We can’t plant our way out of the climate crisis

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RESHAPING
THE ROLE OF ARBORICULTURE
IN TIMES OF CLIMATE EMERGENCY

Ing. Martin Tušer
Chief Researcher and Business Development Director TREEIB®, UTOI president
January 11, 2023

TODAY:

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#Climate change #Climate emergency #Urban forestry & arboriculture

#Large trees #Ecosystem services #Personal mission

My mission is to **connect scientists, policymakers and local implementers** to bring the latest scientific knowledge into daily practice.
My field of work is **combating climate change**, **urban landscape adaptation** to climate change, optimizing **tree ecosystem services**, and **advocacy** for large urban tree conservation.

I am also an entrepreneur, inventor, and president of a non-profit organization protecting large trees in cities.

My connection to arboriculture

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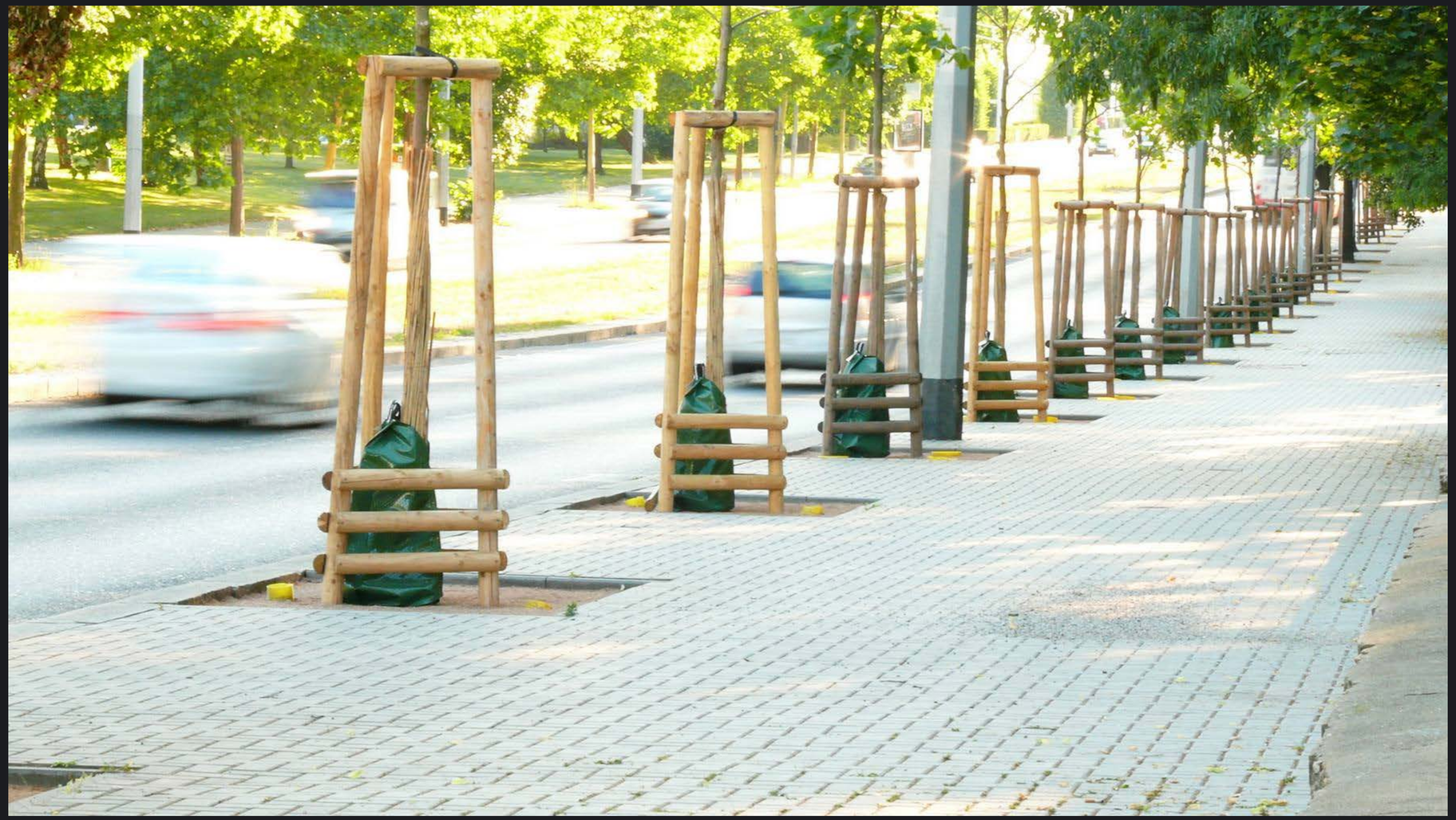

My connection to arboriculture

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Send your guess to chat:

HOW MANY TREES

do we have to plant to replace

ONE LARGE TREE?

