't keep records of planting dates for most trees and palms. Nevertheless, if the current estimates of carbon uptake are simply adjusted proportionally to encompass the entire Gardens, then an estimate of the total carbon uptake rate of the five groups can be made. Given that individual trees in the five groups account for over 95 per cent of the tree species in the RBGM, this value can be scaled up some five per cent more to yield an RBGM tree estimate.

Using the measured relationship between tree mass and growth rate and a scaling theory that relative growth rate (RGR) is inversely proportional to above ground tree mass to the power 0.25[9] researchers then developed a temporal equation for growth of trees for each of the four non-palm groups.

This empirical equation allows accountants to predict the carbon content of a tree at any time after planting. Analysis of the k values indicated that trees from the four non-palm groups will generally grow at a similar rate; however, significantly higher k values – and predicted carbon accumulation rates – were detected for a group of faster growing eucalyptus (from the Evergreen group) and the Kauri pines (Agathis spp., from the Conifer group).

The palms' growth is less complicated to model because researchers found little evidence that RGR is a function of mass as predicted by scaling theory, so they made predictions using a constant RGR.

Researchers validated the model using trees with known planting dates. Trees from each of the categories were selected for the validation, including the oldest planted trees in the RBGM — two English elms planted in 1846.

Using this equation, accountants can more accurately determine how much carbon a tree captures as it grows. It enables much greater confidence in the result, and means accountants have an empirical dimension to enhance their capability to report on carbon sequestration.

The equation for carbon content (Cc) was:

$$Cc = 0.63\left(\frac{kt}{4} + Mi^{0.254}\right)^4$$

where t is time, Mi is the mass of the tree for which a prediction is to be made (in the case of a newly planted tree, it is the seedling mass) and k is a constant that is specific for each of the tree groups.

Discussion

High carbon density and carbon accumulation

The measurements indicate that the RBGM stores an exceptionally high amount of carbon compared to other urban ecosystems.

The researchers estimate that the carbon density of the RBGM is about 493 tonnes carbon per ha, which is much higher than US city-wide estimates ranging from 5.02 tonnes carbon per ha in Jersey City to 47 tonnes carbon per ha in Sacramento.[10]

The RBGM carbon density is higher than many managed zones within urban areas such as the most carbon dense areas of Leipzig, Germany, where the urban woodlands, with an average density of 81 tonnes carbon per ha, and the riparian forests with a slightly higher density of 98 tonnes carbon per ha.[11]

The RBGM carbon density is more comparable to forests. For example a managed eucalypt forest in Kioloa, NSW was estimated to have a carbon density of about 275 tonnes carbon per ha[12], whereas mature Eucalyptus regnans (mountain ash) forests – the most carbon dense forests in the world – can store some 1,870 tonnes carbon per ha.[13] Clearly, large trees at high density are important for carbon density.

Similarly, the rate of carbon accumulation in the RBGM of about 7.2 tonnes of carbon per ha per year is also high relative to other urban environments. For example, accumulation rates for two cities in the USA – Jersey City and Atlanta – were estimated to be 0.2 and 1.2 tonnes carbon per ha per year, respectively.[14] A neighbourhood in Singapore, which included private gardens, street trees and public parks had a higher rate of 5.1 tonnes carbon per ha per year.

Larger trees = more carbon uptake

Another very important finding is the age of the trees. The results of this project shows the largest trees take up carbon the fastest and their level of carbon sequestration will continue to grow as the tree population ages. Trees with exceptionally high rates of growth (in excess of 500 kg per year) are all exceptionally large. These differing levels of growth and carbon sequestration need to be taken into account in decision making.

As a consequence, any factor that causes tree loss, especially affecting very large trees, would have a significant impact on the rate of carbon sequestration in the RBGM. The loss of a large tree brings about a loss of not only the carbon stored over its lifetime but also its future capacity to take in carbon.

Of course, tree loss happens for many reasons, such as natural mortality, management decisions to remove a tree or a species and natural disasters such as storm damage.

The results of this study reinforce the need to manage trees carefully. Replacing a large tree with a small tree has significant consequences because it will take many years - up to 150 years for some trees in the RBGM - for the tree to reach the carbon sequestration rate of its large counterpart.

Conclusion

A key impact of the RBGM study is that we now have a better understanding of the carbon sequestered as trees grow, with carbon models and measurements based on more than 25 years of tree data. This means accountants can now more faithfully represent the actual capture of carbon that occurs when trees grow and the resulting reporting occurs with significantly reduced measurement error. With this enhanced empirical dimension underpinning future carbon reporting, greater opportunities for higher levels of assurance may emerge in the future.

Assets and income

This study is also important for accountants working on financial reporting disclosure and recognition of agricultural assets, such as trees and other plants and their ability to capture carbon. For nearly two decades, International Accounting Standard (IAS) 41 Agriculture has required biological assets to be measured initially and at each balance date at their fair value less costs to sell, with changes in those values reported as gains or losses in the calculation of periodic profit or loss.

> 'This research is important for organisations looking to manage their carbon footprint. They can now make more informed decisions as to which trees to plant. For accountants with regional clients, this research enables them to better estimate the fair value of some agricultural assets and the carbon stored. This will be important for future discussions.'
>
> – Associate Professor Brad Potter CA, University of Melbourne

Because of the subjectivity and risk involved in the measurement calculations, accountants' reporting of fair values for these types of assets has been problematic, with the requirement to recognise increments and decrements in fair values as gains or losses in calculating profit or loss seemingly the most contentious aspect.[15] With a more precise understanding of the carbon stored in these types of assets over time, accountants now have a greater understanding of a key component of the financial value of these assets, potentially enabling more informed estimates of their fair value in the future.

More specifically, improved measurement of carbon capture could enable creation by entities of Australian Carbon Credit Units (ACCUs) under the Australian Government's Emissions Reduction Fund.

Where this occurs, there is potential for the recognition of additional assets in financial reports in the form of ACCUs. Where those ACCUs are subsequently sold, current and future period income may be affected.

Information systems

This research also shows the importance of information systems. When the RBGM collected tree data in 1991, they never knew how it could be used in the future. After researchers collected more comparable data 25 years later, they were then able to develop the models in this study. This illustrates the crucial need for organisations to have robust information systems that identify, capture and store large amounts of data. The availability of historical data on trees in the Gardens, provided a longer time series of data for modelling and subsequent validation.

The carbon measures produced by the researchers' models enable the reporting of carbon information that more faithfully represents actual carbon capture, this can also assist approaches to assurance of sustainability reporting.

End notes

1 These include:

- United Nations (UN) Global Compact
- Organization for Economic Cooperation and Development (OECD) Guidelines for Multinational Enterprises (MNEs)
- International Standard Organization (ISO)`s ISO Guideline on Environmental Performance (ISO 14001) and Guidance on Social Responsibility (ISO26000)
- International Integrated Reporting Council's (IIRC) Integrated Reporting (<IR>) Framework
- Task Force on Climate-Related Financial Disclosures (TCFD) recommendations
- Sustainability Accounting Standards Board's supplemental disclosures for financial statements

2 The 2020 KPMG Survey of Sustainability Reporting found almost all (96%) of the world's largest 250 companies (the G250) report on their sustainability performance. For the N100 –5,200 companies comprising the largest 100 firms in 52 countries – 80% do so. (source: GRI)

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About

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