Behind the word “recycling” lies myriad issues that present an important challenge to organizations that have a stake in the responsible management of the end-of-life products. From adopting different metrics to measuring the success of recycling programs to an increasing demand for tailored solutions, recycling should not be looked at in a vacuum but as part of a larger system where costs and the release of greenhouse gases and toxics, among others, inhabit. We recognize the challenges of the ever-changing dynamics surrounding product stewardship, and we’ve commissioned the following White Paper with the interest of sharing the insights that stem from our 20 plus years of experience in battery stewardship.

- Carl Smith, president and CEO, Call2Recycle, Inc.

Shifting the Focus from End-of-Life Recycling to Continuous Product Lifecycles

By Betsy Dorn and Becky MacWhirter, RSE

When The Circular Economy May Not be Circular At All

We have a love affair with recycling. It is a highly visible, feel-good activity that is easy to take part in. Curbside programs and single-stream collection has increased the convenience level to an all-time high. It is the activity most people point to when asked what they can do for the environment. The result of this love affair is a one-dimensional focus on recycling and a pervasive assumption that higher recycling rates should always be the overarching goal. Pursued in isolation a single minded focus on recycling often fails to make meaningful distinctions between different recovery options or to consider other means by which a broader set of environmental outcomes might be realized.

Over the past decade, two broader materials management concepts have emerged that aim to change this. They represent a paradigm shift that challenges how we think about the products we create, how we use them and what we do with them when they’re no longer wanted.

Sustainable Materials Management (SMM) is concept number one. Primarily under discussion in the United States, SMM aims to broaden our mindset from one that is focused narrowly on managing waste at the end of the chain to one that considers the lifecycle impacts of a product or material with respect to all three pillars of sustainability: environment, economy and society. It calls for reduction where possible and calls on society to use and reuse materials more productively over their entire lifecycles, as shown in Figure 1 below, while minimizing toxicity and all associated environmental impacts.

Its emergence was driven by the increasing complexity and interrelatedness of environmental problems. In this new reality, tradeoffs are unavoidable. Evaluating different methods of managing materials must therefore take into account a much broader set of objectives to balance trade offs and avoid unintended consequences. A key question as this discussion unfolds will be what those objectives are and who ultimately is charged with decision-making.

The concept has its roots in a report published by the United States Environmental Protection Agency (EPA) in 2002 which called for a shift “away from waste management toward materials management.” The term gained more prominence when the EPA made it its focal point in the report ‘The Road Ahead’ in 2009 which led to the term’s use by the Oregon Department of Environmental Quality[i] and influential organizations like AMERIPEN, the National Recycling Coalition, GreenBlue and others. It should be noted that not all stakeholders define SMM in this way, which speaks to the need for a common language to foster constructive discussions.

Figure 1: The materials lifecycle
Image credit: Environmental Protection Agency

Circular Economy is the second. Popularized by the Ellen MacArthur Foundation, a circular economy replaces the ‘take-make-waste’ model with a restorative model that “aims to keep products, components and materials at their highest utility and value, at all times” and “decouples economic growth and development from the consumption of finite resources through reuse, repair, refurbishment and recycling.”[ii]

Circular Economy (CE) and Sustainable Materials Management (SMM) concepts are overlapping. They both strive to preserve natural capital by making better use of resources. What distinguishes the two concepts is the emphasis in the CE dialogue on the role of companies in creating restorative economic systems that keep materials in a constant loop of production, as shown in Figure 2 below. SMM, on the other hand, emphasizes the role of government working in partnership with others to achieve economic, social and environmental goals and creating solutions that optimize all three areas.

