Tree & Open Space Commission of Newport, Rhode Island Information Bulletin No. 5, June 2011

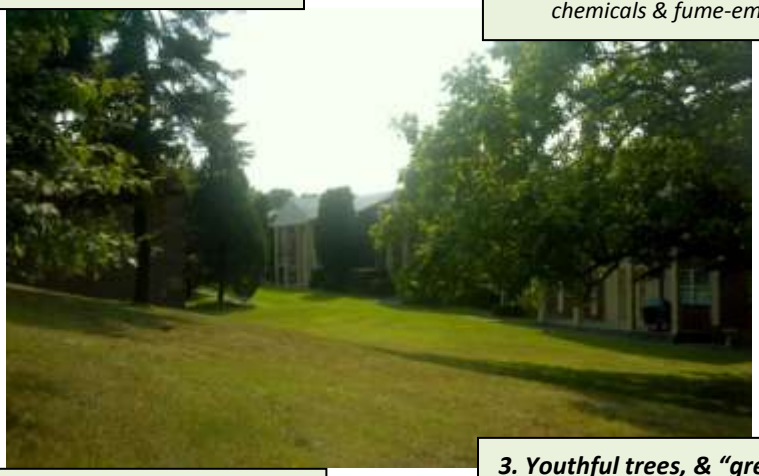
Our Newport Trees as Atmosphere Helpers and Carbon Bankers

by David W. Brown
former Commission member/chair, and retired agri-resource economics professor
with Daniel T. Christina
Commission member, and Assistant Grounds Manager, Blithewold Mansion, Gardens & Arboretum, Bristol RI
and Scott Wheeler
City of Newport Tree and Parks Supervisor, and ISA certified arborist

Trees and forests are often seen as part of the answer for improving our nearby environments and slowing global warming. But can such benefits add up to much in semi-urban settings like Newport's? Maybe yes, maybe no. Much depends on how well we and our younger generations manage our "urban forest." Here's the main story:

1. Our trees help the atmosphere by…
- *Removing CO_2 & some other gasses.*
- *Storing carbon in branches, trunks, roots & nearby soil.*
- *Providing shade that reduces heating, AC & utilities emissions.*
- *Filtering out nearby dust.*

2. But trees may have environmental downsides.
- *Winter respiration & decaying plant materials release CO_2 into the air.*
- *Conventional urban tree care makes heavy use of chemicals & fume-emitting equipment.*



3. Youthful trees, & "green" plant & soil management, can be a <u>low-cost</u> way for us to reduce Newport's carbon emissions.

4. New on-line tools help us to estimate the environmental impacts of trees in our neighborhoods, and to link to interesting info & career frontiers.

This bulletin offers a learning-action starting point for interested students and teachers, tree owners, service providers, and civic leaders. We focus especially on carbon dioxide (CO_2) and carbon banking, as carbon emissions have been in the spotlight. We first explain how trees affect carbon in the atmosphere, tree materials, and soils. We "walk you through" a web link that enables you to estimate the CO_2 effects and other benefits of trees that are planted, or could be planted, near you. We tell about

studies which show that Newport has space for more trees. We provide leads to information frontiers that you may wish to explore further in coming years, and even become involved in.

