EPR Frequently Asked Questions White Paper

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1.0 Introduction

1.1 What is Extended Producer Responsibility?

As per the OECD, Extended Producer Responsibility (EPR) is defined as an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle. An EPR policy is characterized by:

1. the shifting of responsibility (physically and/or economically; fully or partially) upstream toward the producer and away from municipalities; and

2. the provision of incentives to producers to take into account environmental considerations when designing their products.

While other policy instruments tend to target a single point in the chain, EPR seeks to integrate signals related to the environmental characteristics of products and production processes throughout the product chain.

EPR has been demonstrably successful for waste streams such as WEEE, household hazardous waste, batteries, tires etc. Many jurisdictions are now considering EPR legislation for household printed paper and packaging.

1.2 Why is EPR for packaging being promoted as a solution to existing waste management problems?

The adoption of EPR in major developed economies is being driven by a convergence of public policy and commercial interests that reflect a broader movement to quantify environmental impacts and internalize these costs to the producers and users of products which eventually become waste. EPR for packaging has become the dominant approach for transferring the costs of managing used packaging from the local tax base to the producers of packaging (brand owners or the first importers of the packaged product into a jurisdiction). EPR is also intended to provide economic incentives for producers of the package to minimize packaging and to design packaging for improved recyclability and environmental performance.

EPR for packaging has now been adopted in some 35 countries with a combined population of more than 500 million people. In North America, Canada has implemented EPR packaging programs in eight provinces, while the United States has adopted (or proposed legislation) packaging EPR legislation in more than 22 states. It is important to note that EPR has existed for over 30 years in some parts of the country for waste streams such as hazardous waste, waste electronics, pharmaceuticals, paint etc. However, EPR for packaging is still in its relative infancy – in fact, Oregon and Maine were the first states to formally adopt packaging EPR legislation in 2021, with others quickly following suit.

It is important to note that packaging EPR legislation is being adopted in parallel to help support the financial needs and broader waste management programs needs, some of which include: restrictions

or bans on the use of types of packaging, mandatory deposit return systems, landfill bans etc. Current trends suggest that policies and programs to fund the management of used packaging and reduce the amount of used packaging in the market will continue to grow internationally. At present, *EPR is becoming the favored public policy approach to managing post-consumption waste in most developed economies.*

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1.3 What is EPR Intended to Do?

With this in mind, what is EPR intended to achieve as it pertains to the management of EOL packaging waste? As described in the previous section, EPR can largely be characterized as a cost recovery tool to help finance residential waste management systems. However, beyond transferring the financial and physical obligation of managing end of life packaging to producers, advocates of producer responsibility often claim that EPR does the following:

1) Encourage design for the environment: By forcing producers to bare the end of life management costs (in the case of printed paper and packaging, recycling costs) and meet recycled content quotas, the expectation is that producers will design their packaging in such a way that is more readily recyclable given existing infrastructure. EPR is often touted as a mechanism to help support circular economies and reduce carbon footprints.

2) Contain Costs: By shifting end of life management costs onto producers, companies will not only be incentivized to use more readily recyclable material, but do so in a way that minimizes material management costs. If producers are obligated to "foot the bill" of the entire system, then they have a greater incentive to reduce costs relative to model in which municipalities pay none, or a shared part of waste management system costs.

3) Invest in recycling infrastructure to more efficiently capture and recycle light-weight materials: Under a full producer responsibility model, producers are tasked with the responsibility of operating the entire system, which not only includes a financial obligation, but a physical one as well. Previously, municipalities have traditionally served as the waste management operator, providing collection and sorting services. A 100% EPR Model will incent producers to invest and develop infrastructure that allows them to meet their legislative obligations, which in turn, will result in investments in collection and sorting infrastructure to better capture lightweight materials.

4) Develop healthy and robust markets for problematic packaging materials: Given that producers will bare the responsibility of managing all packaging at end of life, this will require significant investments in end markets and end use applications of light weight and composite materials. Despite the increased proliferation of light weight packaging, there remain few viable end markets for these materials. As such, if an EPR model is implemented that obliges producers to recycle their packaging, they will have to develop new and innovative ways to use these materials.

While all of this conceptually makes sense, if we were to take a comprehensive examination of publicly available data for EPR programs, few, if any of these objectives are met. Statements that EPR will lead to either increased diversion performance or cost containment is not born out in the data, which makes it all the more pressing that we challenge these assumptions before attempting to replicate the model in other jurisdictions.

The following is a comprehensive review of common claims and questions surrounding extended producer responsibility for packaging.

1.4 Who is considered an obligated party when paying for EPR?

Obligated Producers are any organization or company that is a resident of a given jurisdiction, and a brand owner/first importer that supplies any of the designated packaging materials into the residential market.

- A brand owner is an organization or company that is the registered trademark holder associated with the designated packaging or printed materials.

- A first importer is a company that is the first to take ownership, possession or control of products into a given jurisdiction in the event that the brand owner does not operate within the obligated jurisdiction.

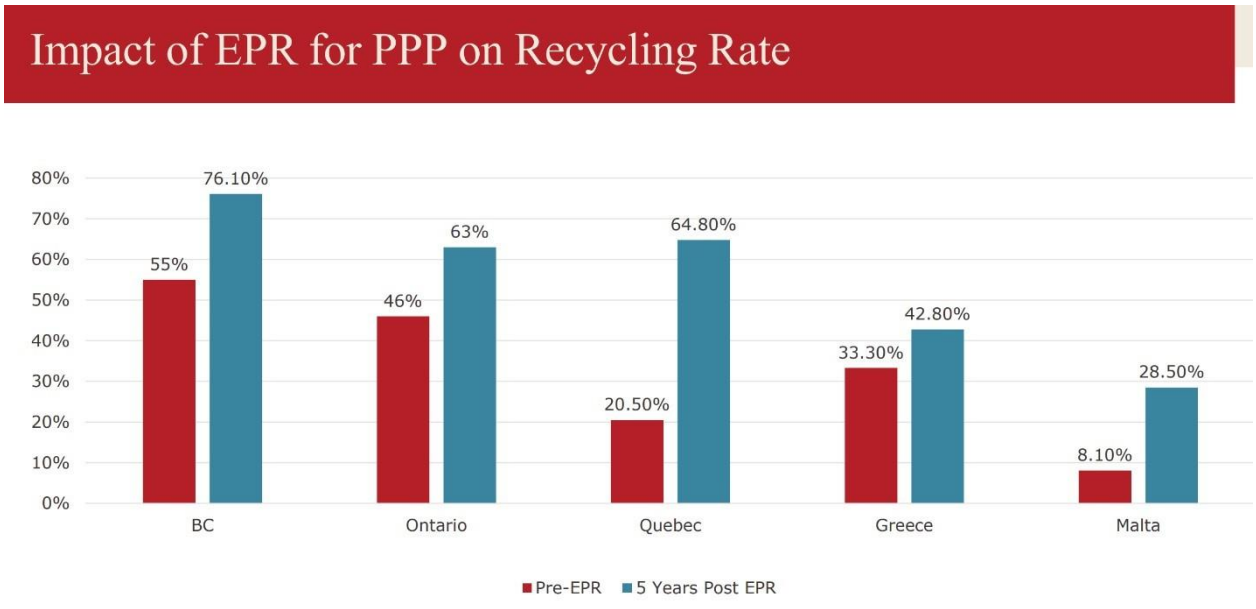
Where things get a bit tricker is the way online retail is managed, particularly entities like Amazon, Ebay and Wayfair, and more recent legislation is trying to figure out how to ensure that these stakeholders are paying their fair share into the system.

