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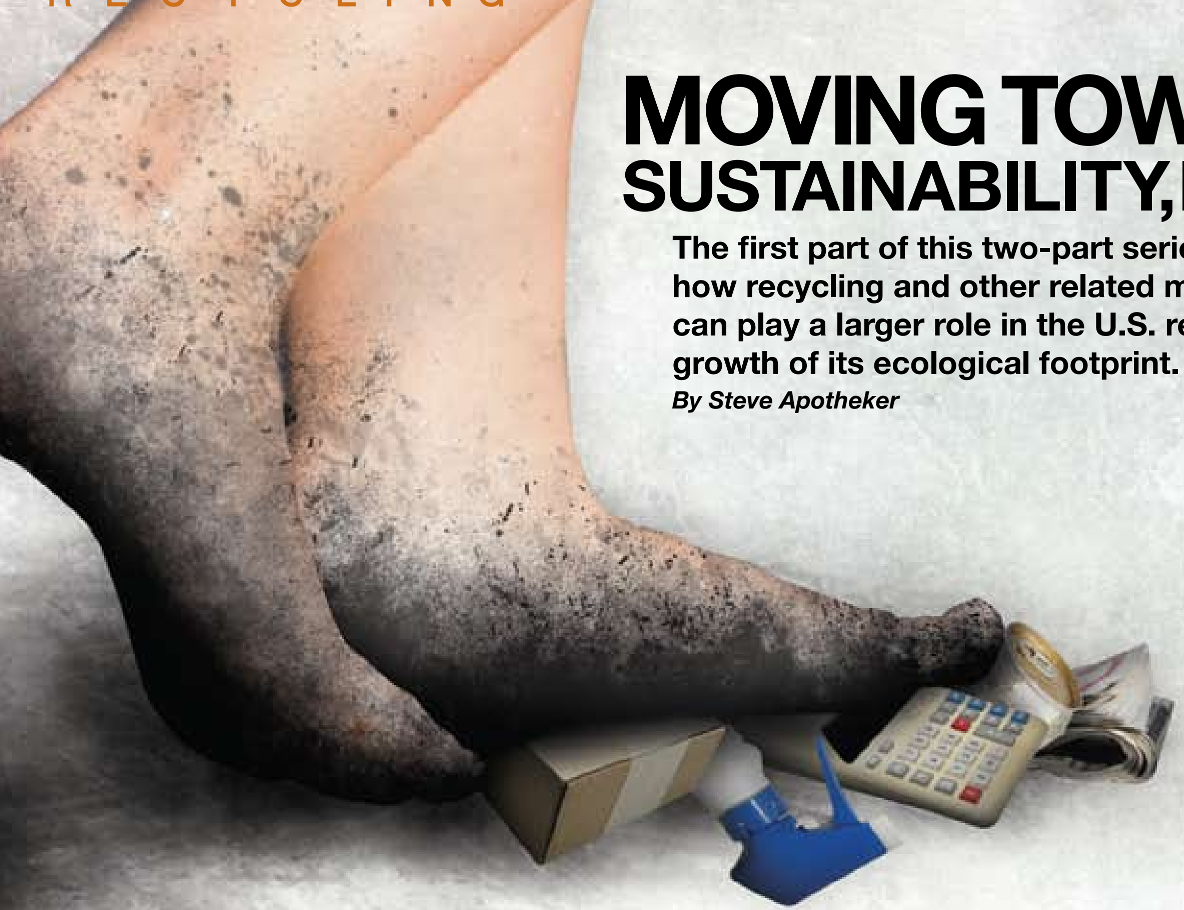

MOVING TOWARD SUSTAINABILITY, PART 1

The first part of this two-part series addresses how recycling and other related material policies can play a larger role in the U.S. reversing the growth of its ecological footprint.

By Steve Apotheker

Although the U.S. rate of recycling has increased in the last 47 years, it has not kept the U.S. ecological footprint from increasing in this period, albeit slowly in the last five years. The footprint measures the land needed to supply one person with resources and to absorb their carbon wastes.

The recycling rate in the U.S. grew from 1960 to 1980, increasing from 6.4 percent to 9.6 percent. In the next 20 years, the recycling rate more than tripled, reaching 29 percent in 2000. In this decade, the national recycling rate has increased to as much as 33.4 percent (2007). The growth of the recycling rate in this decade may not equal its growth in the heyday of the 1990s, but it is on a par with the 6.6 percentage-point jump in the 1980s (the second highest increase for a decade).

