Modeling Reuse in EPA's Waste Reduction Model

Reuse of materials or products is a form of source reduction that can be modeled in EPA's Waste Reduction Model (WARM) using the "source reduction" alternate pathway along with a few additional steps. Source Reduction refers to any change in the design, manufacture, purchase, or use of materials or products (including packaging) that reduces the amount of material entering the waste collection and disposal system. Source reduction and reuse conserve resources and reduce pollution, including greenhouse gas (GHG) emissions that contribute to global warming. Reusing an item reduces the need for new materials and delays or prevents materials from entering the waste stream.

Examples of **Reuse** include:

- Reusing a plastic crate twenty times before recycling it
- Donating a personal computer to a school program or non-profit organization for continued use
- Reusing a cardboard box one time before recycling it

Modeling Reuse in WARM

The total number of times a material or product is reused influences the benefits accrued from reuse. The energy and GHG results from modeling in WARM indicate life-cycle benefits from avoided upstream manufacture of new material plus the avoided downstream disposal emissions of one use.

Users can estimate the GHG and energy benefits of reuse by following these steps:

1. Run WARM using a baseline scenario of recycling, landfilling, combustion, or composting and an alternate waste management scenario of source reduction. The choice of the baseline pathway depends upon the original fate of the material. For example, if the item was originally destined for a landfill and now will be reused, the baseline scenario is landfilling.

2. If using the Excel version of WARM, select whether the material that is reused is manufactured from 100% virgin inputs or the current mix of virgin and recycled inputs. The default choice for this option is current mix of inputs. Selecting manufacture from 100% virgin inputs will result in an upper bound estimate of the benefits from reuse. Note that this option is not available in the web-based version of WARM, which uses the default of the current mix.

3. Multiply the energy and GHG emissions reduction result ("Total Change in GHG Emissions") by the number of times the material is reused. This reuse number should equal one less than the number of total uses to account for the production of the initial material.

The following formula summarizes this basic methodology for reuse:

$$GHG\ Benefits\ of\ Reuse = (N - 1) \times (A)$$

Where,

N = Number of total uses
A = GHG benefits of the source reduction ("Total Change in GHG Emissions")

Example Application

To illustrate the application of this approach, consider reusable HDPE plastic crates, weighing 1,000 tons total, used for transporting bread to a grocery store. Assume that the crates are each used 20 times before wearing out, and are subsequently recycled. In order to calculate the GHG benefits of reusing the crates, run WARM using a baseline of recycling 1,000 tons HDPE and an alternate scenario of source reducing 1,000 tons HDPE. Under the upper bound scenario of 100% virgin inputs, this calculation indicates that source reducing 1,000 tons HDPE results in a net emissions reduction of 583 metric tons of carbon dioxide equivalent ($MTCO_2E$) relative to the baseline recycling scenario. Under the more conservative scenario of the current mix of inputs, source reducing 1,000 tons HDPE results in a net emissions reduction of 403 $MTCO_2E$ relative to the baseline recycling scenario.

Next, multiply the GHG benefits by 19 (20 total uses – 1 original use). In equation form:

GHG Benefits of Reuse = 19 × (source reduction of 1,000 tons HDPE – recycling of 1,000 tons HDPE)

100% virgin inputs (upper bound for reductions):
GHG Benefits of Reuse = 19 × (583 $MTCO_2E$*) = 11,077* $MTCO_2E$

Current mix of inputs (conservative estimate):
GHG Benefits of Reuse = 19 × (403 $MTCO_2E$*) = 7,657* $MTCO_2E$

A similar methodology can be used to calculate the relative GHG benefits of reuse under different baseline conditions. For example, to calculate the relative benefits of (a) reusing the HDPE crate when the baseline is recycling versus (b) reusing the HDPE crate when the baseline is landfilling, the user would run each of these scenarios using the methodology above and then subtract the results to obtain relative GHG benefits. These calculations show that reusing 1,000 tons HDPE 20 times (as above), when the baseline is landfilling rather than recycling results in additional reductions of 27,379 $MTCO_2E$. Thus, the relative GHG benefits of reusing items that are destined for landfills are much higher than reusing items that are recycled at end-of-life. However, in both cases, reuse provides significant GHG benefits.

Limitations

The approach described here does not consider the durability of materials and products. Depending on the type of material and how the material is used, there is a limit on the number of times a material can be reused. It is important to consider durability when modeling reuse.