2.0 Environmental Impacts

2.1 Does EPR lead to increased recycling rates for packaging waste?

This is one of the most fundamental questions at the heart of the debate surrounding EPR, with advocates saying that EPR is essential in order to increase recycling rates for packaging. To substantiate this claim – many point to the fact that jurisdictions who have already adopted EPR legislation have higher recycling rates than those that don't. Also, when looking at recycling rates for EPR jurisdictions over time, recycling rates have increased relative to the baseline year. As shown in figure 1, there appears to be a clear cause and effect between EPR legislation and increased recycling rates. In a study conducted by RRS on behalf of the state of Oregon, it was found that jurisdictions who implement producer responsibility have, on average, higher recycling rates than those that don't, and that recycling performance increased post implementation of EPR. British Columbia in particular was touted as being particularly successful, enjoying recycling rates well in excess of 70% for residential packaging waste.

Fig.1



What is the conclusion we can draw from this finding? While most would be inclined to say that EPR leads to higher recycling rates (as was the conclusion of the report), the reality is that nothing can be inferred based on this information alone – context is critical. Contextual factors that need to be considered include:

- What was the recycling rate of each jurisdiction prior to the implementation of EPR?
- Were there any programmatic or infrastructural changes that accompanied the implementation of EPR?
- What was the available infrastructure of waste management systems both pre/post implementation of EPR, and when comparing EPR and non EPR jurisdictions
- Demographics (age, income, education, ethnicity etc.) of EPR and non EPR jurisdictions, and have demographics changed over time?
- Relative maturity of waste management systems when comparing EPR and non EPR jurisdictions
- Exogenous factors, including macro-economic conditions, commodity pricing for recyclables, national/international legislation etc.

To specifically isolate the effect of EPR legislation on jurisdictional recycling rates, you would have to control for the above factors. While this report will avoid delving into the statistical nuances of how to control for identifying dependent and independent variables, correcting for collinearity/endogeneity etc., the situation is explained by the following: Not everyone begins from the same starting point – some jurisdictions may have well developed collection/processing

infrastructure in place, while others may have depot systems only. Demography is also an often neglected, but significant predictor of recycling participation – as an example, a jurisdiction characterized by a higher density of multi-residential buildings and immigrant population is going to have markedly different recycling performance. The same can be said of areas characterized by rural communities and lower population densities.

Comparing any one jurisdiction (even the same jurisdiction over time) with another *requires* you to control for these differences in order for meaningful inferences to be made. Referring specifically to the EPR studies by both Eunomia and RRS, there is no evidence that EPR conclusively results in higher recycling rates. Rather, jurisdictions who are at a point where they have implemented EPR are likely to have more of the enabling conditions that lead to a successful recycling system, i.e. high levels of access/service coverage, informed population, robust and convenient collection networks etc.

2.1 Won't EPR Help My Jurisdiction Recycle More?

The short answer is – it depends. In jurisdictions that have mature recycling systems with high levels of household participation and access, it is unlikely that EPR will result in an increased recycling rate. Most households in mature recycling systems already have access to recycling services, and materials such as newsprint, office paper, cardboard, beverage bottles and aluminum cans are being recycled at a very high rate. Where things get a bit more complicated is whether EPR legislation can help finance infrastructure to capture difficult to recycle material, i.e. light weight, flexible and multi-resin plastics. These materials are extremely difficult to sort in a conventional mechanical recycling system. They also have few end markets and end use applications, further diminishing the incentive to recycle these materials. While EPR, in theory, could be used to explore alternative forms of recycling such as chemical recycling and pyrolysis, there are very few examples of these systems being used in other jurisdictions. EPR legislation in and of itself does not lead to higher recycling rates, nor does it create new end markets and end use applications. Accessible, convenient, and economical infrastructure is ultimately what drives recycling performance.

2.2 If EPR doesn't lead to increased recycling rates, what does?

The maturity of a waste management system is rarely discussed when evaluating the effectiveness of waste management policy, but it is often the most critical factor. As an extension to a point that was made earlier, where you are starting from radically affects the potential efficacy of a given program or policy. During a program's onset, initiatives such as promotion and education, service expansion, increased accessibility are likely to yield significant improvements in the overall recycling rate. However, as a program matures, the impact of these initiatives diminishes – not because the policies no longer work, but because they have already "captured" people who are likely to participate in recycling. As a system matures, so does the difficulty in diverting the

"marginal tonne". Initial program success is characterized by the recovery of readily recyclable materials (newsprint, OCC/OBB, Aluminum etc.) among groups who face low barriers to participation (single family homes with curbside access). Once a program reaches a "stasis" point, going over and above that particular level of recycling requires increasingly more effort (expressed in terms of time, cost, resource etc.).

Future increases or decreases in diversion rates are unlikely to differ significantly from this stasis point, barring major programmatic changes or systemic disruption (i.e. Financial crisis of 2009/2010, Chinese sword etc.). As an example, Ontario's "steady state" recycling rate for the Blue Box program is between 60% and 67%. By comparison, British Columbia's "steady state", appears to be between 75% and 80%. Differences in the steady state point across jurisdictions are often a function endemic factors that are specific to a particular area (demography, infrastructural access etc.) and cannot be readily replicated by other cities/provinces/states.

The relative maturity of the recycling system is a much more accurate predictor of recycling rates. Numerous studies have identified accessibility as being the primary driver of residential recycling, with a demonstrable correlation between increased accessibility and increased recycling rates. In a meta-analysis of more than 20 studies examining the determinants of residential recycling rates jurisdictions with the highest residential recycling rates all had household accessibility rates in excess of 90%. These jurisdictions were characterized by convenient access to waste disposal and recycling (either in the form of high density waste drop off sites, or scheduled curbside collection) However, of these countries, not all had EPR legislation. Furthermore, there are numerous countries that have adopted EPR legislation that struggle to maintain packaging recycling rates above 40%. Some examples include, Greece, Malta, Romania, Cyprus and Portugal. The common denominator of these countries is that while they have adopted EPR legislation, they all have infrastructural inadequacies and lower rates of accessibility. EPR in and of itself has no positive impact on recycling rates – at best, it is intended to accompany a system that has all of the enabling conditions for success, i.e. accessible/convenient, low cost, high levels of awareness etc.