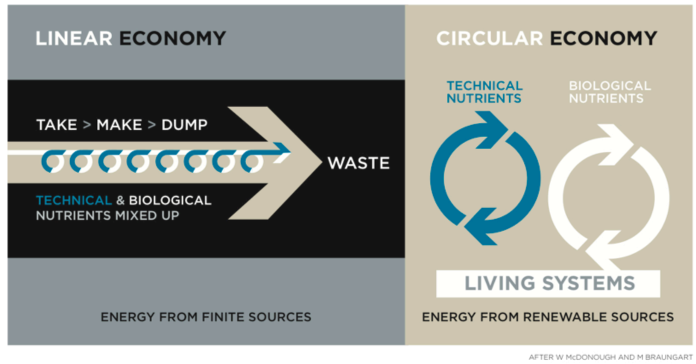

Figure 2: ALTERNATIVE: Moving from a Linear to a Circular Economy
Image credit: Ellen MacArthur Foundation

CE is a widely-used concept in Europe and is at the center of the European Commission’s waste management and green growth strategy as a means to create synergies between previously disconnected policy arenas.[iii] In North America, Circular Economy is the term du jour in corporate circles, perhaps given its relevancy to major multi-national companies participating in the CE 100 network. The SMM agenda is in its infancy in the US and is being driven by government at both the state and federal levels and to a lesser extent by the NGO community. This will likely evolve as government looks to the private sector to play a role in the SMM arena, both with respect to end-of-life (EOL) but also with respect to materials management via “front end” strategies.

A Broader View

These two concepts have broadened the conversation about waste management and prompted us to re-examine our priorities and confront our biases. One such bias is the tendency to focus on recycling above all else and view all forms of recycling as inherently equal. This has resulted in policies that reward higher and higher recycling rates despite the impact that pursuit may have on cost, the release of greenhouse gases and toxics, and other considerations.

Incentives designed to reward recycling place a normative value on recycling above other qualities that may have a more beneficial impact at a different stage of the product lifecycle. For instance, packaging Producer Responsibility Organizations (PROs) in Europe are considering fee structures that reward and penalize producers based on package design and ease of recycling (and thereby cost[iv]). Eco-Emballages, the PRO for packaging in France, has already implemented such an approach. This is logical from the perspective of a PRO whose mandate it is to take responsibility for the end-of-life (EOL) stage of the product lifecycle and whose interest it is to maximize recycling rates and meet stated targets. However, it speaks to the influence of stakeholder values on both EOL outcomes and our ability to adopt a more holistic approach to materials management that maximizes resource conservation and environmental protection. In some cases, non-recoverable materials are better for the environment than recoverable ones.[V] Coffee packaging is a case in point.

The Coffee Conundrum

You're an eco-conscious coffee producer deciding which packaging type to use for your product. You're presented with three packaging options: a steel can with plastic lid, a plastic canister or a flexible pouch. Which would you choose?

You would likely dismiss the flexible pouch automatically because it isn't recyclable. However, a broader analysis reveals that the flexible pouch actually has the lowest environmental impact.

According to the EPA, even though it ultimately ends up in a landfill, a flexible pouch is a fraction of the weight, consumes far less energy in its production and has a significantly higher product to packaging ratio than the other options.[vi] It also takes up far less space than a steel can or plastic canister both before and after the containers are filled which reduces transportation-related GHG emissions. And it's important to remember that even though another package may be recyclable by definition, it is not guaranteed a spot in the closed-loop economy. Ultimately, consumers decide if a recyclable package is destined for landfill or the recycling bin. EPA's analysis assumes current average levels of recycling. In the case of coffee packaging, 38% of steel cans, 68% of plastic canisters and 80% of plastic lids end up in landfill despite their recyclability.[vii]

What this case study tells us is that our preconceived notions of what is best for the environment may in reality be leading us astray. It also tells us that the environmentally preferable decision may differ depending on whether you are the producer or the consumer. Consumers can make decisions from a frame of reference that allows for more optimization than industry. This is not to say that recycling is not important or that we shouldn't be creating incentives for producers to design their products for disassembly and ease of recycling. This is to say that we must be careful about the incentives we create and analyze them within the context of SMM and CE objectives to avoid shifting burden from one stage of the product lifecycle to another. We should strive to keep materials in productive use but should not deny a given packaging type with strong environmental credentials solely on the basis that it is not currently recyclable.

