

PHARMA NATURE POSITIVE

Sustainability by Design



The Consumer Driven Path to Circularity through Future Pharmaceutical Packaging

In an age where sustainability has taken centre stage on the global agenda, industries are reimagining the way they operate in order to align with sustainability principles and the application of increased circularity practices. Across all industries, the call for environmentally sustainable products and responsible practices has initiated a transformation that touches every aspect of consumer behaviour and the companies that serve them. Drug delivery technology and pharmaceutical device manufacturers face a more challenging task. Their task is to find a way to achieve the intricate balancing act to be found between manufacturing capabilities, the consumer drive for enhanced sustainability, and meeting the stringent regulatory requirements that govern the pharmaceutical industry.

Demands for Circularity in the Pharma Space

Sustainability has become a major focus for companies across many industries around the world. In part, this is due to increasing consumer demand for more sustainability, including circularity and recyclability, in the products they select. Consumers interact directly with packaging systems from every industry, in their day to day lives. For most, a plastic drug dispensing device is not thought of much differently with respect to recycling and circularity than many common plastic consumer or cosmetic products. Both are predominantly made of plastic, both protect the product stored inside, and when the consumer finishes with them, both need to be disposed of in a responsible way. One major difference, however, is that the pharmaceutical product is subject to different regulations and performance requirements because of the criticality of its role in patient health. At the end of the day, consumers are increasingly expecting enhanced sustainability through circular and recyclable products. A recent Innova Market Insights survey found that consumer behaviour was the biggest contributor to plastic pollution.¹ Therefore, one of the goals of the pharmaceutical packaging industry must be to find practical but safe solutions that allow the consumer to easily recycle product packaging. This would directly contribute to circularity and help reduce plastic pollution. One of the most pressing questions for the pharmaceutical packaging industry has become, how can it design products that deliver more circularity while also maintaining product performance and compliance with applicable regulatory requirements.

Current Gaps in Circular Plastic Usage

The vast majority of packaging systems are plastic based. This is largely because they represent some of the most lightweight, robust, versatile, and hygienic packaging materials available. As a result, plastics will continue to be consumed at increasing levels, which in turn will lead to increases in the amount of plastic waste generated. This is unless steps are taken to increase their ability to



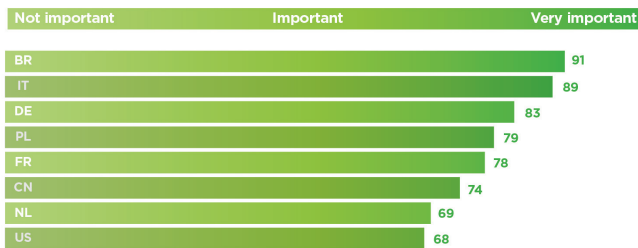
be reused or recycled. For example, 40% of the conventional plastic consumed in the EU is destined for packaging applications, and without any intervention, the EU is expected to see a 46% increase in plastic packaging waste by 2030.² A survey of global consumers also indicated that 61% of respondents believed the increased use of plastic packaging seen since the COVID-19 pandemic was necessary for safety reasons,³ even if the increased use was viewed as undesirable. 72% of the same consumers surveyed also believed that plastics currently offer average or above average recyclability, despite much poorer real-life recycling rates and the notable global explosion of plastic pollutants. In reality, single-use plastic consumption is at an all-time high, with the ratio of new conventional plastic to recycled plastic feedstock is still at 15:1.³ This represents a huge opportunity to expand plastics circularity through increased plastics recycling. Achieving

much higher plastic recycling rates across all industries, helps reduce overall plastic waste. Optimising all steps of the recycling process, qualitatively and quantitatively, will contribute to generating higher quality recyclates, potentially leading to circular feedstock that is suitable for use in pharmaceutical packaging applications. We know that the principle of circularity is supported by consumers with respect to their packaging choices. Encouragingly, over half of consumer survey respondents (52%)¹ indicated they are willing to pay more for products that come in recyclable packaging systems, clearly demonstrating their willingness to participate in initiatives that bring about more circularity. Aptar Pharma conducted its own

international consumer insights survey that found waste recycling was "important", if not "very important" to the vast majority of respondents⁴ (Figure 1A). The majority of the consumers surveyed affirmed that they at least sometimes considered the recyclability of a product when they buy it (Figure 1B). Over 80% of respondents confirmed that they would even prefer to buy a product that could be reused (Figure 1C). Consumer demand for products with enhanced recyclability and circularity is clearly growing.