In a 2019 meta analysis conducted by Geiger et al, accessibility, curbside collection and garbage bag limits (i.e. pay as you throw) were the most significant predictors of recycling performance in urban jurisdictions across North America and Europe[1]. At present, there is not a single academic publication that lists extended producer responsibility as a primary driver of recycling system performance. Even the European Environmental Agency published the following quote to accompany the release of their 2021 annual recycling report:

"The waste recycling rate — the proportion of waste generated that is recycled — is growing in the EU-27, driven by EU binding recycling targets, which indicates progress towards using more waste as a resource and achieving a circular economy. The rate of progress is slowing down, with packaging waste recycling actually decreasing in the past 5 years. Achieving a circular economy and

[1] Geiger, J. L., Steg, L., van der Werff, E., & Ünal, A. B. (2019). A meta-analysis of factors related to recycling. Journal of Environmental Psychology, 64, 78-97. https://doi.org/10.1016/j.jenvp.2019.05.004

improving the environmental performance of waste management requires a faster rate of progress as the majority of waste ends up in disposal operations such as incineration and landfill."

There is no jurisdiction that is immune to the "evolving tonne" issue - in the absence of radical infrastructural and systemic reform, EPR in and of itself will have negligible impacts. There is a temporal dimension to understanding cause and effect in waste that obscures the relationship between action and outcome. Without taking the time to consider system maturity or a given jurisdictions "starting" and "stasis points", it is incredibly easy to arrive at the wrong conclusions.

As an example, if we were to look at Ontario's recycling rates between 2014 and 2020, you would see a decrease in overall recycling rates for printed paper and packaging. Would it be fair to say that the presence of EPR is responsible for this decrease? Of course not. Ontario's declining recycling rate is largely attributed to a change in the composition of the recycling stream – the proportion of light weight, flexible and multi resin plastics as a percentage of overall packaging generated is increasing over time. These materials cannot be readily recovered using existing infrastructure, and their lightweight properties have resulted in a decrease in overall tonnages managed by the recycling system. This shift in the types of packaging being generated into the market is largely an exogenous change (at least in the short term). The recycling system cannot readily adapt to these changes (for both economic and technical reasons), and as a result, recycling rates decline. This decline is often accompanied by an increase in recycling system costs.

2.3 Understanding cause and effect with respect to recycling rates

Policy makers will often erroneously conflate the effectiveness of a particular policy in one area (at a given point in time) and assume that to be true for all other areas. Recycling promotion and education is a good example of this – the effectiveness of P&E at a programs onset (where awareness and attitudes towards recycling are low) is demonstrable. It is a critical tool that yields positive results….. at first. As a system matures, the effectiveness of recycling P&E diminishes (Lakhan, 2014: https://doi.org/10.1016/j.resconrec.2014.07.006) .

While the study linked above goes into a more detailed discussion as to why, the simplest way to describe this phenomenon is that at a certain point, the people targeted by P&E will already be recycling. Appeals to environmental altruism, sustainability and collective responsibility will resonate with certain households, who will then make recycling a habitual behavior (hence the uptick in recycling performance at a programs onset). However, that same messaging over time does very little to encourage recycling among households who either don't care about the importance of recycling, or more likely, face infrastructural, knowledge based or cultural barriers to access.

There is a temporal dimension to understanding cause and effect in waste that obscures the relationship between action and outcome. Without taking the time to consider system maturity or

a given jurisdictions "starting" and "stasis points", it is incredibly easy to arrive at the wrong conclusions.

2.4 Wouldn't EPR mean a shift towards more recyclable materials and help prevent the evolving tonne issue and encourage design for the environment?

While EPR can certainly help promote environmentally preferred outcomes, it is important to clearly understand what the goal of proposed legislation primarily is: Is it increased recycling rates? A lower carbon footprint? Economic affordability and accessibility? (Or some combination thereof).

Existing approaches to EPR legislation being implemented in Canada and the United States tend to prioritize recycling-based targets for printed paper and packaging. Many of these targets are conceptually aligned with the Ellen MacArthur Foundation Plastics Pact, which calls for all plastic packaging to be made up of 100% recyclable or compostable material by the year 2025.

2.41 How is EPR intended to achieve this outcome?

As noted by Mayers and Butler (2014)[2], producer responsibility legislation provides a direct economic incentive for the producer of the package to reduce packaging materials and design packaging for improved recyclability. This is particularly true of EPR programs that implement incentive based eco-modulated fee rates, where the fees paid by producers are in direct proportion to their relative recycling performance.

Any claims of EPR leading to more sustainable packaging cannot be supported by data (particularly in a North American context). Using Canadian EPR jurisdictions as an example (Ontario, British Columbia, Quebec and Manitoba), year over year increases in net system costs per tonne are increasing by more than 10%, while recycling rates are trending downwards. Increases in cost (as well as decreases in overall recycling rates) are largely explained by the proliferation of lightweight composite packaging. Coincidentally, one could argue that this is a direct result of how packaging producers have responded to the evolution of the fee allocation model. The fees charged to packaging producers as part of the province's EPR system are calculated on a per tonne basis. As such, many packaging producers have opted to switch to light weight packaging (namely LDPE (Low Density Polyethylene Terephthalate), PET thermoforms and polystyrene crystal) to minimize the impact of the fee. While these materials traditionally have higher fee rates, fees are denominated in kilograms. As such, the total fee paid by packaging

[2] Mayers, K.; Butler, S. Producer responsibility organizations development and operations. J. Indus. Ecol. 2013, 17, 277–289.

producers tends to be lower in absolute terms (due to light weighting of material). The issue with this is twofold: (1) Consumers don't readily recognize these materials as being recyclable, and (2) these items are voluminous but not very heavy. This not only results in less material being placed in the Blue Box, but lower tonnages (and thus lower recycling rates) for the material that is collected. The impact of these changes have been significant, as Ontario's recycling rate stagnated at 68% in 2010, and subsequently declined to 61% in 2020.

The changing nature of packaging materials is a phenomenon that has been acknowledged and accepted by policy makers across North America – as noted earlier, the recycling bin of today is fundamentally different than what it was even as little as 10 years ago. Readily recyclable materials, i.e. newsprint, corrugated cardboard, boxboard etc., are making up less of the overall proportion of packaging materials currently recycled. By contrast, light weight, flexible and composite packaging (difficult to recycle materials) are now making up a greater proportion of the overall waste stream. Due to the costs associated with attempting to recycle these materials, and the fact that they are making up more of all packaging being put onto the market, we observe rapidly increasing recycling system costs and declining recycling performance. Once again, this is not a matter of debate – every Canadian jurisdiction with EPR for packaging waste has experienced an increase in per tonne recycling costs and stagnating (or declining) recycling rates over time. As such, the claim that a well-designed EPR system encourages cost containment and recycling rate performance is false, and there is no data to suggest that it does.