We must remind ourselves that we recycle not for the sake of recycling, but to preserve resources and reduce pollution caused by the extraction and processing of virgin resources. Recycling is a means of keeping resources in circulation, but not the sole or always the priority means of minimizing negative environmental impacts. While not listed among the choices above, the eco-conscious consumer might bypass all three listed options and buy coffee beans in a reusable container of their own.

Getting it Right

The Waste Management hierarchy provides a general ranking of options to help guide us in making the 'right' choice for managing materials at their end of life. The option at the top represents the highest and best use and is generally preferred. Figure 3 below shows the most common iteration of the waste management hierarchy. Waste reduction (by way of light weighting products and packaging, creating more durable products and designing them for disassembly and repair, using the inputs of production more efficiently and so on) is the preferred option at the top, followed by reuse, recycling, energy recovery and disposal to landfill, in that order. In theory, each of the previous options should be exhausted before we move onto the next.

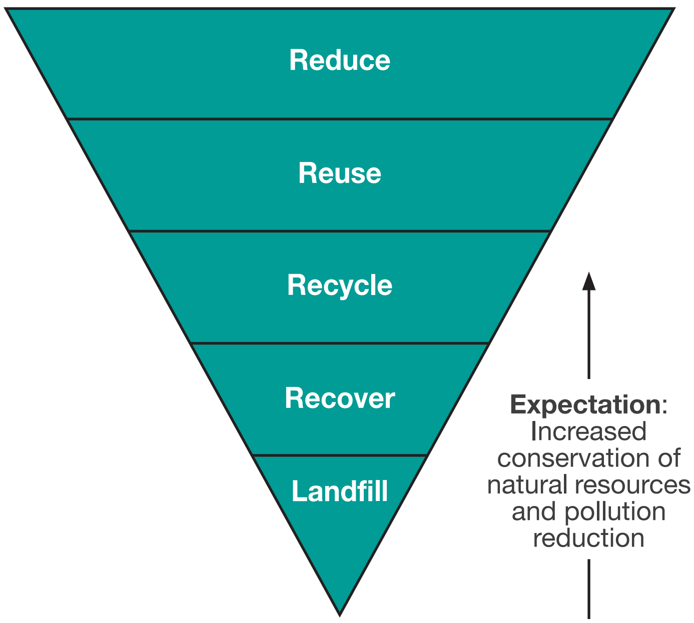

Figure 3: Waste Management Hierarchy

Recycling is commonly defined as the process of transforming waste into usable materials or products. But anyone working in the field can attest: it's become much more complicated than that. The definition of recycling is now under the microscope and creating a new set of preferences. As the conversation around materials management evolves, the definition of recycling has been dissected and a recycling sub-hierarchy has emerged consisting of terms like closed-loop, open-loop, downcycling and upcycling.

Closed-loop recycling refers to recycling end-of-life products back into the same product, such as recycling an aluminum can back into another aluminum can. This is often regarded as a preferred option because a closed-loop process keeps the material in continuous use. In contrast, open-loop recycling generally refers to use of recovered materials to make a different product.

This could result in upcycling which refers to the conversion of waste materials into something of greater value and/or durability (for example recycling of an aluminum can into an airplane wing). This is also regarded as a preferred option. Or it could result in downcycling, where the quality and functionality of the resource is diminished and/or capture of the material for further use is restricted (e.g. office paper recycling that shortens the fiber length so it is only suitable for lower market applications like tissue paper).

Whereas the preferability of closed loop recycling versus open loop upcycling depends on the specific materials and their end use options, downcycling is always regarded as the least preferred recycling approach.