First, a little botany and soil science…

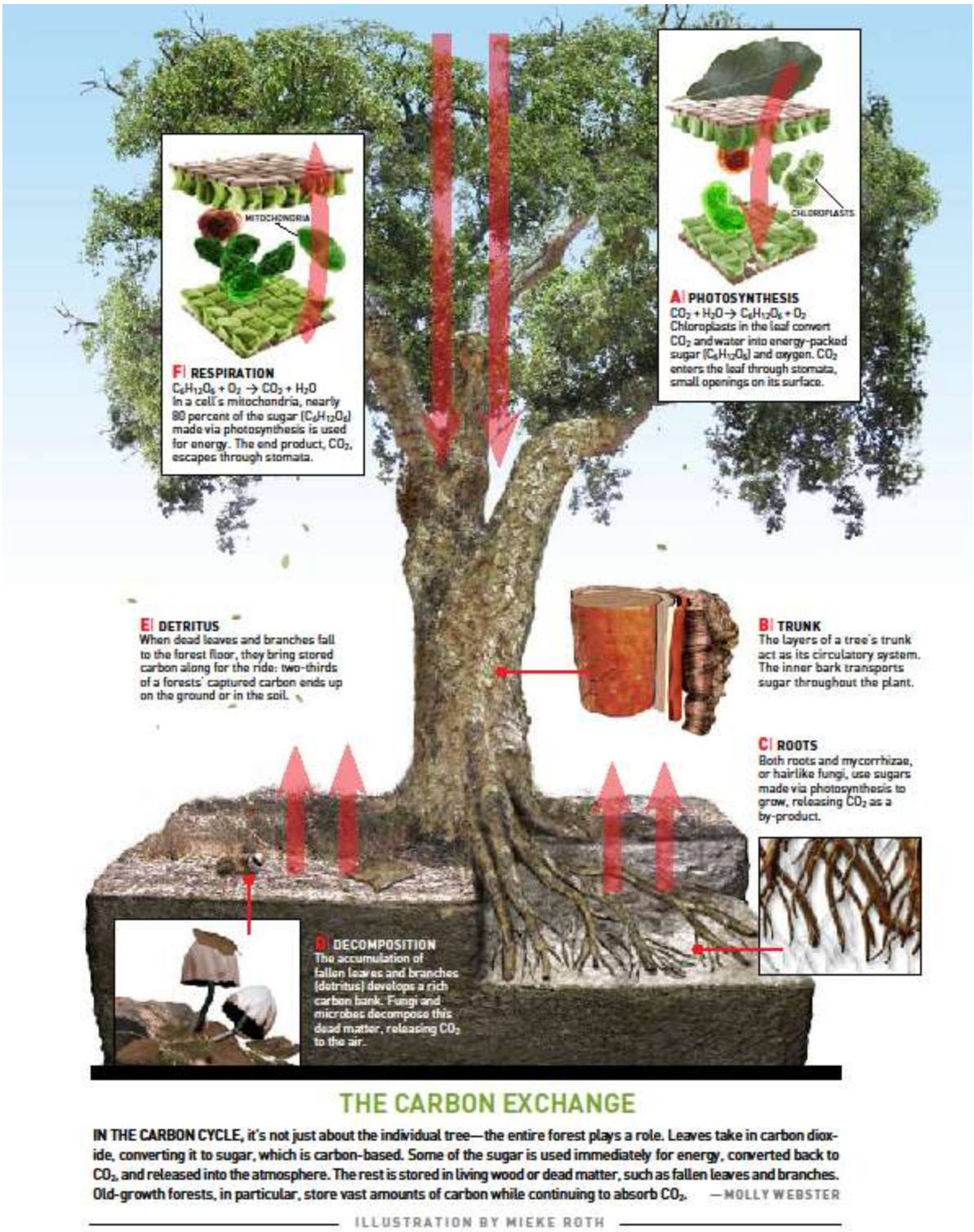
Most of us know something about how trees grow: Their leaves utilize sunlight and absorb CO_2 from the air. Photosynthesis produces liquid sugars that go down into the root system to combine with soil water and minerals. Some of this goes back up the tree to produce more leaves, woody tissue, flowers, and seeds or nuts. Some is stored as starch in the roots themselves, to be used during winter months or when the tree is stressed. The process of respiration converts these starches back into usable sugars, and also releases some CO_2 back into the air.

The pace of photosynthesis, CO_2 removal and carbon banking is affected by a tree's age, health and species. A newly planted tree puts most of its energy into trunk, branch and leaf growth. A well established tree is at its peak of removing CO_2 from the air and *sequestering* (saving) surplus carbon as carbohydrates in its woody tissues. An older tree that has begun to decline will capture and sequester carbon at a slower rate. The life process of a really old tree, or one that has been badly treated or damaged, will start to shut down; decay may set in, and carbon gas may go back into the atmosphere.

Soil conditions are very important. Studies are finding that much carbon banking takes place *below ground* in healthy roots and nearby organic material. The need for good soil structure, proper acidity (pH), minerals, water and air in the soil has long been known. Soil organisms are now seen as very important too. Some can become pathogens, but most are helpful. *Earthworms and other invertebrates* open passageways, and digest and stir materials. *Fungi* have tiny filaments that attach themselves to root hairs and enable the tree to absorb more of the nutrients and moisture that are near its roots. In return, the tree provides the fungi with some of its nutrient flows. Subsurface *bacteria*, *algae*, *protozoa* and *nematodes* have mutual relationships that help to process organic compounds and inorganic elements into forms that the tree can use.

Climate also affects the vigor of a tree's growth and carbon storage processes. In general, these are most active when it is warm, sunny, and moist. But a lot depends on tree species. Some species can grow in cold places. Others need tropical settings. Many tree species, like those that we commonly have in Rhode Island, thrive in the non-arid mid-latitudes. Small changes in climate can affect trees' vigor. Even within the lifetimes of young readers of this bulletin, global warming trends may make some of our Newport trees feel ill-suited. Some species that have historically thrived south of us may begin to feel more at home here. Given the long lives that we hope our trees will have, looking ahead to the future can be important when deciding which species to plant now.

