Defining and Marketing Ecosystem Services Provided by Landscape Plants

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What about ecosystem services of landscape plants?

- ecosystem services = benefits provided to human from ecosystems.
- Landscapes / built environment primarily concerned with "regulating" and "cultural" services provided by plants in landscape.

Thanks to Josh Knight, Extension Associate

Regulating services

Air Quality

Human Health

Biodiversity Potential / Wildlife Habitat

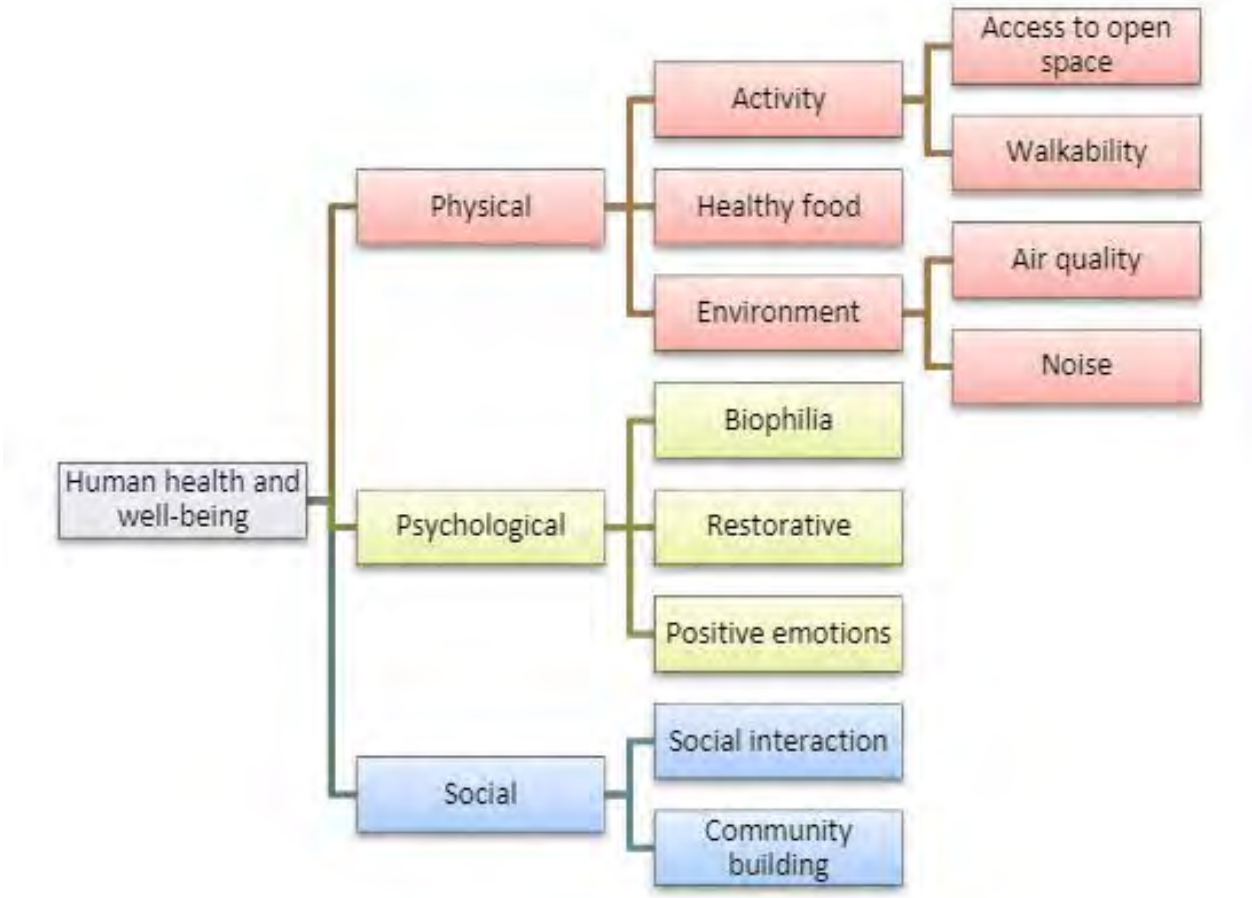
Carbon Sequestration

Energy Conservation and Microclimate Regulation

Noise Reduction

Stormwater management

Summary of human health and well-being benefits of Green Infrastructure



Source: M. Ely and S. Pitman 2014

Life Cycle Assessment:

A research tool to study the environmental impacts of products and processes

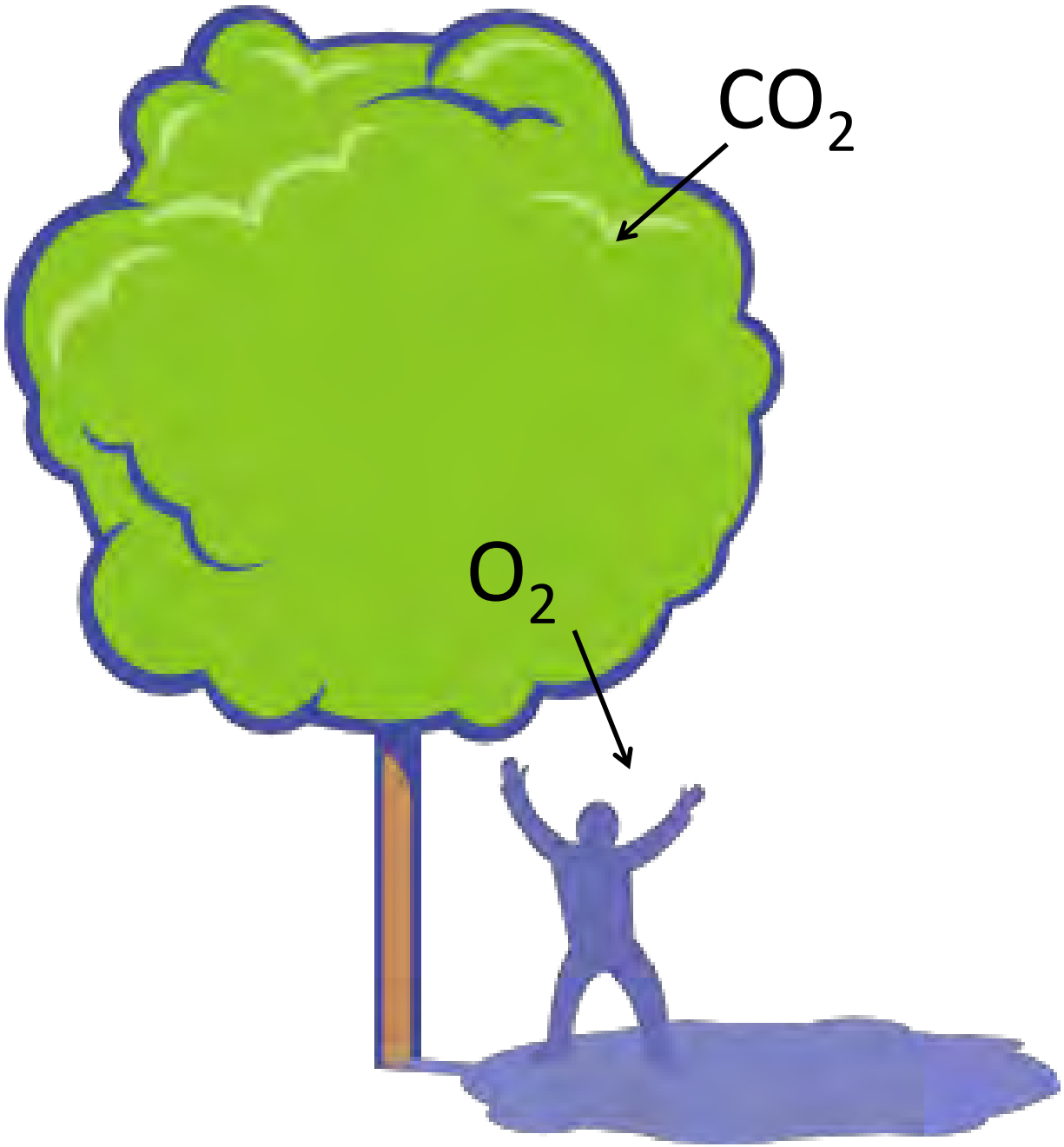
Potential environmental impacts that can be modeled using LCA