The package light weighting phenomenon is also indicative that producers are designing **LESS** recyclable packages over time, not more. The entire reason why municipalities are calling for EPR is that existing recycling infrastructure is now fundamentally incompatible with the types of products being generated. Eco-modulated fee rates (such as the ones used in Ontario and British Columbia) have had no discernable impact on the design of packaging, its recyclability or the development of recycling end markets. One needs to look no further than laminated paper packaging producers (coffee cups etc.) in Ontario, who have paid millions of dollars in packaging fees over the past decade and face the second highest fee rate of all Blue Box materials. Despite the intended eco-modulated incentive that should encourage laminated paper producers to improve recycling rates and develop end markets, recycling performance has remained unchanged, while material management costs have increased by 30%. Arguably, an EPR program intended to encourage recyclability will result in inferior economic and environmental outcomes.

Referring to the principles of the waste management hierarchy – reduction is preferred to reuse, and reuse is preferred to recycling, then through that lens, many producers are already developing more sustainable packaging. Once again, the issue is that most people (both policy planners and the public) conflate recycling with sustainability – if it can't be recycled, it must be bad. This is perhaps what is most dangerous about existing EPR legislation, is that it focuses on recycling-based

outcomes and is intended to “improve recycling rates and recycled content requirements” for printed paper and packaging. However, not all recycling is created equal, and in many instances, prioritizing mechanical recycling at the expense of other end of life outcomes can be detrimental both environmentally and economically.

While package light weighting has often been characterized as a negative due to low levels of recyclability, most life cycle analysis studies demonstrate that the “upstream” environmental savings (resulting from a reduction in material used, efficiencies in transportation and logistics and increased shelf life) significantly offsets or supersedes the environmental impact of being unable to recycle those materials.

Existing and proposed legislation incents recycling (and in some instances, takes punitive measures towards materials that have low levels of recyclability), but offers no credit for the waste reduction that is achieved. In many ways, the existing approach may result in an environmentally and economically perverse outcome, where producers “switch back” into heavier, but more recyclable packaging, yielding a worse environmental outcome.

Evaluating the environmental impacts of any particular packaging choice or policy that affects packaging will require an expanded life cycle analysis framework that captures the complexity of the issue. In its simplest terms, eco-modulation is the concept of penalizing the use of materials that are perceived to be environmentally harmful, while rewarding the use of those which are perceived as being “better” for the environment (i.e. more recyclable). This can take many forms, i.e. placing taxes on products that have a large carbon footprint, or providing subsidies to those with a demonstrable environmental benefit.

Appendix 1 provides an alternative framework for evaluating both the economic and environmental impact of packaging design choices, with the hopes of providing guidance on how to develop methodologically sound policy that is rooted in science and data.

2.42 With a focus on plastic waste, climate change and sustainability, isn’t now the time to implement EPR?

Now is the time to use evidenced based research to help guide effective policy – railroading EPR legislation through without undertaking the necessary due diligence can have catastrophic consequences to both the environment and consumers.

In jurisdictions considering EPR legislation, most cannot tell you how much packaging is generated into the market, what proportion of that material is residential vs. the IC&I sector, and what does it costs to manage packaging waste, by material type. Simply put, nobody has collected this data, and doing so is both a time intensive and complex exercise. Advocates of EPR legislation are

selling it on the idea of environmental sustainability and stewardship, but they cannot give you any clear insight into the size and scale of the issue.

It is irresponsible and unfair to ask industry to pick up the tab for a recycling system, when they have no sense of knowing what that tab will be. The most basic building blocks of an EPR system are not in place, and advancing legislative discussions without gathering baseline data makes no sense. Also, In light of unprecedented inflationary pressures, now is not the time to be implementing policy that has had questionable success in other jurisdictions. Ontario and BC are spending more on a recycling system that recycles less – in what world is that considered a success?

As a conceptual tool, EPR shows promise, but it is no silver bullet to resolving recycling system woes.

3.0 Economic Impacts

3.1 Won't EPR mean that I pay less taxes?

One of the common claims made by advocates of producer responsibility is that it results in a reduction in the municipal tax base. Many proponents of EPR often (baselessly) claim that that the adoption of producer responsibility would save tax payers hundreds of millions of dollars each year. However, the actual impact on the municipal tax base is much more muted. Municipalities (particularly in a post COVID world), grapple with significant budgetary shortfalls and are in all likelihood going to take the funds "saved" from transitioning the recycling program and re-allocating those funds to other programs and services. In EPR jurisdictions such as Ontario, British Columbia, Manitoba and Quebec – property taxes have increased successively for each of the past 5 years. In fact, Ontario's proposed property tax increases for 2023 are historical highs, despite the transition to 100% producer responsibility. It is impossible to say what savings, if any, have occurred (or will occur) as a result of EPR legislation.

There is an argument to be made that the reallocation of funds to support other municipal programs and services does benefits household, but the benefits that are accrued are indirect and do not directly offset the increase in packaging costs that are attributable to EPR. It should be noted that in communities in which households pay a fee for service for recycling will no longer be required to do so.

3.2 I was told EPR has no impact on the price of consumer-packaged goods, and save taxpayers money, is this true?

One of the most common claims made by supporters of EPR legislation is that the impact to consumers will be negligible, and that there is no evidence to suggest packaging producers will

pass costs onto households. Governor Kathy Hochul of New York State was quoted as saying that the cost increase would be fractions of a fraction of a cent.

Another claim made by supporters of EPR legislation is that its adoption will lead to more recyclable packaging, as producers will be incented to use more recyclable packaging and invest in recycling infrastructure in order to minimize their financial obligation under an EPR system (design for the environment).

There are a number of logical inconsistencies with the aforementioned statements, particularly given how EPR is pitched as a way to increase recycling, decrease taxes, encourage design for the environment, and minimize plastic and packaging waste, all at no additional costs to consumers or producers. If the costs of EPR are inconsequential and internalized by packaging producers, then the price signal resulting from EPR would not be sufficient to encourage packaging re-design or rationalize investments in infrastructure and end market development. If the price signal is sufficient to encourage design for the environment, then these costs are likely to be significant, and will be reflected in the price that consumers pay.

Based on the proliferation of light weight and flexible packaging in jurisdictions with EPR, even in light of rapidly escalating system costs, it would appear that EPR has done little to affect packaging design choices. Recycling rates are trending down, while recycling costs are going up, largely as a result of packaging no longer being compatible with mechanical recycling systems.

The phenomenon has been coined the "evolving tonne" – the recycling bin of today is fundamentally different than the recycling bin of 10 years ago, and the infrastructure to recycle packaging is largely incompatible with new packaging formats. While EPR is intended to incent producers to opt for more recyclable packaging to minimize their fee obligation, most CPG companies continue to transition to lighter and flexible packaging formats due to efficiencies in logistics and transportation, product durability, shelf life and cost.