The main message today:

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Large tree is irreplaceable asset

The larger the tree is, the better

In terms of ecosystem services

Today we celebrate the trees that we will not be able to grow in the future anymore.

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Judge Wyndham's Oak in Dorset

An ancient oak at Blenheim Palace, Woodstock, Oxfordshire

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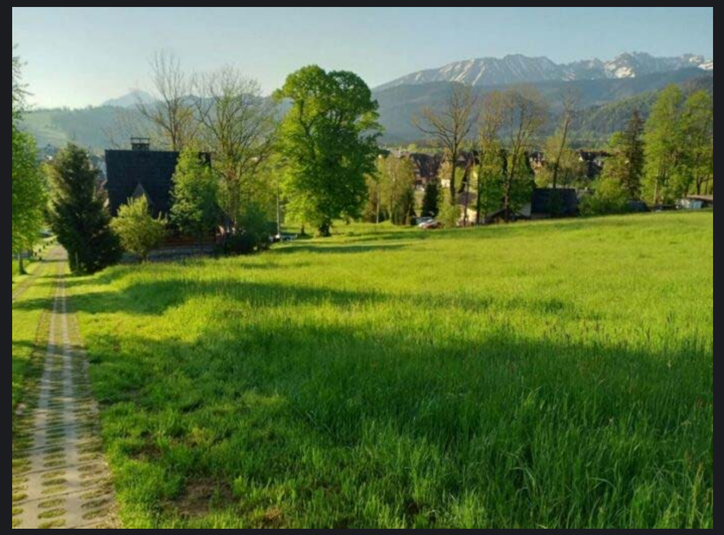

Lipa w Zakopanem

EVERYONE MUST SHIFT THEIR PARADIGM

Large trees
provide **significantly more ecosystem services**
(including carbon sequestration) than small trees.
This relationship is not linear, but rather
exponential.

At the same time, we are no longer able to routinely grow large trees in cities.

43% of carbon stored in 3% of trees

In October 2020, a new study (1) was published by a team of world-leading scientists, including William R. Moomaw, Professor Emeritus of International Environmental Policy at the Fletcher School, Tufts University. He is the lead author of the Nobel Prize-winning Intergovernmental Panel on Climate Change. "A recent study examining carbon storage in forests in the Pacific Northwest found that although large-diameter trees (≥21 inches) account for only **3%** of the total number of stems, they contribute **42%** of the total above-ground carbon storage. The researchers stress the importance of protecting large trees and strengthening existing forest management policies so that large trees can continue to sequester carbon and provide valuable ecosystem services as a cost-effective natural solution to climate change in forest ecosystems worldwide."

Mildrexler David J., Berner Logan T., Law Beverly E., Birdsey Richard A., Moomaw William R. (2020). Large Trees Dominate Carbon Storage in Forests East of the Cascade Crest in the United States Pacific Northwest , USA. Frontiers in Forests and Global Change, 3/2020, PAGES=127, https://www.frontiersin.org/article/10.3389/ffgc.2020.594274
DOI=10.3389/ffgc.2020.594274 ISSN=2624-893X

Life expectancy of trees in cities is 7-28 years

According to various sources (2), the **lifespan of trees in cities is 7-28 years**, which is very short and does not give trees the chance to provide the ecosystem services they could. The annual mortality rate of trees in cities is estimated at a maximum of 9%, or an annual tree survival rate of more than 91%. This study does not include any information on how trees grow. Unfortunately, **most newly planted trees in cities grow very slowly**.

(2) Roman, Lara & Scatena, Frederick. (2011). Street tree survival rates: Meta-analysis of previous studies and application to a field survey in Philadelphia, PA, USA. Urban Forestry & Urban Greening - URBAN FOR URBAN GREEN. 10. 269-274. 10.1016/j.ufug.2011.05.008. https://www.researchgate.net/publication/238003598_Street_tree_survival_rates_Meta-analysis_of_previous_studies_and_application_to_a_field_survey_in_Philadelphia_PA_USA

IS PLANTING NEW TREES IN CITIES A GOOD SOLUTION TO THE CLIMATE CRISIS?