- **Global warming potential** kg CO_2 eq
- **Ozone depletion** kg CFC-11 eq
- **Smog** kg O_3 eq
- **Acidification** kg SO_2 eq
- **Eutrophication** kg N eq
- **Carcinogenic human toxicity** CTUh
- **Non-carcinogenic human toxicity** CTUh
- **Respiratory effects** kg PM2.5 eq
- **Ecotoxicity** CTUe
- **Fossil fuel depletion** MJ surplus

#3 holly on East Coast

Potential environmental impacts

Impact category	Unit	Total
Ozone depletion	kg CFC-11 eq	0.000001
Smog	kg O_3 eq	0.376528
Acidification	kg SO_2 eq	0.029700
Eutrophication	kg N eq	0.019957
Carcinogenics	CTUh	0.000000
Non carcinogenics	CTUh	0.000001
Respiratory effects	kg PM2.5 eq	0.001457
Ecotoxicity	CTUe	105.882290
Fossil fuel depletion	MJ surplus	5.445474

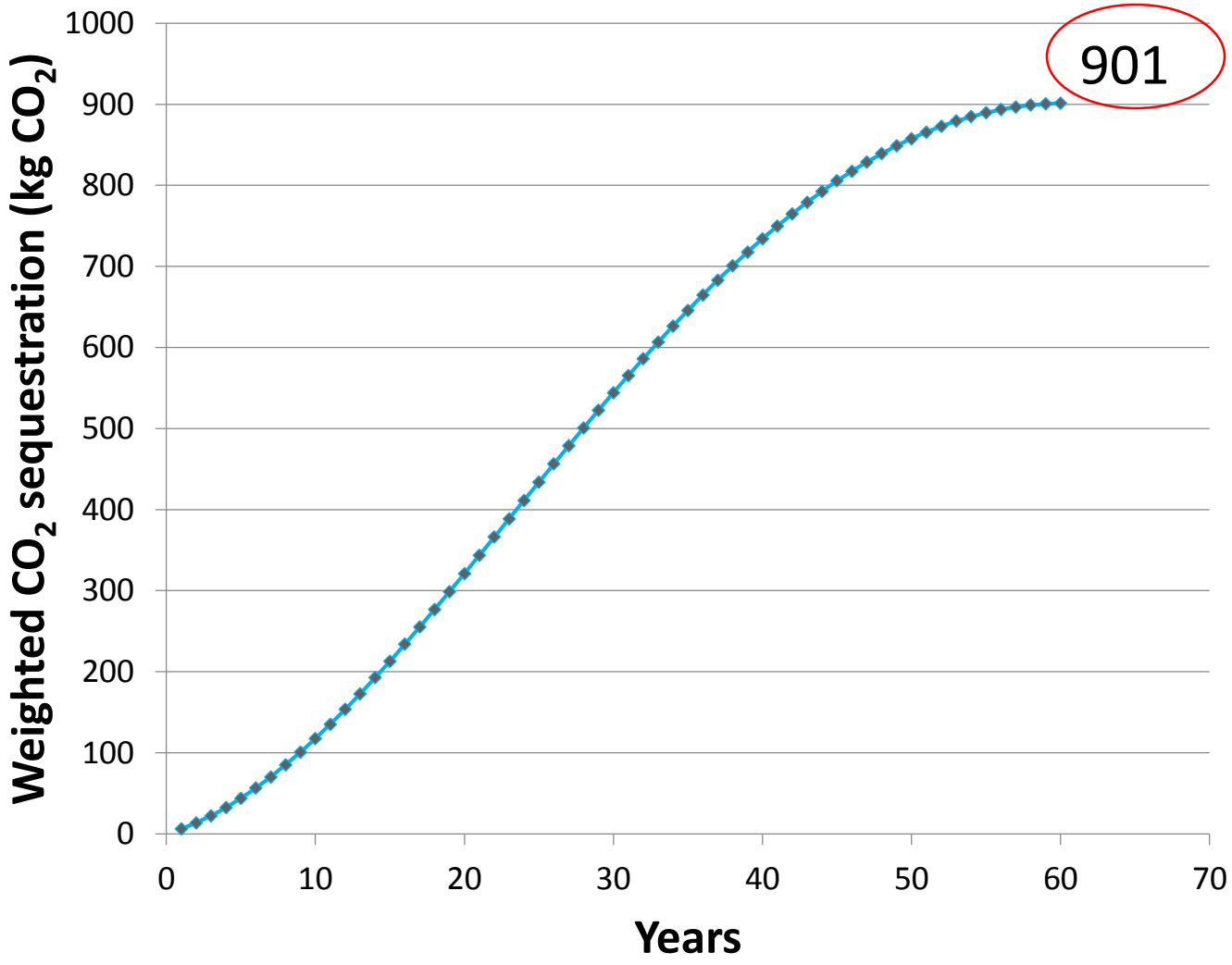

CO_2
O_2

Model System Assumptions:
Use Phase

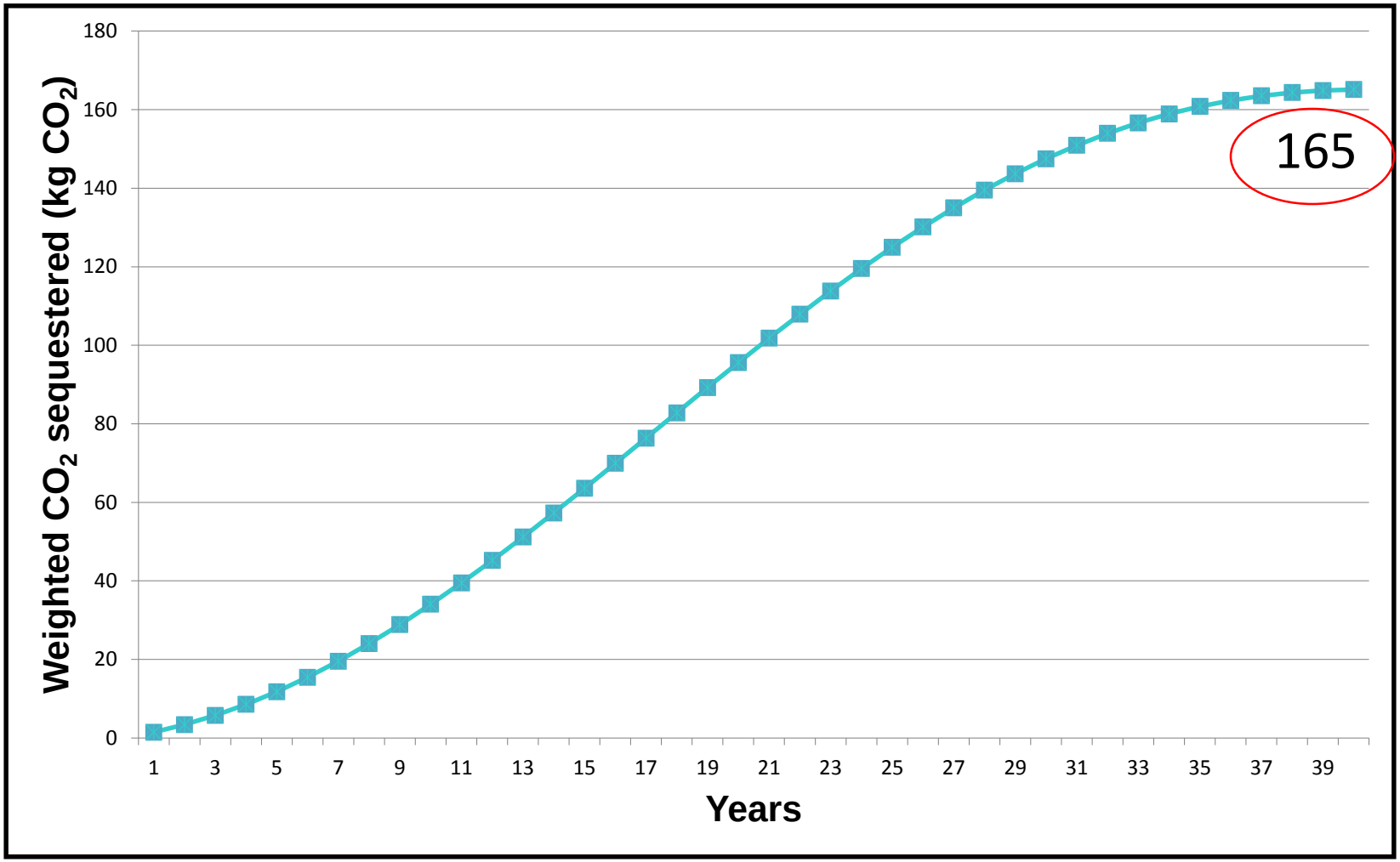
- Transplanted to a favorable suburban site
- 60 years of useful life for Red Maple
- 40 years of useful life for Redbud
- Will take-up CO_2 and store C as wood
  - CUFR Tree Carbon Calculator