> Boulder, Colorado, has produced an interesting explanation of how urban trees can help communities to store carbon, improve air quality, save energy, and reduce storm-water runoff. It utilizes studies by urban foresters and has easy-to-understand visuals. Look up on line **Calculating the Value of Boulder's Urban Forest** or see www.bcn.co.us/basin/boulder. As you browse the report, you might ask yourself, "In what ways is Boulder's urban forest situation like and unlike that of Newport?"



THE CARBON EXCHANGE

IN THE CARBON CYCLE, it's not just about the individual tree—the entire forest plays a role. Leaves take in carbon dioxide, converting it to sugar, which is carbon-based. Some of the sugar is used immediately for energy, converted back to CO_2, and released into the atmosphere. The rest is stored in living wood or dead matter, such as fallen leaves and branches. Old-growth forests, in particular, store vast amounts of carbon while continuing to absorb CO_2. —MOLLY WEBSTER

ILLUSTRATION BY MIEKE ROTH

This diagram provides helpful graphic detail. It was published in Feb. 2008 in "OnEarth" magazine of the **Natural Resources Defense Council** as a creativecommons.org item. You can access other useful pieces related to plant-environment relationships at www.onearth.org.

Estimating the CO_2 impact of an individual tree

What about the CO_2 and carbon-banking benefits of specific trees near our own homes and workplaces? These can be estimated with a web tool called the **National Tree Benefit Calculator** that the public can use without cost. It's at www.treebenefits.com/calculator, and also at www.arborday.org/calculator. The calculator was developed by the Davey Tree Expert Co. and Casey Trees in partnership with USDA Forest Service, university, and local tree researchers. It estimates other tree benefits too—air quality, energy, storm water, property value. It is being applied to community tree inventories and other official uses.

To use the Benefit Calculator, plug in your zip code (02840 for Newporters). Then, for a particular tree you have in mind, enter its species, its trunk diameter at breast height, and whether it helps to shade a building. The Calculator is geared to Windows software; if you have an Apple computer, special conversions may be needed to get it to work.

A refined version of the Tree Benefit Calculator has become available in 2011—**i-Tree Design**. If you'd like to try it, go to www.itreetools.org/design. Then enter your street address. A Google aerial photo of your neighborhood will pop up. On it mark the tree you have in mind and any building it helps to shade The result is a more exact estimate of environmental benefits.

For instance, suppose you live next to a large elegant European Beech tree that helps to shade your building. Plug in *European Beech*, *45" diameter*, and *residential*. The Calculator estimates that this Beech will reduce atmospheric carbon by 695 pounds this year. But it shows the tree "sequestering" (adding) little or nothing any more to the carbon already stored (banked) in its branches, trunk and roots. The energy used to keep this big old tree going (respiration) puts just about as much CO_2 back into the air as its photosynthesis removes.

The Benefits Calculator shows carbon benefits of this mature Beech to come mainly from indirect effects—CO_2 emissions "avoided." Foresters have found that the shade from a large tree like this can help a lot to reduce heating and air conditioning needs of nearby residences, especially if on the sunny sides. This in turn reduces CO_2 emissions from the power sources of that heating and cooling. Of course, much depends on how "clean" our Newport energy sources are.

Doing some "what ifs" with the Tree Benefit Calculator

You can use the Tree Benefit Calculator to guesstimate what the effects would be of having a younger tree. (See figure 1.) A more youthful Beech in the same situation—say with a 25-inch trunk—is judged to reduce more total atmospheric carbon annually (854 lbs.). It would provide somewhat less shade than the older Beech, but a Beech this size would be near the peak of its ability to sequester carbon. A young Beech—e.g., 5 inch diameter—would provide little shade and sequester little carbon; most of its energy would be going into growth.

Likewise, you can use the Calculator to guesstimate the eventual carbon effects of planting a tree other than a European Beech. Figure 2 compares several species of youngish trees with 12-inch trunks. The differences become even more striking as they mature.