But, while recycling grew, the U.S. used more resources. The Global Footprint Network (GFN) reports that the U.S. footprint more than doubled from 1960 to 1980, from slightly over five global hectares (GHA) per person to over nine GHA (one hectare equals 2.471 acres). From 1980 to 2000, the footprint fell to eight GHA before increasing to about nine GHA. And, from 2000 to 2005, the U.S. footprint increased, slowly but steadily, to 9.4 GHA per person, or the second biggest footprint in the world.

By comparison, GFN calculates a sustainable footprint would have been 2.1 global hectares per person in 2005 where only one planet was needed to supply the resources and absorb the carbon wastes. If everyone on Earth lived the American lifestyle, the Footprint would take almost five Earths to do these things.

The flip side of the footprint's measure of demand is the biocapacity, which expresses the supply side of biological capacity. Eight countries account for about half of the world's biocapacity. The U.S. has more than twice the biocapacity of a sustainable world. Despite this abundance, three countries are debtor nations, including the U.S. – the U.S. footprint is twice as large as its biocapacity.

Certainly, without recycling, the U.S. footprint would be even greater than it is now. Could recycling, or another materials policy, play a larger role in decreasing the size of the U.S. footprint? Here are four recommendations for how this might be accomplished.

Restoring credibility to recycling

The first recommendation is to restore credibility to recycling. People are willing to pay more in their garbage bill because of the greater environmental benefits from recycling than landfilling. However, the environmental benefits attributed to recycling are increasingly overstated.

Post-consumer discards can either substitute for virgin materials in the manufacturing of new products or be used with some processing, primarily to prevent disposal in the landfill. The first example is "recycling," while the second one is "diversion." The solid waste hierarchy (i.e., reduce, reuse, recycle, compost, waste-to-energy, landfill) labels them both as "recycling" because they keep discards from going to landfill. However, the two examples have very different values of their environmental benefits.

The importance of recycling's environmental benefits is easy

Table 1 | Recycling versus diversion for glass containers generated in the Metro wasteshed

		Recycling		Diversion		
Parameters		**Glass containers per ton**	**Glass containers total value ($)**	**Glass aggregate per ton**	**Glass aggregate total value ($)**	**Difference ($ per year)**
Tip fee cost		$18		$11		
Drop box (cubic yards)	20					
Load, tons	10					
Clean glass (hours)	3					
Glass cleaner ($ per hour)	18	$5		$5		
Load time with two-cublic-yard bucket (hours)	0.5					
Load wage ($ per hour)	$50	$3		$3		
Travel time from western Metro region (hours per round trip)(1)	0.75					
Travel time from eastern Metro region (hours per round trip)	2.5					
Travel cost ($ per hour)	$90	$23		$7		
Subtotal recycling processor cost (benefit) ($ per ton)		$48	$375,826	$26	$199,172	-$176,654
Subtotal aggregate cost (benefit) ($ per ton)	$12	$0	$0	-$12	-$93,180	-$93,180
Total economic cost (benefit) ($ per ton)		$48	$375,826	$14	$105,992	-$269,834
Environmental cost from MEBCalc (benefit) ($ per ton)(2)		-$61	-$473,665	-$2	-$15,530	$458,135
Net cost (benefit) ($ per ton)		-13	-$97,839	$12	$90,462	$188,301
Glass in 2008 sent to construction (tons per year)	7,765					

(1) The Metro region is the three-county wasteshed located in Portland, Oregon.
(2) MEBCalc stands for Measuring Environmental Benefits Calculator.
Source: Steve Apotheker, 2009.

to underestimate. Ten years ago, recycling was not mentioned by the Union of Concerned Scientists as one of the most effective environmental choices a consumer could make to reduce greenhouse gas emissions. However, in its September 2009 report, *Opportunities to Reduce Greenhouse Gas Emissions through Materials and Land Management Practices*, the U.S. Environmental Protection Agency used a lifecycle approach to attribute 42 percent of greenhouse gas emissions to the provision of goods and food, which represent a greater market share than either transportation or energy for heating buildings alone. In fact, California is proposing mandatory paper recycling as one strategy to reduce greenhouse gas emissions.