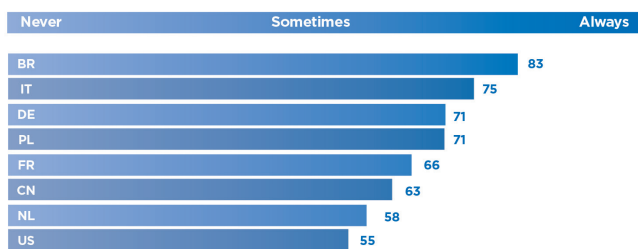


A. How important is it for you that your waste can be recycled?



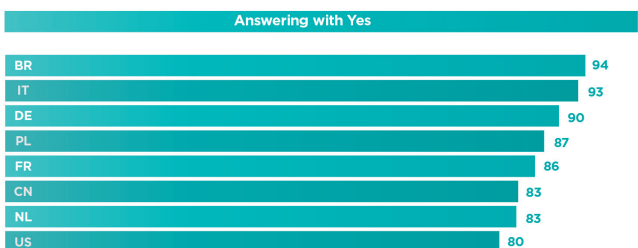
A: Surveyed consumers consider it important or very important that their waste can be recycled. Almost 70% of respondents in the U.S. and in the Netherlands consider waste recyclability to be important, whereas an average of nearly 80% of respondents from European countries including Italy, Germany, Poland, and France think it is important to very important.

B. When buying, do you consider the recyclability of the product?



B: Recyclability influences the consumer buying decision, as seen in the European countries (Italy, German, Poland, and France) where 66–75% consider product recyclability in their buying decisions, whereas 55–58% consider recyclability in purchase decisions in the U.S. and the Netherlands.

C. When buying products, do you prefer those that could be reused (refill and reload)?



C: Surveys show that products that feature “reusable” or “refillable” packaging have the strongest impact on the consumer’s buying decision. More than 80% and up to 94% of surveyed consumers responded that they prefer to buy a product that can be reused, demonstrating their demand for more circular packaging solutions.

Figure 1: Aptar Pharma conducted a 2023 global consumer insight survey in 8 countries, investigating consumer attitudes towards recycling, recyclability of products, and reusable or refillable packaging solutions.

Minimising conventional plastic consumption can only be achieved through implementing enhanced recycling strategies. The global packaging industry can contribute to circularity through reduced plastics use and improving the recyclability of their packaging. Pharmaceutical and consumer goods companies who apply robust action plans with achievable targets, must also apply innovative approaches that consider medical performance and strict regulatory requirements.

Pharmaceutical Packaging Macro Boundaries in the European Union (EU)

Pharmaceutical packaging companies are subject to considerable and increasingly strict regulations when it comes to their packaging systems. Along with shifting consumer sentiment towards demanding enhanced sustainability of packaging systems, the regulatory environment is changing as well. The EU published its draft regulations on packaging and waste on November 30, 2022, with a final version expected in 2024. This will become binding law for EU member states covering all packaging

types, but an extension until 2035 has been granted for packaging that meets the definition of primary pharmaceutical packaging under Directive 2001/83/EC or medical devices under the Medical Device Regulation (MDR) 2017/745. Qualifying Medical or Primary Pharmaceutical packaging/devices will be exempt from composting or recycled content requirements and will not be required to be refillable or reusable. These exemptions are largely due to the critical nature of drug delivery devices intended for medical purposes. It is expected that under the new EU directives, any packaging placed on the EU market after January 1, 2035, will need to demonstrate a minimum recyclability performance of 70%, although these recyclability performance measurements have not yet been clearly defined. Many pharmaceutical packaging companies have already started the potentially lengthy and complex product optimisation process so they will be in a position to offer packaging solutions that can meet these strict regulations when they become effective.

Recycling Plastic Packaging Today

Even when the latest plastic packaging systems can meet the new regulatory requirements, how will they actually be recycled? There are many differences to be found in current recycling streams around the world. Some streams are more advanced and can efficiently separate and recycle a range of plastics, while other jurisdictions offer very limited recycling capabilities. The countries that are the most advanced in recycling, are typically developed economies with strong regulatory environments, like Western Europe and Japan. According to the OECD global plastics outlook 2022, only 9% of global plastic waste is being recycled per year (evaluation based on 2019),⁵ which points to a huge opportunity to increase the amount of successfully recycled plastics. Despite the large quantity of plastic items being put into many recycling streams, a large proportion of them are either unrecyclable plastics or unsortable items that end up incinerated or in landfills. It is the duty of the packaging industry to design product packaging systems that consider, not only the product’s recycling requirements at the end of their life, but also how they will be handled within existing recycling streams. This consideration has the potential to increase the proportion of plastics that are successfully recycled, which in turn can contribute to the availability of higher quality recycled plastic feedstocks. If the plastic packaging industry took a more harmonized approach to packaging design that considered these important parameters, the result could be a more consistent recycling process that produces less plastic waste and more high-quality recycle.

