PYROWAVE

Electrifier.
Régénérer.
Innover.

February 28th, 2022

Ian Drew
Resource Recovery Policy Branch
Ministry of the Environment, Conservation and Parks
40 St. Clair Avenue West
8th floor, Toronto, ON M4V 1M2
Submitted via Ian.Drew@ontario.ca

Re: CIAC submission to ERO 019-4867 Environmental assessment requirements for advanced recycling facilities under the Environmental Assessment Act (EAA)

Dear Mr. Drew,

Pyrowave is a pioneer in the electrification of chemical processes based on low carbon footprint microwaves. Pyrowave is also a Canadian leader in the plastics circular economy and chemical recycling to regenerate post-consumer and post-industrial plastics into new plastics, reclaiming these resources' full value. Its patented high-powered microwave catalytic depolymerization technology platform is the most advanced in the world and is now at the forefront of the next generation of plastics. By restoring plastics to their molecular state (plastic to monomer) identical to virgin materials, Pyrowave technology enables infinite recycling of plastics and provides a circular economy solution to meet the global plastics recycling challenge.

As an equipment manufacturer, we have a demonstration plant and a R&D centre in Canada and we partnered with the Michelin Group in 2020 to deploy our technology in Europe by 2023. We are also developing the Asian market. The accelerated growth Pyrowave has seen in the last two years is partly due to the evolution of a favourable regulatory framework in Europe aiming at incentivising the circular economy and the innovation to achieve ambitious sustainability goals. The European regulatory framework has translated into contracts and attracted new investors for Pyrowave. Pyrowave salutes the intent of the Ontario government to recognize the contribution of chemical recycling and its objective to remove the red tape to foster the implementation of those disrupting technologies.

We believe a portfolio of solutions are the key to addressing the global plastic waste challenge. Our technology, based on microwave that can be powered by renewable electricity, is able to decompose hard-to-recycle plastics as well as contaminated or coloured plastics. This approach, in combination with eco-design rules, mechanical recycling, as well as investment in recycling infrastructures to better sort those plastics, will not only be good for the environment. Il will support the development of a new generation of low-carbon plastics to contribute to the decarbonation of our economy, support the fight against climate change, and it will create new high-skilled jobs in the circular economy shift for Canadian companies who have benefited from Ontario government support such as ours.

As we have seen the positive impact of circular economy regulation in Europe, we will therefore share our comments on the current regulatory project from our international perspective of what kind of legislation fosters demand for plastic recycled content including from innovative technologies such as Pyrowave.

In addition, as chemical recycling is an emerging sector, we believe we have the opportunity to clarify and harmonize terminology pertaining to chemical recycling with the great work that has been done in Europe. As a member of the Chemical Recycling Europe Association, we wish to contribute to a shared understanding of chemical recycling and we believe there should be a harmonized framework for chemical recycling both in Canada and Europe, as we have similar Extended producer responsibility (EPR) schemes that allows for similar streams to treat plastic waste, and will provide certainty for Canadian chemical recycling technology companies such as Pyrowave who want to grow their business as part of Canada-EU trade agreement (CETA).

Summary of comments and recommendations

Pyrowave salutes the Ontario government legislation proposal to recognise chemical or advanced recycling as part of the portfolio of solution to plastics end-of-life and as part of the shift toward a circular, low-carbon economy. We offer government authorities our full support in implementing a legislative framework that accelerates the achievement of a zero plastic waste objective as well as contributes to job creation for the Ontario economy.

As a representative of Canadian chemical recycling technologies, we base our comments on the current legislative proposals on our ten-year experience of growing from a startup to a commercial-stage company with a hands-on view on regulatory brakes and levers. In addition, we take this opportunity to share complementary comments in order to address a broader framework in which we believe Canadian chemical recycling technologies that produce plastic waste to monomer such as ours – with physically traceable recycled content - can contribute to the circularity of plastics while ensuring consumer trust and transparency.