One common way to exaggerate recycling's environmental benefits comes when markets are only asked to report the scrap they buy. In the Metro region of Portland, Oregon, about 10 percent of the baled curbside commingled papers purchased by newspaper mills cannot be used to make newsprint and are disposed by the mill. The majority of true landfilled materials are curbside recyclables (see "Putting quality back into the recovery equation" in the April '06 issue of *Resource Recycling*). More accurate reporting would ask mills to divulge how much scrap makes it into a product, and not give local governments credit for what is disposed (Oregon does this).

Another distortion of these benefits comes when all the collections of a given material are assumed to have the same use. In the Metro region, one-third of the mixed-color glass containers have been diverted from the historical container and fiberglass markets in California to local uses as an aggregate substitute (Table 1). Including the value of environmental benefits can also result in a different outcome. For instance, a recycling processor in the western Metro region saves $177,000 per year when the glass containers are used locally as a substitute for aggregate. In addition, the owner of the landfill saves another $93,000 by not having to purchase 7,800 tons of aggregate. These companies save $270,000 per year on their economic bottom line.

However, the environmental benefits are very different for the two options. When new glass containers are made, the environmental value is $61 per ton (see MEBCalc sidebar). Avoided environmental costs are only $2 per ton when glass scrap is used as an aggregate substitute. This large spread illustrates the impact on the environmental values of different end uses – recycling versus diversion, respectively. The net cost to the public is $188,000 per year to use glass container scrap as aggregate, instead of replacing virgin resources to manufacture new glass containers. One value of MEBCalc, and similar tools, is that they are more nuanced than the waste hierarchy and can distinguish between diversion and recycling.

Finally, recycling rates can be inflated. The rates in some states (e.g., Oregon) include energy recovery for wastes that have been separated. While this method of utilization can provide some energy, it is much less than the energy saved by recycling. Virgin materials must be used to manufacture the combusted products. Also, if combustion takes place in an industrial boiler, there is often less health protection than that provided by a waste-to-energy plant. For example, from 1998 to 2008, the Metro region increased its recycling rate by one percentage point, but added 4.6 percentage points of energy recovery. However, combustion, unlike recycling, requires that virgin materials be mined. While the regional recovery rate increased in this period, it was mostly due to greater energy recovery.

Measuring environmental benefits can directly avoid their exaggeration when only a recycling rate is used. For a given recycling rate, there may be multiple values of environmental benefits, so the direction would be toward the optimal value. The waste hierarchy is unable to provide this direction because it cannot tell the difference between recycling and diversion. The measurement of environmental benefits ensures consistency between what is measured and why people recycle – the value of environmental benefits.

Measuring environmental benefits calculator (MEBCalc)

The measuring environmental benefits calculator (MEBCalc), developed by Dr. Jeffrey Morris of Sound Resource Management Group, computes the avoided environmental costs when one ton of scrap is substituted for one ton of virgin materials in the manufacturing process. It takes an input of materials and calculates an output of dollars of net environmental value. Most models use only one or two indicators, such as energy consumption or greenhouse gas emissions. MEBCalc's seven indicators are diverse, containing human and ecosystem health data, as well as data on acid rain and greenhouse gases.

Using 2007 Metro recovery data as inputs to MEBCalc, the value of the environmental benefits for the region was $155 million, or an average of $120 per ton recycled, composted or used for energy recovery. Excluding the 300,000 tons of wood, yard debris and tires that were source separated and combusted in industrial boilers and furnaces, the value of the environmental benefits for just recycling and composting increased to around $218 million, or $220 per ton. This increase is largely because the negative human and ecosystem health impacts of industrial combustion do not enter into this second calculation. A current rule-making process by the U.S. Environmental Protection Agency should result in cleaner air from these commercial and industrial boilers and furnaces, albeit more expensive recovery.

For more information about MEBCalc, contact Dr. Jeffrey Morris at jeff.morris@zerowaste.com.

Changing the model

The second recommendation is that changing the model will increase the supply of recyclable materials. The current model for most communities is the voluntary, or the opportunity, model. In this approach, recycling is as convenient as garbage, as there are numerous collection programs, education and outreach are pervasive, and, often, the cost of recycling is included with the garbage bill, thus recycling appears to be free.

However, the U.S. resource deficit is more than seven GHA per person. To demonstrate a commitment to future generations to reduce that resource debt, it is important to adopt a model that includes more responsibility. The stewardship model has that. This new model should result in more recyclables, and can eventually lead to zero-waste disposed.

