Aduro Clean Technologies Inc.
(ACTHD-OTCQX/ACT-CSE)

NOTE: The share consolidation, effective August 20th, temporarily changed Aduro's OTCQX ticker to ACTHD for 20 business days, after which it reverts to ACTHF.

EXECUTIVE INFORMATIONAL OVERVIEW® **August 20, 2024**

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Ticker (Exchange)	ACTHD* (OTCQX)
Recent Price (08/20/2024)	$4.64
52-week Range	1.4000 - 5.1025
Shares Outstanding	27.1 mm
Market Capitalization	$125.7 mm
Average 3-month volume	21,854
Insider Ownership +>5%	41%
Institutional Ownership	—
EPS (Qtr. ended 02/29/2024)	($0.03)
Employees	28

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Hydrochemolytic™ Technology (HCT) Applications

HCT R2 REACTORS

COMPANY DESCRIPTION

Aduro Clean Technologies Inc. ("Aduro" or "the Company") is a Canadian company that has discovered a chemical reaction platform that is able to break down and transform large **hydrocarbon†** materials, such as plastic waste or **bitumen**, to more valuable products for use in fuels, new plastics, or other chemicals. The Company's proprietary platform—Hydrochemolytic™ Technology (HCT)—is highly versatile, with Aduro targeting three important commercial sectors: (1) Hydrochemolytic Plastic Upcycling: recycling of plastic waste to chemical **feedstock** for new plastic and other chemicals production; (2) Hydrochemolytic Bitumen Upgrading: upgrading of heavy oil and bitumen to readily transportable crude oils without the use of diluents; and (3) Hydrochemolytic Renewables Upgrading: converting animal or vegetable oils to renewable fuels and chemical feedstock. HCT offers several fundamental advantages over competing technologies. For example, the use of HCT in plastic recycling applications: (1) provides greater tolerance for contaminants, allowing the use of cheaper and more available feedstocks; (2) requires much less chemical post-treatment; and (3) results in a high yield of valuable product. In addition, because the process operates at lower temperatures, the energy demand is lower, saving on energy and emissions. For bitumen upgrading, HTC greatly reduces the use of diluents otherwise needed to transport the bitumen, allowing higher transport capacity and avoiding the costly premiums required to obtain the diluents. For the past few years, the Company's focus has been on scaling-up its technology from lab-scale batch reactors (R1) into a continuous flow processing unit (R2) for both its plastic **upcycling** and its bitumen upgrading applications. With those goals achieved, the Company is now focused on its commercialization goals through its revenue generating Customer Engagement Program (CEP), as well as the development of its pre-commercialization scale Next Generation Process (NGP) reactor.

KEY POINTS

- The three market verticals that HCT platform initially targets—recycling of plastic waste, upgrading of heavy crudes and bitumen, and upgrading of renewable oils—represent a combined market value of more than $200 billion.
- Aduro believes that HCT provides two key competitive advantages: its ability to process a diverse set of feedstocks, including higher rates of contamination; and its scalability, with HCT being able to operate at a smaller scale, making it economically feasible for both large and small operations.
- Currently, Aduro has five paying customers in its CEP, which involves revenue-generating commercial partnerships through demonstration projects.
- Aduro is led by a highly experienced management team with extensive experience in the chemical, petrochemical, renewable energy, and environmental technology industries.
- As of February 29, 2024, Aduro had cash and cash equivalents of C$2.156 million and on June 17, 2024, closed a private placement for gross proceeds of C$3.525 million.

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Executive Overview

Aduro Clean Technologies Inc. ("Aduro" or "the Company") is a Canadian technology company focused on the development and commercialization of its proprietary Hydrochemolytic™ Technology (HCT) platform to chemically transform high molecular weight hydrocarbon materials—such as waste plastics and bitumen—into higher value feedstock for fuels, new plastics, and specialty chemicals.

The HCT platform relies on a unique and patented chemical process to break down large molecules, like those in bitumen and plastics, into smaller molecules, resulting in an uplift in market value as well as significant environmental benefits. Materials with undesirable characteristics are converted into materials useful as feedstocks for fuels, plastics, and chemicals. The technology does so under relatively mild conditions, achieves relatively high yields of valuable products, can easily handle contaminants, and requires much less costly post-treatment to reach desirable specifications than competitive technologies.

The Company's proprietary HCT platform is highly versatile, with Aduro developing different applications to target three important commercial sectors, as seen in Figure 1: (1) Hydrochemolytic Plastic Upcycling, for converting plastic waste to chemical feedstock for new plastic and other chemicals production; (2) Hydrochemolytic Bitumen Upgrading, for upgrading of heavy oil and bitumen to readily transportable crude oils without the use of diluents; and (3) Hydrochemolytic Renewables Upgrading, for converting animal or vegetable oils to renewable fuels and chemical feedstock.

Figure 1

HCT APPLICATIONS

Source: Aduro Clean Technologies Inc.

Aduro's first two applications—Hydrochemolytic Plastic Upcycling and Hydrochemolytic Bitumen Upgrading—are currently in the Pilot Stage phase. During this stage, parallel to the in-house development, revenue-generating engagements with potential future users of the technology are being conducted to assess specific value components. This is part of the Company's Customer Engagement Program (CEP), Aduro's main customer acquisition initiative which enables interested organizations to conduct controlled technology evaluation sessions of HCT, developing partnerships through demonstration projects, and paving the way for future full-scale commercial projects. Aduro is currently engaged with five different paying organizations through its CEP initiative.

Aduro is entering an important stage on its path to commercialization. For the past few years, the Company's focus has been on what it calls its "building blocks"—the creation of its operation and research teams, the building of a laboratory, and the assembly of its lab-scale reactors (R1) to achieve proof of concept—with the goal of moving the technology from lab-scale batch reactors into a larger continuous flow processing unit (R2) for both its Hydrochemolytic Plastic Upcycling and Hydrochemolytic Bitumen Upgrading programs. With those goals achieved, the Company is now focusing on its commercialization goals, through the development of the Next Generation Process reactors, its next scale-up pre-commercialization reactor, as well as the continuation and expansion of its CEP efforts.

According to Aduro, the three categories that its HCT platform initially targets—recycling of plastic waste, upgrading of heavy crudes and bitumen, and upgrading of renewable oils—represent a combined market value of more than $200 billion. Aduro plans to capitalize on this market by making even more plastics recyclable, more heavy oils environmentally sustainable, and more renewable fuels cost-effective.

HYDROCHEMOLYTIC™ TECHNOLOGY (HCT)

Aduro's Hydrochemolytic™ Technology (HCT) was initially developed for upgrading bitumen, a very heavy, viscous fraction of petroleum. This led to two key discoveries: (1) trace metals in the bitumen, considered a nuisance in oil refining, can play an important catalytic role in breaking down complex bitumen components, allowing HCT to operate at lower temperatures; and (2) addition of a combination of small amounts of water and low-cost organic co-reactant (often biobased, such as **glycerol** or ethanol, also called "H-source"), stabilizes bitumen breakup fragments, so that the product maintains its improved properties. Aduro then recognized that these discoveries could also be applied to other heavy molecules, like the **polymers** in waste plastic. In that scenario, not only a useful feedstock for making new plastic is produced, but this can also be done from cheap, more contaminated feedstocks, while eliminating most or all of the costly and capital-intensive post-treatments (typically hydrogenations) commonly required.

A typical HCT process would include:

1. Limited sorting to eliminate inert materials (glass, sand, metal, etc., if any);

2. Preheating the feedstock and feeding it into the reactor system operated at typically 350°C-400°C and moderate pressure; and

3. Co-feeding catalyst (typically inexpensive transition metal salts, sometimes present in the feedstock), water, and the organic co-reactant ("H-source").

The liquid hydrocarbon output, which is highly saturated, requires little or no post-processing before being sold to the end consumer.

HCT Advantages

For HCT's Hydrochemolytic Plastic Upcycling application, the key competing technology is **pyrolysis**, which also produces a liquid hydrocarbon that could serve as chemical feedstock. However, pyrolysis involves much more brutal conditions (e.g., higher temperatures). When compared to HCT, pyrolysis presents significant disadvantages:

1. Pyrolysis turns contaminants in the feedstock into contaminants in the hydrocarbon process, necessitating post-treatments that require multiple reactors with expensive catalysts and a supply of hydrogen gas. It is believed that the cost of these post-treatments is prohibitively high. These post-treatments are not required with HCT.

2. To control the need for post-treatment to some extent, excessive pre-sorting is required for pyrolysis. This causes additional losses of valuable product, extra low-grade waste, capital investment, and effort.

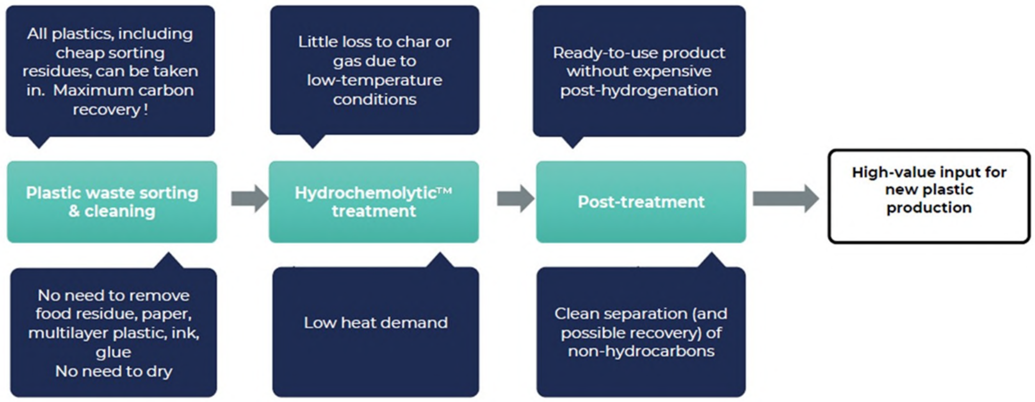
3. The severe conditions in pyrolysis cause additional losses due to **coking** and fuel gas formation; and

4. The energy demand of pyrolysis is much higher, requiring more fuel and causing more emissions.

In addition, alternative **chemical recycling** methods, such as **gasification**, are extremely capital-intensive and can only operate when integrated with large-scale chemical operations which may be prohibitively far from the places where waste is generated. By overcoming the limitations of traditional recycling methods, Hydrochemolytic Plastic Upcycling provides important economic advantages over other chemical recycling alternatives, as shown in Figure 2 (page 5).

Figure 2

HYDROCHEMOLYTIC PLASTIC UPCYCLING ADVANTAGES



Source: Aduro Clean Technologies Inc.

For bitumen treatment, the competitive options include either dilution to a transportable crude or upgrading to a lighter crude. Dilution is the most common technique, but it relies on the availability of diluent at the source and the ability to process and use the diluent at the destination. In addition, the diluent takes up a significant portion of the pipeline capacity. Upgrading avoids the sourcing of expensive diluents but requires large economies of scale and complex processing units.

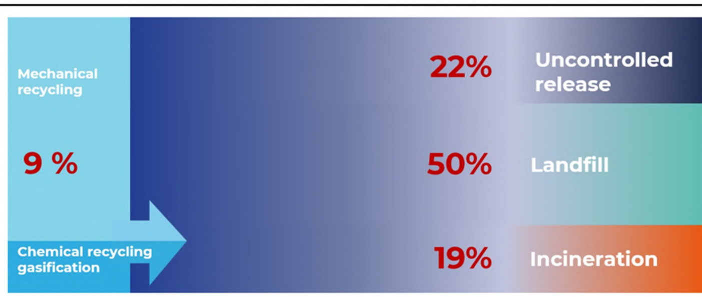
Overall, HCT's simplicity, tolerance for contaminants, and avoidance of post-treatment is likely to enable much more compact and easier-to-operate facilities that require lower capital expenditure (capex) and are likely to be more economical at smaller scale than the competing alternatives. The Company is also looking into modular design that could scale up to address dynamic change of feedstock and large and extra-large projects. The resulting product is stable and can be easily stored and transported to petrochemical facilities. This can allow construction close to sources of waste plastic or bitumen, avoid handling and transporting waste, and provide a more cost-effective solution.

Hydrochemolytic Plastic Upcycling

Aduro developed Hydrochemolytic Plastic Upcycling to address the increasing global problem of post-consumer plastics pollution, whose properties make them difficult to dispose or recycle, as synthetic plastics can take up hundreds or even thousands of years to decompose. This issue is accentuated by the low recycling rate of plastic waste. For example, global plastic recycling rates stand at just 9%, as shown in Figure 3. Most of the plastic waste ends up in landfills, with only a relatively small portion being incinerated or recycled. In contrast, approximately two-thirds of paper, a third of metals, and a quarter of glass waste in the U.S. are recycled. This difference is due to the complexity of the material, with modern plastics sometimes composed of different plastic compositions, blended with other materials, or contaminated to the point where recycling cannot be done in an economically efficient manner.

Figure 3

PLASTIC WASTE MANAGEMENT



Source: Aduro Clean Technologies Inc.

Aduro's HCT platform can transform difficult-to-recycle plastic waste, including mixed and contaminated feedstock, into higher-value resources. Plastic waste can be converted into a liquid hydrocarbon that can be used in the **circular economy** for producing new plastics or converted into hydrocarbon fuels. Either way, the technology serves to reduce the demand for crude oil while also diverting end-of-life and single-use waste materials from landfills and oceans. According to Aduro, HCT's ability to process waste **polyethylene (PE), polypropylene (PP), and polystyrene (PS)**, which represent over 70% of plastics in municipal solid waste streams, coupled with the ability to tolerate feedstock contamination (including multi-layer materials), allows it to process materials that would otherwise end in landfills. This is due to the fact that the sorting and treatments required to clean up the feedstock, or the cost of post-treatment needed through alternative chemical recycling methods, are expensive, making these processes no longer cost effective.

In April 2024, Aduro announced that its R2 semi-continuous pilot reactor for plastics recycling was operational, proving its ability to scale up its technology at yield and economic levels attractive for commercial operations. The R2 reactor serves two purposes: it generates data for its next scaling up step, the (still pre-commercial) Next Generation Process reactor, expected to come to reach the market by early 2025; and it allows the Company to expand its Customer Engagement Program (CEP).

Since commencing the operation of its continuous flow R2 reactor in 2023, Aduro has conducted over 240 test runs on a variety of feedstock compositions, with the longest test stretching to 36 hours. Key results include: (1) confirmation of very low losses (less than 5% of input) of **polyolefin** feedstock to worthless char and fuel gas; (2) confirmation of yields of about 95% of hydrocarbons useful for steam **cracking** or other chemical processes from polyolefin feedstock; and (3) confirmation that the final product is substantially saturated and free of oxygen and nitrogen **heteroatoms**, sharply reducing if not avoiding the need for costly post-processing. The Company believes that this is a clear demonstration of HCT's ability to significantly reduce costs compared to more established chemical recycling methods, making chemical recycling financially viable, and offering a vital instrument for plastic waste management and circularity.

Hydrochemolytic Bitumen Upgrading

Bitumen is a dense, highly viscous, crude oil composed of complex, heavy hydrocarbons that are normally found in deposits such as **oil sands**. The world largest deposits of oil sands are found in Venezuela and Canada. Due to its high density and viscosity, bitumen does not easily flow at normal temperatures. This precludes its transport by pipeline, leaving bitumen producers with two choices: blend the bitumen with expensive diluents to reduce its viscosity and form **Diluted Bitumen (dilbit)**, a lighter product that can be transported via pipeline; or upgrade the bitumen on site to form lighter **synthetic crude oil (SCO),** which can be transported through pipelines without the need for additional diluents.

However, traditional upgrading techniques are energy intensive and expensive, requiring significant capital investment to build and operate the large processing plants. There is a significant need for the development of novel environmentally upgrading processes that allow for the extraction and use of the immense bitumen reserves in an economically and efficient manner. For example, Alberta (Canada)'s oil sand reserves are estimated at 1.7 trillion to 2.5 trillion barrels of oil trapped in the sand mixture—the largest single reserve of oil in the world.