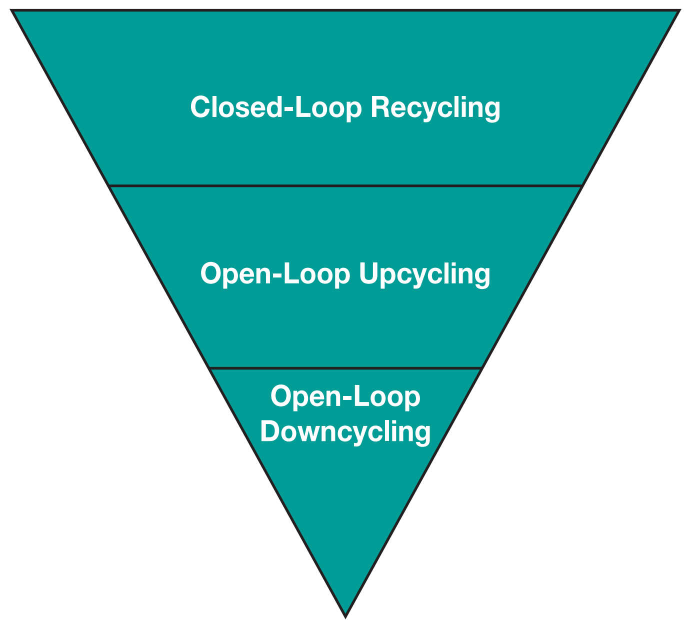

Figure 4: The Evolving Recycling Hierarchy

Adding to the confusion, several interpretations of these terms abound and their relative ranking is sometimes called into question by lifecycle analyses and the criteria used to assess different options. This calls attention to the need for a common playbook to foster meaningful discussion and informed action.

Exceptions to Every Rule

Generally speaking, the waste management hierarchy and the recent recycling hierarchy guide us in the right direction.

The problem with these hierarchies is that they can oversimplify materials management decisions and mislead decision-makers. When assessing the relative value of one recovery option versus another, there is a growing consensus that a hierarchy is useful as a conceptual tool but should not alone dictate "whether one process or material is more "sustainable" than another."[viii]

Take glass for example.

When comparing EOL management options, the recycling hierarchy might lead us to give preference to glass-to-glass bottle recycling (an example of closed-loop recycling) over converting glass bottles to fiberglass (an example of open-loop recycling) because the former maintains the quality and functionality of the original material and keeps it in circulation indefinitely and fiberglass, while a durable good is itself not recyclable at EOL. However, the durability and strong insulation properties of fiberglass "provide huge energy-saving properties throughout its life insulating a building," according to the Oregon Department of Environmental Quality, and an analysis commissioned by the City of Portland revealed higher energy savings from using recycled glass in fiberglass than glass bottle-to-bottle recycling.[ix] As the environmental benefits of recycling are largely a result of displacing virgin resources and reducing energy use and pollution in manufacturing, it is the relative displacement benefits between competing markets that determine what form of recycling is preferable.

However, we must also respect market forces. While a robust analysis may conclude that the highest and best use for recovered glass is fiberglass insulation, the supply of recovered glass feedstock available may overwhelm this particular application. Policy should incentivize highest and best use but not preclude alternatives. We need an informed and diversified end market portfolio.

Understanding these tradeoffs is essential to the successful implementation of SMM. Getting it right entails taking a step back and considering how current policy frameworks are restricting our options to pursue a more responsible path. In Canada, an organization responsible for overseeing the province's product and packaging stewardship programs, is required to favor programs that upcycle materials over those that downcycle. In light of the glass example above and others like it; rules like this could represent a barrier to SMM in practice because they overlook (or undermine) other performance factors outside of recycling, such as energy savings, greenhouse gas emissions and toxicity.

Recycling Rates – Just One Piece of the Puzzle

Careful calculation of recycling rates (counting the amount of material that is actually incorporated into a new product as opposed to set out for collection) helps us hold service providers accountable for high levels of environmental performance and creates transparency with respect to where materials end up. But they have become the primary metric of program success which robs us of the full picture.