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How Green Are Trees? — Using Life Cycle Assessment Methods to Assess Net Environmental Benefits

https://meridian.allenpress.com/jeh/article/34/4/101/80299/How-Green-Are-Trees-Using-Life-Cycle-Assessment

A newly planted city tree is CARBON NEUTRAL after

26-33 years

Aaron C. Petri, Andrew K. Koeser, Sarah T. Lovell, Dewayne Ingram; How Green Are Trees? — Using Life Cycle Assessment Methods to Assess Net Environmental Benefits. Journal of Environmental Horticulture 1 December 2016; 34 (4): 101–110. doi: https://doi.org/10.24266/0738-2898-34.4.101

CONCLUSION: **NOT REALLY A GOOD SOLUTION**

HOW MANY TREES

do I have to plant to replace

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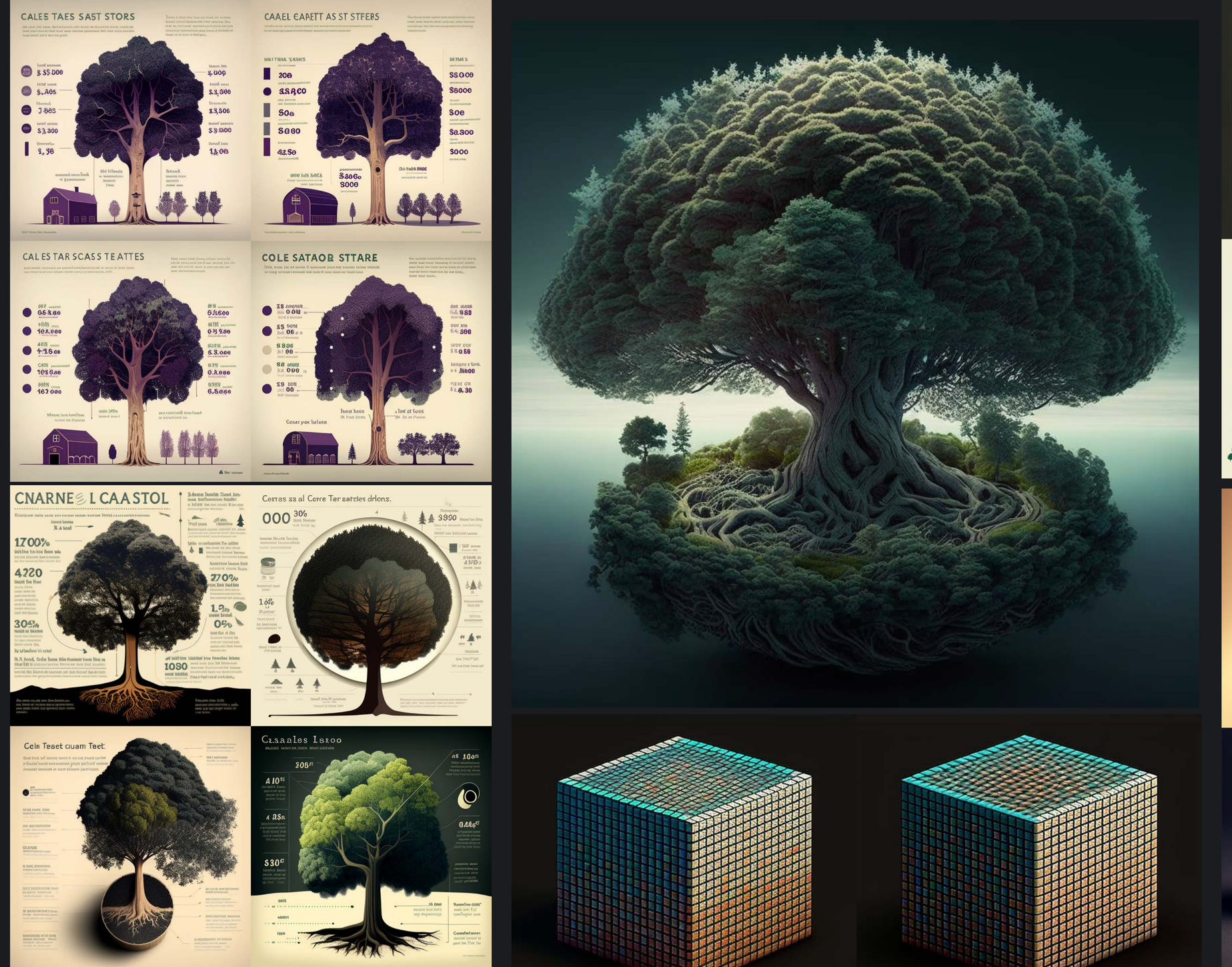
Time to review your answers from chat