Aduro's HCT can be applied to bitumen, offering a radically new approach for transforming it into lighter crude. HCT efficiently deconstructs the heavy components into lighter molecules by chemical reaction mechanisms at mild severity (temperatures), in contrast with the high temperature techniques used by legacy operations. One of the key differentiating factors of Aduro's bitumen upgrading through HCT is its utilization of naturally occurring metal compounds from the bitumen to provide the required catalytic activity. In addition, HCT not only breaks up the molecules, but it also prevents them from recombining by stabilizing the product. However, instead of relying on **molecular hydrogen (H_2)** for stabilization, whose generation from fossil fuels results in carbon emissions, HCT uses a variety of cheap molecules, typically of biogenic origin (such as ethanol, glycerol, and cellulose), which undergo reactions that produces a hydrogen equivalent that stabilizes the reaction, avoiding the need for molecular hydrogen and its fossil fuel intensive production process.

Compared to upgrading options currently available to producers, the application of Aduro's HCT for bitumen upgrading comes with better environmental and financial performance and attractive yield of fungible output product (90% and up versus 80% for the legacy technologies) at anticipated strong cost/results performance Aduro's R2 semi-continuous reactor, commissioned in October 2023 and currently fully operational, supports the scaling of the bitumen upgrading process and provides samples and information for the CEP.

Hydrochemolytic Renewables Upgrading

HCT's third application is the conversion of animal and vegetable oils into valuable fuels (for instance for aviation), and chemical feedstock, reducing the demand for petroleum and supporting the drive to carbon neutrality. Suitable feedstock includes inedible corn oil byproduct from conversion of corn to ethanol; oil extracted from non-food seed crops grown on marginal lands; off-specification canola and soybean oils; used cooking oil and other oils from grease traps in restaurants; and tallow and fat from meat and poultry processing plants.

Unlocking the hydrocarbon content of these "surface oils" offers the possibility to reduce the demand for "below surface" crude oil (petroleum). But that is not easy because of the way oxygen is bound up in renewable oils. Removing that oxygen is necessary to maximize their usefulness as feedstocks for chemicals and fuels. HCT does that effectively without the need of external hydrogen gas, as required in the alternative technologies. The Company believes that HCT applied on these renewable oil and fat feedstocks can make a significant contribution to environmental and clean energy initiatives. A key feature of HCT's application on these oil and fat feedstocks is the potential to operate it economically at a relatively small scale, enabling operation close to remote sources of oils, including biodiesel plants in corn growing geographies.

Additional Market Verticals

The Company believes it has the potential to develop additional profitable market verticals going forward. While Aduro's main focus is currently on the commercialization of its HCT technology for plastics waste and bitumen, and the further development of its renewable oil upgrading technology, the HCT technology has additional application potential, such as recycling of car tires; thermoset polymers as used in piping, cabling, and wiring; end-of-life automotive materials; plastic waste from agriculture; and marine waste.

COMMERCIALIZATION STRATEGY

Licensing model

Aduro pursues a business model based on licensing its technology rather than one of building/owning/operating its own plants. The Company also expects to generate additional revenue from project management and advisory services. A license proposition requires the building and operation of pilot and demonstration plant facilities to convince customers to test new feedstocks and product specifications, and to develop further improvements. In parallel, Aduro expects to further develop its technology and new applications.

Apart from pilot and demonstration facilities for the large application in plastics recycling and bitumen upgrading, the Company might pursue an installed production base of its own or in a joint venture for more niche applications. One such example is the recycling of hard-to-dispose, relatively low-volume production waste that requires a specific configuration of the process—for instance, the clean scrap material from multilayer packaging lines, thermoset polyolefins material, or elastomer resins, or for the production of specialty waxes from polyolefin waste.

Customer Engagement Program (CEP)

Aduro believes that strategic collaborations and partnerships with research and academic institutions, as well as interested companies, are key for the fast development and commercialization of its HCT platform. The Company is currently engaged in collaborations and partnerships in two different modalities: (1) commercial partnerships through demonstration projects as part of its Customer Engagement Program (CEP); and (2) research and academic partnerships to facilitate the continued development of its technological platform and applications.

Customer Engagement Program

The CEP, Aduro's main customer acquisition initiative, is a revenue generating program that enables interested organizations to conduct controlled technology evaluation sessions of the Company's HCT platform, with the aim of facilitating business discussions, building a commercial pipeline, and cultivating a partnership to pave the way for full-scale commercial projects. The program provides an opportunity to showcase the real-world potential of HCT, allowing potential customers to gain in-depth knowledge about the technology, its benefits, discuss specific issues and needs, and collaborate on targeted future projects. The CEP also provides Aduro with key insights into a highly dynamic scene of raw materials (waste stream collection and sorting are continuously changing), product specifications and competitive technologies, anchoring Aduro's development firmly with the realities of the market. Finally, it gives Aduro access to the competences of its partners, thus accelerating development while maintaining an agile organization of its own.

The initial stage of the engagement program is the Technical Evaluation, which generates revenues in the range of $50,000 to $300,000 per engagement, depending on the extent and complexity of the program. The Technical Evaluation phase is followed by a more in-depth Collaboration Phase, with project durations ranging from 12 to 24 months and expected revenues of more than $300,000 per engagement, and most likely significant resource commitments from the customer.

The CEP also provides Aduro with the opportunity to perform analysis and experimentation using diverse waste polymers, each with varying compositions and contaminant levels, with the results supporting the Company's development of its full-scale reactor units. The insights gained by the program contribute to the creation of solutions tailored to meet the specific needs and challenges encountered across different industry sectors and geographies, better preparing the Company to predict issues and pre-configure the system when it applies its technology to real-life situations on a full scale.

Currently, Aduro has five active customers in its CEP in both the plastic recycling and bitumen upgrading markets, with another 20 candidate participants in the portfolio. The Company expects that as the active projects advance and further validate the technology, several of the interested companies will convert to become paid CEP participants. Of note, many of these participants are confidential, with limited information provided on the projects. As part of the paid engagement, the participants will contribute funding to support the work being conducted by Aduro. The Company believes that the fact that it is conducting its CEP through a revenue generating model (not a standard practice in the industry) is a testament to the economic, environmental, and operational benefits that potential customers believe the HCT platform can provide.

Research and Academic Partnerships

Aduro's research and academic partnerships aim at facilitating the development of its technology. The partnerships vary in the scope and reach of the research being conducted; from projects to assess specific areas of the technology (such as the effect of feedstock contaminants), to large projects aimed at the installation of pilot plants. Of note, some of these partnerships include funding or fees that support Aduro's development activities, including Aduro's relationship with the University of Western Ontario, partially funded by a $1.15 million grant by the National Sciences and Engineering Research Council (NSERC) Alliance and Mitacs Accelerate Grants Program (Mitacs); and Aduro's relationship with Chemelot Innovation and Learning Labs (CHILL) to execute an experimentation program at the Brightlands Chemelot Campus in Geleen, the Netherlands, with the aim to optimize its next-generation chemical recycling platform and to accelerate the Company's path to commercialization.

CORPORATE INFORMATION (HEADQUARTERS, EMPLOYEES, AND HISTORY)

The Company, which was formerly named Dimension Five Technologies Inc. (D5), was incorporated in the Province of British Columbia on January 10, 2018. On February 12, 2019, the Company's shares commenced trading on the Canadian Securities Exchange under the symbol "DFT". After the successful completion of a reverse merger on April 23, 2021, the Company changed its name from Dimension Five Technologies Inc. to Aduro Clean Technologies Inc.

The Company is listed on the Canadian Securities Exchange (CSE) under the ticker "ACT," on the OTCQB under the ticker "ACTHD," and on the Frankfurt Stock Exchange under the ticker "9D50". Note that the share consolidation, which went effective August 20th (see press release from August 16, 2024), temporarily changed Aduro's OTCQX ticker to ACTHD for 20 business days, after which it reverts to ACTHF.

The Company is the holding company of Aduro Energy Inc., which was incorporated on December 15, 2011, under the federal laws of Canada. On June 15, 2023, Aduro also established its European subsidiary, Aduro Clean Technologies Europe BV ("ACTE"), based in Geleen, Netherlands.

The Company began operations out of the Western University facility, conducting R&D operations through a research collaboration in its dedicated R&D laboratory—the Western Sarnia Lambton Research Park. In order to enhance the Company's research capabilities and strengthen its ability to accelerate technology development, Aduro completed construction of a new facility in London, Ontario. The new 4,000+ sq. ft. site includes new office space as well as an expanded, state-of-the-art laboratory.

Intellectual Property

Aduro originally developed HTU to upgrade heavy oil and bitumen in 2011. The Company then applied these findings to the recycling and renewables markets, developing its renewables upgrading in 2016 to upgrade renewable oils into fuel and specialty chemicals, and Hydrochemolytic Plastic Upcycling in 2019 to convert plastic waste to high value chemicals and fuels. HCT was developed in 2018. Through these efforts, Aduro has developed seven patents and acquired one. Today, the Company has a total of eight U.S. based patents, of which one is pending. Aduro believes that its ability to protect its intellectual property is key to ensuring the success of the Company's business. In addition to its intellectual property portfolio, the Company relies on trade secrets, copyright and trademark laws, and confidentiality agreements with employees and third parties.

One of Aduro's primary areas of focus in the next 12 months is the expansion of the Company's intellectual property portfolio behind new patents covering both the current applications of its HCT technology (i.e., Hydrochemolytic Bitumen Upgrading, Hydrochemolytic Plastic Upcycling, and Hydrochemolytic Renewables Upgrading), as well as research and development of new applications. Figure 4 provides an overview of Aduro's intellectual property portfolio.

Figure 4
INTELLECTUAL PROPERTY

Patent #	Patent Name	Filed	Issued
U.S. 7947165	Method for Extracting and Upgrading of Heavy and Semi-Heavy Oils and Bitumen	9/14/2005	5/24/2011
U.S. 8,372,347 B2	Method for Extracting and Upgrading Heavy and Semi-Heavy Oils and Bitumen	4/11/2011	2/12/2013
U.S. 9,644,455 B2	System and Method for Controlling and Optimizing the Hydrothermal Upgrading of Heavy Crude Oil and Bitumen	3/18/2014	5/9/2017
U.S. 9,783,742 B2	System and Method for Controlling and Optimizing the Hydrothermal Upgrading of Heavy Crude Oil and Bitumen	10/28/2013	10/10/2017
U.S. 10323492	System and Method of Controlling and Optimizing the Hydrothermal Upgrading of Heavy Crude and Bitumen	5/5/2017	6/18/2019
U.S. 10900327	System and Method for Hydrothermal Upgrading of Fatty Acid Feedstock	11/20/2017	1/26/2021
U.S. 11414606	System and Method for Producing Hydrothermal Renewable Diesel and Saturated Fatty Acids	11/7/2019	8/16/2022
U.S. Application 17494360	Chemolytic Upgrading of Low-Value Macromolecule Feedstocks to Higher-Value Fuels and Chemicals		Pending

Source: Aduro Clean Technologies Inc.

Company Leadership

Aduro is led by a highly experienced management team with proven knowledge and experience in the chemical and environmental technology industries, including petrochemical processes, environmental impact, and renewable energy solutions, as well as the development and commercialization of novel technologies. Biographies of the Company's management team and Board of Directors are provided in Figures 5 and 6 (page 13) and in the accompanying section.

Figure 5

MANAGEMENT

Ofer Vicus	Co-Founder & Chief Executive Officer, Director
Mena Beshay	Chief Financial Officer
Eric Appelman	Chief Revenue Officer
Marc Trygstad	Co-Founder & Principal Scientist, Director
Anil Jhawar	Chief Scientist
Abe Dyck	Head of Corporate Development
Stefanie Steenhuis	Head of Brand and Marketing
Birendra Adhikari	Head of Research & Development

Source: Aduro Clean Technologies Inc.

Management

Ofer Vicus, Co-Founder and Chief Executive Officer

Ofer is CEO and co-founder of Aduro Clean Technologies, formerly known as Aduro Energy, Inc., since its launch in November 2011. With over 20 years of experience in developing and marketing innovative technologies, he is driving the Company with passion and energy, leading and guiding Aduro through its journey from the start. He has extensive business knowledge in alternative approaches to petrochemical processes with a focus of limiting environmental impact of the traditional chemical and petrochemical industries. He has distinguished himself through his ability to bring ideas to reality with advanced academic research and strong intellectual property foundations, supported by government programs and industry partners with strong orientation on the Company's human assets.

Mena Beshay, Chief Financial Officer

Mena is a senior executive with over 20 years of progressive experience in financial leadership roles. As an active change manager with a proven track record of leading publicly traded companies, Mena is accustomed to the rigors of fast-paced corporate environments that require leaders who provide sound advice and strategic vision. He has an extensive background in financial stewardship, strategic planning, mergers & acquisitions, debt, and equity financing, and has led operational and financial turnarounds. Before joining Aduro, Mena worked across North America and several European countries with companies like Deloitte, Domtar, Enercare, and Ernst & Young. Most recently, as Chief Financial Officer and Global Head of Corporate Development with CloudMD Software & Services Inc., Mena served as part of the executive team and significantly influenced the strategic direction of the company by leading and managing the Finance and Corporate Development departments, including all aspects of financial reporting, auditing, treasury, and legal matters. Mena is trilingual and passionate about mentoring young entrepreneurs and advising start-ups on the peaks and valleys, as well as pitfalls, of early growth.

Eric Appelman, Chief Revenue Officer

Eric, who lives and works in the Netherlands, brings 35 years of experience in a variety of jobs and companies in the chemical industry. He worked with Unilever in their edible oils' business and in its renewable chemicals business (which later became part of ICI, then Croda and currently Cargill); he was technical director at Sigma Coatings (now part of PPG) and EVP for innovation, market development, and corporate strategy at the Swedish multinational Perstorp. Most recently, Eric was CTO and Marketing & Sales Director at Brightlands Chemelot Campus, the largest industrial innovation environment for the chemical industry in the world. Eric met Aduro at Brightlands and was immediately captivated by its unique technology, which offers big advantages versus more traditional recycling technologies. In addition, Eric has been on the board or advisor of several startup companies working on sustainable chemistry (Deflamo, Svenska Aerogel, Earth Energy Renewables).

Marc Trygstad, Co-Founder and Principal Scientist

Some years after forging an initial bond with Ofer Vicus, when their lives intersected during work with advanced process analysis technology, Marc joined Ofer to co-found Aduro and explore an idea. The idea grew slowly and uncertainly, but with the added abilities of Anil (see biography below), experimentation yielded knowledge to fuel the Company's initial offerings. In his career developing and applying advanced analytical technology to support petrochemical process automation, Marc combined imagination and insight with graduate training in material science and engineering, chemometrics, and organic chemistry, yielding numerous patents and foundational presentations at industry conferences.

Anil Jhawar, Chief Scientist

Anil has distinguished himself through his insights and innovative work at the intersection of chemistry and chemical engineering in academia and at Aduro. Having knowledge broad and deep paired with an engineer's passion to turn concept into reality, Anil has been at the center of Aduro's innovation from the start. The Company's very first employee, Anik is co-inventor and co-author of patents covering core Aduro technologies. Curiosity that Anil had even when young about the world seen through the lens of science and technology led inextricably to a doctorate in chemical engineering and became a lifelong pursuit. It continues today in his work to lead scaleup that supports commercialization of current Aduro technologies.

Abe Dyck, Head of Corporate Development

A seasoned executive with over two decades of experience, Abe's successful journey encompasses a spectrum of roles in both traditional and renewable energy sectors. Abe co-founded Methes Energies, a venture that grew to list on NASDAQ, post RTO (Reverse Take-Over). This venture was a testament to Abe's foresight in renewable energy solutions, an attribute he carries into his role at Aduro. His tenure also includes a notable stint as a co-founder and board member at Cleantechonomics Energy Ltd., where he orchestrated a capital infusion of $2 million, steering the firm towards pioneering waste-to-energy solutions. His current venture at Aduro is a continued commitment to innovative solutions in the renewable energy sector. Abe's role is quintessential, encompassing strategic partnerships, mergers and acquisitions, and investor relations, aligning perfectly with Aduro's vision of transforming heavy crude and renewable oils into new-era resources.

Stefanie Steenhuis, Head of Brand and Marketing

Before joining Aduro, Stepfanie had the opportunity to deepen her understanding and become an international marketing and communication executive by working with numerous B2B brands like IBM, Siemens, Ecolab, and ThyssenKrupp. She joined Aduro due to her passion to develop and position brands and to accompany this technology platform on its way to market.

