

## 'Sustainable materials management': A new international solid waste paradigm

In recent years, many solid waste practitioners and agencies have argued for a new approach to replace 'end of pipe' waste management technologies such as waste incineration and landfilling. This new approach is often called the 'sustainable materials management' paradigm, which aims at a comprehensive evaluation of how materials are managed upstream of traditional waste management techniques so they can be sustainably managed at all stages of their life cycle throughout the economy (Rogoff, 2013). That is, this new paradigm helps address all the stages of materials and products from raw material extraction to product design, manufacture, and transport, consumption by the consumer, use, reuse, recycling, and then final disposal of residuals.

In essence, this new paradigm encourages society to put the highest value on source reduction and extended producer responsibility, then focus on waste conversion processes that recover materials and energy from wastes (either directly or via production of biofuels) and/or the production of compost. In comparison with the traditional waste hierarchy pyramid, which has shown landfills serving as the base of the pyramid, traditional end-of-pipe waste disposal technologies are more often considered as an option of 'last resort' by many in the solid waste industry for those materials that cannot be economically recovered for beneficial reuse. This new paradigm is broadly based on visions of future solid waste management expressed by environmental protection agencies in both the USA and European Union. This theme has been adopted by many solid waste agencies as they consider revisions to their existing solid waste management plans for the coming decades.

### *Long-term international 'drivers'*

From this perspective in late 2013, the world's economies are slowly emerging from the depths of the 'Great Recession'. Notwithstanding the remaining economic consequences, there are five major trends, in the author's opinion, (energy, climate change, increasing commodity prices, information technology, and private efforts towards corporate sustainability) that will influence a dramatic move towards increased sustainable materials management worldwide.

**Energy.** Daniel Yergin, in his classic review of the oil industry, *The Prize*, points out that there have been many revelations by industry observers that the world was running out of petroleum and, as a consequence, steep increases in the price of oil would soon follow (Yergin, 1992). The end of the era of 'cheap oil' has been predicted many times since the major oil fields were

first discovered in the 1860s in Baku, Russia, near the Black Sea. Time and again, new fields were discovered elsewhere using new technology (e.g. offshore drilling, deep wells, remote locations, fracking, and shale oil) confounding the predictions of a sudden spike in prices and capacity.

Nevertheless, it is imprudent to assume that emerging energy sources will enable us to avoid indefinitely supply interruptions and/or energy price increases. To this observer, sudden spikes in energy prices will become more frequent and volatile because the world is so more integrated than ever... and our energy-using population is relentlessly increasing. A major revolution in an oil producer state or a catastrophic well blowout in one part of the globe can impact energy prices almost overnight. This volatility affects at least the economics of all that we do in solid waste management, from collection, recycling, and processing to disposal technologies. Although we have retreated from triple digit prices for petroleum as of this writing, most energy experts agree that the era of cheap energy is over.

**Climate change.** Climate change is commonly defined by atmospheric scientists as a significant and long-lasting variation of weather patterns over periods of decades to millions of years. There is much philosophical and political debate about the causes of the climate changes we observe today. Some say that these changes are primarily caused by biotic sources, fluctuations in solar radiation, volcanic eruptions, and ocean circulation. Others opine that significant climate changes have occurred in the past and thus what we are observing now is not necessarily associated with combustion of fossil fuels. Scientific consensus, however, is 'that climate is changing and that these changes are in large part caused by human activities'. While much remains to be explained, the overwhelming evidence suggests that hypotheses and scientific models of climate change have stood firm in light of challenging scientific debate over the past few decades. It is reasonable to conclude that the relentless release of carbon dioxide (a demonstrated greenhouse gas) into the atmosphere since the beginning of the industrial era has resulted in a rapid increase in global temperatures, a reduction of ice in the polar caps, a rise in sea levels and more dynamic weather extremes. Moreover, climate change is expected to lead to significant variations in precipitation levels, rising sea levels, temperatures that impact crop production and destructive storm events.

What does the trend in climate change mean to solid waste managers? The real answer in a nutshell is the assumed relationship of solid waste management activities and greenhouse gas (GHG) emissions. The best available scientific evidence

suggests that atmospheric concentrations of carbon dioxide must be stabilized if not reduced, requiring a global reduction of GHGs.