CARBON STORED

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Red oak (Quercus Rubra)
Height: 30 m
DBH: 136 cm

DBH: 31 cm Height: 15,2 m Age: 29	DBH: 15 cm Height: 12,2 m Age: 16	DBH: 10 cm Height: 7,62 m Age: 10	DBH: 5 cm Height: 3 m Age: 7	DBH: 2 cm Height: 1,37 m Age: 3
OAKS NEEDED	OAKS NEEDED	OAKS NEEDED	OAKS NEEDED	OAKS NEEDED
35	150	465	3 068	48 061

WE WERE LOOKING FOR AN ANSWER TO THE QUESTION:

HOW MANY TREES DO I HAVE TO PLANT TO REPLACE ONE BIG TREE?

The whole article
www.treeib.com

Carbon stored in 1 tree by tree age, equivalent to CO2

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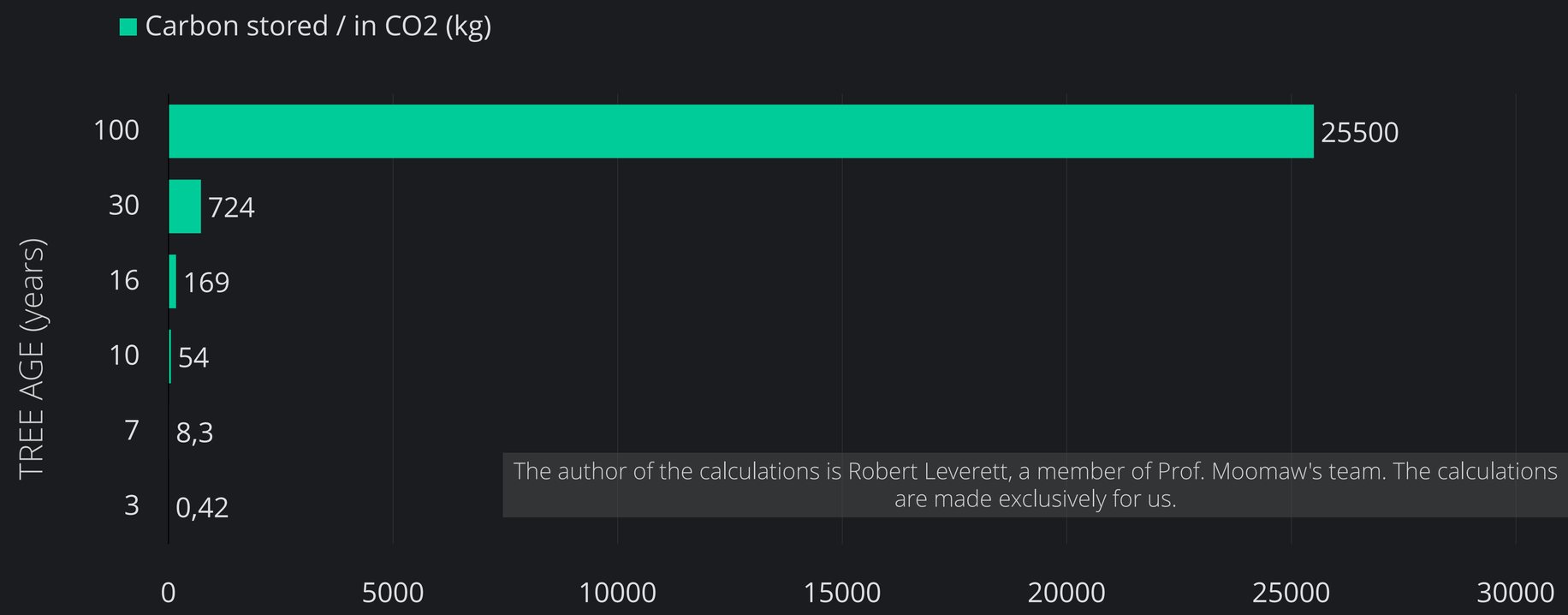
The planting of about 3 068 seven-year-old trees (those planted in cities) or 48 061 three-year-old trees can be considered as a full replacement of a large tree.
If the wood of the initial tree is burnt, this figure must be doubled. If we include the carbon footprint of other associated activities, e.g. planting, etc., we can even get to a figure of 10 000 trees per large one.