It was assumed there was no specific investment of Greenhouse Gas Emissions during the maintenance of the tree in a suburban residence

Red Maple
CO_2 sequestration during use phase



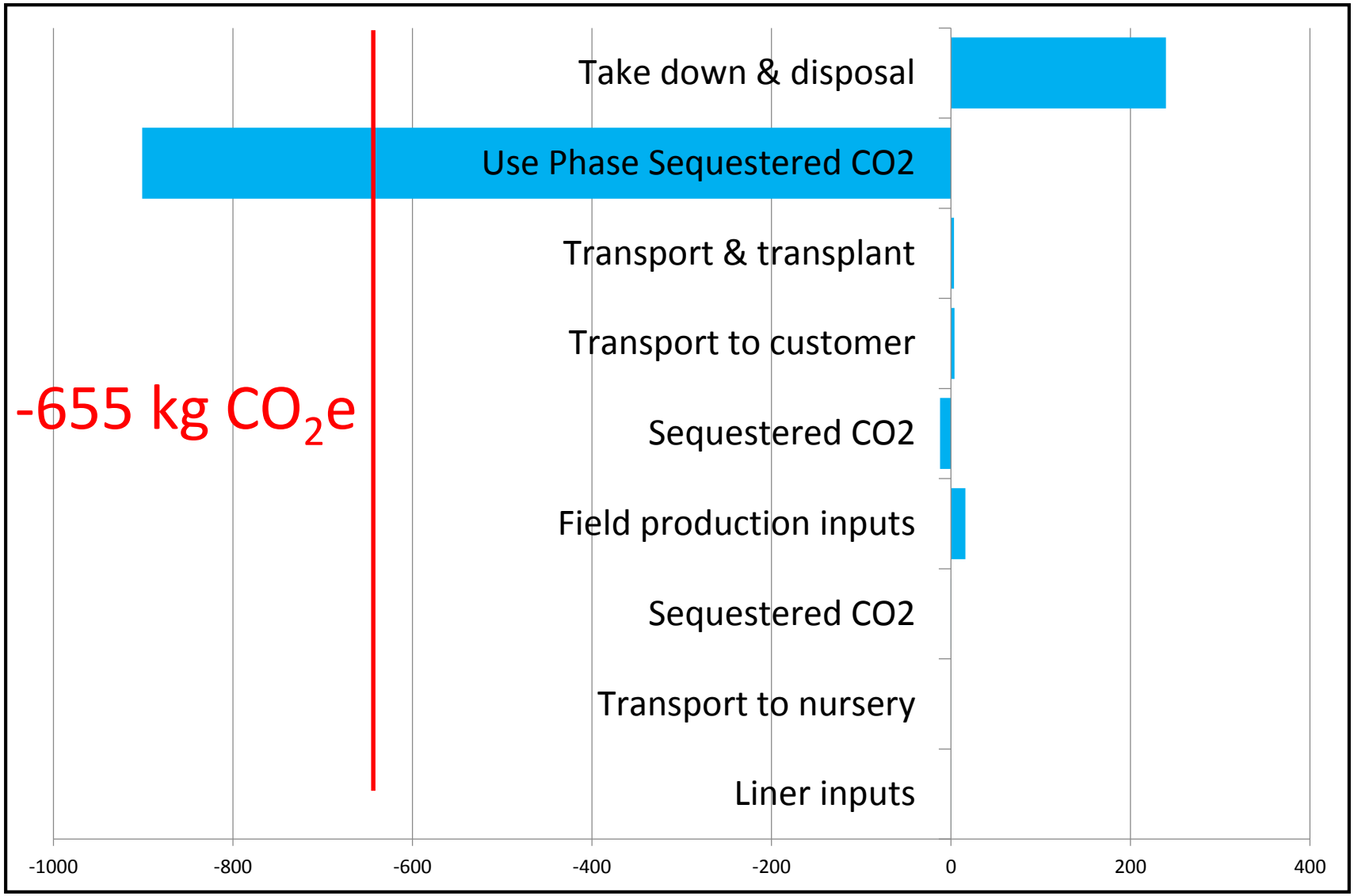
Redbud
CO_2 sequestration during use phase



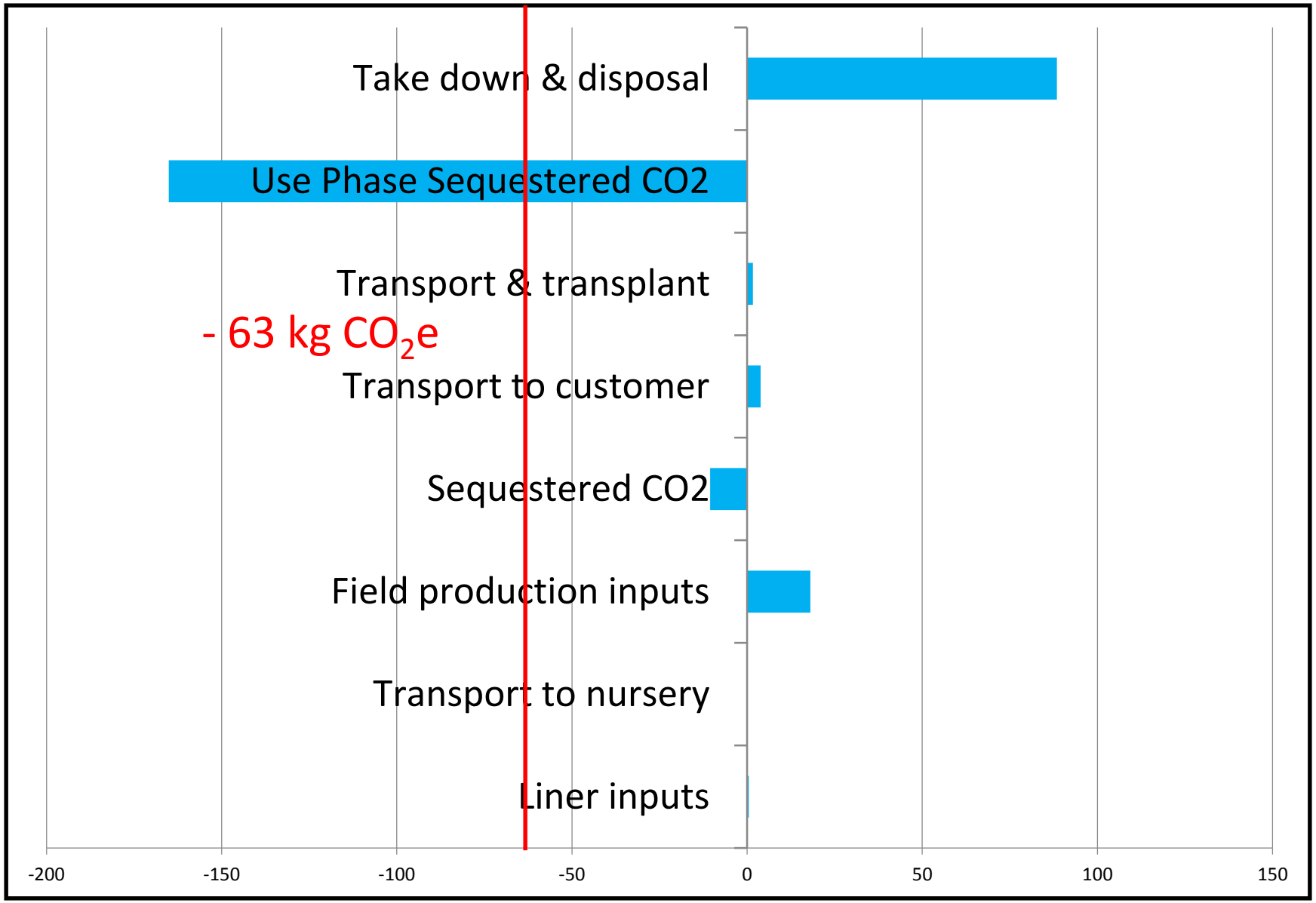
Model System Assumptions:
Take down and disposal