Certified for Recyclability

As regulations are still pending on packaging design for recyclability, it is important for packaging producers to rely on independent organisations and laboratories who are experts in packaging collection, sorting, and recycling to determine their relative success. Each organisation applies their own consistent and standardised methodologies to provide an objective evaluation of the recyclability of individual packaging systems. Otherwise, how could customers and end users be able to determine which packaging systems are the most recyclable? In Europe, two of the most recognized organizations with this role include cyclos-HTP and RecyClass. They can evaluate semi-finished packaging systems, as they do for Aptar Pharma, or they can assess complete finished products submitted by the product owners. These organisations can incorporate the compatibility of a material with a specific recycling stream into

their score, and also reflect the ability of recycling facilities to sort and recycle individual packaging systems which can vary greatly from country to country. Both cyclos-HTP and RecyClass have built their own methodologies, each considering a variety of different factors and perspectives which can contribute to each arriving at somewhat different results for the same product.

The two organisations also use different terminology in their rating systems. Cyclos-HTP provides a class rating of AAA+ to C including a corresponding percentage of recyclability, while RecyClass uses a simple alphabetical rating scale that ranges from A to F.

Until there are harmonised recyclability standards around the globe, these large independent organisations provide the best opportunity for primary packaging manufacturers to determine the relative recyclability of their packaging systems using standardised criteria. With continued uncertainty around pending applicable regulations, packaging manufacturers will need to remain flexible and adapt to changing regulations and continued variations in local recycling streams to achieve their sustainability objectives as measured by recycling classification organisations.

Strengthening your Circular Approach

The challenges facing the packaging industry have been closely studied by Aptar over many years. The result has been, the implementation of a number of cross company initiatives and the setting of ambitious sustainability goals captured in the company's 2022 Corporate Sustainability Report. Aptar recognizes circularity as having the greatest potential to improve packaging sustainability and is a core focus for the organisation. Greater circularity helps to address climate change while delivering measurable benefits to both customers and consumers. In order to achieve its objectives, Aptar doesn't just develop sustainable solutions in isolation. It also leverages cooperative partnerships with industry leaders and organisations who have aligned goals, and can help achieve system level change, overcoming collective barriers that Aptar could not on its own.

Futurity™ - Aptar Pharma's Sustainable Solutions Platform

Futurity™ represents all of the initiatives that live at the core of Aptar's strategic solutions to achieving enhanced environmental sustainability. Some of Aptar's key sustainability initiatives include:

- **Designed for Recycling** – Enhanced recyclability of packaging systems is the foundation of a functioning circular economy. Aptar Pharma designs its new dispensing systems to be easily and reliably recycled. We consider the recyclability of our new systems from the earliest design stage, including each and every individual component.
- **Reducing the CO₂ Footprint** – Reducing or eliminating the use of technical plastic materials or energy intensive metal components help us to reduce the CO₂ footprint of our products.
- **Use of Alternative Materials** – Aptar Pharma offers the use of bio-based alternative materials like renewable feedstocks as a bio-based alternative to conventional fossil-based resins, reducing the CO₂ footprint of their packaging systems. However, these resins are not currently accepted by the Science Based Targets initiative (SBTi) which helps to define

best practices in emissions reduction and reaching net-zero targets.

Another option is the use of chemically recycled resins. This alternative material consists of used plastic that has been broken down to its molecular level through a chemical process. Feedstock generated from this innovative approach can potentially be used in pharma or medical applications as these materials meet the same quality requirements as conventional fossil-based resins. Some countries have suggested users of chemically recycled resins should be eligible for exemption from future plastic use taxes to encourage their adoption.

- **Refill-, Reload- and Reusable Solutions** – Aptar continues to invest in the development of refill, reload and reusable solutions, primarily in the Beauty space. Based on this experience Aptar Pharma investigates packaging solutions that can meet product safety and handling requirements for pharmaceutical applications.