Birendra Adhikari, Head of Research & Development

Birendra is an accomplished organic chemist with a PhD and extensive R&D experience in industry and in academia, where he contributed to 30 scientific articles, papers, and book chapters. Not only a researcher, Birendra is an educator at heart and is passionate about sharing his knowledge and inspiring the next generation of scientists. His passion for science that addresses energy and environmental challenges aligns well with the mission and vision of Aduro, where he brings theory into practice. Having multidisciplinary expertise in organic, analytical, and applied chemistry, Birendra's mind and hands are central to not only development and improvement of core Aduro technology but also discovery of innovative new chemistries that further enrich the Company's technology platform.

Board of Directors

Figure 6
BOARD OF DIRECTORS

Ofer Vicus	Co-Founder & Chief Executive Officer, Director
Marc Trygstad	Co-Founder & Principal Scientist, Director
Peter Kampian	Director
James E. Scott	Director
Marie Grönborg	Director

Source: Aduro Clean Technologies Inc.

Ofer Vicus, Co-Founder & Chief Executive Officer

Biography on page 11.

Marc Trygstad, Co-Founder & Principal Scientist

Biography on page 12.

Peter Kampian, Director

Peter Kampian is a seasoned financial executive with a substantial footprint in the Canadian public company sector, currently serving as the Chief Restructuring Officer (CRO) for PharmHouse Inc. and Muskoka Grown Limited. Both firms are navigating through the Companies Creditor Arrangement Act (CCAA), with Peter working diligently alongside court-appointed monitors and related counsel to optimize stakeholder value. Additionally, Peter holds the audit chair position at Harborside Inc., a public cannabis entity, and Red Pine Exploration, a mining exploration venture, reflecting his versatile financial expertise across different industries. His early career saw impactful roles as the Chief Financial Officer of Algonquin Income Fund (Algonquin Power and Utilities Corp [TSX-AQN]) and Mettrum Health Corp. His strategic financial leadership at Mettrum was instrumental in its public listing in 2014, and subsequent acquisition by Canopy Growth Corporation for $430 million in 2017. Peter's restructuring acumen was notably demonstrated in his contributions to James E Wagner Cultivation Limited and DionyMed Holdings Inc., where he played pivotal roles in restructuring processes to ensure business continuity. His directorial engagements extend to CannaRoyalty Corp (OriginHouse) and Flow Capital Corp, showcasing his ability to navigate complex business landscapes. A certified Canadian Chartered Accountant (CPA, CA) and a member of the Institute of Corporate Directors with the ICD.D director designation, Peter's robust financial and managerial background is further highlighted by his business degree from Wilfrid Laurier University, making him a valuable asset in his directorial roles, poised to contribute significantly in his ongoing and future engagements.

James E. Scott, Director

Since 1998, Jim has been the entrepreneurial force as the Managing Partner of The Scott Company LLC, a Denver-based advisory firm and merchant bank. His journey began in 1992 with Salomon Brothers Inc., diving into the realms of investment banking, which was further honed at SBC Warburg in London. Graduating Summa Cum Laude from Boston University School of Management, he majored in Finance and Operations Management, paving the way for his diverse career path. With over two decades of distinct blend of transaction, operating, and leadership experiences, Jim has navigated successful transactions across a spectrum of business scales. His role as President, CEO, and Board Member at Receptra Naturals between 2018 and 2019 underscored his prowess, steering a significant revenue upsurge. Concurrently, he channels his investment acumen as the Managing Partner of Littlehorn Investments, LLC, focusing on nurturing lower market operating businesses. Beyond his professional realm, Jim has made substantial impacts as an Independent Director of StateHouse Holdings Inc. and held significant positions on the boards of various private and non-profit entities, including the YMCA of Metropolitan Denver. His extensive board directorships and active engagement in capital ventures echo his multifaceted expertise and enduring commitment to fostering business growth and community engagement.

Marie Grönborg, Director

Marie Grönborg, an esteemed leader in the chemical and clean-tech industries, brings to the Aduro CleanTech board a rich tapestry of experience spanning nearly three decades, marked by strategic leadership, innovation, and a deep commitment to sustainability. Her academic foundation, an M.Sc. in Chemical Engineering, laid the groundwork for a career distinguished by influential roles and groundbreaking achievements. Marie's journey in the industry began with a focus on research and development, where she quickly distinguished herself through her innovative approach and strategic thinking. Her leadership tenure at TreeToTextile as CEO is a highlight of her career, where she steered the company towards developing sustainable technologies for manmade cellulosic fiber production. This achievement not only revolutionized the textile industry but also underscored her commitment to environmentally conscious innovations. Before her impactful role at TreeToTextile, Marie led Purac as CEO, where she was instrumental in expanding the company's global footprint in the water treatment and biogas production sectors. Her strategic vision and leadership were further demonstrated at Perstorp, a specialty chemicals company, where, as an Executive Vice President, she played a pivotal role in driving the company's growth in diverse markets like resins, coatings, and animal nutrition. On the board front, Marie has an impressive record. Her position with SSAB showcases her ability to contribute to companies pioneering in sustainable practices. At Permascand and Eolus, she has been influential in guiding strategies towards green transition solutions and renewable energy innovations, reflecting her expertise in aligning corporate strategy with environmental stewardship. Marie's board experiences are complemented by her unique insights into the intersection of technology, sustainability, and corporate governance. She has been a vocal advocate for integrating sustainable practices into core business strategies, a philosophy that she brings to her role at Aduro CleanTech. Her holistic understanding of the industry dynamics, combined with her ability to foresee and adapt to market trends, makes her a valuable asset to the board. In addition to her professional pursuits, Marie is known for her mentorship and advocacy for women in STEM fields, fostering a culture of inclusivity and diversity within the industry.

Milestones

In the past 18 months, Aduro has achieved important milestones that have accelerated its path to commercialization. The Company's focus during that period was the completion of what it refers to as its "building blocks"—the creation of its operation and research teams, the building of a laboratory, and the assembly of its lab-scale reactors to achieve proof of concept—demonstrating its ability to move the technology from lab-scale batch reactors into a continuous flow processing reactor unit for HCT applied on both plastic recycling and bitumen upgrading. With those goals achieved, the Company is now focused on its commercialization goals though its revenue generating CEP efforts as well as the development of its pre-commercialization scale Next Generation Process reactors for both its Hydrochemolytic Plastic Upcycling and Hydrochemolytic Bitumen Upgrading initiatives.

RECENTLY ACHIEVED MILESTONES

General Operations

- Established its European subsidiary in the Netherlands, Aduro Clean Technologies Europe BV.
- Expanded and strengthened its management team, with the appointments of Eric Appelman as the new Chief Revenue Officer and Stefanie Steenhuis as the new head of Brand and Marketing, as well as the appointment of Marie Grönborg as a Director of the Company.

Finance

- Completed two non-brokered private placement for gross proceeds of CD$3.9 million (April 2023) and $3.525 million (June 2024) .
- Upgraded its stock listing to OTCQX to increase exposure to the U.S. investment community.

Technology and Operations

- Finished commission and commenced operation of its continuous flow R2 reactors for both Hydrochemolytic Plastic Upcycling and Hydrochemolytic Bitumen Upgrading.
- Completed and opened its new facility in London, Ontario, which includes new office space as well as an expanded, state-of-the-art laboratory which will function as its Canadian head office.
- Expanded its research and operations teams to support the development of its technology.

Partnerships and Consumer Engagement Program

- Signed four new participants to its CEP program: a multinational building materials company, a multinational food packaging company, as well as two global leaders in the energy and materials sectors, including TotalEnergies SE (TTE-NYSE).
- Announced that it reached the midway point of its **Shell GameChanger Accelerator Program** participation, completing three of the six phases of the project, and is underway with the tasks outlined for phase four.
- Set up a Platinum Partnership with Chemelot Innovation and Learning Labs (CHILL) to conduct an experimentation program to optimize its chemical recycling platform.

POTENTIAL MILESTONES

The Company's main goals for calendar year 2024 are as follows:

- Complete the conceptual design of the integral process for recycling of mixed plastic waste, including recycle streams, catalyst management, and product purification by Q3 2024, ordering equipment for the integral pilot plant by end 2024 and commission the facility in 2025 (part of its Next Generation Process reactor project).

- Advance the ongoing Technology Evaluation and partnership projects, solidifying key relationships, and completing initial project scope in preparation for discussions, including expanded project scope and additional collaboration projects.

- Accelerate and expand its Customer Engagement Program (CEP) by continuing to recruit new participants and converting existing participants from the Technology Evaluation phase to its pre-commercialization Technology Collaboration phase, solidifying a future commercial pipeline of projects.

- Expand the Company's strong patent and intellectual property portfolio in the form of proprietary knowledge and filings of new patent applications.

Core Story

Aduro Clean Technologies Inc. ("Aduro" or "the Company") is a Canadian company that has discovered a chemical reaction platform that is able to break down and transform large hydrocarbon materials—such as plastic waste or heavy bitumen—to more valuable products for use in fuels, new plastics, or other chemicals.

The Company's proprietary Hydrochemolytic™ Technology (HCT) is a next generation technology platform that uses the power of chemistry to transform difficult to recycle materials into valuable resources efficiently and cost effectively. HCT, developed from over 10 years of research and development, is a unique patented way to chemically deconstruct large molecules in bitumen, plastics, and renewable oils into smaller molecules, resulting in an uplift in market value as well as significant environmental benefits. The technology achieves this operating at relatively low temperatures and lower cost than current alternatives, while resulting in high conversion yields. Figure 7 provides an overview of the HCT platform.

Figure 7

HYDROCHEMOLYTIC TECHNOLOGY (HCT) PLATFORM

- Ten years of research and development
- Transforms low-value material into valuable resources
- Operates at lower temperatures and lower costs
- Higher conversion yields

- One technology platform, multiple market applications:
  - Upcycling plastic waste to liquids for chemicals & fuels
  - Upgrading heavy crudes & bitumen to lighter fuels
  - Upgrading renewable oils to fuels & specialty chemicals

Source: Aduro Clean Technologies Inc.

HCT's flexibility allows for the technology to be configured for use in multiple market applications, providing additional economic and competitive advantages. Aduro is currently focusing on three key applications:

- *Hydrochemolytic Plastic Upcycling,* converting plastic waste to liquid feedstock for chemicals and fuels production;
- *Hydrochemolytic Bitumen Upgrading,* making heavy crudes and bitumen transportable and processable into lighter fuels; and
- *Hydrochemolytic Renewables Upgrading,* for converting vegetable and animal oils and fats into fuels and specialty chemical feedstock.

Aduro's first two applications, the upcycling of plastic waste and the upgrading of bitumen, are currently in the Technology Demonstration phase, part of the Company's Customer Engagement Program (CEP), Aduro's main customer acquisition initiative (detailed on pages 42-46). The CEP is a revenue-generating technology assessment process being conducted through a partnership with five different paying organizations, which enables them to conduct controlled technology evaluation sessions of the HCT, discuss specific issues and needs, and collaborate on targeted future projects, cultivating a partnership and paving the way for future full-scale commercial projects. In addition, the Company is conducting research on the use of its HCT platform for additional applications in other market segments, like rubber tire recycling, by tuning the chemistry and controlling the processing parameters of its technology. An overview of the Company's market applications and projects is provided in Figure 8 (page 18).

According to the Company, Aduro is entering an important stage on the path to fully commercializing its technology. For the past few years, the Company's focus was on what it calls its "building blocks"—the creation of its operation and research teams, the building of a laboratory, and the assembly of its lab-scale reactors to achieve proof of concept—which resulted in the Company demonstrating its ability to move the technology from lab-scale batch reactors into a larger continuous flow processing reactor unit for both plastic upcycling and bitumen upgrading. The new units, which are fully operational, support the Company's commercialization goals, allowing Aduro to focus on the revenue-generating CEP efforts, accelerating customer engagement, and generating a commercial pipeline for its platform technology—the first step in its full-scale commercialization efforts.

Figure 8

ADURO'S MARKET APPLICATIONS

Source: Aduro Clean Technologies Inc.

POLLUTION AND RECYCLING

Environmental pollution is the addition of unwanted contaminants due to human activities that lead to undesirable changes on the quality of the environment's essential elements—air, water, and soil. This is due to the release of hazardous waste like plastics, heavy metals, nitrates, fossil fuels, and industrial toxins. In addition to its negative effects on climate change, pollution has also been found to significantly contribute to human disease and health issues, resulting in increased mortality and morbidity.

In 2016, global municipal solid waste generation was estimated at 2.02 billion metric tons and is expected to reach 3.4 billion metric tons by 2050, a 70% increase, driven by a rising population, rapid urbanization, consumerism, and economic growth (Source: World Bank's *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*, 2018). The global waste management market, which consists of collecting, transporting, disposing, and recycling waste items in a manner that minimizes environmental and health impacts, was estimated at $1.6 trillion dollars in 2020, and as is expected to experience considerable growth, reaching $2.5 trillion by 2030 (Source: Statista's *Waste Management*, 2022).

There are several options to dispose of waste, including recycling, landfilling, composting, and waste-to-energy incineration (used to generate heat and electricity). Despite all the recycling technologies in use (and the fact that the EPA estimates that 75% of all waste is recyclable), the global recycling rate estimates range from less than 20% to just above 30%, with the remaining unrecycled waste becoming part of landfill sites (Sources: Development Aid, 2023; and Cleango, Inc.'s Statistics, 2024).

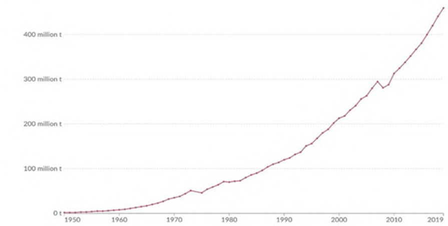
The growing concern over waste pollution has increased the demand for a global efficient waste management infrastructure. This includes sustainable management practices, which in addition to recycling and composting, include waste-to-energy incineration and sanitary landfill. Decreasing the effect of waste and pollutants on the environment can be accomplished by developing new infrastructure as well as new technologies to increase the recycling rate of the most harmful pollutants, including plastics as well as hydrocarbon and oil related products.

According to Aduro, the three waste/recycling categories that its HCT platform initially targets—recycling of plastic waste, upgrading of heavy crudes and bitumen, and upgrading of renewable oils of vegetable and animal origin—represent a combined market value of more than $200 billion. Aduro plans to capitalize on this market by making even more plastics recyclable, more heavy oils environmentally sustainable, and more renewable fuels cost-effective.

RECYCLING OF PLASTIC WASTE

Figure 9

GLOBAL PLASTIC PRODUCTION



Source: OurWorldinData.org

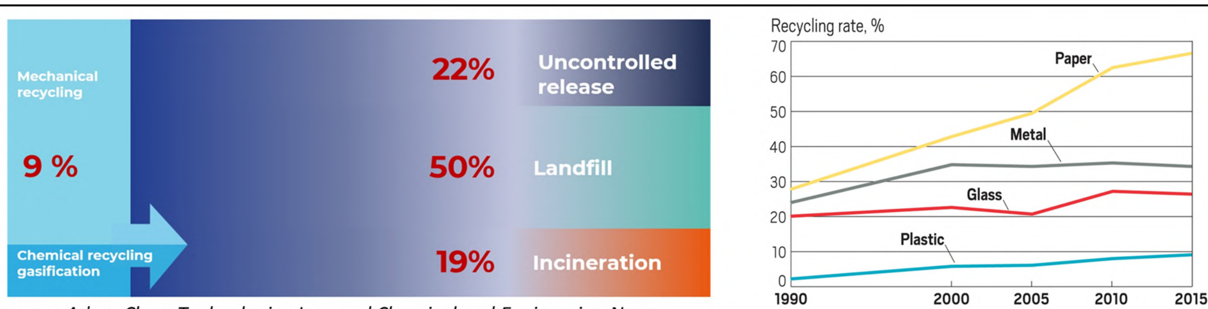
Plastic waste is one of the biggest environmental issues facing the world. Modern plastics are mostly made from mineral oil with long chains of carbon atoms called polymers. Plastics typically do not biodegrade and only break down slowly by other natural processes, taking up to 500 years to decompose, depending on their composition and disposal.

This means that after use, plastics remain in the environment for a long time, causing damage to living organisms. Plastic waste pollution has become a bigger problem in recent decades due to ever increasing consumption of this material, with global plastic production now standing at 460 million tons per annum (Figure 9), roughly the weight of total humanity. Two thirds of this volume is in short-lived products which soon become waste. Consumption of plastics is expected to continue to expand behind economic and population growth, reaching 1,231 million tons in 2060, a faster growth rate than most raw materials (Source: OECD's Global Plastics Outlook: Policy Scenarios to 2060, 2022).