In doing so, we believe the ultimate goal of keeping our precious resources in the manufacturing loop should be reflected in terminology, hierarchy and accounting of recycled content produced by the various chemical recycling technologies. As Canada has trade agreements with Europe and many other jurisdictions, fostering a harmonized legislative framework pertaining to chemical recycling should be viewed both through the export lens of Canadian technologies as well as their deployment in Ontario. Our partnership with an industrial leader such as Michelin in France is a great example of Canada-EU trade opportunities offered by the global issue of plastic waste pollution. Our European project with Michelin announced in 2020 has shown us the positive impact of the modernisation of the European union legislation on circular economy and the regulatory incentives adopted to better manage plastic waste end-of-life. Our comments are also inspired by our key learnings on regulatory levers that can accelerate the growth of innovative solutions for plastic waste.

We strongly believe the Ontario government has an essential role to play to shape a legislative framework that could become a springboard for Canadian chemical recycling technologies, here and abroad.

Lastly, there is a momentum on the legislative front as many Canadian jurisdictions – provincial and federal – are currently modernising their legislation on related topics: Extended Producer Responsibility, mandatory recycled content in addition to the development of recycled content standard by the Bureau de normalisation du Québec (BNQ) mandated by the Federal government, which Pyrowave is part of the working committee. These are all great steps forward that have the potential to strengthen one another if designed based on a shared vision.

Here is a summary of our recommendations:

RECOMMENDATION #1: To exclude plastic-to-fuel as part of advanced recycling technology terminology and classify energy recovery as a separate category of waste management.

RECOMMENDATION #2: To define conditions upon which a waste can be classified as raw material when reintegrated into manufacturing of new products.

RECOMMENDATION #3: We support the threshold for Environmental Assessment (EA) process and the inclusion of an 80% recovery rate as an additional indicator.

RECOMMENDATION #4: To bonify advanced recycling technology by including thermal depolymerization.

RECOMMENDATION #5: To provide a clear distinction between ‘chemical recycling’ and ‘chemical recovery’ technologies.

RECOMMENDATION #6: To clearly establish the distinction between physical content (proportional to the amount of recycled matter found in the product) and accounted recycled contend (credits transferred from one product to another).

1. Terminology

Firstly, we welcome the clarification of the regulatory terminology related to advanced recycling and recovered materials. However, we believe that what is considered 'recycling' under advanced recycling terminology should be restricted to technologies that keep our resources in the manufacturing loop of new products and **exclude energy recovery**, which is the spirit of a circular economy. This is aligned with definitions agreed upon in Europe as well as provides more clarity of the meaning of the word 'recycling' while avoiding greenwashing perception from a consumer perspective.

In the document *Plain Language Description of Advanced Recycling Proposal*, in the section on relevant terminology, we agree with the definition of a recovered material if the material is not a fuel; however, we do not support the inclusion of fuel as part of recovered material from advanced recycling sites.

PYROWAVE RECOMMENDATION #1: TO EXCLUDE PLASTIC TO FUEL AS PART OF ADVANCED RECYCLING TECHNOLOGY TERMINOLOGY AND INCLUDE ENERGY RECOVERY AS A SEPARATE CATEGORY OF WASTE MANAGEMENT.

Additional recommendation out of the scope of the current consultation: Definition of waste versus raw material
Many definitions on thermal processing of residual material are out-dated in the law at various levels (municipal, provincial, federal). Moreover, the definition of residual material can sometimes be more restrictive than when handling toxic substances. While the environment should always be protected by the regulatory framework around residual material, industrial symbiosis and circular economy of plastics should be encouraged and facilitated from a regulatory standpoint. The EU has solved this issue in 2018 by excluding waste used for the production of new products from the waste definition and regulatory framework to facilitate its use as raw material for new products[1]. This definition needs to be updated to allow innovative chemical recycling technologies to emerge and deploy their activities in Canada.