Moving to a stewardship model does shift the major roles and responsibilities. Extended producer responsibility (EPR) defines the responsibilities of manufacturers to bear the collection costs of their obsolete products, and any associated packaging (see The modern bottle bill sidebar), to make sure their products are reusable or recyclable, meet the recycling targets set by government for their materials and, above all, to be transparent about what is happening. Direct take back may be preferred by producers if the primary products, such as consumer electronics, have a high economic value, infrequent generation or high toxicity. However, they wish to pay the cost of an existing collection program if the primary products have a low economic value, a daily or weekly generation and little or no toxicity.

Ontario, perhaps at the center of the stewardship debate in North America, presently has producers paying 50 percent of the curbside recycling system cost, though the Ministry of the Environment has proposed legislation to have producers pay 100 percent of the program cost (plan may be debated this summer). If this legislation is successful, the transition to producers paying the full cost would occur over the next five years.

The Liquor Control Board of Ontario perhaps sees the handwriting on the wall. The agency has already negotiated an agreement with the Beer Store to take their large glass bottles, primarily wine and liquor ones. This moves these bottles from curbside bins, freeing up some space, to the higher recovery rate of the deposit system operated by the Beer Store.

EPR is also a way to ensure market development. When a manufacturer talks to a mill about changes that could enable the mill to use more scrap, it can develop market demand more effectively when talking as a customer than if a government offers grants and loans to the mill. For one thing, there is less risk to the mill when a customer requests an increased use of a scrap feedstock, because that customer will have to use the finished product and the government may not.

Local governments are responsible for establishing performance standards and determining consequences for participants in the EPR recovery system, instead of being just an end-of-the-pipeline regulator. Also, they may work in state, regional or national coalitions to provide industry with consistent EPR goals, instead of acting locally to manage programs or provide a collection service. Just as producers and governments have increased responsibilities under the stewardship model, consumers have the responsibility to recycle their products. This increased consumer recycling acknowledges the seriousness of our commitment to future generations to

The modern bottle bill

Bottle bills were an early form of producer responsibility, and the mechanics have remained relatively unchanged. Consumers pay a deposit on the containers at the time of purchase. The deposit is returned by stores when the containers are returned for recycling. Distributors then take their containers back from the stores and refund the deposit on returned containers to the stores. Distributors often keep the unclaimed deposits or escheat.

Today, though, the scope of bottle bills have changed. Initial efforts targeted beer and soft drinks. Now, other single-serve beverages are sold, such as bottled water, juices, teas and sports drinks. When first passed, the bottle bill was seen by many as a way to reduce litter caused by the proliferation of single-use beverage containers that were likely to be thrown away. The litter issue is still important 30 years later; but, marine concerns have become more compelling, with fatal harm done to marine animals that mistake the plastic litter for food.

In recent years, the growing lack of resources in the U.S. has become a more pressing issue than litter. Since deposit systems get higher recycling rates than other collection programs, the modern bottle bill includes all beverage containers, such as liquor and wine. For example, wine bottles in Oregon achieved a respectable 69-percent recycling rate in curbside collection programs and are rarely littered items. But, if wine bottles were included in a bottle bill, they could achieve a 10 percentage point to 30 percentage point increase in recycling rates, which is significant when the U.S. has a large footprint of 9.4 global hectares per person.

One way that systems can become more efficient is to have one activity meet multiple policy objectives. A bottle bill is a good way to meet the high targets set by some states to reduce greenhouse gas emissions. In the U.S. Environmental Protection Agency's WAsteReduction-Model (WARM), recycling one ton of aluminum saves 13.7 metric tons of carbon (CO_2) equivalents, the greatest savings of any material in the model. Aluminum is also known as "solidified electricity" because of its high energy use. Recycling rates for aluminum beverage cans range between 80 percent to 95 percent in a deposit system. However, rates are at least one-third less for states without deposits. In contrast, other common bottle bill materials, such as polyethylene terephthalate (PET) and glass bottles, reduce greenhouse gases by 1.6 and 0.3 metric tons of CO_2 equivalents, respectively. Their impact is eight to 41 times less than aluminum.

In a modern bottle bill, manufacturers take responsibility not just for their beverage containers, but for all their beverage packaging. Beverage carrier stock contains a wet strength chemical that keeps the paperboard from being easily recycled by most paper mills. For a few cents per box, a recyclable alternative coating can be used. Without this recyclable alternative coating, it sends a mixed message to the public when beverage containers can be recycled, but the beverage carrier stock is disposed.