Aptar Pharma assesses potential Futurity™ products against a number of key criteria such as recyclability, emission reduction, weight reduction, reusable/refillable capabilities, and recycled content, as well as any recyclability classifications provided by external organisations. Using its proprietary EcoDesign tool, Aptar Pharma designs new product solutions for optimal recyclability. Our developers attempt to eliminate recycling disruptors such as metals or aim to create mono-material solutions that can conveniently be fed into existing recycling streams. Aptar Pharma's Futurity™ solutions are aimed at improved circularity in the drug-delivery market and the Futurity™ mark helps pharmaceutical manufacturers to make the more sustainable choice when it comes to selecting dispensing systems for their medical products. In an evolving regulatory landscape, where recycling streams and manufacturing processes are continually upgraded to allow for a more circular flow of resources, Aptar Pharma will simultaneously adapt its Futurity™ criteria and solutions to reflect the current environment. For example, even though a device may be too small to be reliably sorted by currently available recycling stream technology, products are being developed with the expectation that recycling technologies will continue to improve and deploy more efficient sorting and recycling processes going forward. Futurity™ represents the drive to always look ahead to future regulations, future technologies, and future realities.

Futurity™ – A Growing Family

Futurity™ is in its inception. Aptar Pharma has launched a number of projects and products that were designed to provide more circularity and sustainability, meeting the requirements of the Futurity™ brand (Figure 2). Some examples of Futurity™ solutions include:

Aptar Pharma's Proventu mono-material polypropylene (PP) closure for dermal drug delivery earned the Futurity mark for its enhanced recyclability, when combined with matching material tubes.

Our multidose Ophthalmic Squeeze Dispenser (OSD) saves a significant amount of plastic waste and reduces the CO₂ footprint when compared to single dose blow-fill-seal eye dropper formats.⁶

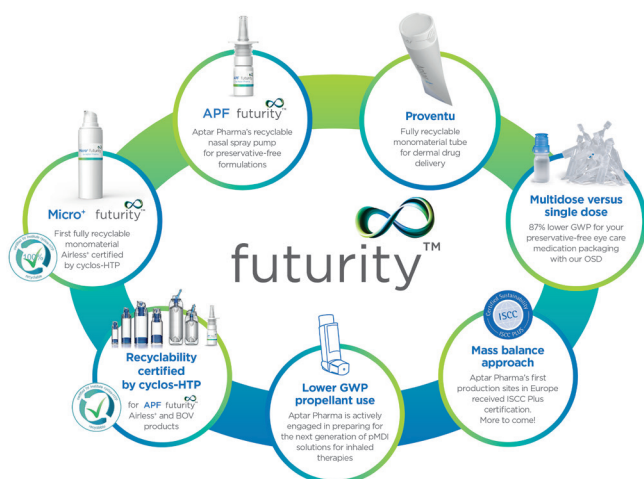


Figure 2: Futurity™ is Aptar Pharma's platform of sustainable solutions, that has a focus on enhancing circularity in drug delivery, and reducing the CO2 footprint of pharmaceutical packaging solutions through a variety of means. Solutions range from recyclable packaging and drug delivery solutions, to the significant reduction of packaging material through multidose solutions. Aptar Pharma's Futurity™ solutions also include the use of renewable feedstock and supporting the use of low-global warming potential (GWP) propellants in next generation pMDI solutions.

Aptar Pharma is working closely with customers to update their pressurised metered dose inhaler (pMDI) valves and devices to accommodate new lower Global Warming Potential (GWP) propellants for an improved environmental impact. This involves partnering with customers through a complex and multifaceted process that includes activities from valve optimisation to providing in-depth regulatory support.

We've also achieved high recyclability ratings from cyclo-HTP for our Airless+ and BOV technologies, both designed with recyclability in mind.

Aptar Pharma supports the use of circular or alternative materials. Relevant Aptar Pharma sites have achieved ISCC PLUS certification in preparation for the implementation of a mass balance approach with alternative materials.

The First metal-free and Highly Recyclable Nasal Spray Pump

Aptar Pharma recently launched its first metal-free, highly recyclable Advanced Preservative Free (APF) nasal spray pump system that met the sustainability requirements of the Futurity™ brand. The APF Futurity™ was specifically designed to enable the recycling of nasal spray packaging systems used to administer nasal saline or comparable OTC formulations. Removing metals and replacing specific parts of the pump produced a nasal spray solution made of only polyolefin materials, simplifying the recycling of the pump in existing recycling streams. According to Aptar internal Life Cycle Assessment (LCA) calculations, this reduces the CO₂ footprint of the product by approximately 45%. The innovative polyolefin tip-seal and actuator bellows spring maintains spray performance as well as its preservative-free multi-dosing capabilities, all the while enhancing its recyclability. Consequently, the APF Futurity™ achieved a rating of highly recyclable (AA) from cyclo-HTP rating organisation.