Figure 1 Lbs of atmospheric carbon removed in a year by a European Beech tree of various sizes, if shading a residence, as estimated by the National Tree Benefit Calculator (beta)

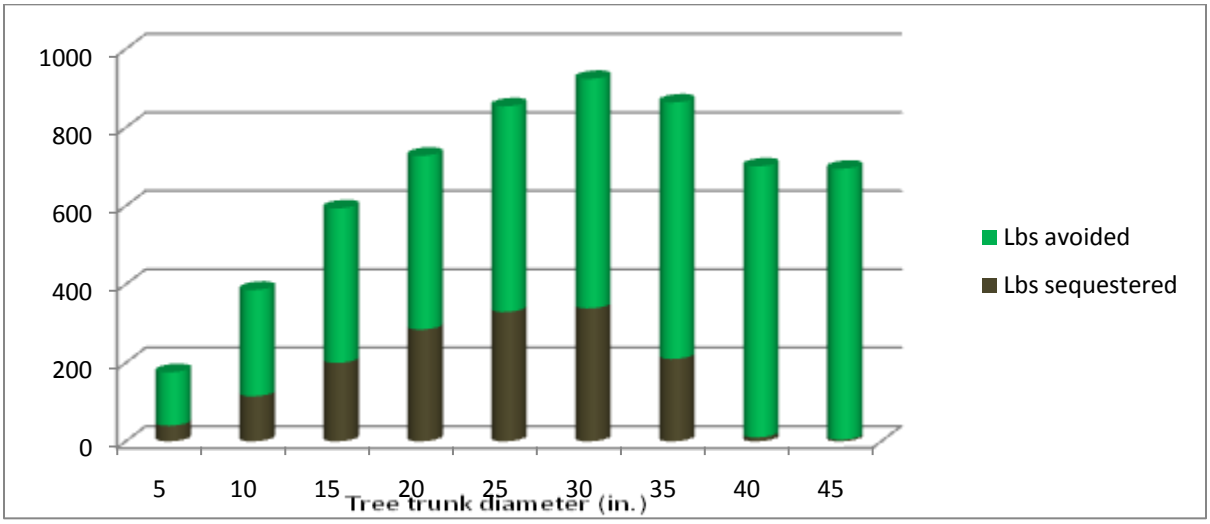
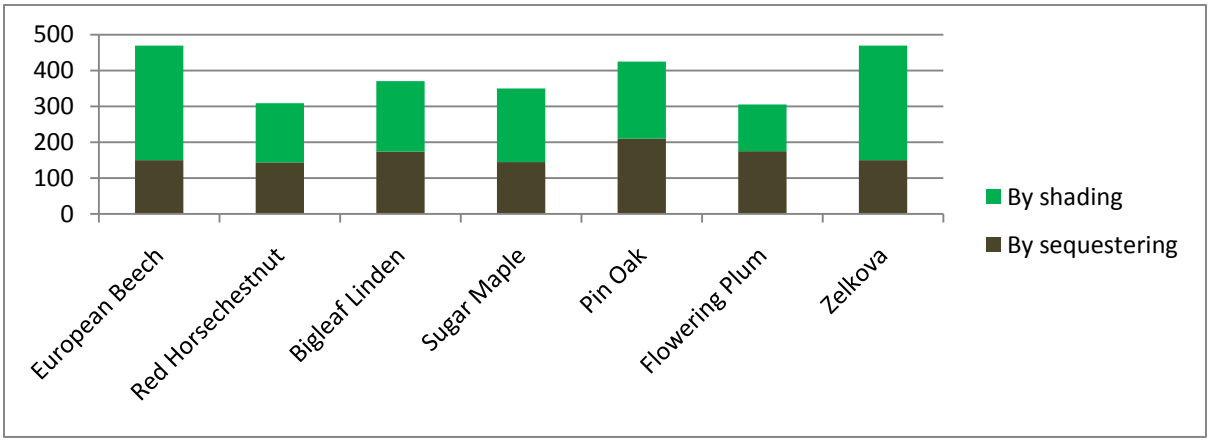


Figure 2 Lbs of atmospheric carbon removed in a year by a tree with a 12-inch diameter trunk, if shading a residence, as estimated by the National Tree Benefit Calculator (beta)



Using the Calculator to gauge other benefits of Newport trees

In this Bulletin, we have focused on carbon removal impacts, as carbon has been much in the public eye when discussing global warming. But the Calculator provides estimates of additional kinds of tree benefits—air quality improvements, energy savings, storm-water interception, and property value increases. In fact you'll see that, in terms of the dollar values placed on these benefits, most trees' carbon and CO_2 effects tend to be a rather modest part of the picture.

The Benefits Calculator is based on detailed study results for a sample of cities, adapted to traits of major U.S. regions. The tree benefit estimates may not fit some Newport settings too well. And, when considering how long to keep an old tree and which species to replace it with, environmental impacts may not be the only key consideration. E.g., it seems important to sustain the unique vistas provided by European beeches and other magnificent species along Bellevue Avenue and other streets that are part of the new series of "Newport Arboretum" tree walks. Other considerations may well be proneness to damage from storms and serious tree pests. Still, many Newporters want to take environmental impacts into account. The Calculator provides a good starting point for assessing tree retention, replacement and location options on our particular properties and nearby public areas.