It is also worth noting that the fee allocation methodology used in Canadian jurisdictions is calibrated around recycling system costs. By definition, any increase in net system costs are passed onto the consumer. This isn't a matter of debate or speculation, this is how the fee model actually works – the totality of any increase in recycling system costs is reflected in the fee that producers pay (which is built into the price of a product at the point of sale).). If the overall net system cost increases by 10% (i.e. $200 million to $220 million), fees for obligated producers will be automatically adjusted to recover these costs.

3.3 I was told that EPR has existed for more than 30 years in countries across Europe and Asia, and there is no evidence to show that EPR has an impact on packaging prices. Is this true?

York University has undertaken a comprehensive review of EPR jurisdictions from around the world, including several studies surrounding EPR governance as well as historical recycling system performance across jurisdictions (measured both in costs and diversion rates)

The claim that there is no evidence that EPR legislation increases consumer packaged goods costs is based on a faulty premise – the absence of evidence is not proof of outcome. There is a relative paucity of studies that specifically examine the economic impact of EPR for packaging waste, with no clear consensus among stakeholders about what these impacts are, and it is also very difficult to prove. Previous attempts to do so by RRS, York University and Columbia University, all arrived at very different conclusions.

On one end, RRS said there was no impact on the price of consumer-packaged goods and on the other end, York University said the impact was significant. Columbia University's study occupied the middle ground, suggesting that there is an impact, but it is relatively small. Each of the respective approaches used to quantify potential impacts have several deficiencies, primarily a lack of jurisdiction specific data. The potential impact on the price of consumer-packaged goods as a result of EPR is unknown, and it is impossible to know without having a better sense of what the recycling system is going to cost. At present, few jurisdictions have any data on material specific recycling costs, no way to track quantities of packaging being sold into the market (or which sector it is being sold to – residential vs. IC&I), limited information on the composition of the recycling stream, and no mechanism by which to quantify and assign costs to individual material categories and producers.

Using experiences from other EPR jurisdictions to use as a reference, we can look at how recycling system costs have changed over time in response to EPR. In jurisdictions such as British Columbia, Ontario and Manitoba, we know that recycling costs are increasing by double digits year over year, while recycling rates are stagnating (and in some instances, decreasing). We also know that the composition of the recycling stream has a significant impact on total recycling system costs. With reported recycling system costs in the hundreds of millions of dollars (and increasing), previous attempts to model the impact of EPR legislation found that costs could go up from as little as 2%, to as much as 12%, depending on the material category. As noted earlier, not all recycling is created equal, and the costs of managing end of life packaging waste differs significantly across material types. As a result, the economic impact of EPR on the price of consumer packaged goods will vary across jurisdictions, as well as across product categories. Plastic based packaging is more likely to see their costs increase in response to EPR, when compared to something like aluminum packaging. While the magnitude of these economic impacts is not fully known, inflation for consumer-packaged goods is at an all time high, while economic activity is beginning to slow. Adopting EPR legislation without performing the due diligence to understand what impacts EPR may have on the broader economy is both short sighted and dangerous.

The ability to model the potential economic of impacts of EPR legislation prior to its adoption affords greater control of study variables, and in many ways, provides more meaningful and credible insights.

It is the absence of research in this area that necessitates further investigation – the statement ("we have more than 30 years of data to evaluate the impact EPR for packaging has on the price of consumer goods") is patently false. Whatever data exists is not in a form that readily allows for modeling the impact of EPR legislation on packaged goods pricing. Once again, the absence of evidence is largely because nobody has asked the question – it is not indicative of proof of outcome, and presenting it as such is disingenuous. The following is a critical evaluation of both the EPR costing study conducted by RRS, as well as the Recycling Partnership. It is absolutely essential that stakeholders understand what can and can't be done with data, particularly how to interpret the context of what they are looking at, and how it can influence the results.

3.4 Studies by Resource Recovery Systems and The Recycling Partnership have shown that EPR has no impact on the price of consumer goods, who should we believe?

3.5 Issues Surrounding the Study Conducted by RRS

The study undertaken by RRS examined several Canadian jurisdictions (both with and without EPR legislation) and compared the in store prices of various packaged goods to determine whether EPR legislation had an impact on product pricing. The hypothesis was that if EPR were to have an impact on price, then jurisdictions with EPR policy should observe higher prices in stores than those without.

Based on the analysis conducted by RRS, the study found that there was no statistically significant difference between product prices, and therefore concluded that EPR did not have a discernable effect on the price of packaged goods. This finding was embraced by supporters of EPR policy, who often contend that EPR will not adversely affect consumers.

RRS' finding, however, was based on a faulty premise, as there were numerous methodological deficiencies that were not addressed in the study. These deficiencies ultimately led to erroneous conclusions that could be supported superficially by the data. Given the way the study was designed, it was not objectively possible for the study to make any statements regarding the effect of EPR policy on packaging prices. Comparing costs across jurisdictions (even for like products and retailers) is not likely to yield any meaningful inferences with respect to the impact of EPR policies.

There are literally hundreds of variables that affect the price of goods across localities (even for the same product and retailer). Demographics, infrastructure, relative purchasing power, proximity to markets, density of competing retailers, etc. all affect in store pricing. In order for the authors of that study to make the blanket statements and conclusions that they did, they would have to control for all of these factors using statistical techniques to specifically isolate the effects of EPR

on packaging prices. Given that many of these explanatory variables are collinear (interrelated), they would also need establish controls for interdependency among explanatory variables.

The findings presented by RRS demonstrate a fundamental lack of understanding surrounding the appropriate statistical procedures, as well as how to design and interpret the relevant tests to determine the presence of any correlations. Several of the slides referenced during RRS's presentation indicated that they had done correlation coefficient testing (R2). While this is a standard test used to detect the presence of relationships between variables, they made no attempt to assess residuals (error) resulting from omitting variables, or variable misspecification. In fact, given that they excluded all other variables that could potentially influence the price of a package, the test they used (ordinary least squares) cannot be used. By omitting and failing to control for all other explanatory variables, no correlation coefficient (R2) can be calculated.

In response to this criticism, RRS asserted that since their study used "real prices" taken from actual retailers, it added a degree of legitimacy to the analysis that the study conducted. Unfortunately, in the absence of proper study design, the use of "real prices" has no bearing on the legitimacy of the analysis. In the simplest terms, it is no different than looking at flyers from different cities and making an informed guess as to what impact EPR may have on prices.

3.6 Issues Surrounding Studies Conducted by The Recycling Partnership

It is important to note that the study conducted by Dr. Bose was paid research at the behest of the Recycling Partnership, an organization supportive of EPR legislation.

Dr. Bose's study is premised on the following:

1) Consumer demand for consumer-packaged goods is elastic, and as a result, producers would be reluctant to pass on any increases in cost resulting from EPR onto the consumer, in fear of decreased demand;
2) Producers (particularly those that are national in scope) do not engage in discretionary pricing – *i.e.*, the price of Kellogg's cereal in one jurisdiction is going to be the same in other jurisdictions; and
3) EPR does not add any additional costs to the system, it is merely a transfer of costs from the municipality/city to producers.