Aptar found that nasal sprays with round bottles were not being efficiently recycled as they could roll from some automated sorting systems. To avoid this, Aptar Pharma designed a new oval shaped finger flange for the APF Futurity™. Its preservative free multi-dose capabilities reduces the amount of plastic waste and

provides an added benefit as it avoids the use of formulation preservatives, minimising the risk of preservative related side effect risks in patients. The whole polyolefin APF Futurity™ pump allows consumers to simply put the empty product into existing plastics recycling streams with no manual separation of components or disassembly required. The APF Futurity™ demonstrates that taking a holistic approach is crucial when designing products for more circularity and one should always consider material selection, current recycling processes and human behaviours in the design process.

Why a Highly Recyclable Nasal Spray Matters

The broader benefits of developing this highly recyclable nasal spray pump for administering nasal saline or comparable OTC formulations are measurable. Looking at the nasal saline market only, over 150 million such nasal spray devices are used annually and end up in landfill or the incinerator. Using a recyclable pump solution like APF Futurity™ could make these 150 million nasal spray pumps immediately suitable for recycling streams, which represents a major change in the circularity of such delivery devices.⁷ This new recyclable alternative could make a significant contribution to reducing plastic waste and contribute to the availability of more recycled plastic feedstock that can be used for other applications, avoiding plastic landfill and waste incineration.

Micro+ Futurity™ – Circularity in Dermal Drug Delivery

Aptar Pharma's latest member of the Futurity™ family is the Micro+ Futurity™ semi-solid drug dispensing system. Based on Aptar's long proven Airless+ technology platform, the Micro+ Futurity™ advances dermal dispensing systems with enhanced recyclability. Designed to protect and precisely dispense pharmaceutical formulations, such as lotions and gels, Micro+ Futurity™ is constructed entirely of medical grade polyethylene (PE) resins that meet today's raw material requirements for the primary packaging of medicines. Our original Airless Micro+ systems were differentiated from many competitors by their all-plastic construction of both polypropylene (PP) and Polyethylene (PE) components. The new Micro+ Futurity™ system was constructed of only PE, resulting a truly mono-material drug dispensing system (Figure 3). These changes contributed to the Micro+ Futurity™ system receiving a "Completely Recyclable" or "AAA+" rating with 100% recyclable content from cyclo-HTP, which is their highest rating for recyclability. Aptar Pharma also considered how the product is used in the real world and how it will be recycled by

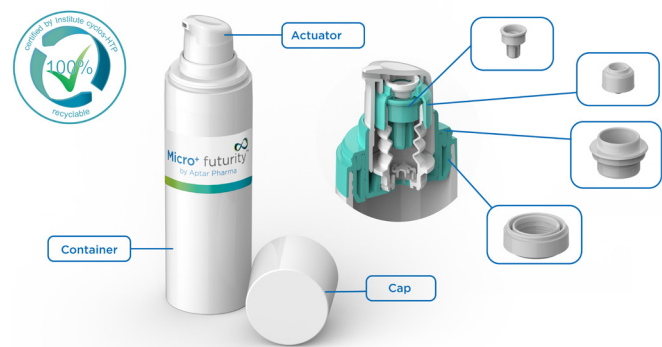


Figure 3: Micro+ Futurity™ is the mono-material evolution of Micro+ dispensing systems, a member of Aptar Pharma's Airless+ range. To achieve a mono-material Micro+ solution, several functional parts of the actuator were replaced with alternative components made from polyethylene (PE), but still maintained the functional performance of the Airless+ system. The container and cap of the Airless+ Micro+ Futurity™ product were also replaced by polyethylene parts resulting in a truly mono-material dispensing system that achieved the highest cyclo-HTP rating of "complete recyclability" (certified for Germany and Netherlands).