Further, refillables are integral to most bottle bills outside of the U.S., as they have not been included in U.S. deposit programs for decades. The refillable technology of the beverage companies was not available in the U.S. because grocery stores and their customers preferred the convenience of single-use packaging. However, refillable bottles can reduce resource use by as much as 80 percent, as claimed by Finland government officials. *Uncapping the Potential of Glass Packaging*, a June 2009 report prepared by consulting firm 4|R Sustainability for the non-profit Oregon Recycling Markets Development Corp., documents many of the economic benefits of using refillables that would accrue if craft brewers in Oregon were to go to a refillable system for their beer bottles. While older studies document the environmental benefits of refillables, a more recent life-cycle analysis is needed to determine whether lightweight single-use containers or multi-trip refillables are better for the environment in the U.S.

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reduce the large resource debt.

In the stewardship model, the aspirational goal is zero-waste disposed. The last two options of the waste hierarchy are removed; no incineration (even with energy recovery) and no landfilling.

Zero-waste disposed is not impossible to achieve. Already, more than 44 percent of all generated discards in the Portland metropolitan region have "strong" markets that demand and use scrap. As a result, the scrap is collected municipally, banned from disposal or recovered at a 90-percent level (e.g., lead-acid batteries). Another 30 percent of generated discards are in the "needs improvement" category, with some non-technical change needed to balance collection and markets. For example, siting a local food scrap composting facility would move seven percentage points from the "needs improvement" category to the "strong market" one. About 26 percent of discards do not meet the zero-waste goal at present. More than half of this amount is wood.

Zero-waste disposed has a significant benefit over a 100-percent recycling rate goal. Recycling competes with waste prevention for the same tons of material, but zero waste does not. For example, home composting and curbside recycling collection programs may fight over the same tons of yard debris to make their program have a higher rate. However, both actions lead to a reduction in disposal. The stewardship model maintains freedom of choice; it is just moved farther upstream. People can choose whether or not to buy something; but, once they buy something, they have a responsibility to recycle it. A colleague of mine says, "To buy is optional, to recycle is not."

An illustration of the effectiveness of the stewardship responsibility for consumers to recycle is the City of Seattle. In 2005, the city made recycling mandatory for households and businesses. In 2006, program officials added fines, or refused waste pickups for generators, if inspectors found program recyclables made up 10 percent or more of garbage. From Seattle's data on the sampling of curbside recyclables and waste in 2002, under the opportunity model, the city was capturing an average of 78 percent of the commingled recyclables and the glass (Table 2). In 2006, under mandatory recycling, an average of 86 percent of the Emerald City's commingled recyclables and glass containers were captured by curbside, an improvement of eight percentage points. Seattle kept its costs down by providing households with rollcarts and every-other-week curbside collection.

By comparison, the Metro region, with an opportunity model and a weekly

Table 2 | Comparing Seattle's curbside recycling for opportunity (voluntary) and stewardship models, in tons(1)

Models(2)	Material	Recycling	Disposed	Generated	Recycling rate
Opportunity	Commingled (3)	48,493	13,595	62,088	78.1%
Opportunity	Glass	10,518	3,054	13,573	77.5%
2002 total		59,012	16,649	75,661	78.0%
Stewardship	Commingled	52,949	9,295	62,244	85.1%
Stewardship	Glass	11,997	1,465	13,461	89.1%
2006 total		64,946	10,759	75,705	85.8%

(1) Seattle provided every-other-week collection with glass separate from commingled recyclables, which were in a roll cart.
(2) Seattle's curbside program was voluntary in 2002 and stewardship one (with enforcement) in 2006.
(3) For comparative purposes, commingled comprises all recyclable paper, plastic bottles, aluminum cans and foil, and steel cans. This comparison does not agree with Seattle's on-line reports, which include other materials in their commingled recycling.
Source: Seattle recyclables and waste sampling reports, and recycling reports; Steve Apotheker, 2009.

collection standard for curbside households, experienced lower results. One of the best curbside recycling programs in the Metro region achieved an 80-percent capture rate for commingled recyclables from its households. While good, the rate was still five percentage points lower than Seattle's average commingled recycling rate. In 2008, that difference would have meant 5,000 more tons for the Metro region and a reduced collection frequency.

Tuning up recycling programs

The two recommendations offered this month maintain the scope of the traditional recycling programs. Progress can be made by measuring environmental benefits more accurately and adopting the stewardship model. The result is a larger supply of recyclables and less skepticism from the public that we are actually sending recyclables to markets.