- Travel 24 miles in heavy truck
- Use chain saw 3.5 hours for Red Maple
  and
  1 hour for Redbud
- Use 140 hp chipper 2 hours for Red Maple
  and
  0.5 hours for Redbud… 120 hp chipper
- Chips hauled to site for municipal use as mulch
- Data based on interviews with certified arborists

Red Maple


Take down & disposal
Use Phase Sequestered CO2
Transport & transplant
Transport to customer
Sequestered CO2
Field production inputs
Sequestered CO2
Transport to nursery
Liner inputs
-655 kg CO_2e
-1000
-800
-600
-400
-200
0
200
400

Redbud


Take down & disposal
Use Phase Sequestered CO2
Transport & transplant
- 63 kg CO_2e
Transport to customer
Sequestered CO2
Field production inputs
Transport to nursery
Liner inputs
-200
-150
-100
-50
0
50
100
150

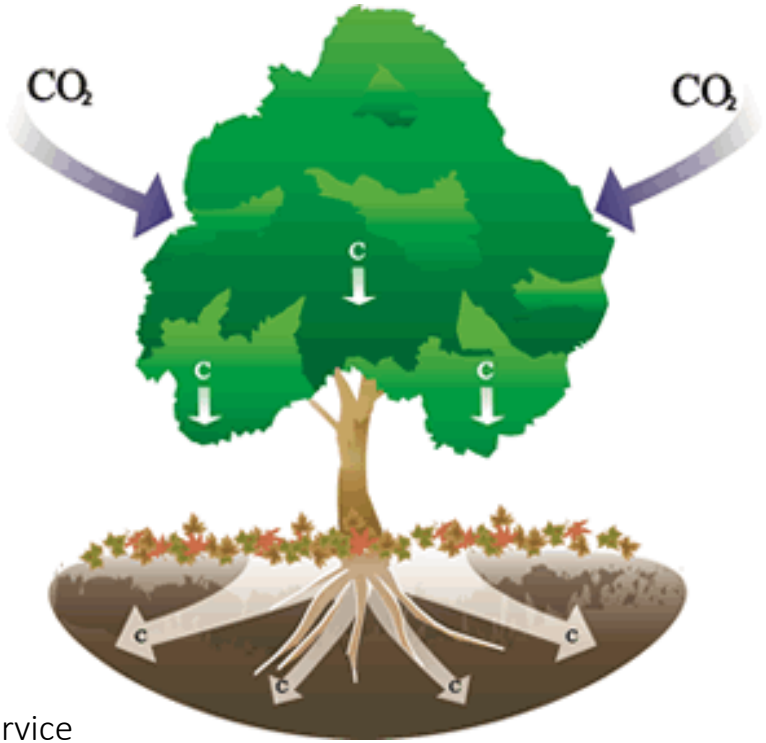


Image: US Forest Service

50% of an individual tree or shrub's dry biomass is carbon, sequestered from the atmosphere via photosynthesis.

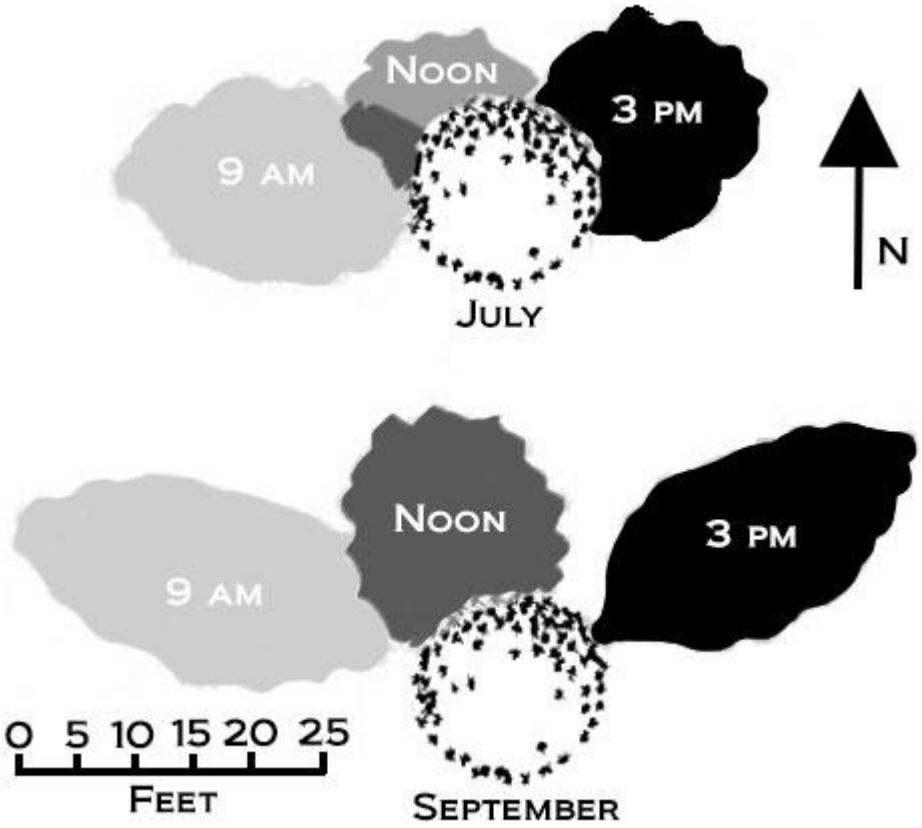
_____

Below ground, long term sequestration in soil not quantified at this time, but may be substantial for some plants.

Landscape Plant	kg CO2
Red maple tree – *Acer rubrum*	655
Evergreen tree – *Picea pungens*	430
Flowering deciduous tree – *Cercis canadensis*	63
Deciduous shrub – *Viburnum spp.*	11
Evergreen shrub – *Taxus spp.*	9

Reduced global warming impact of above ground growth plant's life expectancy, after accounting for emissions during production and take down at end of life.