This waste issue is made worse by the low recycling rate of plastic waste, which lags those of other waste materials. Most of the plastic waste ends up in landfills, with only a relatively small portion being incinerated or recycled. Global plastic recycling rates stand at just 9% (Figure 10, left). In contrast, in the U.S., approximately two-thirds of paper, a third of metals, and a quarter of glass are recycled yearly (Figure 10, right).

Figure 10

PLASTIC WASTE MANAGEMENT



Sources: Aduro Clean Technologies Inc., and Chemical and Engineering News.

As a result, nearly 300 million tons of plastic waste are produced globally every year, with 1.3 billion tons of plastic waste projected to accumulate by 2040. It is estimated that 75% of all plastic produced has become waste (Source: SeedScientific's *Plastic Waste Statistics: A Deep-Dive*, 2022). This plastic waste can break down into smaller micro-plastic particles, which are then discharged into the soil and further degrade into other harmful materials, which are carcinogenic and toxic. Plastic waste can also end up in waterways, making its way into the ocean. It is estimated that between 4.8 million and 12.7 million metric tons of plastic debris reach marine environments every year, resulting in the death of over one million marine animals annually (Source: Encyclopedia Brittanica).

Plastic Recycling Market

The global recycling plastic market was valued at $69.4 billion in 2023 and projected to reach $120 billion by 2030, driven by growing consumer awareness, energy savings, and government initiatives. However, this growth comes with a number of challenges, including proper collection of materials, separation of components, either at the source or at the processing facility, hard-to recycle residues, and the need to achieve full recycling at an affordable cost (Source: Markets and Markets' *PET largest market – Recycle plastic Market – global forecast to 2030*, 2023). Another major challenge is the overcapacity of virgin fossil plastic production from giant modern installations, leading to prices that the developing recycling industry cannot yet match.

Due to these constraints, regulatory support by several international entities, governments, and local communities has been a key factor for the growth of the plastic recycling market, including tax incentives, credits, minimal use of recyclate requirements, Extended Producer Responsibility (EPR), and penalties. Examples of these initiatives are as follows:

- The United Nations Environment Program (UNEP) (2022): UN member states, including the U.S., agreed on a resolution to create a new international agreement by 2024 to end plastic pollution, including measures along the entire life cycle of plastics, from product design to production and waste management.

- End Plastic Pollution International Collaborative (EPPIC) (2023): The U.S. is spearheading an international public-private partnership that seeks to galvanize global action to reduce demand for plastic and advance solutions to enhance circularity across the plastics lifecycle.

- U.S. State Department and USAID (2022): A U.S. driven partnership with UNEP and other organizations, where the U.S. committed $75 million for global, national, and local programs to combat plastic pollution and build capacity in countries around the world to address this important crisis.

- Multiple U.S. government initiatives, including the U.S. Environmental Protection Agency (EPA)'s $100 million in grants to boost recycling and waste management; the EPA's publication of its National Strategy to Prevent Plastic Pollution document (2023) that includes actions to eliminate the release of plastic and other waste into the environment by 2040; and the DOE Plastics Innovation Challenge to coordinate the many initiatives across government departments on plastic recycling, upcycling, and design for circularity, among others.

- EU's European wide strategy to curtail plastics consumption and pollution (2018), including a ban on single-use plastics, the creation of a comprehensive reuse system, and the establishment of a market for recycled plastics.

In addition, many countries and municipalities have implemented Extended Producer Responsibility (EPR) policies assigning manufacturers greater responsibility for the end-of-life management of their products, making them responsible for creating an infrastructure to take back and recycle the products that they produce. EPR policy leads to increased recycling and collection rates, a reduction in overall waste and landfill management costs, a reduction of public spending on waste disposal and waste management, and the development of environmental impact innovations. In the U.S. alone, there are more than 130 EPR laws in 33 states across 18 product categories (Source: Product Stewardship Institute).

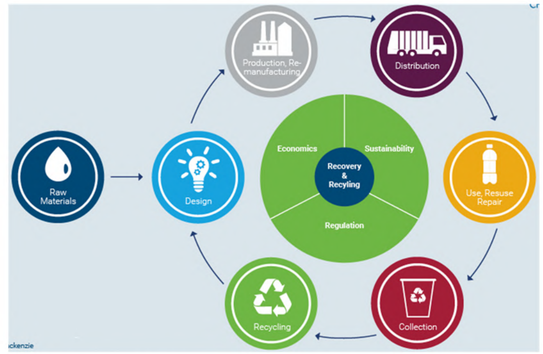
Recycling and the Circular Economy

In a circular economy, useful plastic materials are kept in circulation as opposed to being landfilled, incinerated, or leaked into the natural environment, through processes like maintenance, reuse, refurbishment, remanufacture, recycling, and composting. The circular economy encompasses petrochemical companies that produce plastic raw materials, plastic manufacturers, users, and waste management and recycling companies working together (Figure 11 [page 21]). To fully benefit from the promise of a circular system, investment in suitable collection systems and recycling facilities are required to maximize their effect on pollution and waste. The development of novel and advanced chemical recycling processes, in particular, could play a key role in the implementation and expansion of the circular economy principles. The circular economy tackles climate change and other global challenges, like biodiversity loss, waste, and pollution, by decoupling economic activity from the consumption of finite resources.

Chemical recycling can play an important role in the circular economy as it creates value in previously unrecyclable plastic waste by breaking down these plastics into petrochemical feedstock, which can then be reused as building blocks for new virgin-quality polymers. Chemical recycling processes create a bridge between the petrochemical industry, plastic manufacturers, and waste management and recycling companies.

Figure 11

CIRCULAR ECONOMY



Source: Wood Mckenzie Chemicals.

The petrochemical sector is striving to increase the supply of plastics with recycled content and is committed to collaborating with partners in the plastics value chain to research and develop the use of feedstocks from plastic waste. To achieve this objective and optimize a circular value chain for plastics, cross-industry collaborations and commercial partnerships between plastic recycling companies, plastic manufacturers, and petrochemical companies are needed to develop the technology expertise and secure access to the supply of waste plastics (Source: British Plastics Federation).

Mechanical Recycling

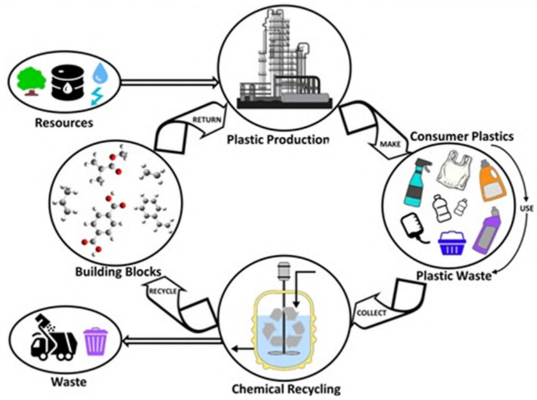
Currently, the dominant plastic recycling technology is mechanical recycling, which uses physical processes—such as sorting, shredding, grinding, washing, and reprocessing—to recover used plastics into new applications. Mechanical recycling is characterized by the fact that the polymeric material is not undergoing any change, it is basically cleaned, separated, melted, and cast into a new shape. However, mechanical recycling technology is not perfect, resulting in mixed materials with relatively low quality. Moreover, many applications of plastics are sensitive to impurities (think of food packaging, which accounts for about half of all plastic use) and specifications can rarely be met from mixed waste sources. As a consequence, mechanically recycled plastics are usually downcycled into applications with less-demanding specifications than what the virgin materials were designed for. For example, a soda bottle is processed to be used as material for a carpet or a fleece vest.

A special version of mechanical recycling can be achieved with dissolution. This is a process in which plastic is dissolved in a suitable solvent, after which a series of purification steps are performed to separate the polymer from additives and contaminants. Once the polymers are dissolved, they can be selectively crystallized and reformulated into plastics. The resulting output is the precipitated polymer, which ideally remains unaffected by the process.

Chemical Recycling

To address the shortcomings of mechanical recycling, more advanced technologies must be developed and deployed to recycle the plastics that cannot be dealt with through mechanical recycling. One such technology is chemical recycling of plastics. Chemical recycling involves using heat, sometimes with the aid of catalysts and additional chemicals, to break down long polymer chains into smaller fragments, and in some cases, even revert them to their original molecular building blocks. These fragments can then be converted to feedstock for new polymers, for instance through steam cracking (this is the route for polyethylene and polypropylene) or be re-polymerized (for instance to PET) to produce recycled plastics for new plastic products or other chemicals (Figure 12 [page 22]).

Figure 12
CHEMICAL RECYCLING



Source: Progress in Energy and Combustion Science

Chemical recycling is essential for plastic waste that cannot be recycled by other methods or that is difficult or too expensive to recycle mechanically, because it is too complex in composition or too contaminated. By turning plastic waste back into base chemicals and chemical feedstocks, chemical recycling can, in combination with mechanical recycling, improve total recycling rates and divert plastic waste from landfill or incineration. Chemical recycling complements mechanical recycling processes by enabling the further extraction of value from polymers that have exhausted their economic potential during mechanical processing, as well allowing for the treatment of mixed-polymer waste streams. Chemical recycling can also produce high-quality raw materials used to produce more plastic or different kinds of fuels, decreasing demand for fossil fuels and other natural resources used to create these products (Source: Chemistry Views Chemical Recycling's *A Key Technology for the Circular Economy*, 2024).

Despite its advantages, implementing chemical recycling techniques faces numerous challenges and obstacles, including issues related to feedstock availability, logistics, technological limitations, and infrastructure requirements, as well as the following:

(1) chemical recycling is typically more capital-intensive and operates at more severe conditions, which can cause significantly higher cost. In addition, since it is a nascent industry, it still requires significant development, optimization and scaling, as well as significant investment in infrastructure and technology;

(2) there are concerns about the energy and carbon emissions associated with chemical recycling processes, although these may be mitigated by using renewable energy sources and carbon capture technology; and

(3) depending on the specific process used and the plastic material being recycled, chemical recycling can also generate hazardous emissions and waste streams, which release a range of pollutants (Source: Resource.co's *What is chemical recycling? The good and the bad*, 2023).

According to the Company, its proprietary HCT technology affords significant improvement in these three areas over legacy technologies, providing a competitive advantage.

Chemical recycling starts with the collection and sorting of waste plastic, which is followed by the actual treatment. Depending on the output requirement, chemical recycling can take various forms. The three main steps are cleaning, depolymerization, and post-processing.

Cleaning

Cleaning is done to remove any dirt attached to the sorted plastics, for instance food residues and dust, sometimes also inks and adhesives. It does not remove any additives that are embedded in the polymeric material. Various processes exist, including water washing, or dry-friction processes. The cleaned sorted plastic can subsequently be forwarded to chemical recycling.

Depolymerization and Feedstock Recycling

Depolymerization, the reverse of polymerization, is a process that involves breaking down the long polymer chains that make up plastic into the very same building blocks from which the polymer had been assembled. From there, it is a matter of recombining them after purification, to create new plastic products without any loss in quality. Depolymerization only works on so-called condensation polymers, such as polyethylene terephthalate (PET) or nylon, and a few others such as polystyrene. It cannot be used on the much bigger polyethylene (PE) and polypropylene (PP), and therefore it can only address a minor fraction of the total plastic waste amount. Depolymerization requires relatively little energy resulting in lower operating costs. The equipment used for depolymerization is sometimes simpler and less expensive than that required for chemically recycling polyolefins.

Depolymerization is also called **solvolysis**, glycolysis, or hydrolysis because the depolymerization is mostly done by reaction with a solvent, such as water (hydrolysis), alcohol (e.g., methanolysis), or ethylene glycol (glycolosis). It is used predominantly for treatment and recycling of PET (the plastic in water and soda bottles as well as many disposables and much clear plastic packaging). The big PET polymer companies have talked about investing billions of dollars in recycling in both mechanical and solvolysis recycling of PET packaging. The application of solvolysis to a plastic waste stream leads to monomers used to make virgin PET (Source: Gerson Lehrman Group, Inc.'s *Chemical Recycling Types: Advantages and Disadvantages*, 2022). Examples include methanolysis as announced by Eastman Chemical, and glycolysis by startup companies like Ioniqa.

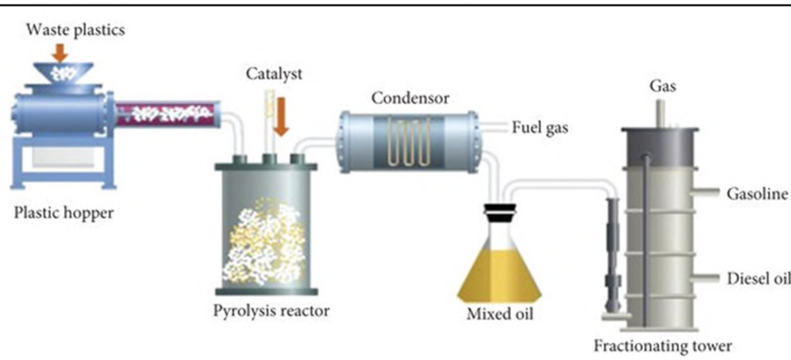
Feedstock recycling uses thermal processes to break down the polymer chains in plastic into shorter hydrocarbon chains or monomers. This produces intermediates feedstock chemicals, such as hydrocarbons or syngas, which are subsequently converted in a second step to feedstock chemicals. The feedstock chemicals are subsequently converted to monomers and those are then reacted to yield a new polymer. The two best known feedstock recycling processes are: (1) pyrolysis; and (2) gasification. Aduro's HCT is also a feedstock recycling process, with unique benefits that make it intrinsically superior to pyrolysis.

Pyrolysis

Pyrolysis is the most established (although still far from mature) technology within the nascent chemical recycling industry and is often used interchangeably with the phrase. It involves heating plastic waste to high temperatures, between 450ºC and 600ºC, which breaks the polymer chains in plastic into shorter segments (basic hydrocarbons) that can, after a number of posttreatment steps, be converted to building block ethylene and propylene by steam-(cracking). These building blocks can then be used to make new plastic products (Figure 13).

Figure 13

PYROLYSIS



Source: Journal of Energy.

The output feedstock is called pyrolysis oil. Pyrolysis oil can be sent to steam crackers but only after very substantial and costly upgrading to remove unsaturation and heteroatoms that are unavoidable but undesirable in pyrolysis oil. After this upgrading, the oil can be sent to steam crackers or other chemical plants. Some of this upgrading might be done in existing refinery operations, but at a significant cost. Alternatively, it can be used as fuel after it is refined and blended. The plastic produced using upgraded pyrolysis oil will be virgin-quality and contaminant free and may be used in all the same applications as new plastic (e.g., food packaging).

Pyrolysis works best when handling relatively pure polyolefin waste. Historically, pyrolysis had been commercialized in applications relating to heavy crude oil fractions, and biomass. In the waste plastic recycling, pyrolysis of mixed plastics has been in development over the last two decades but is only now becoming a commercial reality with several semi-commercial demonstration plants in operation and more industrial-scale units announced for the next few years.

Since pyrolysis requires high temperatures and a combination of substantial pre-sorting and extensive post-treatment, it is considered as a more expensive recycling option overall. In addition, some plastics that contain oxygen in their composition (such as PET) can be inefficient. However, if managed well, pyrolysis can reduce CO_2 emission by approximately 50% compared to straightforward incineration, with the environmental impact of pyrolysis and mechanical recycling being comparable (Source: Resource.co's *What is chemical recycling? The good and the bad*, 2023).

Gasification

Gasification is an entirely different recycling process. It subjects mixed waste to extremely high temperatures, breaking the substrate down to small molecules of one carbon atom only, plus hydrogen, to a mix called synthesis gas, from which larger molecules and polymers are built up from scratch. The heat is typically provided by burning part of the input. Because of the extreme temperatures (1,000^{o}C) and the associated high capex, it can only successfully be operated at massive scale and with high capex. The advantage is that it is tolerant to all impurities, minimizing pretreatment. The disadvantage is that the syngas cannot be transported, making it imperative to integrate the massive gasification units with very large-scale next step processes to make manageable chemicals, such as ammonia and fertilizers, or methanol. Because of these different characteristics, gasification could be a perfect complement to the combination of mechanical recycling and feedstock recycling, where it takes care of the most difficult waste streams and residues.