Next month, the final two recommendations will indicate one way to expand the boundaries of traditional recycling programs. The objective is to make the U.S. footprint shrink to a sustainable size (i.e., 2.1 GHA per person in 2005). It is unlikely we can recycle our way out of this (unsustainable) mess. RR

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RESOURCE RECYCLING

MOVING TOWARD SUSTAINABILITY, PART 2

The final part of this two-part series details why we need to move from a recycle-only focus to one that addresses better management and sustainable use of resources.

By Steve Apotheker

Resource use in the U.S. is increasing, that we know. However, when one examines the nation's municipal recycling rate, as well as its ecological footprint, different stories are being told. For example, though the U.S. recycling rate has increased fivefold over a 45-year time span (presently at 33.2 percent), the nation's ecological footprint has doubled in this period, too (the footprint measures the land needed to provide the resources consumed by one person and to sequester their carbon wastes). Put plainly, even though use of recyclables has grown, so has the nation's use resources.

Four recommendations on strategies to reduce this resource use are offered. The first two recommendations, made in last month's issue of *Resource Recycling*, addressed how restoring credibility to recycling and changing from a voluntary/opportunity model to one of extended producer responsibility could play a role in decreasing the size of the U.S. footprint. The two recommendations provided this month go beyond the historic boundaries of recycling.

To reiterate, the first recommendation is to determine if the resource was being used effectively. The greatest resource effectiveness is usually associated with the greatest value of environmental savings. Just reporting the recycling rate for a material tends to exaggerate the environmental savings that would be more accurate if reported for a specific application or market. For example, the same recycling rate for glass is reported, whether it is used to make glass containers or to substitute for aggregate. However, the environmental benefits of each are very different. With glass-to-glass recycling, virgin materials are displaced by scrap in the manufacturing process for containers, while diversion to aggregate requires the mining of virgin raw materials for glass containers. So, the environmental value of using glass to make containers is 30-times greater than when glass is used to replace aggregate, according to the measuring environmental benefits calculator (MEBCalc).

The second recommendation is to change recycling models from an opportunity one of voluntary recycling to a stewardship model of responsibility. Under the stewardship model, manufacturers make their products and packaging to be reusable or recyclable, while consumers are required to recycle their purchases. The model change would result in a more recyclable discard stream and more recovered materials overall.

In both cases, greater accuracy in recycling, by stating the environmental benefits of specific uses and more recyclables from a model change, would make it more likely that virgin resources would be reduced. However, it is very unlikely that a recycling program alone will get us out of this unsustainable mess. As Albert Einstein once observed, "We can't solve problems by using the same kind of thinking we used when we created them." In this case, the underlying problem of growth cannot be offset by more recycling.

The two recommendations offered in this article limit this growth by managing resources, instead of discards, and using only a fair share of the world's resources to carry out this increase. These recommendations provide a different view of recycling and expand what it can accomplish. Hopefully, they will result in a smaller ecological footprint.

Manage the resources

The first recommendation is to manage the resources rather than focus on the discards. This has a number of implications for recycling and composting, of which four will be mentioned.

First, a broader definition of resources would count at least energy along with materials. Products and packaging, which comprise the majority of the items managed, use primarily materials and energy. Energy fashions the raw materials to a specific purpose. The combination of materials and energy use is a more accurate measure of the resources we use to support our lifestyle. Also, for the discards that are recycled, the average energy reduction might be two-thirds. The balance of the energy must be provided by another source. Hopefully, this new supply is one of renewable energy.

Second, resource use is more accurately measured at the point of consumption, rather than waiting until the material is discarded. Many resources never, or very slowly, become discards.

For example, the sewage treatment plant handles tissue and disposal food, so these items never become part of the discard stream. Also, some fiber is too short to make it through the paper recycling process and is screened out before becoming part of recyclable paper.

Renewable resources will always have some loss and need replacement by virgin materials. In the case of organics, such as food and yard debris, there is no replacement, so they must be regrown.

Also, construction and demolition materials (C&D) account for 20 percent to 30 percent of the post-consumer discards generated by households and businesses. Wood discards may only represent five percent to 10 percent of a new house's weight, but the bulk of this resource use, as much as 90 percent, goes directly into the new house. It may be decades before a remodeling or demolition project acknowledges this larger resource use.

