

## Trees: The Carbon Storage Experts

The heat is on. Global warming has speeded up, yet debates continue about the best way to slow the increase of carbon dioxide that is trapping heat in the Earth's atmosphere. Carbon needs to be pulled out of the atmosphere and put into long-term storage elsewhere. This process is called carbon sequestration, and high-technology ways to accomplish it are being explored worldwide.

However we don't have to wait for high tech sequestration. We can increase carbon sequestration now by working with some experts. They're called trees, and they have almost 350 million years' experience in sequestering carbon. Trees, like other green plants, use photosynthesis to convert carbon dioxide (CO<sub>2</sub>) into sugar, cellulose and other carbon-containing carbohydrates that they use for food and growth. Trees are unique in their ability to lock up large amounts of carbon in their wood, and continue to add carbon as they grow. Although forests do release some CO<sub>2</sub> from natural processes such as decay and respiration, a healthy forest typically stores carbon at a greater rate than it releases carbon.



*One half the dry weight of wood is carbon.*

The actual rate of carbon sequestration will vary with species, climate and site, but in general, younger and faster growing forests have higher annual sequestration rates. Considering that one half of the weight of dried wood is carbon, trees in a forest hold a lot of carbon. When the enormous amount of carbon stored in forest soils is added to the trees' carbon, it becomes obvious that forests are major carbon storage reservoirs.

The main strategies for using forests for carbon sequestration are listed below in order of their potential for carbon sequestration in New York:

- **Active forest management** - enhancing forest growth through sustainable forestry
- **Avoided deforestation** - reducing the loss of forested land by promoting smart growth and less sprawl.
- **Forest preservation** - leaving forests undisturbed as is done in the 3 million acres of the Adirondack and Catskill Forest Preserve.
- **Afforestation** - adding forest to previously unforested land, as was done on State Forest land during the Great Depression .

### Active Forest Management

Working forests are a critical component of a sustainable future for New York State. They reduce atmospheric CO<sub>2</sub> by carbon sequestration, and they produce wood products and alternative energy. Although it may seem counterintuitive to manage a forest for both carbon sequestration and energy production, it can be done with New York's abundant post-agricultural forests. Many people do not realize how fast trees can grow in New York's climate. An abandoned farm field can be covered with a forest of good-sized trees within 50 years. Proper management of these second and third growth forests for wood products and energy production actually enhances their ability to sequester carbon by enabling the remaining trees to grow more vigorously. By mimicking the effects of natural forest events such as fire and windstorms that create beneficial openings, timber harvesting can be used to open crowded canopies and encourage the growth of specific species such as oaks.

Active forest management enhances a forest's carbon sequestration capacity by keeping the trees healthy and promoting vigorous growth. Strong healthy trees are more resistant to pests and diseases, and may also be better able to adapt to the stresses of a changing climate and are growing more vigorously and sequestering more carbon.

DEC has more than 760,000 acres of State Forests which are managed for timber production, as well as for wildlife

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habitat, recreation and biodiversity.

More than 62% of New York State is forest land, which amounts to 18.6 million acres, or 29,000 square miles, of land covered by trees. More than 80%, 14.8 million acres, is privately owned. About 1 million acres of this is industrial forest land owned by large timber or investment companies and actively managed for timber production.

To encourage sustainability of non-industrial private forest land, New York's Forest Stewardship Initiative helps private landowners develop forest management plans. The Forest Tax law provides incentives for managed forest lands. Many landowners have worked with Department of Environmental Conservation (DEC) Lands & Forest's Private Forest Management staff to develop management plans for their land. Almost 2 million acres of private forest land is managed under the Forest Stewardship Program and about 650,000 acres are covered by the Forest Tax Law program. But there are more than 10 million acres of private forest land outside these programs. Much of this land is left un-managed, but could contribute significant carbon sequestration under active forest management.

## Avoided Deforestation

Significant land disturbance is a major source of CO<sub>2</sub> emissions. Human disturbance has much more impact on forests than natural disturbances such as fires or hurricanes. When forested land is converted to agriculture or development, soils are typically ploughed, graded, compacted or excavated, and then often left exposed to erosion. Natural disturbances, other than landslides, rarely cause deep damage to soil structure. Some of the CO<sub>2</sub> given off from forest disturbance comes from decay, but the biggest source is from the disturbed soil. Although they accumulate carbon much more slowly than trees, forest soils ultimately become storehouses for enormous amounts of carbon, over twice as much as is stored in the wood of the trees.