PYROWAVE RECOMMENDATION #2: TO DEFINE CONDITIONS UPON WHICH A WASTE CAN BE CLASSIFIED AS RAW MATERIAL WHEN REINTEGRATED INTO MANUFACTURING OF NEW PRODUCTS.

2. Thresholds for environmental assessment (EA)

Pyrowave supports the goal to eliminate red tape where the environmental impacts of advanced recycling technologies are minimal and to include an indicator of recovery rate. We support the proposition that an advanced recycler that produces a higher percentage of recovered materials should be able to access a streamlined EA process or not be subject to comprehensive EA requirements, whereas those who produce little recovered material should be subject to more scrutiny as they will also be producing waste for disposal. We are also in favour of adding a resource recovery rate (i.e. the percentage of material recovered) as an additional indicator.

In the specific case of Pyrowave, our modular equipment is designed to treat local volumes of plastic waste thus avoiding the transportation of plastic waste on long distance, in order to reduce GHG emission. One Pyrowave module treat about 1,200 tonnes of plastic waste per year and has a yield of 95% (recovery rate), while producing a 99,8% pure monomer. A typical Pyrowave plant is an assembling of 6 to 12 modules corresponding to approximately 25 to 60 tons/day capacity. We agree with the government it will help recover the value from waste, reduce the burden on high-performing businesses while continuing to safe-guarding our environment.

PYROWAVE RECOMMENDATION #3: WE SUPPORT THE THRESHOLD FOR EA PROCESS AND THE INCLUSION OF AN 80% RECOVERY RATE AS AN ADDITIONAL INDICATOR.

[1] See Annex 1 – Extrait de la directive de l'Union européenne2018/851 modifiant la directive 2008/98/CE relative aux déchets, 18 mai 2018

3. Thermal treatment technologies

In order to clearly differentiate chemical or advanced recycling from waste to energy recovery technologies, we recommend to add a category of thermal treatment technology which Pyrowave falls under: using microwaves to decompose plastic waste into its basic constituents, monomers that are identical to virgin monomers but lower in carbon, to make new products with this recycled content. We believe that thermal depolymerization should be included in the list of technologies as it is more specific than conventional pyrolysis. Thermal depolymerization focuses on producing monomers or oligomers that can be purified and used directly into manufacturing of new chemicals and products.

PYROWAVE RECOMMENDATION #4: TO BONIFY ADVANCED RECYCLING TECHNOLOGY BY INCLUDING THERMAL DEPOLYMERIZATION

4. Plastic-to-product vs plastic-to-fuel: for a hierarchy of technologies based on carbon footprint and circular economy

The Ontario government proposes to remove the fuel component from the description of establishing a thermal treatment site that generates energy from waste and include it in the description of establishing an advanced recycling site, which, in our opinion, would be confusing.

The Chemical Recycling Europe Association defines chemical recycling as: "…*any reprocessing technology that directly affects either the formulation of the polymeric waste or the polymer itself and converts them into chemical substances and/or products whether for the original or other purposes, excluding energy recovery*."[2]

In Europe, waste to energy is not considered recycling as our precious resources would then not be kept in the manufacturing loop. However, while we recognise that in some cases, hard-to-recycle plastics might not find better alternative, we believe that it is important to hierarchize and separate the advance recycling technologies from plastic-to-fuel approaches as their environmental footprint differ as well as the possibility to truly recycle and keep those resources in the loop.