Third, scrap from manufacturing (a.k.a. pre-consumer or post-industrial scrap) represents the equivalent of 10 percent to 20 percent of total post-consumer discards. It had not been defined as a municipal solid waste before and so was not addressed by the recycling manager. However, nature does not care about the difference between post-consumer discards and pre-consumer manufacturing scrap. It gives them the same environmental benefits. For the purpose of the U.S. ecological footprint, they are both eligible resources to use in a new product.

Including manufacturing scrap in the definition of "municipal solid waste" possibly offers more legal protection for this resource. The original assumption that all manufacturing scrap was being recycled is no longer true when one includes materials from the C&D substream. Clean manufacturing scrap may be suitable alternative daily cover, or some other beneficial use, but the environmental benefits are sharply reduced. If the definition of solid waste were revised to include manufacturing scrap, then these single-use diversion options would not be as easily available.

Fourth, municipal recycling managers shift their focus from managing discards to resources. Recycling savings, such as "recycling aluminum cans saves 95 percent of the energy" or "recycling one ton of paper saves 17 trees," are relative measures that tell the recycling manager how much better using discards are than virgin materials. However, the resource manager uses absolute measures to indicate all the materials and energy consumed by virgin and recycled products alike. Ironically, the recyclables with the greatest savings (e.g., aluminum cans) may not be the ones with greatest re-use potential (e.g., glass bottles).

Adopt sustainable resource use

The fourth recommendation is to attain sustainable use of resources. To meet this objective, current generations in the U.S. face the challenge of consuming no more than our "fair share" of the world's resources and providing that same quantity of resources to future generations.

In 2005, a fair share of the world's resources, or sustainable footprint, was 2.1 global hectares (GHA) per person, far below the 9.4 GHA attained by the U.S. footprint. However, as the global population increases, the size of the sustainable ecological footprint will shrink. This will make it more difficult to meet the challenge of reducing the U.S. footprint to a sustainable level.

One framework for achieving a sustainable use of resources is The Natural Step (see The Natural Step Framework sidebar on page 17). The Natural Step Framework (TNSF) consists of a definition of sustainability, which is provided by the four conditions, and a planning process, often called backcasting.

The first three conditions provide a definition of sustainability from an environmental perspective, and are rooted in science (i.e., ecosystem resources, energy and toxics). The fourth condition highlights the important socio-economic perspective of satisfying "needs" as opposed to "wants" (see Shortcomings of the waste hierarchy framework sidebar on page 16).

For more than a dozen years, the authors of *e Business Guide to Sustainability*, Darcy Hitchcock and Marsha Willard, have provided strategies and tools to organizations on how to become sustainable. According to authors' guide, "Natural Step system conditions must be embedded in your sustainability framework in some fashion. Otherwise, you are still working on being…less bad, and ignoring the undeniable limits of nature." Many of the existing frameworks provide principles or guidelines on how to be sustainable. However, they do not have measurable end-points like The Natural Step Framework.

Ecological footprint is a measure that is easily understood by the public. It remains to be seen if footprints specific to materials and energy use in products can be developed, especially on a sub-state level. The footprint uses federal data, which means the calculation process is completed in three-year increments. As such, the footprint is a lagging indicator for total resource use.

However, the TNSF provides goals, such as zero waste disposed, zero buildup of persistent, bio-accumulative toxics and all energy is renewable, with the goal to predict the direction of a sustainable material and energy use in products and packaging. These goals can provide leading indicators for reduced resource use.

One development that favors the footprint calculation is that more communities want to inventory their greenhouse gases (GHG). Greenhouse gas emissions comprise almost two-thirds of the U.S. footprint, and nearly half of all emissions come from a provision of materials and food when a lifecycle analysis is conducted.

Sustainably-managed ecosystems would reduce the time and cost of meeting a sustainability resource goal. Some ecosystems owned by state and federal governments could implement sustainable management criteria within a year. Their action might be motivated by the value of environmental benefits or because they operate collection programs. In any case, the more the ecosystem is affected, the more likely owners can justify the cost of change.

For example, paper only accounts for about one-third of the 15 billion cubic feet of logs produced annually in the U.S. More paper recycling would shrink this market share even further. However, dimensional wood and veneer from trees require half of the forest (i.e., fuel takes the remainder). And, adding construction materials to the resources managed would then account for as much as 85 percent of all forest logging processes. The owners of private woodlands and public forests are more likely to make changes to these forests because they receive a faster payback from the greater market share.