1) Consumer demand, elasticity, and producer internalization of costs

Dr. Bose's first assumption is based on a faulty premise - the conventional interpretation of demand elasticity is that consumers would either a) switch to a cheaper substitute good, or b) abstain from the purchase as the price increases. This would make sense for goods that are classified as discretionary, but EPR for packaging often applies to food-based packaging and other consumer staples. EPR for packaging fees apply to the *entire material category* (*i.e.* corrugated cardboard) and unless a consumer is able to make substitutions across product categories, the impacts of EPR

fees would apply to all goods with that particular material type. Cereal is a good example of this. Almost universally, packaging for cereal is made of paperboard. It doesn't matter if a consumer switches from Kellogg's to a no-name brand, the impact of EPR fees on paperboard prices is going to apply to all products in that material category. In this example, demand elasticity doesn't apply.

As a result, it is not unreasonable to assume that producers will pass the majority of costs onto consumers, as consumers are unlikely or unable to switch into a substitute good in response to any increases in price, thereby giving producers no incentive to internalize any of these costs. This is particularly true of food-based packaging. Indeed, in the November 15, 2022 CCSMM presentation, a Canadian EPR management company admitted that the entire cost of EPR is passed to the consumer in response to a question on the point – "So if you're talking manufacturers as the producers, the tire manufacturers I mean, broadly economically speaking, it all gets passed to consumer."

However, in the event that a consumer abstains from making the purchase altogether due to potential increases in price, then there is a bigger implication of affordability, access and equitability. The vast majority of consumer packaged goods products are not discretionary/luxury goods – they are groceries and household essentials.

As for Dr. Bose's assertion that producers will internalize some, or all, of the costs associated with EPR due to concerns surrounding a decrease in demand, it is inconsistent with what we observe in the real world. In a period of unprecedented double-digit inflation, the New York Times, Forbes and CBC all found that producer margins were increasing during the inflation crisis. In some instances, producers were accused of profiteering and are under investigation for predatory pricing practices. I contend that the notion that producers are willing to pass on the costs of inflation, but internalize the costs associated with EPR is inconsistent, if not naïve. As a tangent to this point, if demand is elastic in response to a change in price attributed to EPR, then that is an admission that the economic impacts are material. If it wasn't, producers wouldn't care about changes in demand in response to changes in price.

2) National Producer Pricing

One of the primary arguments made by the Columbia study is that there is little variation in product pricing across jurisdictions – producers who have a presence across the country are likely to engage in "national pricing," where in the price of product 'A' is the same, irrespective of jurisdiction. As a result, national pricing would eliminate any jurisdiction-specific aberrations in costs attributable to EPR. Much like Dr. Bose's earlier claims surrounding internalized costs, there is very little data, if any, to suggest that producers engage in national pricing. In fact, the exact opposite has been observed, with producers engaging in discretionary pricing (even for the same product/good) as a means to maximize profits and have prices reflect endemic local characteristics (*i.e.*, wage rates, population density, proximity to markets, etc.). A 2019 study by the OECD found that the price for the same product could vary by as much as 35% depending on locality. In Ontario, locality is one

of the primary determinants of product pricing - prices vary significantly across jurisdictions, even among the same retailer and product categories. A 3L bag of milk in North Bay, Ontario is more than twice the price of what it is in Windsor, Ontario.

3) Costs associated with the development and operation of an EPR program

Perhaps the most perplexing of Dr. Bose's assertions is that EPR does not add costs to a system, but merely reassigns costs to the relevant obligated party (in this case, producers). Not only is it not true, but it illustrates a complete lack of understanding surrounding the complexity of how an EPR program works. Calculating fees and assigning costs to producers, coordinating between service providers and stewards, administrative enforcement and oversight, data collection, monitoring and verification, etc. are all essential and *costly* components in developing and administering an EPR program.

At this juncture, most jurisdictions do not have the necessary data to develop and administer an EPR program, as most of this data has yet to be collected. The costs associated with conducted waste audits and activity based costing studies, developing a process for remitting fees, granting oversight authority to a central agency to ensure that fees are calculated in accordance with legislative requirements, etc. have not been quantified.

EPR programs cost a lot of money to set up and administer. Costs that are not present in a free-market system. For context, year over year EPR administrative expenses in Ontario are estimated to be 5% of total system costs ($16.5 million dollars annually). This cost does not include the initial startup cost associated with launching Ontario's EPR program for packaging waste dating back to 2002. The notion that EPR does not add costs to a system is divorced from reality – not only is there a long history in other EPR jurisdictions that speaks to the contrary, but proponents of EPR legislation cannot tell you the most basic of things, *i.e.,* recycling rates by material type, how much obligated material is generated into the market and sold into to the residential sector, and what individual material management costs are by material type. In short, the State has no idea as to the size and scale of the problem, and suggesting that there are no costs associated with EPR is both wrong and dangerous.

It is also worth noting that the Recycling Partnership Study makes no attempt to factor in any costs associated with developing collection and processing infrastructure that will be needed to have an effective recycling program for consumer-based packaging waste. As an example, EPR legislation proposed in Colorado made no provision for investments that would need to be made with respect to increasing household access, collection, material recycling facilities (MRFs), etc. Proponents of EPR legislation assume that this infrastructure is already in place, when in reality, some jurisdictions will have to invest hundreds of millions of dollars before they can even begin to think about adopting EPR legislation.

3.6 If CPG companies sell their products across the country, aren't prices going to be the same regardless of the jurisdiction it is being sold in?

This is one of the arguments put forward by proponents of EPR legislation as evidence that companies do not engage in discretionary pricing in response to producer responsibility legislation. A pack of Oreo cookies being sold at a Walmart in Connecticut, should be the same in a Walmart in Maine. It is unclear where that argument came from, or what data was used to inform it, but identical products routinely differ in price depending on where the retailer is located. A 2014 study on price discrimination and consumer substitution published in the American Economic Journal of Economic Policy found that companies actively engage in price discrimination, with prices for the same product varying by as much as 36% depending on locality . This study also found that price discrimination can even occur in the same city, with a tiered pricing structure that was directly correlated with proximity to the city center. In short, it is not only normal that producers set different prices for the same products depending on locality, but also expected as a means to maximize consumer discretionary spending .

3.7 Why are some producers in favor of EPR legislation?

The impacts of EPR legislation are not the same for all stakeholders – the impact on packaging producers may be radically different depending on the types of material that they use for their packaging. Brand owners (such as Coca Cola, Pepsi etc.) who primarily manufacture highly recyclable and low cost packaging such aluminum and PET beverage containers are relatively unaffected by EPR legislation. The potential costs incurred amount to pennies per unit, and depending on how legislation is scoped, EPR could be advantageous to these groups. By contrast, producers that use more difficult to recycle and costly packaging materials such as plastic film and thermoforms are likely to be adversely impacted by EPR. By definition, the producer obligation (what companies are responsible for) is a direct function of what it costs to recycle – in jurisdictions which use an incentive-based model that specifies recycling rate targets, these difficult to recycle materials will face an even higher fee rate (which, in turn, will lead to an increase in the price of that particular product).