Over the last few decades, the economies of China, India, Brazil, South Korea and other large developing countries have expanded rapidly producing consumer economies similar to the United States, Europe and Japan. The material aspirations of populations in these developing economies pose increasing threats to the sustainability of our global environment. This has increased the demand for increasingly scarce energy resources, timber, agricultural commodities and minerals. In turn, this has caused a substantial increase in the number and extent of long-term arrangements between consuming nations and resource-rich countries in Africa and South America to secure these resources for the developing economies. Pressures on these increasingly scarce natural resources will continue as worldwide demand expands, resulting in changes to consumption patterns and trends to substitute these materials either through increased recycling and substitution. Here is where those in the waste management industry can help reduce the demand for extraction of virgin materials by optimizing materials sourcing from what would otherwise be a waste stream.

*Increasing commodity prices.* The global economy is becoming more highly integrated than ever in recorded human history. This has resulted from a loosening of trade barriers enabling freer movement of money and materials and a higher prosperity in many countries. The integration of world economies poses unprecedented opportunities for production and consumption of goods and services, and an increasing demand for manufacturing capacity and minerals, most of which are finite, will tend to be more dispersed across the globe. Undoubtedly, there are pluses and minuses to these global trends for sustainable development.

*Information revolution.* Through the development of increasingly integrated communication resources, the amounts and variety of information will become available to nearly everyone on the planet. Use of the Internet, cell phones, and social media applications enables billions to access and share this information virtually in real time. It is hard to underestimate the impact the information revolution will have on politics and the way business, including the trash business, is conducted in many nations.

What does this mean to solid waste management and recycling in general? In my opinion, a more efficient dissemination of information about the workings of recycling markets and consumer choices will translate into more sustainable solutions for both consumers and businesses. Those seeking to buy secondary materials can much more readily connect to those with recovered wastes to sell. Moreover, those who trade in recycling markets, and those who regulate the markets, can be much more aware of environmental trade-offs, resulting in more and safer choices for products and services.

*Increased corporate and governmental sustainability.* The increasing cost of energy and materials and the impacts of

global pollution are being recognized by business as significant threats to their competitiveness and overall profitability. However, all of these external threats also pose opportunities for corporations to find ways to reduce costs, become more efficient, and, at the same time, become less polluting and more sustainable. In their groundbreaking book, *Cradle to Cradle: Remaking the Way We Make Things*, which was published in 2002, architect Bill McDonough and co-author, Michael Braungart, influenced the current generation of industrial designers and corporate sustainability officers by arguing that they must radically alter the designs of their products to make them more sustainable (McDonough and Braungart, 2002). In a recent sequel to this seminal book in 2013, *The Upcycle: Beyond Sustainability – Designing for Abundance*, these authors present a compelling argument for the concept of ‘upcycling’, namely reusing materials in products that end up in other products that end up lower and lower on the value chain (but that still have some value) (McDonough and Braungart, 2013).

Working through the World Business Council for Sustainable Development, multi-national companies such as Caterpillar, Coca Cola, General Motors, Proctor and Gamble, and others, have concluded that the ‘...current global consumption patterns are unsustainable’. The Council has called for business to become more proactive in addressing more sustainable methods of consumption through innovation, improved communications, and working in partnerships with governments and other stakeholders.

Product stewardship has become the centerpiece of solid waste legislation in many Canadian provinces and the European Union, which has created an incentive for manufacturers or brand owners to set aside funds to invest in education, research, market development, and collection and processing infrastructure to reduce packaging and take back these materials. In the United States, the states of California, Maine, Minnesota, Oregon, Rhode Island, and Washington have already promulgated product stewardship legislation as well.

One way to advance these trends toward building coherent sustainable materials management policies is to increase research and development efforts by the governmental, academic, non-governmental, and corporate sectors to identify programs that provide the most enhanced environmental benefits at the least economic costs. Here’s where readers of *Waste Management & Research* can provide guidance to governmental and business leaders across the globe.

## References

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