Post-Processing

The product resulting from many chemical recycling processes often requires expensive and capital-intensive post-processing to achieve a desirable end product. The specific post-treatment depends on the intended application, whether for fuel, new plastics, or other chemicals. For instance, pyrolysis oil typically needs costly upgrading before it can be further processed as feedstock for new plastics. One of HCT's most significant competitive advantages is its potential to substantially reduce the need for post-treatment.

Positioning Aduro's HCT technology

Aduro's HCT technology is a novel form of chemical recycling, called **chemolysis**. It is a feedstock recycling process with some very substantial advantages over pyrolysis:

(1) It elegantly separates oxygen and nitrogen heteroatoms out, allowing both more contaminated input, and reducing the need for expensive post-treatment.

(2) It produces a substantially saturated product, further reducing post-treatment needs to a significant extent.

(3) It operates at milder conditions (temperatures of 350ºC-400ºC), which sharply reduces the losses of input material to char and fuel gas.

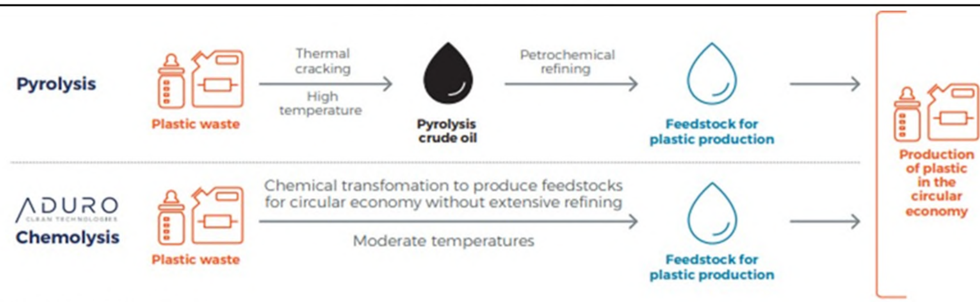
(4) Because of the lower operating temperature, and the lower endothermic energy demand, total energy input requirements are much lower.

(5) Because of a simpler process layout, with less pre- and post-treatment requirements, HCT can be implemented with less capex, and therefore be operated commercially at a smaller scale.

Figure 14 provides a comparison between pyrolysis and chemolysis (HCT).

Figure 14

HCT VERSUS PYROLYSIS



Source: Aduro Clean Technologies Inc.

UPGRADING OF BITUMEN/HEAVY CRUDE OILS

Bitumen is a dense, highly viscous, low grade crude oil composed of complex, heavy hydrocarbons that is found in deposits, such as oil sands. Natural bitumen and heavy oil differ from light oils by their high viscosity (resistance to flow) and high density. Bitumen owes its density and viscosity to its chemical composition, mainly large hydrocarbon molecules known as asphaltenes and resins, which are present in lighter oils but to lesser degree. In addition, bitumen frequently has a high content of metal contaminants, such as nickel and vanadium, and significant content of nonmetallic inorganic elements, such as sulfur, nitrogen, and oxygen.

Bitumen is processed in three steps:

(1) Extraction–bitumen is recovered from the formation sand either through mining and extraction of the bitumen from the sands directly or through injection of steam into the reservoir (in-situ), which heats the bitumen allowing it to flow to production wells;

(2) Processing for transportation—the extracted bitumen is too heavy to ship directly in pipelines. The bitumen is therefore either upgraded at the production site to a lighter crude or diluted with a light crude (diluent) for transport; and

(3) Refining–once transported the upgraded or diluted bitumen is refined, similar to other crude oils, into final products, such as diluents, lubricants, and gasoline.

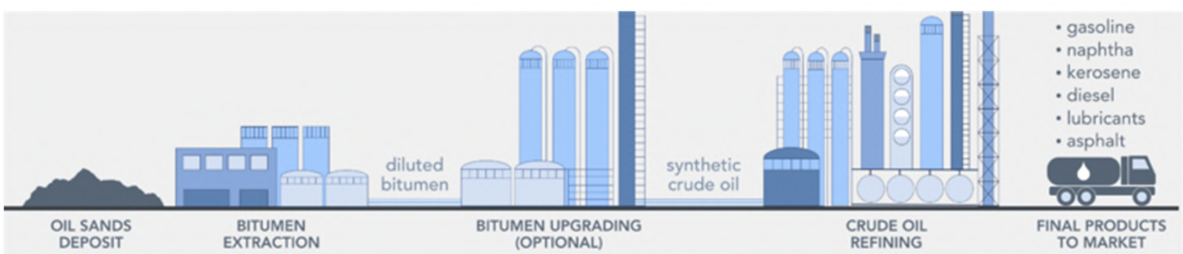
Bitumen is normally found in oil sands, a mixture of sand, clay, and bitumen. The world's largest deposits of oil sands are found in Venezuela and Canada, with an estimated 3.5 trillion to 4 trillion barrels of original oil in place. However, oil in place is not necessarily oil reserves, as not all of the deposits can be recovered. The development of improved extraction technologies has enabled profitable extraction and processing of the oil sands. For example, Alberta's (Canada) oil sand reserves are estimated at 1.7 to 2.5 trillion barrels of oil trapped in the complex oil sand mixture, which represents the largest single reserve of oil in the world. Even if only 15% of this can be recovered, this amounts to about 75% of the petroleum reserves in North America (Source: College of Earth and Mineral Sciences).

The heavier components of refined bitumen are used in the construction industry, specifically in paving asphalt and roofing applications. In addition, bitumen could be processed in high conversion refineries into a full range of petroleum products, including gasoline. However, the costs of production and transportation of bitumen from oil sands are high, mainly due to its viscosity and transportation limitations.

The bitumen extracted is very viscous and does not easily flow at normal temperatures, making it difficult to transport by pipeline. Oil sand producers have three options to lower viscosity and allow bitumen to be delivered to market: (1) heat the bitumen to reduce its viscosity (difficult to do for long distances); (2) blend the bitumen with diluents to form diluted bitumen (dilbit); or (3) upgrade the bitumen on site to form lighter synthetic crude oil (SCO).

Blending consists of mixing the bitumen with a lighter oil (i.e., lighter conventional crude or natural gas condensates) to reduce its viscosity, creating dilbit. Dilbit can then be transported via pipeline to refineries or any other destination. Another option is to upgrade the bitumen through the use of facilities near or at the extraction site that convert the extra-heavy oil into lighter crude that can be transported through pipelines without the need for additional diluents. Figure 15 provides an overview of the bitumen processing steps.

Figure 15
BITUMEN AND HEAVY OIL PROCESSING



Source: oilsandmagazine.com

Bitumen Upgrading Process

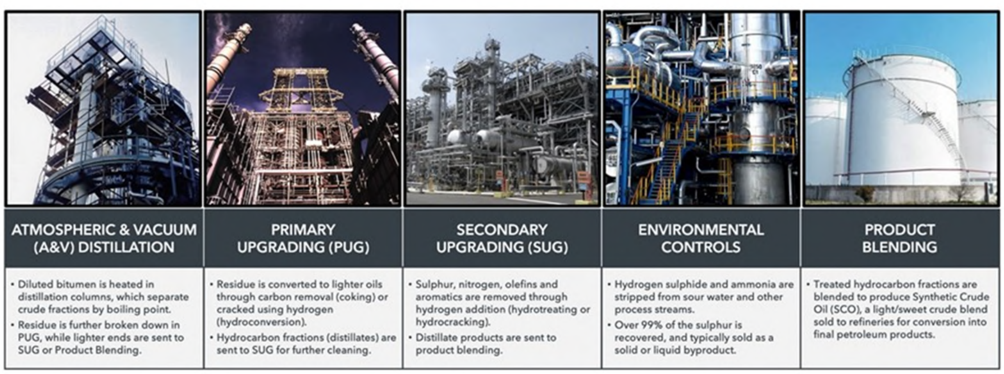
Undiluted bitumen extracted from the oil sands requires extra processing or upgrading before it can be transported and sold to refineries. Bitumen upgrading is a chemical treatment process that turns bitumen into synthetic crude oil (SCO). SCO is easier to refine than bitumen because it does not require expensive facilities to convert it into light products. Many refineries are designed to treat light or medium crude oil with lower sulfur content than the 4% to 7% that is typically found in bitumen or have limited capacity to process diluted bitumen. In addition, upgraded bitumen can be transported through pipelines without the need to add diluents, which saves producers not only the cost of the diluent, but the expenses associated with removing the diluent before final processing is done.

In the Canadian oil sands, bitumen produced by surface mining is generally upgraded and delivered as SCO. In 2021, about 40% of all bitumen from the Canadian oil sands was upgraded on-site into SCO before being delivered to downstream refineries. That amounted to 1.2 million barrels/day (Source: Oil Sands Magazine's *Upgrading 101: From Heavy Bitumen To Light Synthetic Crude*, 2022).

The upgrading process begins with the distillation of the bitumen, which separates the crude into fractionated components, including any diluent used during the extraction. The heavier or residue portion is then upgraded into lighter oils (primary upgrading), leaving behind three streams—light gas oil, heavy gas oil, and naphtha. Each stream is processed through a hydrotreater, which stabilizes the product and removes sulfur, nitrogen, and other contaminants (secondary upgrading). Post-hydrotreating, the three product streams along with the original fractionated materials are then blended into a final SCO product (Source: Oil Sands Magazine's *Upgrading 101: From Heavy Bitumen To Light Synthetic Crude*, 2022). The bitumen upgrading process is detailed below and illustrated in Figure 16.

Figure 16

BITUMEN UPGRADING PROCESS



Source: Oil Sand Magazine.

(1) Distillation

A significant portion of the bitumen is crude oil that does not need further upgrading and is distilled out at the start of the process along with any diluent that is used in the extraction of the bitumen. These fractionated components are returned as diluent to the production/extractions facilities or blended in the final SCO product.

(2) Primary Upgrading

The residue from the distillation process is converted into lighter hydrocarbons through cracking, where the long-chain hydrocarbon molecules are broken down (cracked) into shorter-chain simpler hydrocarbon molecules. This process also involves upgrading of the hydrogen to carbon (H:C) ratio, with a higher H:C ratio being indicative of a better-quality crude (Source: Oil Sands Magazine's *Bitumen Upgrading Explained*).

The primary upgrading process can be achieved by either carbon removal (carbon rejection or coking) or by adding hydrogen (hydro-cracking). Cokers operate at temperatures of about 475°C to 520°C, thermally cracking the residue into light hydrocarbons, such as naphtha, kerosene, and gas oils, which rise to the top of the drum and are drawn off. The remaining solid product or coke is high in carbon and can be used for fuel or discarded. The coking process also produces carbon monoxide, which can be used as fuel to produce steam and power.

As an alternative to coking, hydro-cracking is a process where the heavy molecules are cracked through the addition of hydrogen in the presence of a catalyst (such as platinum). Since hydrogen is added during the cracking reactions, the volume of the resultant SCO is higher, with yields above 100%, versus 80% to 90% for a coker. While the higher yield is attractive, the higher complexity, capital, and operating costs, and the need for more in-depth extraction processing makes the hydrocracker less attractive versus coking for field upgrading. However, all these processes take large amounts of energy and water, while emitting more CO_2 than extraction of conventional oil (Source: Canada Energy Regulator).

A primary factor in the need for energy and the emission of CO_2 is the fact that when cracking breaks the bond between two carbon atoms, each becomes highly reactive and seeks to make new bonds. Thus, these unstable molecules need to be stabilized with hydrogen in the secondary upgrading process. Conventional petroleum processing creates hydrogen in a process called steam methane reforming. Natural gas and water are heated in the presence of a specially designed catalyst to create the hydrogen gas used in secondary upgrading. In addition to being expensive, reforming creates a significant amount of CO_2.

(3) Secondary Upgrading

The secondary upgrading process improves the quality of the naphtha, kerosene, and gas oils streams resulting from the primary upgrading process by removing sulfur and nitrogen content, as well as other impurities, through the addition of hydrogen in the presence of a catalyst (hydrotreating). Since hydrogen is added to the product, this step enhances the quality, stability, and marketability of the final crude oil product, while adding volume and improving yield.

(4) Product Blending

The final stage of the bitumen upgrading process involves blending the lighter-end crude, separated during distillation, with the upgraded streams of naphtha, kerosene, and gas oils, as well as other products, to create SCO, which is then sold to downstream refineries for conversion into final consumer products.

UPGRADING OF RENEWABLE OILS/BIOFUELS

The high demand and consumption of fossil fuels has resulted in environmental pollution problems which extend to potentially irreversible consequences with regard to global warming. Increasing concerns about environmental impacts and the potential depletion of the non-renewable resources of fossil fuels have increased the interest in the development and use of clean fuels and alternative renewable energy sources as a substitute for conventional fuels. One of the main options is the use of biomass energy resources for the generation of alternative fuels.

Using biomass has many advantages in comparison to other renewable sources due to the diversification of biomass resources, different processing options, and variety of products and uses. In addition, since disposal of biomass waste poses environmental concerns, converting them into **biofuel** is a promising proposition to both lessen their disposal problem and reduce the dependance on fossil fuels (Source: *Catalysts, Vol. 10 (12):1381*, 2020).

In general, biofuels are classified into three different generations based on the type of resources: (1) the first generation is derived from palatable food crops (for example, sugarcane, wheat, grain, corn, potato, soybean, sunflower, and coconut), agricultural products containing sugar or starch, and oilseeds or oily residues; (2) the second generation is derived from various agriculture and forest feedstocks, including non-edible plant sources, building waste, industrial waste, and municipal waste; and (3) the third generation is derived from algae (Source: Journal of Energy Resources and Conversion's *A Review of the Production and Upgrading of Biofuel; Raw Materials, Processes and Products*).

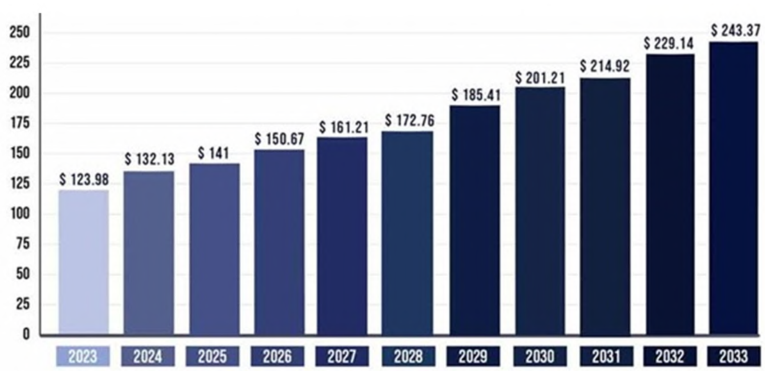
One of the most important sources of renewable fuel is the oil extracted from non-food seed crops grown on marginal lands as well as from various vegetable oils, such as canola, palm oil, sunflower, soybean, rapeseed, and castor oil. These include the use of "waste cooking oil" as a source, which refers to edible oil which has formerly been used for frying in restaurants, hotels, and other establishments, and can no longer be used for similar purposes. Biodiesel production from waste cooking oil and similar sources is considered environmentally friendly as it recycles the leftover oil, reducing the environmental impact of its disposal, and providing renewable energy with lower pollution. Unlocking the hydrocarbon content of these oil-based sources can result in a reduced demand for traditional fossil fuels (Source: *Scientific Reports Vol. 9, #18982*, 2019).

Biofuel Market Overview

The global biofuels market size was valued at $123.98 billion in 2023 and is expected to reach $243.37 billion by 2033 (Figure 17) . The rising demand for sustainable and environmentally friendly fuel sources is behind a focus on lowering greenhouse gas emission. Increased government regulation and support for environmentally friendly power options are expected to keep the biofuels market growing at rapid pace (Source Precedence Research's *Biofuels Market Size, Share & Growth Analysis Report, Regional Outlook 2024 – 2033*, 2023).

Figure 17

BIOFUELS MARKET SIZE ($ Billion)



Source: Precedence Research.

Emerging applications of biofuels are projected to generate lucrative growth opportunities for companies operating in the global biofuel market. Furthermore, technological advancements in the biofuel industry have reduced the cost and the carbon footprint of their production. When burned, biofuels have a lower carbon footprint than traditional fuels. However, the method through which they are produced can eliminate this advantage. New and more efficient production methods can not only drive the adoption of the technology but produce commercial opportunities for companies involved in the development of these technologies.

On the basis of the feedstock segment, oil represents 28% of the market share, only behind grain, with the vegetable oil feedstock segment expected to dominate in terms of revenue. This is due to the benefits offered by vegetable oil, such as low manufacturing costs and easy processing due to its low saturated fat content (Source Precedence Research's *Biofuels Market Size, Share & Growth Analysis Report, Regional Outlook 2024 – 2033*, 2023).