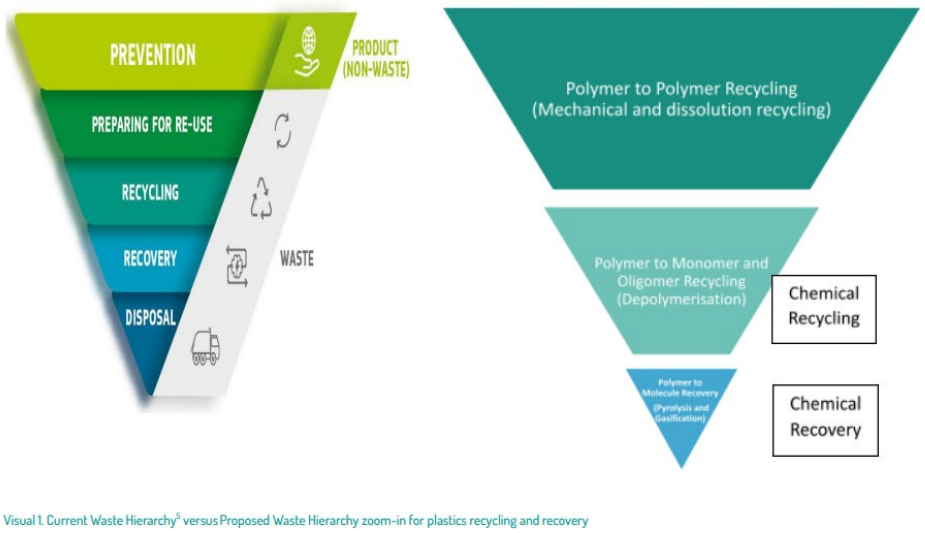
As such, Zero Waste Europe, a European NGO, stated in a recent letter with the support of 44 other European organisations that: "*We recommend that only chemical recycling technologies which produce polymer materials are legislated as 'recycling' while processes that produce feedstock for petrochemicals are defined as 'chemical recovery'. This distinction in the waste hierarchy is important to define the priority order between different waste management activities according to their environmental impacts, in order to successfully achieve the EU climate targets. In a circular economy, polymer materials should be kept in use as long as possible and processing of plastic to oil or gas should be approached only as a last resort. Clarifying the distinction between 'chemical recycling' and 'chemical recovery' minimizes the risk of diverting waste supply chains away from reuse and recycling towards petrochemicals feedstock recovery*."[3]

[2] Chemical recycling Europe Association definition of chemical recycing : https://www.chemicalrecyclingeurope.eu/about-chemical-recycling

[3] Zero Waste Europe October 2020 recommendation for a hierarchy of chemical recycling approaches : https://zerowasteeurope.eu/wp-content/uploads/2020/10/zero_waste_europe_10_14_2020_open-letter-to-DG-Envi_-chemical-recycling-in-the-waste-hierarchy.pdf

Here is the proposed hierarchy that includes chemical recycling and plastic-to-fuel:

Source : https://zerowasteeurope.eu/2019/05/a-zero-waste-hierarchy-for-europe/



Visual 1. Current Waste Hierarchy[5] versus Proposed Waste Hierarchy zoom-in for plastics recycling and recovery

Source : https://zerowasteeurope.eu/wp-content/uploads/2021/12/December2021_ZWE_Chemical_Recycling_position_paper.pdf

To further support this sustainability objective and in a spirit of transparency and clarity, the WWF has issued principles on chemical recycling that highlight some of these key elements, namely[4]:

Its purpose to establish clear implementation principles, aimed at protecting people and nature,…and…that these principles inform decision-making and help actors make choices which result in transformative change to the global plastic system to build sustainable, circular plastic use, and support WWF's vision of No Plastic in Nature.

Principle #2. Chemical recycling processes should demonstrate a reduced carbon footprintcompared with the production of virgin resin. It is important that chemical recycling processes deliver greenhouse gas (GHG) improvements over virgin-fossil plastic. GHG emissions should be verified with an independent Life Cycle Assessment.

Principle #5. The use of chemical recycling should be complementary to existing waste management systems and not compete for feedstocks with mechanical recycling.

Principle #6. Plastic waste streams should be matched to the most environmentally efficient technology available. This consideration should include the effective yield of the recycling process, as process loss may differ substantially across technologies.
Chemical recycling operators should be transparent with all requirements, including energy and water requirements and yield information.