Microclimates



Shade patterns shift **daily and seasonally**

Temperature

Suburbs with trees:

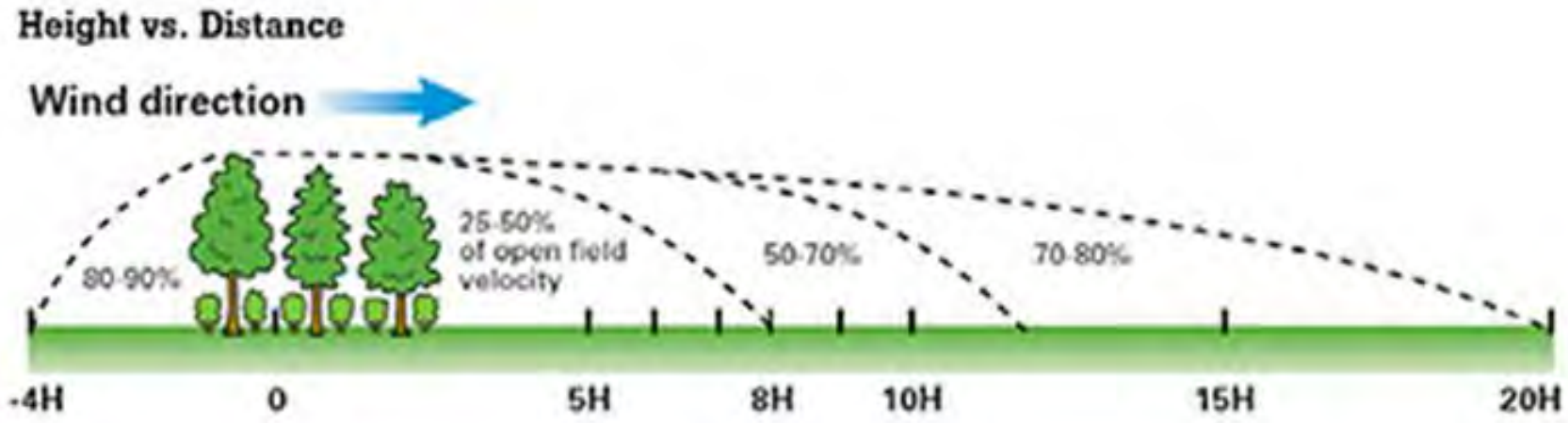
Air 4-6 degrees cooler

Schoolyards with trees:

Air 20 degrees cooler

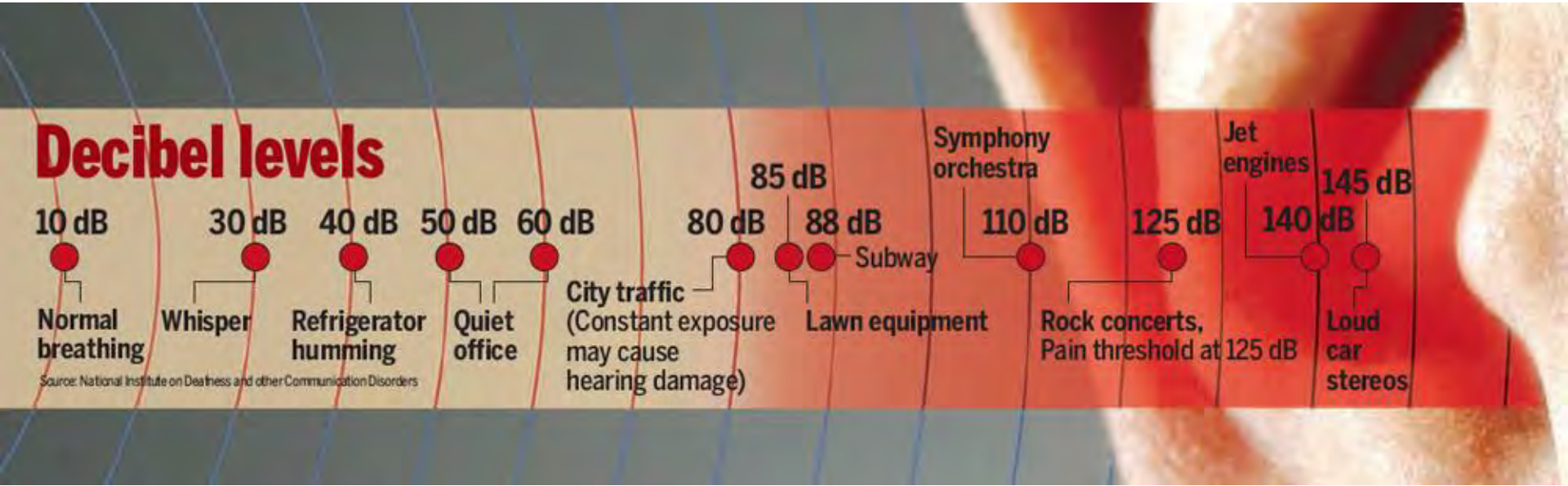
1 Properly watered tree can evaporate-transpire
40 gallons of water each day and
offsetting heat equivalent from
100x 100 watt lamps burning for 8 hours.

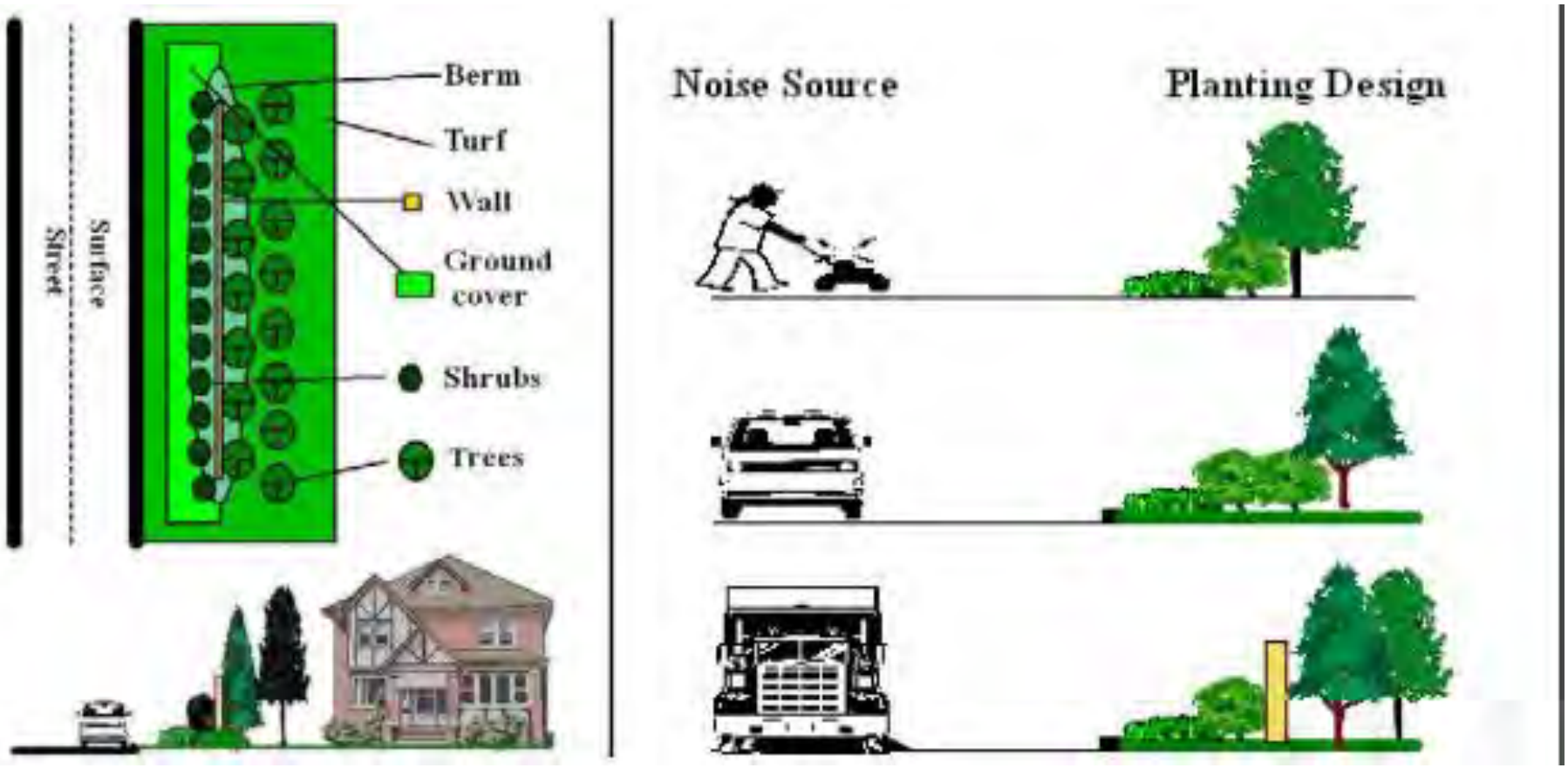
Wind


Height vs. Distance
Wind direction
80-90%
25-50%
of open field
velocity
50-70%
70-80%
-4H
0
5H
8H
10H
15H
20H