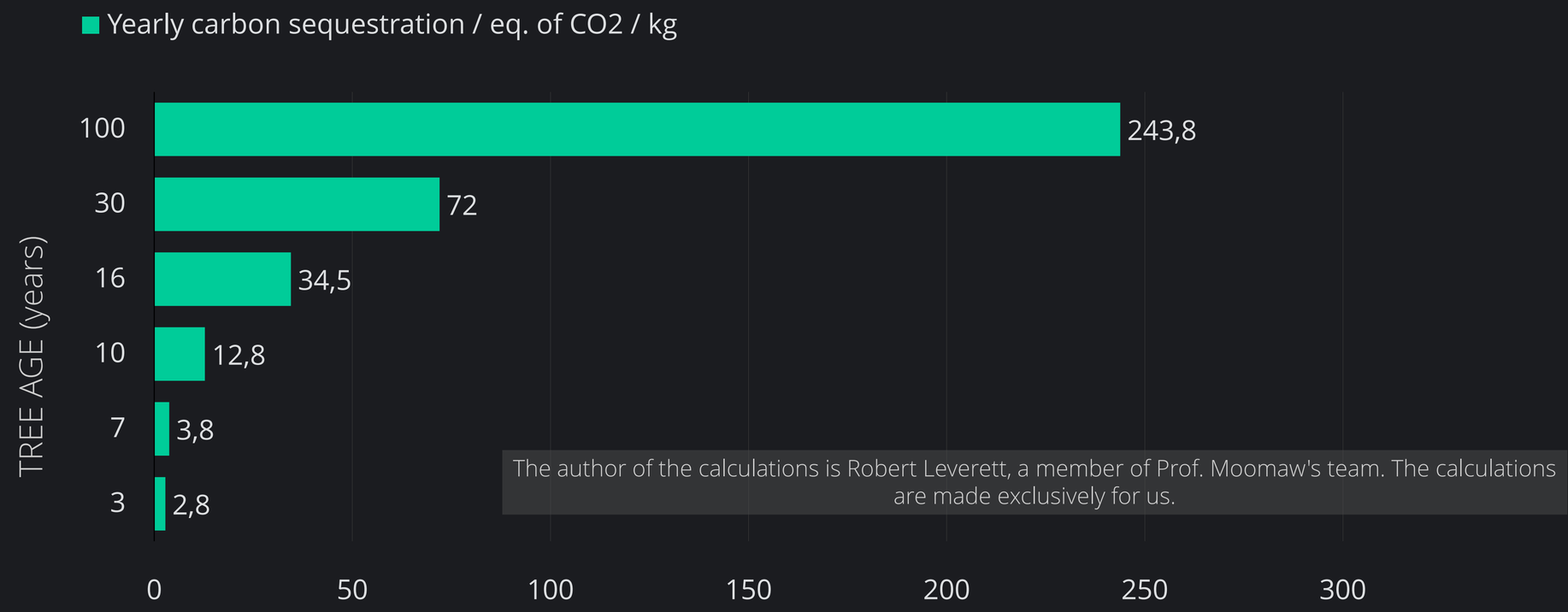
The author of the calculations is Robert Leverett, a member of Prof. Moomaw's team. The calculations are made exclusively for us.

WE WERE LOOKING FOR AN ANSWER TO THE QUESTION:

HOW MANY TREES DO I HAVE TO PLANT TO REPLACE ONE BIG TREE?

Annual carbon sequestration by tree age, converted to CO2

It no longer takes that many trees to fully replace a large tree in terms of carbon sequestration, but the numbers are still high. The point is that there simply isn't room for those numbers. It is often the case that we can no longer plant a new tree where there was a big old tree. Replacement planting is done somewhere outside the city. If we count on the trees to grow immediately after planting, which is usually not the case, we need, for example, 64 seven-year-old trees or 3.4 thirty-year-old trees.