In the US, there has been much discussion about the stagnant recycling rate which hovers at around 34% and what can be done to "move the needle." What this figure fails to reflect is the changing material mix taking place in the US market which makes each ton of recovered material that much harder to recover. Packaging has been on an increasingly strict diet over the past decade as manufacturers lightweight their materials and switch from heavier materials like glass to lighter substitutes. Even if the volume of recovered material grew, you may not know it by the weight-derived recycling rate.

Recycling rates as a barometer of success also fail to capture other elements of program success, like convenience, accessibility, transportation efficiencies and program cost.[x] Furthermore, depending on what stakeholders decide constitutes recycling; higher value uses for a given material may be overlooked because they won't contribute to a higher recycling rate. Batteries are a prime example.

Batteries in Focus

Both in Canada and in Europe, there is much discussion regarding what constitutes battery recycling. Should converting used batteries into roadbed slag be considered recycling? What about recovering manganese, zinc and phosphorus for use as fertilizer? Stakeholder discussions on these very topics are currently underway in both regions.[xi] It's a complicated state of affairs with many jurisdictions having different rules on the matter.[1]

In a jurisdiction in Canada, battery recyclers must recover 80 percent of an alkaline battery's weight for use in the manufacturing of new products (known as the Recycling Efficiency Rate – RER). They can do so by using a variety of recovery methods, some of which would result in a one-time use of the recovered product and others that would keep the recovered materials in a closed loop for potential use again and again. For instance, an alkaline battery could be processed using an eco-friendly battery technology whereby battery material is refined and transformed back into an active ingredient in the production of new batteries. This closed loop recycling process would generally be regarded as a superior form of recovery.[xii] However, in this Canadian jurisdiction processors using this method are not given any additional credit for pursuing this option. It is weighted the same as harvesting battery material for use in adhesives, tires, or paint additives and for use as fertilizer. Each recovery method is on a level playing field, despite the relative superiority of the closed loop method over the "one and done" downcycling approach.

In the case of batteries of this jurisdiction, high RERs where a number of recovery methods are considered equally valuable encourage recyclers to adopt processing methods that capture more of the battery product to attain the mandatory recycling target but may sacrifice higher value applications by doing so. This example highlights that not all forms of recycling are equally "good" and putting too much emphasis on a single metric can lead to suboptimal outcomes.

This begs the question: Have we missed the point? Is it time to go beyond tons recycled?

Proposed Assessment Criteria: A Balancing Act

A broader evaluative model is emerging to properly assess the sustainability of recovery activities. A diverse set of stakeholders has begun to flesh out criteria that should be considered when evaluating options.

The diagram in Figure 5 reflects a compilation of the criteria referenced in recent publications of leading stakeholder groups including the Environmental Protection Agency, the Oregon Department of Environmental Quality, the Canadian Standards Association and the Sustainable Materials Management Coalition (a group convened by Waste Management with representatives from business and industry, government, community and environmental groups, and academia).[xiii]

Essentially, a holistic assessment of material choices and recovery options is being proposed that considers both "macro" and "micro" concerns and attempts to create balance among multiple (and at times, competing) objectives.

Assessment in Action

A one-size-fits-all approach to applying the assessment criteria in Figure 5 below is not practical. We will likely never have consensus on the relative importance of one factor versus another as these discussions are stakeholder driven. Inevitably, some stakeholders will be louder than others and they will almost always have different, and sometimes competing, goals and objectives. Furthermore, the resources needed to evaluate the merits and drawbacks of different approaches are often lacking.

What we do have is a place to start. If we can agree that shifting focus from managing waste at end of life to identifying the impact "hot spots" over the full product lifecycle is a worthwhile pursuit, we can begin to take action in a more informed, systematic manner.

For instance, the Oregon Department of Environmental Quality (DEQ) has released examples of how SMM can help us understand the different actions that can be taken across the full lifecycle of materials. One such example compares different methods of delivering drinking water.[xiv]

DEQ found that a narrow focus on increasing the recycling rate of single-use PET water bottles would in fact reduce greenhouse gas emissions, energy use and respiratory pollutants over the lifecycle of the package. However, taking a broader view, they found that making the bottles thinner improved results further. But what made the most dramatic impact on resource conservation and pollution avoidance was switching from using single-use PET bottles to drinking tap water using reusable bottles. Even when a consumer washed the reusable bottle at home every day using the worst performing dishwasher on the market, this action maximized environmental performance.