The dollar benefits stem from studies of tree ecological relationships in a number of U.S. cities. They reflect estimated "externality values"—e.g.,, how much more the public would be paying for health costs and drainage systems if those trees weren't there to reduce air pollution and storm-water flows.

For more detail, see E. Gregory McPherson et al., *Northeast Community Tree Guide: Benefits, Costs, and Strategic Planning* (USDA Forest Service General Technical Report PSW-GTR-202, Aug 2007). Available on line.

Various technical writings of Dr. David Nowak and colleagues at the Northern Research Station of the USDA Forest Service give an idea of the careful work that has gone into gauging and modeling the environmental effects of urban trees. This in turn has become the main basis for the National Tree Benefit Calculator and the new Version 4 set of "i-Tree" online tools. For a recent overview, see David J. Nowak et al., *Sustaining America's Urban Trees and Forests* (USDA Forest Service GTR-NRS-62, 2010).

The larger view is that our urban forest is helping the atmosphere a lot, but Newport has need and space for more trees

Newport doesn't have an up-to-date tree inventory for both public and private holdings. But satellite imaging, digitalized overlay maps and census data can be meshed with local information to provide a general picture of our trees as a land-cover component. The 2008 USDA Forest Service publication, ***Urban and Community Forests of New England*** (GTR-NRS-38), by David J. Nowak and Eric J. Greenfield, provides information of this kind. This report, along with maps and data for Rhode Island, can be downloaded via www.nrs.fs.us/pubs/19199. It shows how the benefits of urban trees in Rhode Island can really add up:

If you're nimble with computers and have download capacity and patience, try to use **i-Tree Vue,** www.itreetools.org/vue. It can provide land-cover and tree-canopy facts for specific areas in Newport or other places of special interest to you.

- In 2000, 37% of RI's land was classified as urban; 91% of RI's people lived in those urban areas.
- 34% of that urban land had tree canopy cover—that's like each urban Rhode Islander benefitting from a tree canopy nearly 70 feet in diameter.
- The Nowak team estimated that these urban RI trees had stored about $68.4 million worth of carbon (were sequestering $2.3 million/year), and were removing about $19.6 million of air pollutants a year (O_3, particulate matter, NO_2, SO_2 & CO).

However, GTR-NRS-38 shows also that we could be rejuvenating and adding to our urban forest. Even with all the elegant grounds and trees that we have, Newport has not been one of the places in RI with large coverage of dense tree canopies:

	Rhode Island	All RI urban land	City of Newport
% of the land that was "impervious" (mostly built-up or barren) in 2000	13	30	39
% of the land that was "green space" (mostly residential grounds & open areas with plant cover) in 2000	87	70	61
% of green space with dense tree canopy cover in 2000	62	48	24

In sum, trees in Newport, Rhode Island, can be important in reducing, or at least delaying, emissions of carbon and other unwanted gasses—especially if they are placed to help shade buildings … and we use "greener" tree and soil-care practices … and we don't let old leaves and woody materials go to waste. This won't replace steps we can take to reduce emissions from fossil fuels—less car gasoline use, more energy-efficient devices, better home insulation, etc. But we have plenty of spaces for new trees, and need to replace those in serious old-age decline, even while preserving the tree-lined, grassy, and seaside vistas that Newport is famous for. Young trees needn't cost much to establish, and they provide much joy and learning as they grow. Trees are not just for our elegant estates, parks and avenues. If every neighborhood plants and nurtures more young trees each year, we can reverse the trend for Newport's "urban forest" to be old, in decline, and not good at banking carbon and providing shade. We owe it to our next generations! In turn, you younger readers of this bulletin can be part of new knowledge and action frontiers in your own decades. Exciting careers are to be found in realms of urban forestry, soil science, ecology, "green" care of plants and grounds, and reducing fossil fuel use and environmental damage. Besides USDA Forest Service urban work (especially www.itreetools.org and www.unri.org), you can learn much from:

www.cityofnewport.com *>departments>public services>trees* has information about tree care, our City Street Tree Planting Program, our Tree & Open Space Commission, and other tree and park work.

www.newporttreesociety.org and www.newportarboretum.org have information about newly mobilized tree walks, other Newport Tree Society initiatives, and links to technical sites about trees.

www.ritree.org tells about tree steward training opportunities, tree improvement programs elsewhere in Rhode Island, tree pest problems to be alert for, Arbor Day events, and RI Tree Council involvements.

www.treesaregood.org provides professional information from the International Society of Arboriculture, including fun facts and links for kids.