Principle #7. Only material-to-material applications of chemical recycling should be considered recycling and part of a circular economy. Technologies that recirculate products or packages in the economy fulfil their circularity mission. These plastic-to-plastic technologies ensure that recycled content is being used in place of virgin material. Chemical recycling only contributes to a circular material system when it is applied to material-to-material production; activities such as plastic-to-fuel should not be considered recycling. Chemical recycling operators should not count fractions of material that are converted to energy, fuel, or otherwise lost in processing as "recycled". Plastic-to-fuel technologies do not offset virgin plastic entering the system.

Principle #9. Claims made regarding chemical recycling should be true, clear, and relevant. Public facing claims about content that is recycled using a mass-balance approach should clearly distinguish that content from physically segregated recycled content.

Principle #10. Plastic recycled with chemical recycling technologies should be verified with chain of custody. Because plastic recycled with these technologies cannot be distinguished from virgin fossil plastic by the public, 3rd party verification of chain of custody to ensure the authenticity of the amount and distribution of chemically recycled content is necessary. Credible chain of custody is required as proof for any claims made on plastic that has been recycled using chemical recycling technology.

PYROWAVE RECOMMENDATION #5: To provide a clear distinction between 'chemical recycling' and 'chemical recovery' technologies

5. Aligning Federal proposed regulation *on minimal recycled content requirement for certain plastic manufactured items* and calculating Chain of Custody for recycled content

There is currently a consultation by the Federal government on minimal plastic recycled content requirement as well as a mandate from the Federal government issued to the BNQ to work on a plastic recycled content standard. We believe all this work is a great effort to drive plastic circularity and that such effort should be aligned to ensure a harmonised vision among the various government authorities.

[4] WWF : chemical recycling implementation principles: https://www.worldwildlife.org/press-releases/wwf-releases-new-position-chemical-recycling-implementation-principles

It should be noted that there are many ways to calculate recycled content in a Chain of Custody model which ISO standards a based upon. As such, not all recycled content is equal, as the various ways to calculate recycled content offer a spectrum from a physical traceability (segregation) to an accounting rule (book and claim).

The mass balance approach includes various degrees of traceability, from batch segregation, where a specific batch can be located, to a book and claim approach, which refers to an accounting rule where there is no actual recycled content in a specific product or packaging but content accounted for and attributed to this specific product or packaging. This diagram from ISO Standard on Chain of Custody illustrates the level of physical traceability of each approach:

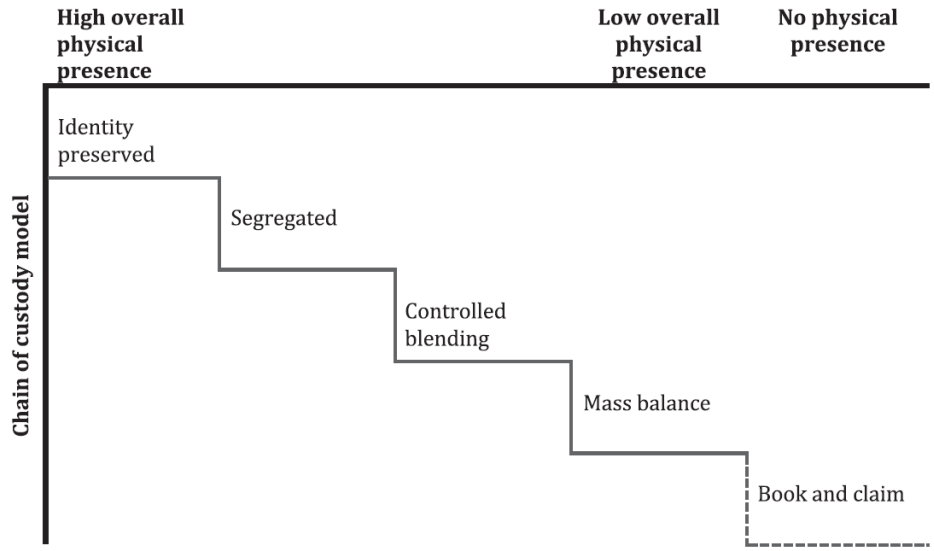


Figure 1 — Indicative illustration of chain of custody models ranked according to the physical presence of specified characteristics