---

[1] In Ontario, Canada, recovering manganese, zinc and phosphorus for use as fertilizer is considered recycling whereas in Europe it is not. In certain USA states, such as Minnesota, use as fertilizer is considered a "beneficial use"(a distinct category of material recovery regarded as less desirable than recycling).

If the evaluation is weighted to favor resource conservation and pollution avoidance, reusable bottles (cleaned at home) are the clear winner based on this analysis. However, if maximizing consumer convenience, meeting consumer demands for recyclability or increasing financial benefit were more heavily weighted, would the preferred outcome be different? Likely yes. What's important is having the information necessary to fully understand the tradeoffs inherent in SMM decision-making. A sharper pencil and an open mind are needed.

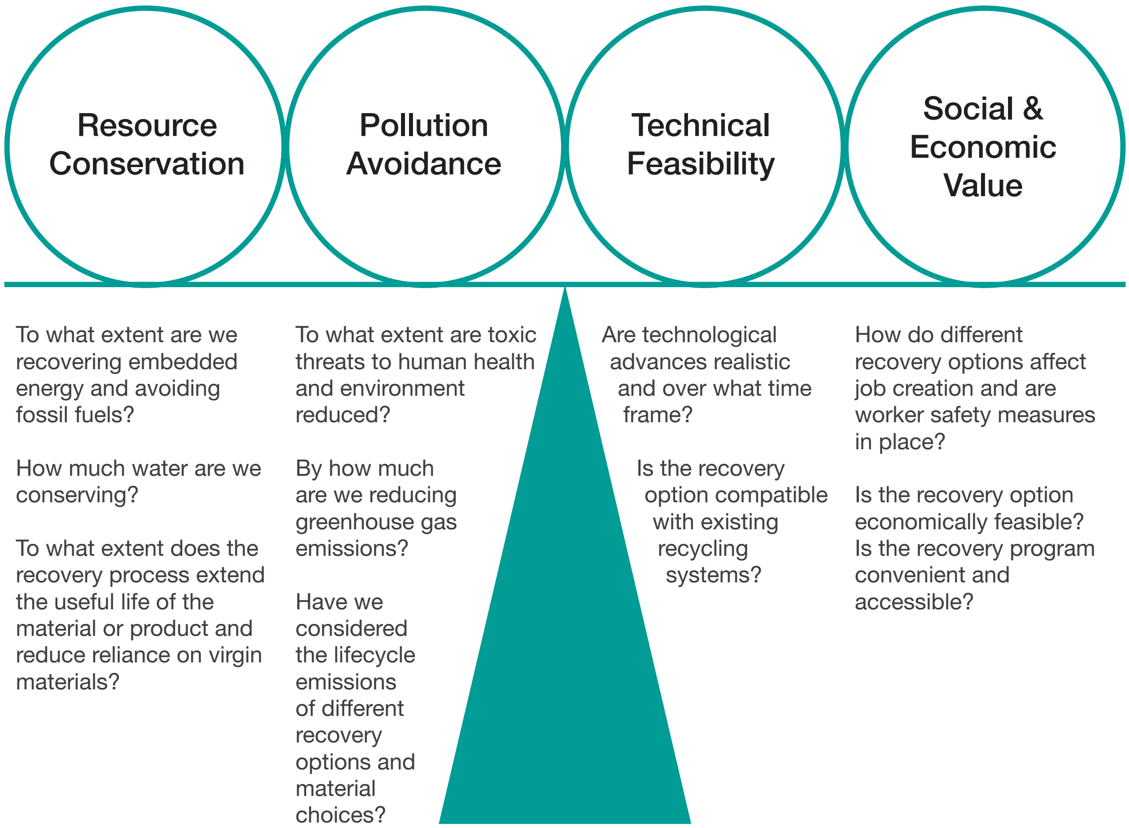

Figure 5: Holistic Assessment Criteria for Material Recovery Decisions

Revisiting What Motivates Us

Our one-dimensional focus on managing 'waste' at end of life blinds us to oftentimes more impactful phases of the life cycle. According to the National Recycling Coalition, disposing materials in landfills represents only 2% of US greenhouse gas emissions.[xv] We must therefore **look upstream** and consider a material's full lifecycle from extraction to EOL management. This means that actors along the entire value chain, from designers to recycling program managers, have a role to play in SMM strategies.

Contrary to conventional wisdom, this new way of analyzing material choices may lead us to settle on lower rungs of the hierarchy in order to maximize environmental outcomes elsewhere in the product lifecycle. For instance, a packaging producer may decide that a difficult-to-recycle package composed primarily of renewable materials may be more beneficial from a lifecycle perspective than a recyclable package. A recycling manager may implement policies and initiatives that increase the quality of collected recyclables rather than the quantity. A procurement specialist may remove requirements for post-consumer recycled content and add guidelines that give preference to products that demonstrate a broader set of environmental qualities.

What's needed is balance between micro and macro considerations where each project is evaluated on its own merit. This will take cooperation among a diverse group of sectors, industries and institutions. When evaluating recovery methods, we need to be clear about what our goals are and be frank about the interests at play. A guiding set of principles could help all stakeholders view these evaluations through the same lens.