3.8 Some Canadian provinces have enacted EPR – Ontario and British Columbia. What has been the economic impact in those provinces?

The cost of Ontario's Blue Box is approximately $300 million annually, while British Columbia comes in it at roughly $100 million dollars. What is of greater interest is that the cost of Ontario's Blue Box program has almost tripled since program inception, and both British Columbia and Ontario experience year over year cost increases in the double digits. Costs are growing exponentially, while the amount of material they are actually recycling is decreasing. Ontario in particular recycles less today, than it did 5 years ago, but it costs significantly more to operate the program.

It's important to note that this isn't really the fault of the province or service providers – the composition of the residential recycling bin has fundamentally changed over the past decade. Increasingly, our packaging is being made up of lighter, but more volumous materials that are likely to be made of flexible or composite plastics. Simply put, our infrastructure was never really designed to collect and recycle these materials.

This raises a secondary question of whether it makes sense to try and continue to recycle these materials, and invest in modernizing our infrastructure to improve recycling rates. There is no clear answer to this, as not all recycling is created equal, and legislating that something should be recycled, doesn't magically make it happen. For context, Ontario has spent more than $100 million dollars over the past 13 years trying to recycle paper laminates, and the recycling rate has remained unchanged at 1%. At tremendous amount of money is being spent attempting to recycle materials that face fundamental technical barriers to being recovered. It's spending good money after a bad idea – a sustainable system is one that is economically tenable, and one of the biggest issues with current incarnations of EPR legislation, including what is being proposed in several jurisdictions, is that recycling rates are the yard stick by which we are measuring success. While this may have been an appropriate objective during recycling's nascency, it is becoming painfully clear that it is no longer compatible with the changing nature of packaging and current state of waste sorting infrastructure.

3.81 Recycle BC: Peaking behind the curtain

The Recycle BC program, which is often touted as a "best practice" model of steward lead extended producer responsibility, and is seen as a potential model to be replicated in jurisdictions across the United States. However, are the results nearly as good as they seem? In 2020, York University undertook a comprehensive evaluation of the Recycle BC EPR for program for packaging waste, with several of the key findings summarized below:

- Program costs have increased by approximately 26%, while program performance (measured as tonnes diverted) has increased by 1%
- Despite a 7% indcrease in service coverage (measured as # households with access to curbside/depot collection), total collected recycled tonnes remains unchanged, while tonnes of material being sent to landfill disposal is increasing. Overall, tonnes being collected by Recycle BC (including recycling, recovery, energy from waste and disposal) is trending downwards
- The most significant driver of increase in costs can be traced to increase in per tonne material management costs (which increased by 20.5% year over year between 2017 and 2018). While the specific cause for this increase is difficult to isolate, a potential explanation is that the proliferation of light weight and composite materials cannot be readily managed in existing recycling systems.
- There is no evidence to indicate that a steward operated extended producer responsibility scheme will result in cost containment or increases in recycling performance. In fact, the

rate of year over year cost increases is greater in British Columbia (steward lead) than it is in Ontario (municipally lead), when compared over the same time period.

3.9 If I'm a manufacturer or a consumer who doesn't have anything to do with producing packaging material, how will EPR affect me?

Even though proponents of EPR will disagree or downplay this point, consumers are the ones who ultimately bare the cost of adopting producer responsibility legislation. Without getting into the specifics of how fee models work, the approach used in Ontario and British Columbia automatically pass recycling system costs onto consumers, as fees are calibrated around the producer obligation. By definition, consumers pay for the cost of EPR, and that isn't even a matter of debate, that's the math of how the fee models work. Quantifying indirect and tertiary economic impacts of EPR legislation is where things get trickier.

For the purposes of simplicity, we use something called an input-output model to calculate indirect and induced costs. In general terms, input output models provide a detailed picture of the flow of products and resources within a given economic system, and the actors both within and outside of said system. Input-Output models are commonly used to estimate economic multipliers for specific industries and sectors resulting from things like an increase in taxes, investments made by government etc.

But what does that have to do with EPR? Going back to costs facing producers, they can respond in one of three ways – pass that cost along to the consumer, company contraction through job losses, reduced investments and downsizing, or some combination thereof.

These decisions have a snowball effect throughout an economic system – it's sometimes easiest to conceptualize the problem as taking X million dollars out of an economy, which has a series of cascading impacts on producers, industry, households etc. The net effect of these impacts is often multiples larger than the initial direct impacts.

While some are critical of this approach and contend that an input/output model is not something that should be applied to EPR legislation, there is a methodological precedent for doing so. Ironically, the same approach has been used when attempting to quantify the economic benefits of recycling. A report by Eunomia consulting proudly stated that investing in the recycling industry would lead to hundreds of new jobs and tens of millions of dollars for the local economy. If that's true, then we have to accept that the economic impacts of EPR legislation also have the same indirect and induced impacts.

One thing that has also been omitted from the analysis is the cost of data collection and the administrative complexity of developing fees, assigning costs and overseeing a program. These are not insignificant costs – Ontario has spent the better part of 20 years gathering data on residential recycling for packaging, and developing the processes that underpin our EPR program. And even

with these decades worth of experiences, the data is poor, and calculating and assigning costs is an inexact process at best.

3.10 EPR will lead to end market innovation and help support recycling markets

EPR is often characterized as being a solution for helping identify new end use applications for difficult to recycle materials and help support healthy and robust recycling markets. However, a comprehensive review of data from across North America and Europe show virtually no evidence of this – arguably, market volatility for recycled commodities is at an all time high, and jurisdictions with EPR are market "takers", and not market "makers".

There are three issues at hand with respect to the claim that EPR can help support end market innovation and development:

1) Technical and Infrastructural Barriers
2) Economic Scalability and Feasibility
3) End Market Demand and End Use Applications

The vast majority of materials that are characterized as "problematic" and specifically being targeted by EPR legislation (i.e. composite materials, multi-resin plastics and light weight films/flexible packaging), face enormous technical and infrastructural barriers to their recovery.

It is not as simple as "finding value" in a material and investing in an end market to maximize that value. That is putting the cart before the horse – in the absence of an end market or end use application, that material has no (or nominal) economic value. Forcing producers to create artificial markets for their packaging (using mediums such as Terracycle, or even investing in more efficient ways to collect and process materials), is going to exacerbate the cost of managing and operating the system.