Noise Reduction

- Cities are loud
- Constant exposure to city traffic sounds can cause hearing damage!
- Decibel is a logarithmic unit: "small" unit increases or decreases are more noticeable at higher levels





More layers reduce louder noises.

Source: Georgia Forestry Commission

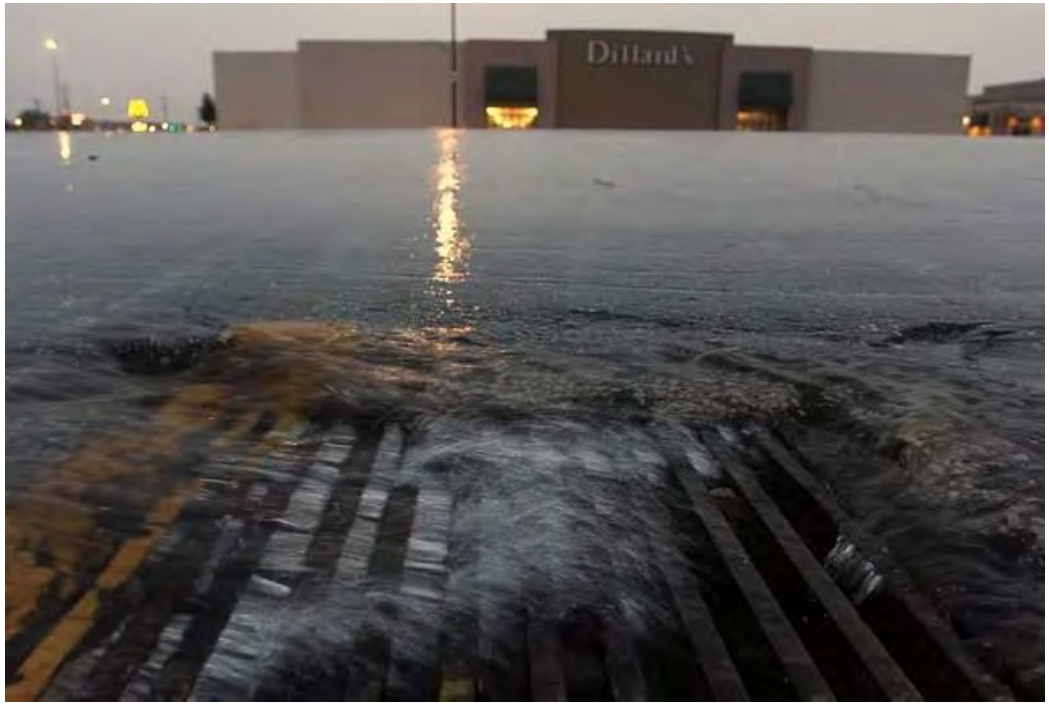
GEORGIA FORESTRY COMMISSION

Green Buffers for Screening and Noise Reduction

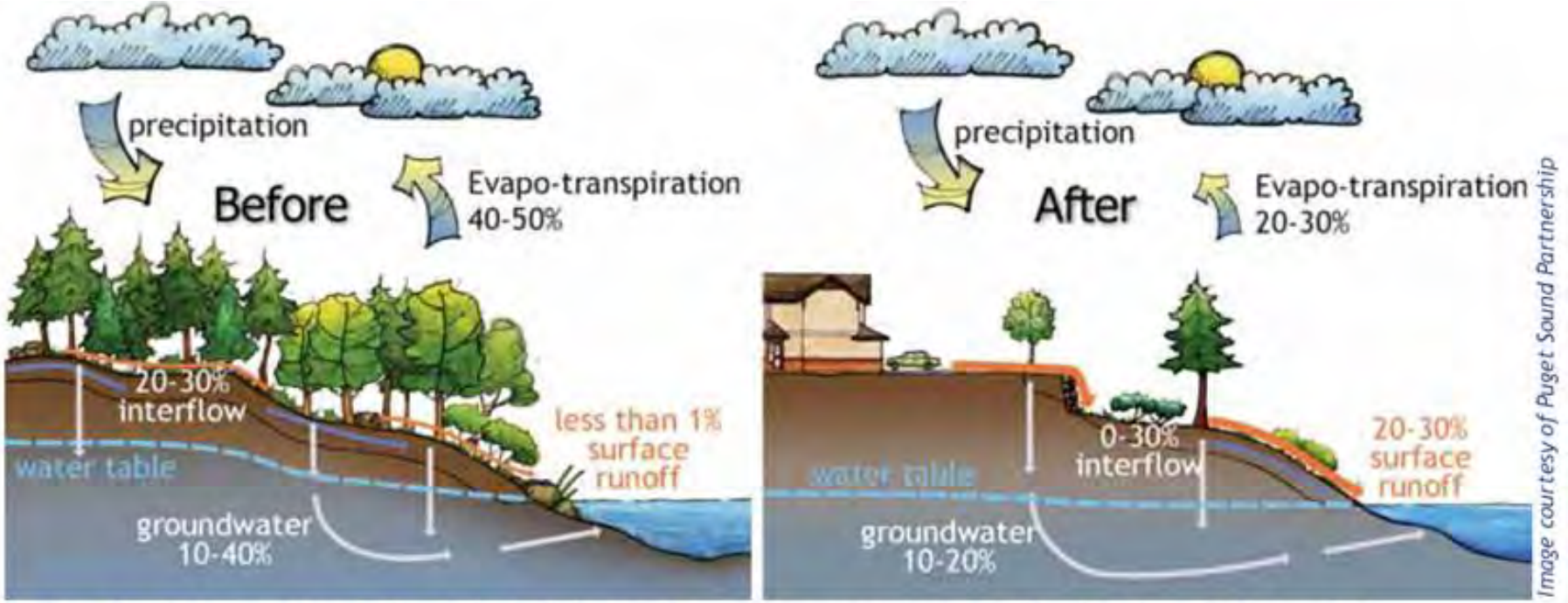
"Plant materials help attenuate sound and 'calm' the noise. Some types of plants are better at performing this function than others. **Efficient trees and shrubs have thick, waxy leaves, dense evergreen foliage, and branches that extend to the ground.**"

- Georgia Forestry Commission

Stormwater Management



Impervious Surfaces cause Stormwater Runoff



Before *development almost all rainfall is taken up by plants, evaporates or infiltrates through the ground.*
After *conventional development, surface runoff increases significantly while evaporation and infiltration into the ground decrease.*