The goals behind materials management may change depending on who you ask (a recycling manager responding to their constituents may be motivated by different goals than a packaging producer, for instance); but from a macro perspective, we recover materials in order to reduce pollution and maintain stable supplies of materials to produce the goods and services we rely on long into the future.

With this in mind, it is in our best interest to accelerate the transition to a SMM approach. If we are to achieve Sustainable Materials Management, there is a collective need to replace our myopic focus on recycling with lifecycle thinking that includes recycling as a means to an end but not the end in and of itself.

Betsy Dorn is director of USA Consulting and Becky MacWhirter is a consulting associate with Reclay StewardEdge (RSE), offering product stewardship solutions globally.

ABOUT THE AUTHORS

Betsy Dorn is Director of RSE USA, a sustainable packaging and product solutions consulting firm serving USA clients. She has over thirty years of experience managing, designing, and implementing recycling and solid waste management projects. For 25 years, she has been a consultant assisting public and private sector clients with developing plans, evaluating operations, launching new programs, and training recycling professionals. In recent years, Betsy has worked in sustainability and product stewardship with a focus on the end-of-life management of packaging materials and printed paper.

Becky MacWhirter is a consultant at The City of Belleville. She works on strategy development, program planning, policy research and regulatory compliance, responsible for measuring sustainability performance and driving action to improve it. As sustainability coordinator for the Loyalist College in Belleville, she worked collaboratively with administrators, faculty, staff, students and community partners to advance a range of sustainability initiatives including carpooling, waste reduction and recycling, energy conservation and more.

The complete White Paper, authored by leading consultant RSE USA and commissioned by Call2Recycle, Inc., surrounding these topics can be found online at call2recycle.org.

---

[i] Oregon Department of Environmental Quality. 2012. *Materials Management in Oregon 2050 Vision and Framework for Action.*

[ii] Ellen MacArthur Foundation. 2013. *The circular model - an overview.* Available at: http://www.ellenmacarthurfoundation.org/circular-economy/circular-economy/the-circular-model-an-overview

[iii] European Commission. 2015. *Circular Economy Strategy.* Available at: http://ec.europa.eu/smart-regulation/impact/planned_ia/docs/2015_env_065_env+_032_circular_economy_en.pdf

[iv] Kunz et al. 2013. *Extended Producer Responsibility: Stakeholder Concerns and Future Developments.* Available at: http://research.insead.edu/2014/03/KunzAtasuMayersVanWassenhove.html