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BUT: IT ALL DEPENDS ON THE GROWTH OF THE TREE.

This model calculation somewhat lowers the standard growth of a large tree (a conservative assumption) and increases the growth of a young tree. UTOI works on the basis of real data measured in the field. The above is a model case.

WHAT COULD BE THE RESULTS

if we start supporting our existing green infrastructure

The tables below show how the amount of carbon sequestered (converted to CO2) varies depending on how the tree grows. If we can significantly improve the growth of the tree, the carbon sequestered could be significantly higher than it is now without care.

Examples are given by calculating the first two largest trees from the previous graphs. Calculated based on the FIA-COLE model by Robert Leverett.
Values from the previous graph are marked in purple.

It is important to note that each tree species sequesters carbon at a different rate. These calculations are all for red oak.

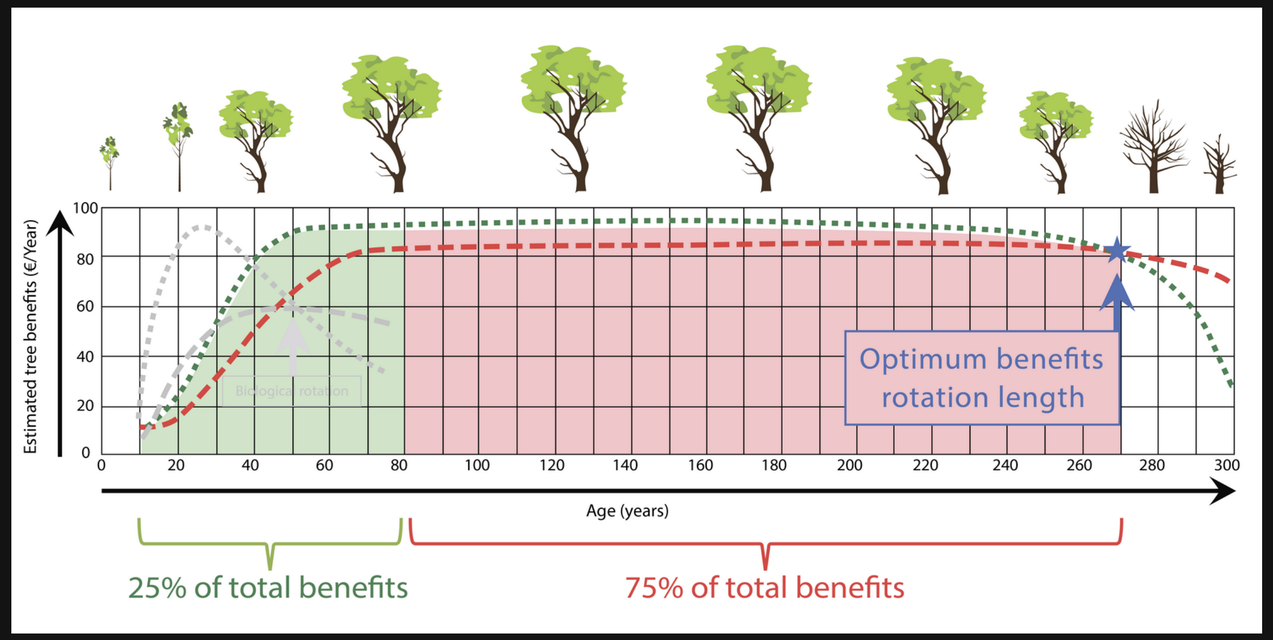
Oak tree, approx. 100 years old,
height 30,5 m, trunk diameter 136 cm

Annual sequestration / CO2 equivalent/ kg	Annual increment of trunk diameter / mm	Annual height gain / m
101,50	1	0,03
243,79	2,413	0,07
364,10	4	0,07
390,20	4	0,1
477,10	4	0,2
728,10	5	0,4

Oak, age about 30 years,
Height 15,2 m, trunk diameter 30,5 cm.

Annual sequestration / CO2 equivalent/ kg	Annual increment of trunk diameter / mm	Annual height gain / m
13,82	1	0,1
73,83	6,35	0,3
89,70	8	0,3
115,57	8	0,8
128,90	12	0,3
415,23	12	0,6

Our opinions are supported by others around the globe



JEREMY BARRELL

Jeremy has spent his entire career caring for trees and promoting a pragmatic approach to their conservation in the built environment. His passion is writing and he regularly gives talks and seminars to other professionals and enthusiasts around the world.