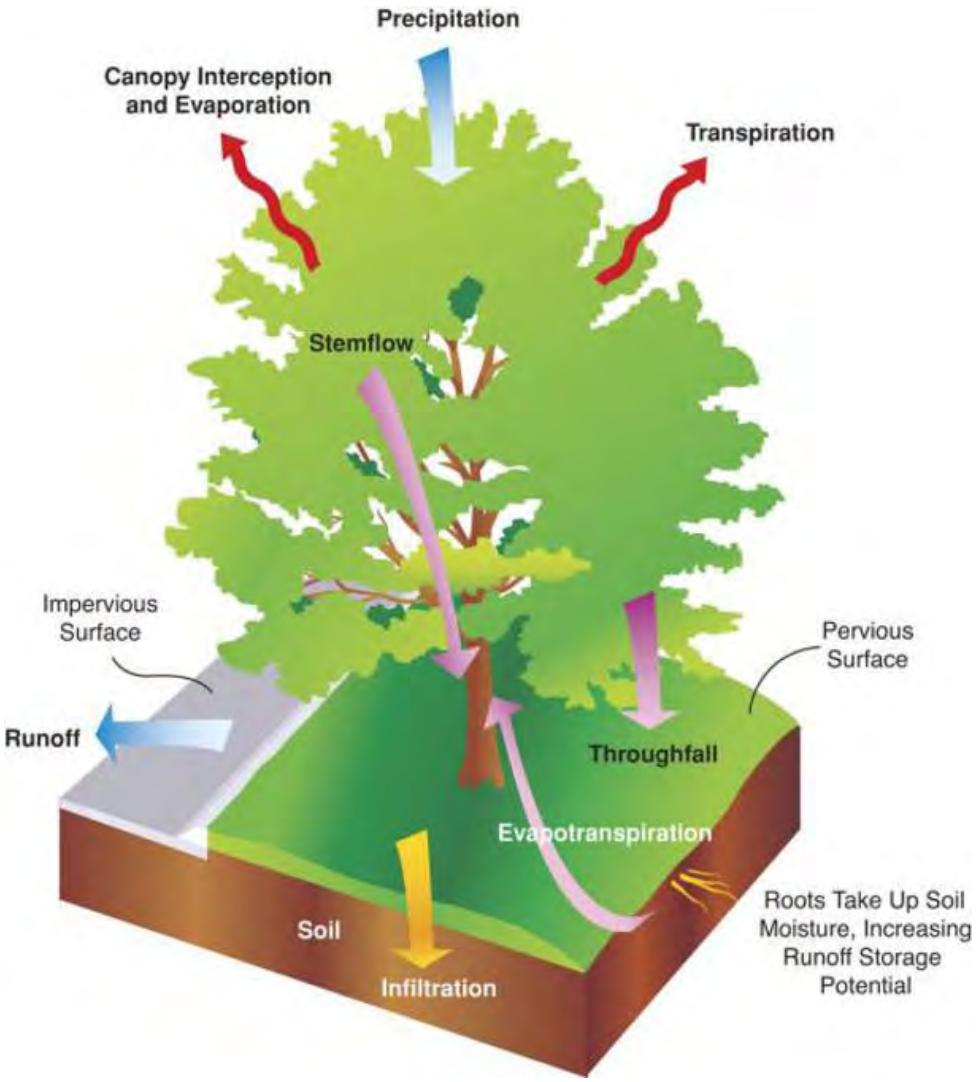
Problems with runoff:

- Toxic! Metals, animal waste, pathogens.
- Gravelly/Sandy soils allow rapid infiltration of stormwater, can contaminate ground water.
- Leading cause of water pollution in urban creeks/waterways.
- Impaired habitat for fish / wildlife.

Grey infrastructure is at risk during peak events.

Green infrastructure flattens these peaks by slowing runoff during and after rainfall events.

Green infrastructure improves the capacity of existing grey infrastructure, saving public funds.



Cultural Services

- Aesthetic, Recreation and Cultural values difficult to quantify, though Property Values are representative

- "150% return on investment of 8-10% of the value of the property is **conservative**" – John Gidding, HGTV's "Curb Appeal"

Monetary credit for carbon sequestration… in our future

- Sequestered carbon has monetary “credits” in a carbon “market.”
- According to a Bloomberg Business Report, the August, 2015 value for off-setting carbon dioxide equivalents was $662 per ton.
- The “weighted” 655 kg CO_2 (0.7 tons) sequestered by a red maple tree during its life cycle would have a value of $463.
- We don’t have a functioning market yet for carbon credits!

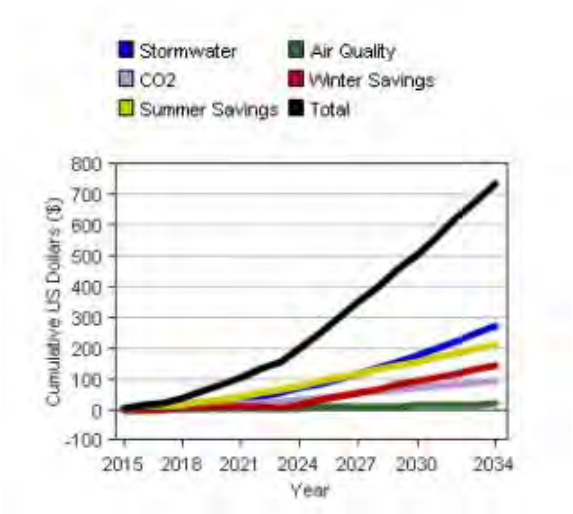
https://design.itreetools.org/

Summary
i-Tree Lexington, KY

Over 20 years, a single red maple planted in 2015 located ~25' from the southwest corner of a climate controlled structure in Lexington, KY will…

- Save $143 in winter heating costs
- Save $210 in summer cooling costs
- Intercept 44,028 gallons of water
  - Saving the community $273 in stormwater reduction costs
- Save $18 in air quality improvement upgrades
- Reduce contributions to atmospheric carbon by 9,766 lbs through sequestration and decreased energy production needs.

- Total Value Added: >$700



Cumulative tree benefit forecast for a properly sited red maple planted in 2015. (Lexington, KY)

Source: i-Tree Design itreetools.org

Summary
i-Tree Gainesville, FL

Over 20 years, a single red maple planted in 2016 located ~25' from the western face of a climate controlled structure in Gainesville, FL will…

- Save $20 in winter heating costs
- Save $511 in summer cooling costs
- Intercept 39,271 gallons of water
  - Saving the community $238 in stormwater reduction costs
- Save $26 in air quality improvement upgrades
- Reduce contributions to atmospheric carbon by 11,191 lbs through sequestration and decreased energy production need.

- Total Value Added: >$900

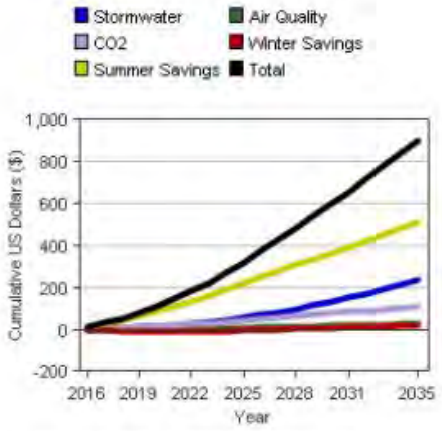


Figure 1. Tree benefit forecast for 20 years

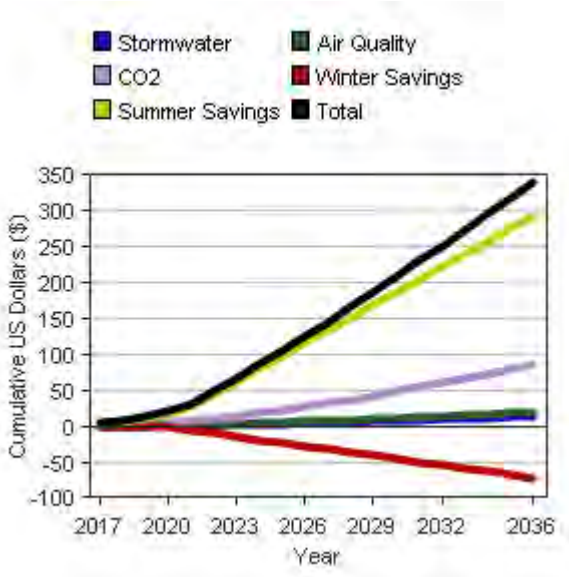
Cumulative tree benefit forecast for a properly sited red maple planted in 2016. (Gainesville, FL)

