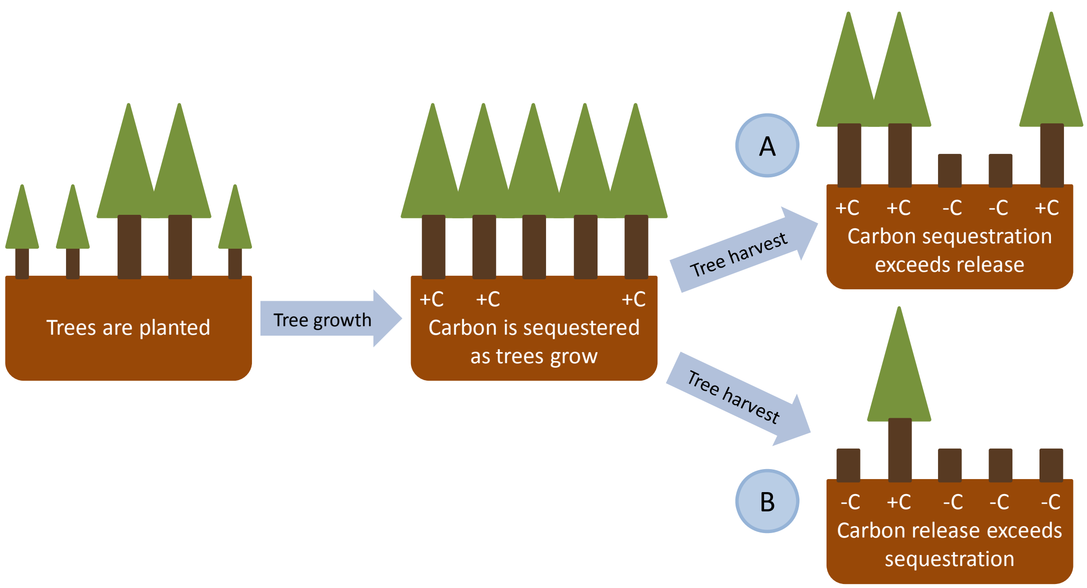
Forest Carbon Storage in EPA's Waste Reduction Model

Storage of carbon in forests is one of the greenhouse gas (GHG) emission offsets and sinks modeled by EPA's Waste Reduction Model (WARM) as for recycling or source reducing paper and wood products. When paper and wood products are recovered for recycling (i.e., remanufactured into new materials or secondary products) or source reduced (i.e., any practice that changes the design, manufacture, purchase, or use of materials such that less of the source material is used and less enters the waste collection and disposal system), trees that would otherwise be harvested are left standing in forests. In the short term, this reduction in harvesting results in avoided GHG emissions through storage of carbon in forests.

How Does Forest Carbon Storage Work?

Forests absorb carbon dioxide (CO_2) from the atmosphere and sequester it in the form of cellulose (the chief constituent of all plant tissues and fibers) and other materials as they grow. Trees naturally release carbon throughout their life cycle as they shed leaves, branches, nuts, fruit, and other materials, which then decay; carbon is also released when trees are cleared and processed or burned. When the rate of tree growth for a given amount of trees in forests exceeds the rate of tree harvest and decay (scenario A below), carbon is stored. Conversely, when a given amount of trees in forests is harvested, or the rate of tree decay exceeds the rate of tree growth (scenario B below), carbon is released.



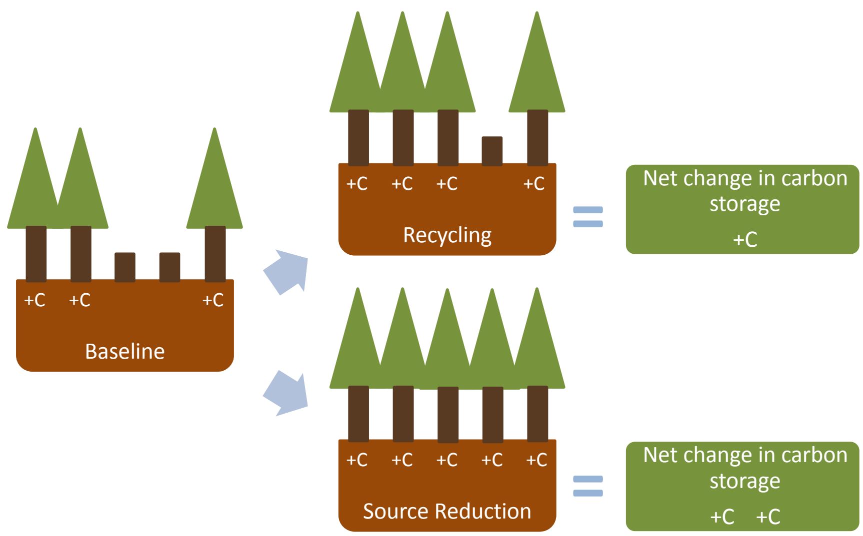
Why is Forest Carbon Storage Modeled in WARM?

In the United States, forest growth has long exceeded harvest and decay (scenario A above). This is influenced by yield-sustaining forest management activities and the reforestation of previously cleared areas. EPA estimated that the annual net carbon flux (i.e., the excess of carbon sequestration from tree growth minus carbon loss due to harvest and decay) in U.S. forests was about 792 million metric tons of carbon dioxide equivalent (MTCO2E) in 2008, offsetting about 13 percent of U.S. energy-related CO_2 emissions. Clearly, forests already store a large amount of carbon each year due to current forest management techniques. When paper and wood products are recycled or source reduced, however, less planted trees need to be harvested from forests, which increases net forest carbon storage even further than current levels. Modeling the linkage between recycling, source reduction, and forest carbon storage in WARM for paper and wood products captures the *additional* benefits that source reduction and recycling have on forest carbon storage, above and beyond the substantial GHG sink that forests already provide in the United States.

Modeling Forest Carbon Sequestration in WARM

WARM adopts a "waste management" perspective in that its life-cycle boundaries start at the point of waste generation (i.e., the moment a product such as paper or dimensional lumber reaches end-of-life), and examines the resulting life-cycle GHG implications of alternative material management pathways relative to a baseline waste management scenario. WARM evaluates forest carbon storage implications for all wood and paper products including corrugated containers, magazines/third-class mail, newspaper, office paper, phonebooks, and textbooks, dimensional lumber, medium-density fiberboard, and hardwood flooring.

To estimate forest carbon storage, EPA first assesses the amount of wood that would have been harvested from the forests to meet current paper or wood product demands. This establishes a baseline of wood harvests. Next, EPA examines how increased recycling or source reduction practices would reduce the demand for wood harvests (by avoiding or reducing the use of virgin wood used in paper and wood products) relative to this baseline. When paper and wood products are recycled or the production of these materials is avoided through source reduction, trees that would otherwise be harvested are left standing in forests. The net increase in forest carbon storage from recycling or source reduction is equal to the additional amount of carbon contained in wood that is not harvested as a result of increased recycling or source reduction. The figure below displays this approach in a simplified fashion.



Conclusion

The inclusion of forest carbon storage allows WARM to more accurately model the carbon flows and emissions that occur for recycled and source reduced materials from a life-cycle perspective; however, it is important to remember that the forest carbon storage factor represents one component of the net emissions associated with recycling or source reducing materials across their life cycle. Other factors, such as process energy and transportation also contribute to the net life-cycle emissions. However, the forest carbon storage factor is the largest share of the GHG benefit for recycling or source reducing paper and wood products in the model. By considering the GHG benefits of forest carbon storage, WARM provides a more complete estimate of the GHG emissions associated with different waste management options from a life-cycle perspective.