Biofuel Processing and Upgrading

Chemical processes are the most important step in converting biomass to biofuels. In general, chemical methods for the production of biofuels fall into one of two categories: bio-chemical (i.e., anaerobic digestion and fermentation) and thermochemical. Thermochemical biofuel production has several advantages over bio-chemical processes, including faster reaction times, increased efficiency, feedstock flexibility, and complete biomass utilization. Thermochemical processes include gasification to produce syngas, pyrolysis to produce bio-oil, and hydrothermal liquefaction (HTL) to produce aqueous sugar (Source: *Materials (Basel), Vol.16 (1):394*, 2023).

Pyrolysis and HTL target the conversion of biomass to liquid transportation fuels and chemicals. Fast pyrolysis involves the rapid heating of biomass to high temperatures (400°C–600°C) in the absence of oxygen. HTL converts biomass using liquid water at moderate temperatures (~300°C) and high pressures. Both technologies target the production of an energy dense bio-oil.

However, the biggest difference between the generated bio-oil and petroleum feedstocks is oxygen content. Bio-oil has oxygen levels from 10% to 44% while petroleum has essentially none, making their chemical properties vastly different. The high oxygen content creates several undesirable properties, such as low energy density, instability that leads to polymerization, and high viscosity (making transportation difficult). Therefore, bio-oil upgrading is required for the creation of usable fuels or chemicals. Biomass upgrading processes include catalytic hydrodeoxygenation (HDO), catalytic cracking, steam reforming, and esterification. Since the bio-oil needs to be upgraded, to make biomass conversion commercially competitive, bio-oil production plants need to be located close to either major agricultural or forestry centers, or to major logistic hubs or ports and are typically smaller in size than crude oil facilities (Source: *Materials (Basel)*, Vol.16 (1):394, 2023).

ADURO'S HYDROCHEMOLYTIC™ TECHNOLOGY (HCT)

Aduro's Hydrochemolytic™ Technology (HCT) is a novel and patented technology platform that chemically transforms high molecular weight hydrocarbon materials—such as waste plastics and bitumen—into higher value feedstock for fuels, new plastics, and specialty chemicals. The HCT platform relies on a unique and patented chemical process to break down large molecules, like those in bitumen and plastics, into smaller molecules, using low cost readily available catalysts and chemical agents. Materials with undesirable characteristics are converted into materials that are more useful as feedstocks for fuels, plastics, and chemicals. The technology achieves this operating under relatively mild conditions (lower temperatures), achieves relatively high yields of valuable products, can easily handle contaminants, and needs less costly post-treatment to reach desirable specification versus competitive technologies.

The Company's proprietary HCT platform is highly versatile, allowing for the technology to be configured for use in multiple market applications. Aduro is currently targeting three important commercial sectors:

- *Hydrochemolytic Plastics Upcycling,* for recycling plastic waste to chemical feedstock for new plastic and other chemicals production;

- *Hydrochemolytic Bitumen Upgrading*, for upgrading heavy oil and bitumen to readily transportable crude oils without the use of diluents; and

- *Hydrochemolytic Renewables Upgrading*, for converting animal or vegetable oils into renewable fuels and chemical feedstock.

According to the Company, its technology platform is designed to address the shortcomings of traditional methods of recycling plastic waste and upgrading bitumen and renewable oils. In the plastic waste sector, these technologies (such as pyrolysis), generally lack selectivity due to operating at extremely high temperatures (from 400 °C to as high as 1100 °C) and require costly post-processing treatment to obtain a desirable end-product.

In contrast, HCT offers a comparatively simple, configurable technology that operates at relatively low temperatures, sharply reducing the losses of input material to char and fuel gas, resulting in high yields and less energy requirements. In addition, HCT results in a high-quality saturated end-product that reduces post-treatment need to a significant extent.

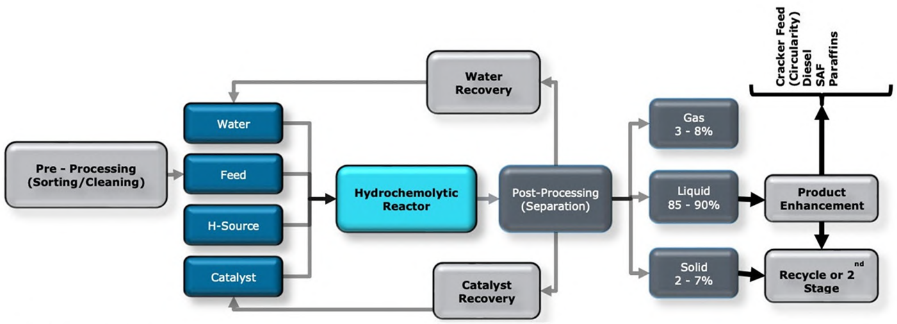
Aduro states that its technology is estimated to be up to 50% less expensive than traditional processes on some applications, offering an economical recycling process that minimizes implementation and operational costs. In addition, HCT's flexibility and configurable platform allows the Company to scale the process to fit both large and smaller production requirements, allowing it to operate commercially at a smaller scale, unlike the massive facilities required by other competitors to achieve the needed economies of scale.

HCT PROCESS

Aduro's HCT platform achieves the deconstruction of long molecules into smaller molecules though the mixing of the feedstock, some water, catalyst, and an H-source, while subjecting the mix to moderate temperature (350°C-400°C) and pressure (about 50 bar). The HCT process for the plastic application, illustrated in Figure 18 (page 32) and detailed in the accompanying page, occurs within the system's reactors, which operate at relatively low temperatures. Process flow for other applications, such as Bitumen, renewables, or others may be different and may even use different base technologies developed by Aduro.

Figure 18

HCT PROCESS



Source: Aduro Clean Technologies Inc.

(1) The first step is the introduction of either post-consumer plastics, bitumen, or renewable oils into one or more reactors, with a configurable temperature to accommodate different feedstocks.

(2) Water is used as a co-reactant, at relatively modest dosage. Any remaining water can be recovered and recycled.

(3) Relatively cheap transition metal salts act as a catalyst and are added in small amounts. In the case of bitumen, catalytically active compounds can already be present in the feedstock. This possibility provides an advantage over competing processes, as it eliminates the need to remove these metals prior to the start of the process. Catalyst can be recovered after the reaction, although this might not always be needed for good commercial operation.

(4) HCT uses organic hydroxy components like glycerol, ethanol, or ethylene glycol, as co-reactants to stabilize the reaction products, with low dosage requirements. This stabilization reaction allows HCT to eliminate the need to use molecular hydrogen, a process used by most alternative recycling technologies, which has negative environmental impact and requires complex and costly infrastructure and operation.

(5) The upgrading chemistry reaction results in the deconstruction of polyolefins polymer chains, with immediate stabilization of the resulting radicals, producing a substantially saturated hydrocarbon mixture (which reduces or even eliminates the need for post-hydrogenation).

(6) At the same time, any condensation polymer, such as PET or nylon, is depolymerized by the water that is present, pushing all the heteroatoms into a mixture of monomers that can be easily separated from the hydrocarbon.

(7) The liquid product from the reactor platform is separated into: (a) a volatile pure and substantially saturated hydrocarbon fraction; (b) an aqueous phase with possibly some water-soluble decomposition products; (c) a not yet fully converted leftover of heavier hydrocarbons that is recycled to the reactor; and (d) a residue containing solid contaminants, catalyst, char, and high-boiling monomers from polyester and polyamide carrying their heteroatoms. Catalyst can be separated and recycled if economically attractive.

(8) The liquid hydrocarbon output is almost fully saturated and is expected to be sold directly to the end customer without any further post-processing.

HCT COMPETITIVE ADVANTAGES

According to Aduro, HCT's capabilities result in four key technical advantages over competing technologies:

(1) the use of lower temperatures, reducing input loss to char and fuel gas and energy requirements.

(2) the ability to operate with higher rates of feedstock contamination.

(3) the ability to forego the need for costly post-treatment in additional installations, which typically require molecular hydrogen; and

(4) The possibility to operate commercially at a smaller scale.

This combination results in significant competitive and operational advantages, as it allows HCT to produce a high yield and higher quality products at a lower cost and carbon footprint. The combination also minimizes the need for post-processing, allows high configurability to address a variety of feedstocks (i.e., feedstock flexibility), and accommodates varying operational sizes and scalability. Figure 19 provides a summary of HCT's advantages.

Figure 19
HCT ADVANTAGES

Source: Aduro Clean Technologies Inc.

Temperature

The prevalent pyrolysis technologies normally use high temperatures to break the bonds between carbon atoms, reducing the size of the large molecule hydrocarbons (i.e., polymers in plastics and asphaltenes in bitumen). The Company equates this to using a sledgehammer to break the molecules apart. In addition to the high energy requirements for this process, the uncontrollable breakage can cause a complex mixture of molecular pieces, including useless char and fuel gas.

Alternatively, HCT's use of catalysts enables much milder processing conditions (temperatures), significantly reducing both byproduct formation and the energy required. HCT-based processes operate at only 350°C to 400°C. This not only makes them significantly less energy intensive (reducing energy consumption and producing savings), but the lower temperatures permit control of more selective chemical reactions. This reduces input loss to char and fuel gas, improving product yields and product quality. For Bitumen processing, HCT's application normally results in yields of up to 90% of fungible output product at a strong cost/results performance, compared to a yield of less than 90% of the legacy technologies at uneconomic levels due to their higher operational costs. For plastic recycling, the Company's application results in yields of 80% to 90% based on polyolefin content of the input material, compared to less than 70% normally associated with other competing technologies.

Feedstock Flexibility and Post Treatment

When the bond between two carbon atoms is broken, two so-called radicals, with high reactivity, are formed. They will typically react further very rapidly to form double bonds, which are undesirable for applications as chemical feedstock and can only be treated by hydrogenation after the event in a separate installation with expensive hydrogen gas and catalyst. To avoid this, the reactive carbons need to be quenched (stabilized), which is achieved in the HCT process with hydrogen radicals generated by simultaneous reaction of water with hydroxy components like glycerol or ethanol. The quenching reaction is instantaneous and produces substantially saturated hydrocarbon product fully suitable as chemical feedstock.

A distinctive feature of Aduro's HCT platform is that stabilization is achieved by using bio-based materials (in most cases already existing in the feedstock) to provide the needed hydrogen. The Company discovered that certain bio-based materials, like ethanol or glycerol, are consumed during the process by a reaction with water, releasing hydrogen radicals. During the HCT process, the glycerol reacts with water, setting free hydrogen radicals.

The elegant simultaneous hydrolysis of polyesters and nylon by water conveniently removes their oxygen and nitrogen heteroatoms out of the main hydrocarbon product. As a result, HCT can tolerate a substantial level of those common impurities in plastic waste and save on sorting and/or raw material cost, whereas pyrolysis operators must find relatively pure polyolefin feedstock, which are more costly. Furthermore, HCT's stabilization reaction produces a substantially saturated product, further reducing post-treatment need to a significant extent.

Scalability

One of the key competitive advantages of Aduro's HCT platform is that, due to its simple layout, with less pre- and post-treatment necessary, the process is highly scalable and modular, making it appropriate and economically feasible for both large and small operations. Due to the lower energy requirements translating into both economic and operational flexibility, HCT is able to operate on a smaller scale.

The traditional large-scale infrastructure needed for plastic waste and heavy oil upscaling facilities to achieve profitability demands significant capital investments, which creates multiple limitations. In terms of bitumen upgrading, the collocation of an upgrading facility on-site was limited to larger extraction operations, with smaller sites having to look for other alternatives as they have been historically left out of the recycling ecosystem due to economic viability. In terms of plastic recycling, it also required centralized operations, leading to the need to transport the waste material from longer distances.

HCT's efficiency and lower capital and operational requirements allow Aduro to set up decentralized operations near the sources of waste or heavy oil feedstock. HCT operations can be installed in a modular fashion, scaled up as capacity requirements of the site increase. This provides the Company with a significant competitive advantage as it can expand its customer base. HCT can be implemented in small stand-alone recycling or oil extraction sites at remote locations; small to medium recycling operation units at the site of industrial waste producers; bigger installations at municipalities' waste recovery facilities; or larger installations integrated into a petrochemical plants' operations (Figure 20 [page 35]).

Figure 20

HCT SCALABILITY

Source: Aduro Clean Technologies Inc.

The ability to start at a small scale, and upscale as requirements dictate, results in minimized implementation risks for Aduro's customers. For example, economic limitations of traditional plastic recycling methods dictate operations to be able to manage a minimum of between 60 tons to 100 tons of recycled plastic per day. HCT, on the other hand, allows for smaller economies of scale, starting with systems which have capacity as small as 25 tons per day, while being scalable to larger facilities (over 500 tons a day).

HCT's ability to set de-centralized locations provides another advantage. Since the Company can set up smaller operations near the source of the waste feedstock, it eliminates the need to transport waste from different sources into a centralized location, which can further contaminate the feedstock and mix different plastics from different sources, complicating the sorting and processing of the feedstock. This not only eliminates the transportation costs, but can also simplify its processing and operational complexity, as single-source waste plastic material is normally more homogeneous than that of a mix of multiple sites. Thus, HCT's scalability and smaller economies of scale provides significant advantages in the plastic-recycling operations, including: (1) reducing the costs associated with collection and transportation of the waste feedstock; (2) improving the quality of the feedstock; and (3) simplifying the processing of the feedstock (more homogenous), resulting in operational savings.

HCT's modular operations also allow the Company to expand its applications into market verticals that would normally struggle to make the needed economies of scale work, such as agricultural waste, marine waste, and food packaging. This provides the Company with a unique ability to work within individual sectors based on a smaller scale. For example, the Company is currently engaged with a food packaging prospective customer that is aimed at upscaling its plastic waste on-site before having to dispose of the material.

HCT DEVELOPMENT

Hydrochemolytic Plastic Upcycling Development

Aduro's development strategy began with the creation of its lab-scale R1 Hydrochemolytic Plastic Upcycling batch reactor, with outputs of milliliters per hour, to achieve proof of concept and fine tune the technology for further development. The next step was the creation of its R2 Hydrochemolytic Plastic Upcycling continuous flow processing unit (Figure 21). The Company completed construction and mechanical assembly of its R2 Hydrochemolytic Plastic Upcycling reactor in December 2022, with the system operational by April 2023. Use of its R2 Hydrochemolytic Plastic Upcycling unit intends to demonstrate that its chemical processing technology can achieve the successful upscaling of plastics, including mixed feedstocks, at yield and economic levels attractive for commercial operations. This essential data will also enable Aduro to apply for funding grants, which could see the fast-track development of its operations.

Figure 21

HYDROCHEMOLYTIC PLASTIC UPCYCLING R2 REACTOR

Source: Aduro Clean Technologies Inc.

The R2 Hydrochemolytic Plastic Upcycling unit is expected to be used for obtaining data to develop its pre-commercial Next Generation Process reactor, the next scale-up step before finalizing the plans for a commercial unit design and workflow. The Next Generation Process reactor aims to demonstrate the ability of Aduro's technology to achieve commercial scale, with output of up to 2,000 kg per day.

The completion and operation of its R2 Hydrochemolytic Plastic Upcycling reactor also supports the Company's commercial development strategy, as Aduro plans to use the R2 unit for its Customer Engagement Program (CEP) (detailed on pages 42-46). CEP–enables interested organizations to conduct controlled technology evaluation sessions of the HCT, enabling the Company to develop profitable commercial partnerships through demonstration projects. Aduro has engaged with potential customers through product sample analysis and technology demonstrations with the aim of facilitating business discussions and building a commercial pipeline.

In July 2024, Aduro announced that, following the successful completion of a series of tests and work done over the last six months, the Company was conducting semi-industrial scale experiments to finalize reactor configurations. These experiments are crucial for determining the necessary configurations for the Next Generation Process reactor.