If our goal is to recycle at any cost, then that makes sense, but what if our goal is to promote the most sustainable outcome: Economically, Environmentally and Socially? While future innovation and improvements in technology may lead to these materials being economically recoverable in the future, mechanical recycling faces very real technical barriers with respect to managing composite and light weight materials. It has limited value at its end of life, limited end market demand, and in virtually all instances, it is downcycled into an inferior product that is ultimately landfilled. It is delaying disposal, not promoting circularity, with a very real cost that represents funds that could be better spent on alternative sustainability endeavors. As an anecdote, Ontario has spent more than $90 million dollars on trying to recycle paper laminate cups since 2002, and its recycling rate remains unchanged at 1% two decades later. Asking producers to "Build it and they will come" does not seem to be rooted in any sound evidence to suggest that this will be the outcome.

While it is certainly possible that EPR legislation could potentially help improve the collection and recovery of packaging keeping it out of landfills and the environment, that is very much jurisdiction specific. As noted earlier, EPR can be used to help finance the development of recycling infrastructure, improving accessibility and opportunities for consumers to recycle packaging. However, that infrastructure is already in place in several of the states pursuing EPR legislation. Furthermore, the types of packaging that are ending up in our environment (i.e. plastic bags, chip bags and candy wrappers etc.), are materials that largely cannot be recycled in conventional mechanical recycling systems. Even if these materials were somehow collected and sent to a material recycling facility, there would be very few end markets, and nothing to turn it into. These types of plastics have very few economically viable and scalable options with respect to mechanical recycling and are often landfilled and treated as residue/contamination. While chemical recycling does show promise in processing these materials, it is still a technology that is in its nascency.

4.0 Conclusion: Stakeholders need to understand what you can and can't do with data

Both opponents and proponents of EPR legislation need to understand what can and can't be done with data. York University has waded into this conversation not because we were asked to by any particular group or stakeholder, but because we have seen just how catastrophic poorly designed EPR policy can be.

What is most concerning about the discussions surrounding EPR legislation is the lack of understanding surrounding the state of data (what is available, who has it, what can be done with it, what needs to be collected etc.). As noted above, many of claims made by proponents of EPR cannot be supported by data, and are often the result of not fully understanding the differences between correlation and causation, or how to correctly interpret and analyze data. York University strongly encourages additional research in this area by individuals who have the requisite training in quantitative analysis, study design and statistics.

Research surrounding the impacts of EPR legislation on consumer packaged goods and the economy as a whole remains in its conceptual infancy. While EPR legislation has been in place for the better part of three decades in some jurisdictions, it has received scant academic attention, under the presumption that more recycling is a "good thing". However, recent research (conducted by York University and other) has not only shown that recycling may not be a good thing in all instances, but that that the performance of our recycling systems is declining in response to package light weighting. A dearth of relevant research is an opportunity to go out and gather data to better understand the issue – it is not a green light to railroad EPR policy where the impacts remain poorly understood.

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APPENDIX 1: Life Cycle Analysis Thinking

Life cycle thinking for the purposes of informing policy decisions is not a new phenomenon – in fact, many of the studies included in the Environment Canada literature review included a life cycle component when evaluating the environmental safety of various packaging types.

However, most contemporary approaches to life cycle analysis, particularly within the context of end of life management of packaging waste, define system boundaries that are too limited in scope. Often times, model boundaries are defined from the point of disposal, to its final end use application (recycling, composting, energy from waste, or landfilling). The environmental impacts of a particular end of life option are compared against a baseline assuming 100% virgin production (i.e. Recycling 1000 tonnes of PET, would be compared against the environmental impacts of producing 1000T of virgin PET, with the delta in LCA key performance indicators being the measured impact)

The vast majority of life cycle analysis specific to waste management and material design is only concerned with what happens to an item once it reaches its end of life. It is through this lense that many plastics, particularly single use plastics, are deemed to be environmentally problematic. In many instances, particularly for light weight and composite plastics, these materials cannot be readily managed in existing waste management infrastructure.They either cannot be recycled or composted, and even when sorted at a material recovery facility, there are limited end markets for most non PET and HDPE plastics.

As a result, the characterization of these materials is often seen as being “bad” for the environment, with many environmentalists and municipalities pointing to the lack of recyclability as being the primary driver for banning single use plastics. In the absence of recycling or reuse, there is no offset to the environmental burdens associated with virgin production of these plastic materials. If these materials end up in a landfill, the risk of entering into our environment and disrupting both aquatic and terrestrial eco systems increases.

While this outcome may lend credence to the decision to ban single use plastics, it fails to account for the upstream impacts (economic, environmental and social) of a material, prior to consumption. In spite of many single use plastics possessing low levels of recyclability, potential benefits attributable to plastic packaging include:

- A reduction in the amount of materials used. The transition to plastics for many products has resulted in the light weighting of materials – less physical material is used to make the product.

- Logistical efficiencies (more material can be transported per shipment) – largely attributed to the reduction in overall weight, the use of light weight and composite plastics has resulted in a reduced emissions footprint related to the transport of materials.
- Increased durability, longer shelf life (both in the store, and in the home), and allowing for discretionary consumption (you only use what you need). This is particularly true of plastic food packaging. As an example, a laminate package for soup (in lieu of the conventional tin can) allows users to reseal the pouch, allowing it to be stored longer and avoiding waste.

This white paper expands the list of criteria for what should be considered in a life cycle analysis, as a means to create more informed and defensible policy decisions.

Expanding life cycle criteria

This white paper recommends expanding the boundaries of a life cycle analysis to capture criteria such as material reduction/light weighting, logistical impacts attributable to light weighting, effects on useful product life (both at the store and in the home for perishable items packaged using plastics), discretionary consumption, direct and indirect economic impacts, available waste management infrastructure, risks when landfilled and risks when incinerated.

Table 1 below summarizes what variables are included in the proposed expanded life cycle analysis. It is important to note that depending on the scenario and circumstances being modeled, not all criteria will apply.

Table 1: Variables to be considered in expanded Life Cycle Analysis

Initial Production
Primary Production (Raw material extraction)
Primary Production (Raw material extraction)
Secondary Production (Product Manufacturing)
Transportation
Transport (Virgin extraction to manufacturing)
Transport (Manufacturing to end market)
Transport (Waste Collection)
Transport (Transport to Recycling Center/Landfill/Incinerator)
Transport (To End Market Destination)
Consumption
Shelf Life (At store, in home)
Discretionary Consumption
Design for the Environment
Material Reduction (Light weighting)
Reuse (Material Durability)

End of Life Infrastructure

Recycling
Composting
Landfill
Waste to Energy

Material Management Costs

Waste to Energy
Recycling Cost
Landfilling Cost
Cost of Composting

The above KPIs include both quantitative measures (i.e. $ cost per tonne managed,) as well as qualitative variables that provides useful contextual information that can better inform decision making.

While expanding our life cycle approach to capture these variables may result in a more time and data intensive life cycle analysis, adopting this methodology is critical in understanding the "true" impact of plastics, particularly single use plastic packaging. In theory, a comprehensive life cycle analysis is intended to capture the aforementioned components, however, there is little methodological guidance with respect to how to do that, and for which materials can it be applied. Further complicating the inclusion of these additional variables is an issue of measurement – how can we measure things like waste reduction, shelf life etc?