Source: i-Tree Design itreetools.org

Summary
i-Tree Irvine, CA

Over 20 years, a single Sweetgum planted in 2017 located ~50' to the east of a climate controlled structure in Irvine, CA will

- Save $293 in summer energy savings by shading and air cooling through evapotranspiration
- Intercept 7,217 gallons of water
  - Saving the community $13 in stormwater management costs
- Save $19 in air quality improvement upgrades
- Reduce contributions to atmospheric carbon by 8,910 lbs through sequestration and decreased energy production need
- Total Value Added: >$411

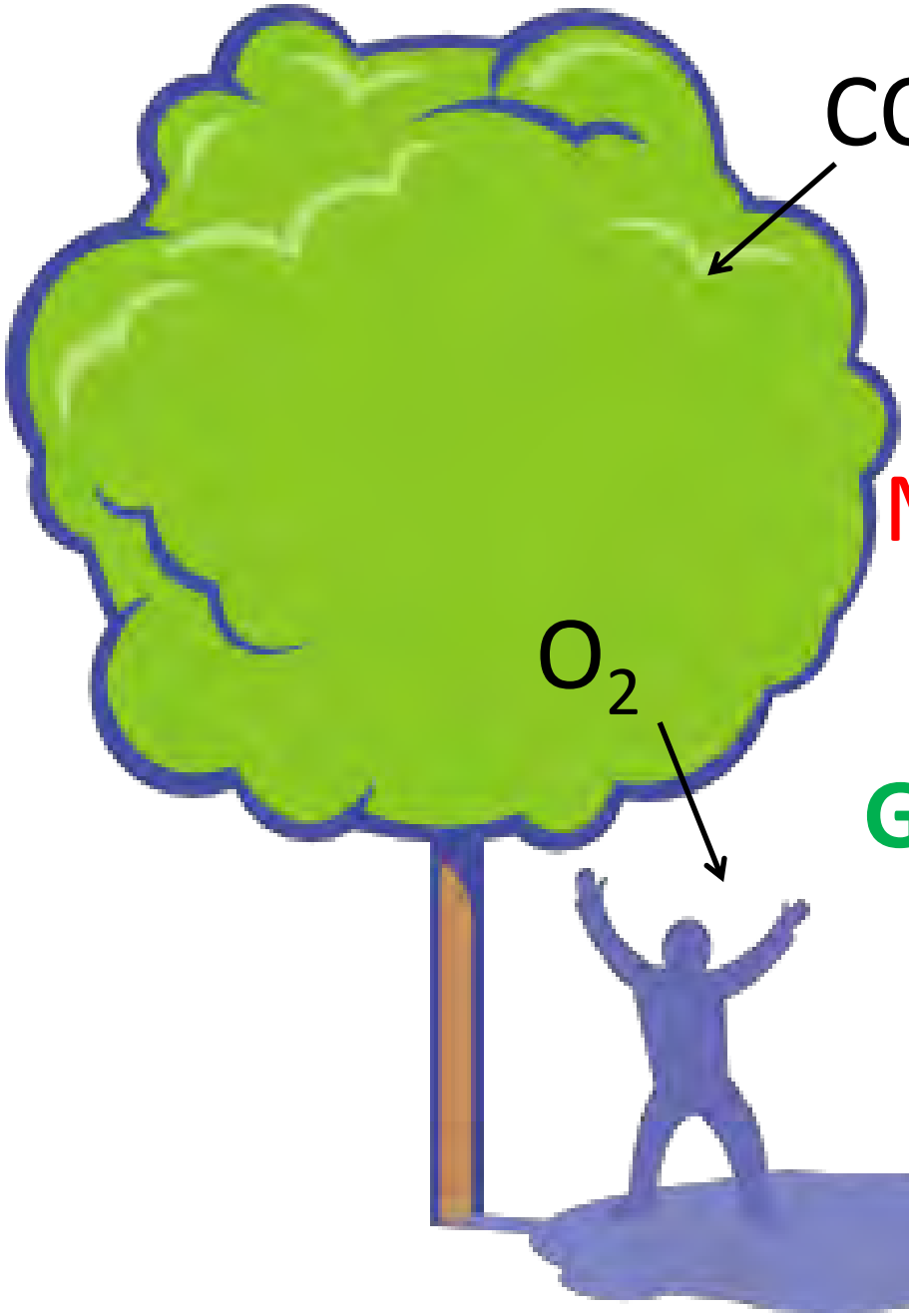


Cumulative tree benefit forecast for a properly sited red maple planted in 2016. (Irvine, CA)

Source: i-Tree Design itreetools.org

What else are we learning?

- Life cycle ecosystem services greatly out-weigh the GHG emissions during tree and shrub production.
- The industry should market its products' life cycle impact, and its success in modifying production systems to minimize CF, to environmentally conscious consumers.



Market…

Green Industry

and

GWP remediation

and

Ecosystem enhancement

http://NCER.ca.uky.edu/ecosystem-services

HO-115

University of Kentucky
College of Agriculture, Food and Environment
Cooperative Extension Service

Ecosystem Services of Landscape Plants

A GUIDE FOR GREEN INDUSTRY PROFESSIONALS

Joshua Knight and Dewayne L. Ingram, Horticulture

Introduction

This publication is meant to assist green industry professionals in marketing and customer education efforts as they explore marketing their products and services to improve green infrastructure. Consumers are placing increasing value on and acknowledging the critical role that landscape plants play in the urban environment, from reducing urban heat islands to improving the aesthetic experience (i.e. curb appeal) we derive from the landscape of an individual home. Further, there is a growing body of scientific literature evaluating the critical role of trees in landscaping within urban and suburban environments such as residential neighborhoods, commercial/industrial areas, and associated green infrastructure such as park systems and green belts.

An **ecosystem** is a community of living organisms in combination with the nonliving components (air, water, mineral soil) interacting as a system. One useful tool for articulating the functions landare all benefits to humankind provided by ecosystems."

The focus of this publication is to describe the contributions of woody landscape plants to urban ecosystems with the goal of aiding green industry professionals in their work with customers who may have ecologically minded demands. Customers may include private businesses capitalizing on sustainability initiatives, community associations promoting open spaces, public firms engaged in climate change mitigation, and private homeowners hoping to increase the value of their property.

The resource list at the end of this document provides readers more detailed information. The free, peer-reviewed software suite i-Tree from the U.S. Forest Service is particularly valuable to individuals, firms, and communities who want to quantify the environmental services provided by existing and potential trees in their communities. The software was particularly valuable in the development of the species reference table located in

Types of Ecosystem Services

Woody landscape plants provide us with numerous valuable ecosystem services, including improvement of air quality, increased cultural and aesthetic value, biodiversity potential, carbon sequestration, energy conservation and microclimate regulation, improvement of human health, noise attenuation/reduction, and stormwater management. Green industry professionals must express to their customers the ability of landscape plants to improve green infrastructure.

Air Quality

Back in the 1800s, parks, habitats for trees and other landscape plants, were referred to as the "lungs of cities" by Frederick Olmsted, considered the "Father of American Parks." Air pollution is a significant risk factor for a number of health conditions, including respiratory infections, heart disease, stroke, and lung cancer. The human health effects of poor air quality are far reaching. The most common sources of air pollutants include particulate matter, ozone, nitrogen dioxide, and sulfur dioxide. Indoor air

SCRI - CLEAN WATER^3

REDUCE, REMEDIATE, RECYCLE

USDA NIFA

United States Department of Agriculture

National Institute of Food and Agriculture

Horticultural Research Institute

The AmericanHort Foundation

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