[v] Oregon Department of Environmental Quality. David Allaway & Peter Spendelow. 2011. *Briefing Paper: Oregon's Solid Waste Hierarchy - Intent and Uses.* Available here: http://www.deq.state.or.us/lq/pubs/docs/sw/2050vision/BriefingPaperSWHierarchy.pdf

[vi] Environmental Protection Agency. Elisabeth Resek. 2015. *Sustainable Materials Management.* Available at: http://nrcrecycles.org/mobius/nrcwp-content/uploads/2015/02/Liz_powerpoint.pdf

[vii] Environmental Protection Agency. Elisabeth Resek. 2015. *Sustainable Materials Management.* Available at: http://nrcrecycles.org/mobius/nrcwp-content/uploads/2015/02/Liz_powerpoint.pdf

[viii] Sustainable Materials Management Coalition. 2012. *Sustainable Materials Management: A New Materials Hierarchy, Solutions to Barriers, and Recommendations for a Path Forward.* Available here: https://www.michaeldbaker.com/wp-content/uploads/2014/01/smm_final_report.pdf; Oregon Department of Environmental Quality. David Allaway & Peter Spendelow. 2011. *Briefing Paper: Oregon's Solid Waste Hierarchy - Intent and Uses.* Available here: http://www.deq.state.or.us/lq/pubs/docs/sw/2050vision/BriefingPaperSWHierarchy.pdf

[ix] Oregon Department of Environmental Quality. Peter Spendelow. 2012. *Briefing Paper: Highest and Best Use of Recovered Materials.* Available here: http://www.deq.state.or.us/lq/pubs/docs/sw/HighestBestUse.pdf

[x] Lakhan, Calvin. 2015. *The relationship between municipal waste diversion incentivization and recycling rate performance: An Ontario case study.*

[xi] ABRI. 2014. *Recycling efficiency for alkaline batteries.* Available here: http://www.batteryrecycling.org.au/wp-content/uploads/2014/06/Recycling-efficiency-final.pdf; Recycling Council of Ontario. Date Unknown. *Developing Standardized Reporting Requirements for Single-Use Battery Recycling.* Available here: https://www.rco.on.ca/uploads/File/projects/underway/Reporting_Standardization_Advisory_Committee_TOR.pdf

[xii] Energizer. 2015. *Energizer® Introduces World's First High-Performance Battery Made with Recycled Batteries.* Available here: http://www.energizer.ca/docs/default-source/pdf/press-release-canadian.pdf

[xiii] US Environmental Protection Agency. 2009. *Sustainable Materials Management: The Road Ahead.* Available here: http://www2.epa.gov/sites/production/files/2015-09/documents/vision2.pdf; Canadian Standards Association. 2015. *A Guideline for accountable management of end-of-life materials;* Oregon Department of Environmental Quality. David Allaway & Peter Spendelow. 2011. *Briefing Paper: Oregon's Solid Waste Hierarchy - Intent and Uses.* Available here: http://www.deq.state.or.us/lq/pubs/docs/sw/2050vision/BriefingPaperSWHierarchy.pdf; Sustainable Materials Management Coalition. 2012. *Sustainable Materials Management: A New Materials Hierarchy, Solutions to Barriers, and Recommendations for a Path Forward. Available here:* https://www.michaeldbaker.com/wp-content/uploads/2014/01/smm_final_report.pdf;

[xiv] Oregon Department of Environmental Quality. David Allaway. 2015. *How Recycling Managers Can Best Contribute to Achieving Sustainable Materials Management.* Available here: http://nrcrecycles.org/learn-3/archived-webinars/#toggle-id-1

[xv] National Recycling Coalition. 2015. *A Guide to Sustainable Materials Management and Summary of White Paper Ideas.* Available here: http://nrcrecycles.org/mobius/nrcwp-content/uploads/2015/01/SMM-Guide-and-Summary-of-White-Paper-Ideas.pdf