Source : ISO 22095[5]

While in some cases, a mass balance approach is required for certain hard-to-recycle plastics, we believe the recycled content that is claimed should reflect the physical recycled content of the product **in priority**. This is an important element of trust for consumers. There is a need to distinguish physically traceable recycled content in order to instill trust among consumers and allow clients to use the resin of their choice based on transparent and complete information.

We believe that this distinction should also be reflected on the way we account for and communicate on recycled content to consumers and within EPR schemes. To that effect, the GreenBlue organisation recently issued claims proposals for recycled content to differentiate mass balance content from traceable content called *The recycled material Standard – Label and Trademark Guidelines*[6].

PYROWAVE RECOMMENDATION #6: TO CLEARLY ESTABLISH THE DISTINCTION BETWEEN PHYSICAL CONTENT (PROPORTIONAL TO THE AMOUNT OF RECYCLED MATTER FOUND IN THE PRODUCT) AND ACCOUNTED RECYCLED CONTEND (CREDITS TRANSFERRED FROM ONE PRODUCT TO ANOTHER).

[5] ISO 22095 Chain of Custody - https://www.iso.org/standard/72532.html
[6] Guidelines for recycled content claims from GreenBlue, November 2021 - https://www.rmscertified.com/wp-content/uploads/2021/11/rms-LabelTrademarkGuidelines.pdf

SUMMARY OF PYROWAVE RECOMMENDATIONS:

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RECOMMENDATION #2: To define conditions upon which a waste can be classified as raw material when reintegrated into manufacturing of new products.

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In conclusion, Pyrowave salutes the Ontario government legislation proposal to recognise chemical or advanced recycling as part of a shift toward a circular and low-carbon economy. We offer government authorities our full support in implementing a legislative framework that accelerates the achievement of a zero plastic waste objective as well as contributes to job creation for the Ontario economy.

Virginie Bussières
Vice-President, Communications and Government relations
vbussieres@pyrowave.com

ANNEX 1 – EXTRAIT DE LA DIRECTIVE (UE) 2018/851 DU PARLEMENT EUROPÉEN ET DU CONSEIL DU 30 MAI 2018 MODIFIANT LA DIRECTIVE 2008/98/CE RELATIVE AUX DÉCHETS

(16) Afin de promouvoir l'utilisation durable des ressources et la symbiose industrielle, les États membres devraient prendre des mesures appropriées pour faciliter la reconnaissance en tant que sous-produit d'une substance ou d'un objet issu d'un processus de production dont le but premier n'est pas de produire ladite substance ou ledit objet si les conditions harmonisées établies au niveau de l'Union sont respectées. La Commission devrait être habilitée à adopter des actes d'exécution afin d'établir des critères détaillés pour l'application du statut de sous-produit, en privilégiant les pratiques reproductibles de symbiose industrielle.

(17) Afin de donner aux acteurs des marchés des matières premières secondaires davantage de certitude quant au statut de déchet ou de non-déchet de substances ou d'objets et de favoriser des conditions de concurrence équitables, il importe que les États membres prennent des mesures appropriées pour veiller à ce que les déchets qui ont subi une opération de valorisation soient considérés comme ayant cessé d'être des déchets s'ils remplissent toutes les conditions énoncées à l'article 6, paragraphe 1, de la directive 2008/98/CE telle que modifiée par la présente directive.

Source: https://eur-lex.europa.eu/legal-content/FR/TXT/HTML/?uri=CELEX:32018L0851&from=FR