Further, consumers could choose products where the materials are manufactured from recycled materials or virgin sources – ideally, energy comes from a renewable source. For example, The European Union (EU) Ecolabel criteria

Shortcomings of the waste hierarchy framework

The waste hierarchy of the 3Rs has at least four limitations that The Natural Step Framework (TNSF) addresses.

First, the waste hierarchy focuses just on post-consumer discards, while the TNSF takes into account all materials, including virgin ones. Second, the waste hierarchy provides little advice on toxics, whereas the TNSF unifies the two. The TNSF prohibits the persistent buildup of bio-accumulative, toxics. Also, it does not allow toxicity (in a product) that systematically contributes to the loss of biodiversity or physical impoverishment of an ecosystem.

Third, the waste hierarchy is silent on energy. Conversely, the TNSF calls for the use of renewable energy sources that do not have to be mined from the earth, unlike fossil fuels.

Finally, the waste hierarchy sets up a competition between waste prevention and recycling. These two materials management strategies compete for the same materials. This competition is exacerbated by a recycling goal, but not a separate one for waste prevention. For example, prevention is advanced by more two-sided copies, but less office paper is produced for recycling collectors to meet their goal.

The Natural Step Framework

According to The Natural Step Framework, four conditions define sustainability. For our society to be considered sustainable, we must satisfy all four conditions, including:

- **Eliminate our contribution to the progressive buildup of substances extracted from the Earth's crust (e.g., heavy metals and fossil fuels)**
- **Eliminate our contribution to the progressive buildup of chemicals and compounds produced by society (e.g., dioxins, polychlorinated biphenyls and dichloro-diphenyl-trichloro-ethanes)**
- **Eliminate our contribution to the progressive physical degradation and destruction of nature and natural processes (e.g., overharvesting forests and paving over critical wildlife habitat)**
- **Eliminate our contribution to conditions that undermine people's capacity to meet their basic human needs (e.g., unsafe working conditions and not enough pay to live on).**

The first three conditions focus on environmental criteria of sustainability, while he fourth emphasizes the importance of the social dimension of sustainability, with attention to meeting the needs of people. Human needs are defined by Chilean economist Manfred Max-Neef as "subsistence, protection, affection, understanding, participation, leisure, creation, identity and freedom." These nine basic needs do not change over time or in different cultures.

The backcasting or ABCD planning process of developing a sustainable society consists of four steps, including:

- **Awareness – A common understanding of the problem, such as nature has limits that we are exceeding**
- **Baseline – An analysis of the data on where the organization is today**
- **Compelling vision – The sustainable end-point that the organization is trying to reach**
- **Down to action – The actions that bridge the gap from the organization of today to a sustainable one in the future.**

This is process is repeated until the organization reaches its sustainability vision.

For more information on The Natural Step, visit naturalstep.org.

for copy paper accepts wood fibers from 100-percent scrap paper, or virgin fiber taken from sustainably-managed forests, of which 10 percent should come from certified sources. EU Ecolabel criteria also states that GHGs generated from combusting fossil fuels must not exceed 1,000 kilograms per ton of paper produced.

Market prices could determine whether recyclable materials, or virgin materials taken from sustainable ecosystems, should be used; conventional ecosystems would not be an option. Government would then have the responsibility to set the standard that U.S. use of resources did not exceed its fair share of the world's resources.

Consumption is the common theme here

With the current recycling level affecting one-third of post-consumer discards, the four suggestions in this article would have a larger and faster impact on decreasing the U.S. ecological footprint. This includes:

- Valuing discards by the amount of environmental benefits provided by their end-use, not scrap type, is more accurate about resource utilization
- Adopting stewardship, or a responsibility, model would increase the stream of recyclable discards
- Managing resources rather than just discards
- Adopting a sustainability standard matches the right answer to the right question of consumption.

Without a more expanded strategy to resource use, recycling of discards alone is unlikely to reduce consumption levels measured by the U.S. footprint. Between 1995 and 2005, in the Portland, Oregon metropolitan region, recovery for recycling increased by almost one million tons; but, because generation also increased by a similar mark, the market share of recycling changed by only a few percentage points.

Recycling is a preferred strategy of manufacturers because they use less materials and energy when scrap is substituted for virgin resources. However, growth in recycling still consumes resources. The pertinent question is not what is saved by recycling, but what total resources are actually used by all products. With recycling's vision expanded to resource use then, hopefully, it will be more aligned with the U.S. footprint. The result might be a smaller ecological footprint, which would allow more material and energy resources to be available for future generations.

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