Data on the Operation of the R2 Hydrochemolytic Plastic Upcycling System

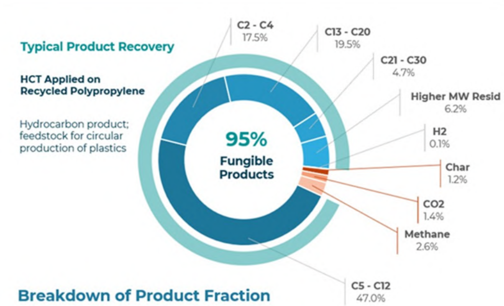
Since commencing the operation of its continuous flow R2 Hydrochemolytic Plastic Upcycling reactor in 2023, Aduro has conducted over 240 test runs on a variety of feedstock compositions, with the longest test stretching to 36 hours. The unit was committed to running experiments both for the Company's CEP and to achieve research goals, working with a broad variety of feedstocks and advancing the design of the technology. Key sample results include:

- Less than 5% of feedstock input ends up as non-recyclable material (carbon and fuel gas);
- Up to 95% of the carbon in polyolefin is converted into hydrocarbon feedstock used for the production of new plastics and/or other chemicals; and
- All resulting hydrocarbon feedstock is highly saturated, avoiding the need for costly post-hydrogenation.

Achieving a high yield of total fungible products from waste plastics is one of the main advantages of HCT, with these results being a strong validation of the Company's technology and the progress made in the development of its Hydrochemolytic Plastic Upcycling system. Other results have demonstrated the Hydrochemolytic Plastic Upcycling system to also produce yields of over 90% in the treatment of other plastic feeds, such as PE and PP (Figure 22). A key reason for the high yield is the system's ability to achieve less than 5% carbon loss to methane and char. These test results confirm Aduro's assessment that its HCT technology is able to convert the majority of the polymer's substance into a fungible product. The Company believes that this is a clear demonstration of HCT's ability to outperform traditional chemical recycling methods, potentially offering a sustainable solution with strong environmental and economic benefits.

Figure 22

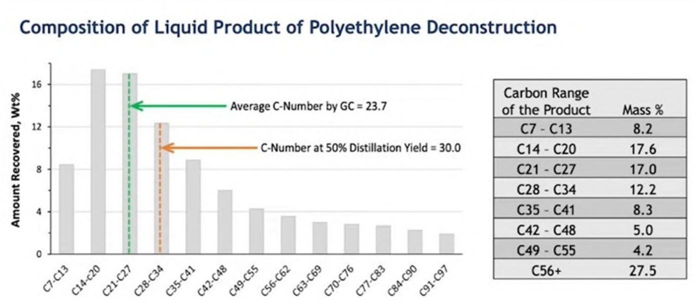
HCT YIELD



Source: Aduro Clean Technologies Inc.

Figure 23

FINAL PRODUCT COMPOSITION



Source: Aduro Clean Technologies Inc.

A key measure of the advantages to Aduro's technology is the purity of the output material (Figure 23). This is due to the high degree of adjustability of the system, controlling key parameters (temperature, pressure, time, components ratio, additives, etc.) to drive the output material towards the desired elements.

Hydrochemolytic Bitumen Upgrading Development

Similar to the development process of HTC application for plastic recycling technology, Aduro's bitumen upgrading development strategy began with the creation of its lab-scale R1 Hydrochemolytic Bitumen Upgrading batch reactor to achieve proof of concept, followed by the creation of its R2 Hydrochemolytic Bitumen Upgrading continuous flow processing unit, commissioned in October 2022 and currently fully operational (Figure 24, page 38).

Figure 24

HBU R2 REACTOR

Source: Aduro Clean Technologies Inc.

The HBU R2 reactor enables the Company to conduct its revenue generating CEP activities (detailed on pages 42-46), which allows interested organizations to conduct controlled technology evaluation sessions of the HCT technology. The Company sees these commercial partnerships as a key element in the future commercialization of its technology as it allows it to establish a commercial pipeline while conducting ongoing customer engagement, as well as technical and business discussions. In addition to its CEP program, operation of its R2 Hydrochemolytic Bitumen Upgrading reactor results in further data acquisition that expands the Company's knowledge of its HCT platform's capabilities and provides data that supports the development of its scale-up and pre-commercial Next Generation Process unit.

Hydrochemolytic Renewables Upgrading

HCT's third application offers the possibility to transform renewable oils into valuable feedstocks for renewable motor fuels (diesel), bio jet fuel, and specialty chemicals, diminishing the demand for petroleum and supporting the drive to carbon neutrality. This process is currently undergoing research and is in a pre-pilot program stage.

The Company believes that its Hydrochemolytic Renewables Upgrading technology can play a vital role in supporting environmental and clean energy initiatives. At the heart of this novel, patent-pending deoxygenation process is a highly scalable continuous-flow reactor that upgrades lipids regardless of fatty acid composition. Feeds can include inedible corn oil byproduct from conversion of corn to ethanol used in fuel; oil extracted from non-food seed crops grown on marginal lands and off-specification canola and soybean oils; cooking oil and other oils from grease traps in restaurants; and tallow and oils from meat poultry processing plants. Unlocking the hydrocarbon content of these "surface oils" offers the possibility to reduce the demand for "below surface" crude oil (petroleum).

Hydrochemolytic Renewables Upgrading conversion technology can be configured to produce a diverse line of products, including renewable fuels. A key element of the Hydrochemolytic Renewables Upgrading technology is the removal of oxygen from the end product, a necessity in order to maximize their usefulness as feedstocks for chemicals and fuels. The Hydrochemolytic Renewables Upgrading technology achieves this with chemical reactions that selectively eliminate oxygen from renewable oils, producing high purity hydrocarbons that can serve as feedstocks for fuels and chemicals normally produced from petroleum. The process can be configured for stand-alone operation or integrated with existing biofuel operations to increase their efficiency.

Additional Market Verticals

While the Company's focus is currently on the commercialization of its plastics upcycling (Hydrochemolytic Plastic Upcycling) and bitumen upgrading (Hydrochemolytic Bitumen Upgrading) technologies, and the further development of its renewable oil upgrading (Hydrochemolytic Renewables Upgrading) platform, Aduro's HCT flexibility allows it to be applied to additional market verticals. The Company continues to assess the expansion of its technology platform's applications, including the recycling or upcycling of car tires, foam mattresses, and lubricant engine oils, among others.

ADURO'S COMMERCIALIZATION PLANS

Over the last few years, Aduro has focused on the internal design and development of its technology, including the construction of its Hydrochemolytic Plastic Upcycling and Hydrochemolytic Bitumen Upgrading R1 lab-scale reactors to achieve proof of concept as well as to provide the necessary data to upscale into its small-scale continuous flow units (e.g., R2 reactors). The completion and operation of its R2 reactors marked an important milestone in the Company's technology development strategy, allowing Aduro to drive its Customer Engagement Program (CEP), its revenue generating customer acquisition initiative. Aduro is now in the process of the next scale-up step, the Next Generation Process, where the definitive reactor configuration will be implemented in an integral process, including product purification steps.

Currently, the Company is at the pilot stage for both its Hydrochemolytic Bitumen Upgrading and Hydrochemolytic Plastic Upcycling initiatives. Aduro is actively engaged with five participants on its CEP program, with all participants conducting technology evaluation of the HCT platform. The Company is focused on achieving three key commercialization objectives:

(1) Expand its CEP participants for both its Hydrochemolytic Plastic Upcycling and Hydrochemolytic Bitumen Upgrading programs;

(2) Convert existing CEP participants from its Technology Evaluation phase to its Collaborations phase; and

(3) Continue the development of its commercial scale Next Generation Hydrochemolytic Plastic Upcycling and Hydrochemolytic Bitumen Upgrading reactors.

Facilities and Geographic Expansion

The Company began operations out of the Western University facilities, conducting R&D operations through a research collaboration in its dedicated R&D laboratory—the Western Sarnia Lambton Research Park—where Aduro is conducting its ongoing testing of its bench and R2 Reactors.

In order to enhance the Company's research capabilities and strengthen its ability to accelerate technology development and support customer engagement, Aduro recently completed construction of a new facility in London, Ontario, which will function as its Canadian head office (Figure 25 [page 40]). The facility includes new office space as well as an expanded, state-of-the-art laboratory, expected to be the centralized base of operations for the Company's research team and support its scale-up and commercialization plans. The 4,000+ ft^2 facility, which doubles Aduro's research footprint and features new analytical equipment, is expected to increase its capacity to host customer trials and demonstrations as part of its CEP program and accelerate its research and scale-up capabilities.

Figure 25

ADURO'S FACILITIES

London , Ontario Office and Laborataory

Western Sarnia Laboratory

Source: Aduro Clean Technologies Inc.

In addition to its headquarters in Canada, the Company is also conducting efforts to expand its international footprint, an initiative that Aduro believes its instrumental in its ability to engage global companies with expansive international operations. To this end, the Company has established its European subsidiary, Aduro Clean Technologies Europe BV (ACTE), based in Geleen, Netherlands. ACTE will focus on advancing the Company's Hydrochemolytic Plastic Upcycling initiative with the primary goal of constructing a future demonstration unit, expanding its CEP program into European markets. The Company is also conducting ongoing discussions at various stages with a range of organizations across the globe and is assessing expanding its operational hubs to additional countries as dictated by the market. Aduro plans to model each future new hub as a duplicate of proven operations, cutting costs and reducing risk.

Licensing Model

Aduro pursues a business model based on licensing its technology, rather than one of building/owning/operating its own plants. In return, companies using the technology will pay Aduro a licensing and royalty fee, estimated to be up to 20% of the gross margin generated from the outputs in some applications. The Company also expects to generate additional revenue from project management and advisory services and ongoing technical support and optimizations.

A licensing model allows Aduro to monetize its technology without having to build and operate the facilities and upcycling infrastructure, where it is focusing instead on the continuous R&D of its technology. This strategy is expected to allow Aduro to aggressively enter markets with its technology by leveraging customer's capital sources and operational experience, avoiding the need for major own capital and operational expenses.

Aduro's technology lends itself to modular application, allowing customers to grow by adding additional units as needed, making it easier for the Company to rapidly start generating income. Monetization of Aduro's HCT platform through licensing models reduces the Company's need for capital while enabling a pathway to commercialization that Aduro's management believes is relatively straightforward, timely, and capital efficient.

Apart from pilot and demonstration facilities for the large application in plastics recycling and bitumen upgrading, the Company may pursue an installed production base of its own or in joint venture for more niche applications. An example is the recycling of hard-to-dispose, relatively low-volume production waste that requires a specific configuration of the process; for instance, of clean scrap material from multilayer packaging lines, thermoset polyolefins material, or elastomer resins, or for the production of specialty waxes from polyolefin waste.

Research and Academic Partnerships

Aduro believes that strategic collaborations and partnerships with research and academic institutions, as well as respected companies, are key for the fast development and commercialization of its HCT platform. The Company's research and academic partnerships facilitate the continued development of its technological platform and its applications. All intellectual property generated from the projects will be owned by Aduro Energy Inc., the Company's wholly owned subsidiary. In addition, the Company has forged government relationships with Ontario Centre of Excellence, The National Research Council Canada (NRC), The Natural Sciences and Engineering Research Council of Canada (NSERC), and Reseau BioFuelNet Canada; as well as multiple associations in the green energy and upcycling markets.

Western University

In 4Q 2022, Aduro announced a joint research project in conjunction with the University of Western Ontario (Western University) entitled "Tuning Supercritical Fluids for Polymer Recycling to Monomers and Chemicals," with the intent to advance the Company's polymer recycling program. The program was funded by a $1.15 million grant by the National Sciences and Engineering Research Council (NSERC) Alliance and Mitacs Accelerate Grants Program. Aduro will contribute an additional $382,500 for a total project budget of $1.53 million.

The objective of this joint research project is to assess the impact of contaminants, such as food, organic waste, plasticizers, and fillers present in plastic feedstocks, on the process quality, yield, and process design. The project also strives to improve pre- and post-processing techniques.

The commercial aim is to develop efficient strategies that minimize the requirement for costly sorting and separation systems during pre-processing. Aduro aims to achieve this by building a database for use when engaging with real-life waste feedstocks. The database can be used in real-life scenarios to predict issues and configure the system to ensure higher efficiency and environmental benefits. The joint research project is envisioned to further improve the HCT process for chemical recycling of post-consumer and post-industrial plastics.

The project is currently engaged in the research of sorting and processing techniques for polyolefin waste, laying the groundwork for more precise and effective recycling methods to maximize the conversion of mixed plastic waste into valuable chemicals and streamline the recycling processes. The project is ongoing and continues to generate relevant data.

Brightlands Chemelot Campus/Chemelot Innovation And Learning Labs (CHILL)

Since 2021, Aduro has been present at the Brightlands Chemelot Campus located in Geleen, the Netherlands. The campus is Europe's largest innovation and incubator hub aiming to provide technology for the chemical industry of the future through research and scale-up in a highly collaborative setting. The campus houses over 3,000 professionals across more than 120 companies, all working towards a sustainable future for the chemical industry. Research topics include electrification, the use of recycled and biobased feedstocks, biotechnology, advanced plastic materials, and battery materials. The presence at Brightlands Chemelot Campus also allows the Company to be exposed to the European recycling market, which seems to develop faster than those elsewhere. It is possible that further scaling of Aduro's process will take place at Brightlands Chemelot Campus, which is well-equipped for pilot and demonstration units.

In a special involvement at Brightlands Chemelot Campus, on March 2023, Aduro set up a Platinum Partnership with Chemelot Innovation and Learning Labs (CHILL) to conduct an experimentation program at the Brightlands Campus to optimize its next-generation chemical recycling platform and accelerate the Company's path to commercialization. Aduro provides financial support to CHILL while gaining access to skilled researchers, specialized equipment for testing and analysis of data, and additional services, including access to CHILL partner events and public relations campaigns.

Under this partnership, CHILL is expected to conduct focused experiments around the HCT process for plastics upcycling (Hydrochemolytic Plastic Upcycling). The engagement provides an opportunity for Aduro to work on several defined-scope projects that accelerate the scale-up of the Company's HCT platform. These projects complement the scale-up and research activities currently being completed by Aduro, including the commissioning and operations of the pilot-scale continuous flow Hydrochemolytic Plastic Upcycling R2 reactor and the work being conducted at Western University on different contaminants in plastic feedstocks. The project is ongoing and is anticipated to be completed by the end of the calendar year 2024. The partnership with CHILL and Brightlands facilitated the establishment of relationships between Aduro and supply chain and industry leaders in Europe, which culminated in the formation of Aduro's European subsidiary in the Netherlands.

Membership and Associations

In addition to its research and academic partnerships, Aduro has relationships and memberships in multiple associations that participate in the heavy oil and plastic recycling and manufacturing industry, as shown in Figure 26.

Figure 26
MEMBERSHIPS AND ASSOCIATIONS

Source: Aduro Clean Technologies Inc.

Customer Engagement Program (CEP)

The Customer Engagement Program, or CEP, is a revenue generating program that enables interested organizations to conduct controlled technology evaluation sessions of the Company's HCT platform, with the aim of facilitating business discussions, building a commercial pipeline, and cultivating a partnership to pave the way for full-scale commercial projects. The program provides an opportunity to showcase the real-world potential of HCT, allowing future customers to gain in-depth knowledge about the technology, its benefits, discuss specific issues and needs, and collaborate on targeted future projects.

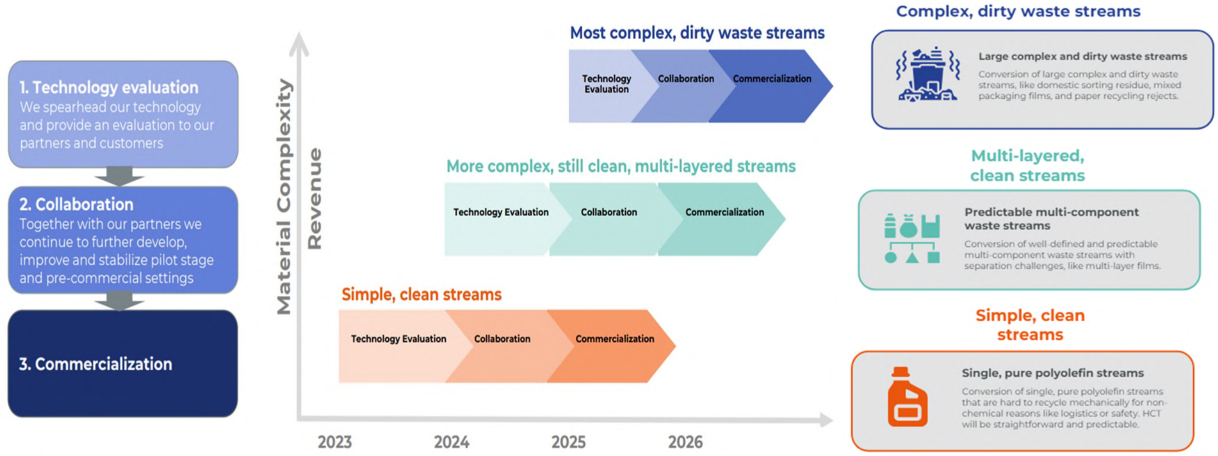
According to the Company, there are significant and crucial benefits to working with real-life customers at this early stage (beyond the revenue generating and the commercial prospects). The CEP program also provides Aduro the opportunity to perform analysis and experimentation using diverse waste polymers, each with varying compositions and contaminant levels, with the results supporting the Company's development of its full-scale reactor units. This is especially important because waste management is a highly dynamic field with new separation technologies and waste stream compositions coming along frequently. The CEP projects generate a detailed report on technology, performance, key parameters, and operational variables (including chemical characterization of the feedstock and products). The insights gained contribute to the creation of solutions tailored to meet the specific needs and challenges encountered across different industry sectors and geographies, better preparing the Company to predict issues and pre-configure the system when it applies its technology to real-life situations on a full scale. The database can be used in real-life scenarios to ensure higher efficiency and environmental benefits.