When forest soils are disturbed, they can lose carbon rapidly from the fast decay of organic material. In parts of the Pacific Northwest, a clear-cut replanted with conifer seedlings can continue to emit CO<sub>2</sub> for as long as 20 years. Even though the young trees are sequestering carbon, the accelerated rate of soil decay caused by disturbance gives off carbon at a higher rate than the young trees can take up.

While some land must be cleared in order to build, too often everything is stripped off leaving only bare soil. Although it is possible to save many mature trees during development, it is cheaper to get the trees out of the way by stripping the site. A land use study of upstate New York showed a 30 % increase in land development between 1982 and 1997, but only a 2.6 % growth in population during the same period. The study was appropriately titled *Sprawl Without Growth*.

There is ultimately a high price for poor development practices, a price that ends up being paid for by the community and taxpayers rather than the developer. Once the trees are gone, the many benefits, or ecosystem services, which they provided, are also gone. These benefits include reduced storm run-off, clean water, clean air and natural cooling, as well as carbon sequestration. The adverse impacts of the cleared land include increased run-off, which can overload stormwater systems, soil erosion, water pollution, and, of course, adding more CO<sub>2</sub> to the atmosphere.

Saving trees and planting additional trees are vital for water resource management alone, but along with the use of Smart Growth and green infrastructure for developments, could ultimately lead to better communities where trees can make a much greater contribution to improving the environment.

## Forest Preservation

One forest-based carbon sequestration strategy is to preserve forests in their natural state, as has been done in the Adirondack and Catskill Forest Preserve. These forests will never be actively managed or cut. These mature late succession forests hold vast amounts of carbon in their wood, and even more in their undisturbed organic soils. They may sequester carbon at lower rates than do managed forests with younger trees, because older trees usually grow more slowly. In un-managed forests, only natural disturbances such as storms and fire, will provide clearings where young trees can get enough sun for rapid growth. Although mature trees which generally dominate undisturbed forests don't grow as fast as young trees, they too can take advantage of the added light from natural clearings. Depending on the species, even mature trees can put on surprising growth spurts under favorable conditions.

The forests of New York's Forest Preserve lands, State Unique Areas, State Parks and other protected lands, represent substantial carbon reservoirs, particularly in their soils. They are also vital for water quality, biodiversity, wildlife habitat, preservation of very old forests, and as genetic reservoirs for the future.

## Afforestation

Since the mid-nineteenth century, New York, along with most of the Northeastern states, has undergone major afforestation as millions of acres of abandoned farmland, which were covered with forest in pre-colonial times, have reverted back to forest. Consequently there are relatively limited opportunities for new, large scale additions of forest

cover.

The largest potential for adding forest cover is probably in urban areas. Although urban forests may not be as effective at sequestering carbon as managed forests, they do have some sequestration capacity. However, their bigger role in greenhouse gas reduction is reducing energy used for air conditioning. Trees provide both shade and evaporative cooling which helps reduce the temperature both inside and outside a building. Increasing the amount of urban forest goes beyond just planting additional trees. The use of vines for green walls provides many of the same benefits in places where there may not be room for shade trees. Studies have shown that many plants, such as fast-growing vines, respond dramatically to higher levels of CO2 by growing faster and taking up CO2 at an increased rate.

Greater use of plants in cities not only helps save energy, but also benefits human health by improving air quality. Trees are effective at capturing particulate pollution from the air and also help lower concentrations of other air pollutants such as ozone and nitrous oxide. Trees and other plants help reduce excess runoff and water pollution by capturing and filtering stormwater. Adding green to a city can also produce direct economic benefits, such as increased tourism, and also job creation in plant-based industries, such as green roof installation.

## Forests Are Truly a Green Way to Reduce CO2

Increasing the carbon sequestration capacity of New York's forests can be started now. DEC is working on policies and programs to encourage wider use of these strategies to increase forest carbon sequestration:

- Promote stewardship of private forest lands.
- Reduce unnecessary deforestation.
- Add forest, especially in urban areas.
- Increase the use of sustainable forest management.

The costs are comparatively low, and there are minimal environmental impacts. But the biggest advantage of increasing forests for carbon sequestration capacity is that there are so many environmental benefits from forests that it would be worth increasing them anyway - even if they weren't so effective at sequestering carbon.

Although forests alone can't sequester all of the excess carbon added by burning fossil fuels, they can make a difference, especially if we help and encourage them. Wisely managed forests can sequester carbon and also provide a sustainable source of fuel and lumber, help clean our air and water, preserve wildlife habitat, provide recreation opportunities and preserve the beauty of trees in their natural home for generations to come.

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