Jeremys BIO:
https://www.barrelltreecare.co.uk/assets/Uploads/J-Barrell-CV.pdf

barrell TREE CONSULTANCY

Simplified representation of one approach to estimating **the optimal rotation period of trees in urban environments**. It is based on the **financial benefits** that trees provide. It is a concept that is based on estimated values. It demonstrates the principle, the reality in different places may of course be different. Because of the different local conditions, it is therefore important to treat the illustration with caution and not to enforce it across the board, always and everywhere.

According to forest management theory, the optimum time to fell a tree/stand is the time when the curve of annual actual growth and average annual growth intersect (grey color). It is called **the clearing maturity** and in this example it is 51 years.

If we extrapolate this principle to the **urban environment**, ignoring timber production and focusing on other, more important benefits that trees provide to people in the city, the curves change. The current annual benefit (green) and the average annual benefit (red) intersect **at about 270 years** of age (blue arrow). **Felling an urban tree at age 80 will only deliver 25% of the total potential (potential) benefits (green area) that the tree could deliver if it were not felled. We can also say that 75% of the benefits that the tree can provide are lost due to premature removal.**

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IT MAKES ECONOMIC SENSE

using trees we already have

to mitigate climate change and use the current infrastructure to adapt to climate change.

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WHAT CAN WE DO?

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WHAT CAN WE DO?

Reshape the focus of arboriculture

Take personal action at the local, national and global level.

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DEFINITION:
The Arboricultural Association defines arboriculture as the science and practice of the cultivation, establishment and management of amenity trees for the benefit of society...
... Ultimately the meaning is the same: arboriculture is tree care.

It is not enough in time of climate emergency.

1. for the benefit of society is very vague definition
2. it is not done anyway

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DEFINITION:
Urban and peri-urban forestry is the practice of managing urban forests to ensure their optimal contributions to the physiological, sociological, and economic well-being of urban societies" (*).

FAO. 2016. Guidelines on urban and peri-urban forestry, by F. Salbitano, S. Borelli, M. Conigliaro and Y. Chen. FAO Forestry Paper, No.¬178. Rome, Food and Agriculture Organization of the United Nations.

It is not enough in time of climate emergency.

1. well-being of urban societies shouldn't be the core objective anymore
2. it is not done anyway

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Someone told me urban trees do not deliver anything to climate but more to microclimate (local ecosystem services).

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Urban forest in the US stores about 800 millions ton of carbon (3 billion of tons CO_2) and sequesters 150 millions ton of CO_2.

$CO_2 = C \times 3{,}664$

The US yearly emissions are about 5 billion CO_2

5% of total emissions

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If we triple the urban trees grow, we cover 15% of total emissions

TREEIB

You are the ones who can have a direct impact, and I offer you to consider an alternative way of doing your job.

Transform your job from reactive arboriculture to conservation arboriculture. A new term can be climate change mitigation arboriculture.

Become evangelists or ambassadors of such as approach.

SINS OF TODAY’S URBAN FORESTRY:

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Talking about how important trees and acting in opposite way	Replacing large trees with small crown cultivars

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Thinking a large tree removed can be replaced by one newly planted tree	Not replacing removed trees at all
Removing large trees, which grew up in periods when there was less stressors and reached maturity	Being reactive not proactive
Not communicating the real climate value of trees to public	Being oriented towards the future, not the present

No money for that? it is about changing the approach and positioning of the industry
Arboriculture (urban forestry) can become one of the most important industries in cities

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Planting large amounts of trees	Not supporting the fact that removing carbon anywhere around the globe has the same value

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SINS OF TODAY'S URBAN FORESTRY:

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Planting large amounts of trees	Not supporting the fact that removing carbon anywhere around the globe has the same value
Not adopting new technologies	Not supporting the localization of ecosystem services

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SINS OF TODAY'S URBAN FORESTRY:

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Planting large amounts of trees	Not supporting the fact that removing carbon anywhere around the globe has the same value
Not adopting new technologies	Not supporting the localization of ecosystem services
Not really protecting the biodiversity (e.g. stump grinding)	Add some!

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Not adopting new technologies	Not supporting the localization of ecosystem services
Not really protecting the biodiversity (e.g. stump grinding)	Add some!
Not explaining that ecosystem disservices are insignificant	Add some!

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