Figure 4: Micro+ Futurity™ meets consumer demands for circular solutions: a completely recyclable drug delivery system, that can be put into plastic recycling streams and that does not require any complicated disassembly or separation steps from the user.

the consumer or patient when it is empty. The effortless emptying of Airless Micro+ dispensers starkly contrasts, how patients must struggle to squeeze the last drops of their valuable product from conventional foil tubes. With Micro+ Futurity™ systems, this also means the consumer easily gains access to almost the entire quantity of lotion or gel formulation, especially important for high value drug products, and because of its mono-material construction, it can be placed directly into existing recycling streams with no requirement for the consumer to disassemble and separate any of the materials (Figure 4).

Aptar Pharma fulfilled their mandate of designing new products that are worthy of the Futurity™ name. The Micro+ Futurity™ design process considered the technical requirements of product performance as well as compliance with regulations and built in circularity features that address patient demand for enhanced recyclability. Ultimately, Aptar Pharma made the Micro+ Futurity™ Airless drug delivery system so that it is easy for the end-user to place into existing recycling streams and feed it back into the circular supply of plastic resins.

Conclusion

The pharmaceutical packaging industry has a number of difficult challenges ahead of it with respect to circularity. Improving the recyclability of their primary packaging systems will take a multi-faceted approach that considers materials science, engineering, and regulatory requirements, as well as the real-world impacts of variability in recycling systems and consumer behaviours. Independent certification bodies like cyclos-HTP or RecyClass also play a positive role in defining the recyclability of the industry's products through standardised assessments. Aptar Pharma has demonstrated its leadership position in the primary packaging industry by taking a holistic approach to device design that considers not only the properties of the device itself, but also the recycling streams they will be placed into and the behaviours of

the end-users that will recycle them. Futurity™ represents realised progress towards this goal, with APF Futurity™ and Micro+ Futurity™ being prime examples of this achievement. Although the industry is facing many evolving challenges to growing the circular economy, Aptar Pharma is ready to take the lead.

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6. All calculations have been made with Aptar's Eco-design LCA tool. No third-party review was conducted. Secondary packaging / cartonnage has not been considered in this approach.
7. Aptar Pharma Internal Market Intelligence.

Dr. Stefan Hellbardt



Dr. Stefan Hellbardt is Vice-President Business Development and Scientific Affairs within Aptar Pharma's Consumer Health Care (CHC) division. As a trained biologist, he has held various positions in the pharmaceutical industry with established experience in clinical development. At Aptar Pharma, he leads the global business development for dermal drug delivery. In this role, he has been instrumental in delivering Aptar Pharma's expertise and services to customers developing pharmaceutical products for topical dermal application. As Head of Scientific Affairs CHC, Dr. Hellbardt leads a team of scientists supporting customers regarding Aptar Pharma's preservative-free products and material characterisation.

Julien Storz



Julien Storz is Director of Business Development within Aptar Pharma's Consumer Health Care (CHC) division. He holds a bachelor's degree in business administration and has over 19 years of medical industry experience. Julien has held various positions in marketing, sales, and business development. Julien joined Aptar Pharma and the CHC Global Market Development team in 2019, where he is responsible for supporting business development efforts across numerous application fields in addition to driving CHC sustainability efforts.

The Future starts now



Strengthen your circular approach with Micro+ Futurity™, the first fully recyclable Airless+ monomaterial solution for dermal drug application

Circularity and recyclability is a must-have for consumer packaging. In fact, 80% of consumers rate as very important that their waste is recycled, and 70% always consider the recyclability of the products they buy (Aptar Pharma consumer study, 2023).

With the same consumers using your dermal drug products, they expect this packaging to also be recycled at the end of its lifespan. In terms of recyclability, the optimal solution is monomaterial, packaging made from a single kind of material.

With Micro+ Futurity™, Aptar Pharma has achieved a breakthrough towards more circularity in dosed delivery of semi-solid medication to the skin. Micro+ Futurity™ is the first monomaterial Airless+ drug delivery solution made only from medical grade polyethylene and is completely recyclable, certified by cyclos-HTP.

This new Airless+ product combines easy handling with convenience that end-users appreciate: hygienic application, precise and clean usage, and best-in-class evacuation rates, which makes it easy to get out the last drop of your drug product. Even better, users can directly recycle with no need to disassemble their Micro+ Futurity™ pump.

Take the next step on your journey towards more sustainable product solutions with Micro+ Futurity™.

To learn more, contact Dr Stefan Hellbardt, VP Business Development and Scientific Affairs, Consumer Healthcare at Stefan.hellbardt@aptar.com or go to www.aptar.com/products/pharmaceutical/micro-futurity-airless-packaging/




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