CEP Stages

Aduro's CEP engagement spans multiple stages, from initial lab-scale bench reactor assessments to advanced testing in the continuous flow reactor, offering insights into the technology's scalability. A key feature of the CEP is the development of an extensive library that details the compositions of diverse low-value feedstock materials. Through the CEP, the Company's goal is to cultivate partnerships with key industry stakeholders and to pave the way for upcoming commercial projects.

The program is structured in three different progressive stages, as shown in Figure 27: (1) Technology Evaluation; (2) Collaboration; and (3) Commercialization.

Figure 27
CEP STAGES



Source: Aduro Clean Technologies Inc.

The Technology Evaluation stage is structured to initially focus on benchmarking select materials provided by the customer. This is typically followed by larger-scale testing on the Company's continuous flow R2 reactors. This method enables a thorough assessment of Aduro's technology, creating a solid and informed basis for the next phase of the program, while also allowing the Company to gain a deeper understanding of the customer's waste feedstock characteristics and to identify their precise requirements. This program generates revenues of $50,000 to $300,000 from each engagement for the Technical Evaluation phase (the initial phase), depending on the extent and complexity of the program.

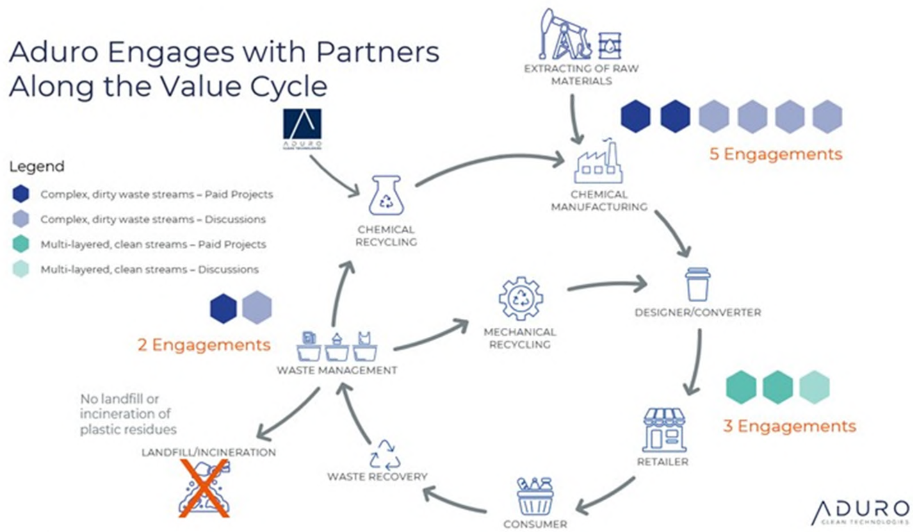
The Collaboration phase aims to expand the relationship, scaling-up the scope of the project, and creating a more customized process to address the specific operational needs of the customers. At this stage, Aduro has access to the partner's organization, engineering resources, and real-life feedstock. The Collaboration phase is a longer-term engagement that aims at the final development and configurations of the system during its pilot stage, prior to commercialization. This Phase can generate estimated revenues of over $300,000 per engagement, depending on the scope of the project.

Aduro's CEP program, and its development timelines, considers the complexity of the client's feedstock to prioritize the different projects. As seen in Figure 27, the different colors represent the feedstock complexity. Orange are simple clean feedstock streams, which the Company believes can achieve commercialization faster. Examples of these are agricultural waste or single plastic streams. HCT's flexibility and scalability could allow initial commercialization of these include feedstocks at a small scale, which the traditional upcycling methods could not do due to their larger economies of scale, speeding time to market.

One key competitive advantage that the HCT platform flexibility provides Aduro with is its ability to work with different waste streams present during the complete life cycle of the plastic industry, as seen in Figure 28 (page 44). Aduro is currently engaged with customers across the full value chain, from the initial stages—the petrochemical companies that provide the raw material to make plastics, the plastic producers, and the consumers—to the waste management companies and recycling facilities. In each step of the value cycle, the organizations have different needs, with different feedstock complexity. HCT's ability to process different feedstocks, from heavy oils to plastics, and its scalability allows it to approach the different organizations in each step of the value cycle, regardless of size requirements, location, or complexity. This gives Aduro a better understanding of the needs of the industry as a whole, and the needs at each level.

Figure 28

CEP VALUE CYCLE



Source: Aduro Clean Technologies Inc.

CEP Engagements

Currently, Aduro has five active customers in its R2 program across both its Hydrochemolytic Plastic Upcycling and Hydrochemolytic Bitumen Upgrading units, shown in Figure 29, and described below. In addition, there are over 20 interested parties in Aduro's CEP program spread globally. The Company believes that as the active projects advance and further validate the technology, especially when they reach the commercialization stage, several of the interested companies will convert to paid CEP participants. Of note, many of these participants are confidential, with limited information provided on the projects.

Figure 29

CEP AND REVENUE GENERATING CUSTOMERS

Customer	Engagement Date
Switch Energy Corporation	March 2022
Shell's GameChanger Program	November 2022
TotalEnergies SE (Global Petrochemical Company)	October 2023
Multinational Buildings Materials Company	March 2024
Global Multinational Food Packaging Company	March 2024

Source: Aduro Clean Technologies Inc.

As part of the paid engagement, the participants will contribute funding to support the work being conducted by Aduro. Aduro believes that the fact that it is conducting its CEP through a revenue generating model, which is not a standard practice in the industry, is a testament to the economic, environmental, and operational benefits that potential customers believe the application of its HCT platform can provide.

Shell GameChanger Accelerator Program

In November 2022, Aduro announced its acceptance into the Shell GameChanger Accelerator Program, an accelerator program designed to partner with businesses to deliver innovative solutions that have the potential to drastically impact the future of energy and the transition to net-zero emissions. The Company's project is based on the application of its novel HCT platform to produce sustainable naphtha cracker feedstock from polyethylene, polypropylene, and polystyrene, individually or on a mixed basis.

To support the project, Shell will contribute non-dilutive funding with the contribution payments being spread over six project phases, with each phase and associated payment being contingent on meeting the objectives set for the previous phase. In addition, Shell will provide technical expertise to help Aduro develop reliable process designs and optimize the HCT technology for commercial implementation. Shell will also mentor Aduro in developing its commercial strategy and market position.

Aduro's six phase project started with the use of small-scale batch reactors, moving through a continuous flow reactor and into design basis of commercial style facilities. The project is devised to support the rapid movement of the process to commercialization while reducing the developmental risk for the technology. In September 2023, Aduro announced that it had passed the midpoint of its project as part of the Shell GameChanger Accelerator Program and was underway with the tasks outlined for phase four. The tasks outlined for the first three phases involved evaluating the performance of HCT using pure and mixed plastic feeds, measuring the impact of HCT when contaminants are present, and understanding and optimizing the key additives in the process for effectiveness and economics. All three phases achieved results that aligned with mutually agreed performance targets.

In April 2023, Aduro initiated its commissioning runs of the pilot-scale R2 Hydrochemolytic Plastic Upcycling continuous flow reactor, which aligns well with the performance targets outlined for phase four. During this phase, Aduro will be demonstrating the efficiency of HCT process in a continuous flow set-up, focusing on operability, product quality, and yield. Additionally, the Company will be examining how the process transitions from batch to a continuous system and evaluating the configurability to maximize naphtha cracker feed yield.

Switch Energy Corp

On March 29, 2022, Aduro entered into a letter of intent (LOI) with Switch Energy Corp. to build a pre-commercial pilot plant for converting waste agricultural polyethylene into high-value products. Switch Energy is a recycler and operator participating in Canada's agricultural and industrial film recycling program by owning and operating the largest collection program for agricultural waste in the province of Ontario. With over a decade of experience with the collection of agricultural waste, design and development of plastic washing, mechanical shredding, and feed systems set-up, the Company believes that Switch Energy is an ideal partner for this pilot plant. The LOI outlines a stage gated plan with three main phases. The first phase includes the design and development of a pre-processing operation to support testing and optimization of feedstock preparation for subsequent upcycling in a configured HCT process system. Phase two includes the design, building, and commissioning of the pilot plant, with phase three detailing the framework for expanding the pilot project into a post-pilot commercial phase. Aduro's advancements, leading to the construction and operation of its R2 Hydrochemolytic Plastic Upcycling reactor, resulted in the project efforts directed at finalizing a rigorous model to support engineering of the commercial process.

TotalEnergies SE (TTE-NYSE) —Hydrochemolytic Plastic Upcycling

In October 2023, Aduro announced the inclusion of a confidential leading petrochemical company into its CEP, with the petrochemical company expanding its initial project scope the following month following positive technical evaluation results. In July 2024, following additional positive results, Aduro announced it entered into a Research and Development (R&D) strategic collaboration phase with the no-longer confidential participant, TotalEnergies SE. In the next phase, which will take over a year, work will be done on a broad range of waste plastic materials, specifically targeting those with higher concentrations of PET, polyurethane, metals, and other challenging contaminants. The expanded scope is expected to provide important data to support the Company's development and scale-up program as well as increase the respective project funding committed by 450%.

Multinational Building Materials Company—Hydrochemolytic Plastic Upcycling

In March 2024, Aduro announced the addition of a multinational building materials company to its CEP. The materials company, with extensive manufacturing operations across over 20 countries and a global distribution reach, generates multi-billion-dollar annual revenues. The company is recognized for its vast range of building materials and is dedicated to promoting sustainability through material circularity—emphasizing the recycling and reuse of materials across its product lines. Its extensive product line includes solutions for infrastructure, energy systems, municipal sewer, ventilation, and water treatment. The engagement will begin with a technical evaluation project focused on assessing HTC's potential for recycling cross-linked polymers (XLPE), a key material in the client's product range. The test samples will be sourced from waste streams at the client's production facilities.

Cross-linked polymers, essential and versatile materials, are foundational across a multitude of industries due to their superior durability, chemical resistance, and mechanical strength, and are found in everyday items such as automotive tires, rubber tires, conveyor belts, seals, tubes, hoses, household adhesives, protective coatings, and medical devices. Moreover, their significance extends to critical sectors like aerospace, automotive, construction, and electronics, where their exceptional properties are indispensable. However, unlike thermoplastics, these materials do not break down under heat; instead, they are exceedingly difficult to decompose, presenting a significant recycling challenge. Even when subjected to the extremely high temperatures necessary for their breakdown, they primarily degrade into char and fuel gas, substances unsuitable for repurposing into new materials. Roughly 2.5 million metric tons of XLPE is produced annually, representing a $6.4 billion growing industry expected to reach $8.7 billion by 2028 (Source: Mordor Intelligence's *Cross-Linked Polyethylene Market Size & Share Analysis - Growth Trends & Forecasts: 2024 - 2029*).

On May 2024, Aduro reported promising results from the preliminary tests with yields up to 84% of lower-molecular-weight hydrocarbons, confirming the effectiveness of HCT in breaking down complex polymers like XLPE, which have high thermal stability and complex decomposition pathways, into valuable hydrocarbons. This work not only solidifies Aduro's pathway into the building materials sector, but also opens the door to very sizeable markets for crosslinked polymers to be recycled. Aduro now considers tire rubber and elastomeric materials as additional potential feedstock to demonstrate the versatility of HCT in chemical recycling of polymeric materials. Accordingly, the Company is actively engaged in discussions with potential customers in these sectors.

Multinational Food Packaging Company—Hydrochemolytic Plastic Upcycling

In March 2024, Aduro announced the onboarding of a leading, global multinational food packaging company to its CEP. The food packaging company is a prominent participant in the global food processing and distribution sector, boasting an attractive portfolio of well-known brands. It operates in over 15 countries and generates multi-billion-dollar annual revenues. The company is dedicated to recycling or recovering 90% of its solid waste and aims to reduce plastic use, increase the use of biodegradable and recycled materials, and minimize the use of virgin plastic.

The technical evaluation project is focused on assessing the potential of HCT for recycling the client's plastic waste from food packaging. Through this collaboration, Aduro is expected to conduct direct tests of HCT on the specific types of plastic waste produced by the customer. The Company's objective is to showcase its technology's effectiveness and gain a deeper understanding of the unique waste management challenges faced by the food industry, while developing a customized chemical recycling solution tailored to the specific needs for recycling food packaging plastic waste, positioning HCT as a viable solution for advanced recycling in the food industry.

The necessity for such innovative solutions arises from the challenges faced by the food industry in recycling packaging materials through mechanical methods, which often fall short of achieving the required purity and safety standards for materials that come into contact with food. Particularly, recycling multicomponent packaging materials, essential for preserving and safeguarding delicate foods, proves difficult due to their complex nature, rendering them nearly impossible to recycle mechanically. HCT technology emerges as a superior alternative by chemically deconstructing waste plastics to their molecular level, a replacement of virgin fossil-derived materials, ensuring compliance with these standards. Given the food industry's significant contribution to plastic waste, there is a pressing demand for an advanced recycling approach that is both technically viable and economically feasible to recover these materials for reuse.

Investment Highlights

- Aduro Clean Technologies Inc. ("Aduro" or "the Company") is a Canadian company developing a proprietary chemical recycling platform, Hydrochemolytic™ Technology (HCT), to transform low value hydrocarbon materials—like waste plastics, heavy bitumen, and renewable oils—into higher value resources. HCT is based on a unique and patented chemical process that breaks down big hydrocarbon molecules into smaller ones that can be used as fresh feedstock for new plastics, chemicals, or fuels.

- The Company's proprietary HCT platform is highly versatile, with Aduro developing different applications to target three important commercial sectors: (1) Hydrochemolytic Plastic Upcycling, for recycling of plastic waste to chemical feedstock for new plastic and other chemicals production; (2) Hydrochemolytic Bitumen Upgrading, for upgrading of heavy oil and bitumen to readily transportable crude oils without the use of diluents; and (3) Hydrochemolytic Renewables Upgrading, for conversion of animal or vegetable oils to renewable fuels and chemical feedstock. These three markets represent a combined market value of more than $200 billion.

- HCT provides significant advantages over current technologies. For example, for its waste plastic application, it provides a higher tolerance for contaminants in feedstock, a much-reduced post-treatment requirement, substantially lower material losses, lower energy cost, and a more compact process design when compared to alternative technologies (such as pyrolysis), allowing profitable operations at smaller scale.

- For the past few years, the Company's focus has been on up-scaling its technology from lab-scale batch reactors (R1) into a continuous flow processing unit (R2) for both Hydrochemolytic Plastic Upcycling and Hydrochemolytic Bitumen Upgrading. With those goals achieved, the Company is now focusing on its commercialization goals through its revenue-generating Customer Engagement Program (CEP), which involves commercial partnerships through demonstration projects.

    - Aduro's CEP program enables interested organizations to conduct controlled technology evaluation sessions of HCT, while allowing Aduro to calibrate its efforts against a highly dynamic reality of feedstock and product developments. This offers the possibility to tap into complementary competences, generate revenue, and build a portfolio of commercial prospects—paving the way for future full-scale commercial projects.

    - Currently, Aduro has five paying customers in its CEP across both its Hydrochemolytic Plastic Upcycling and Hydrochemolytic Bitumen Upgrading programs, as well as is ongoing discussions with more than 20 potential customers, including Fortune 500 companies.

- Aduro's business model is based on licensing and royalties, avoiding the need to own and operate the processing plants. This strategy is expected to allow the Company to aggressively enter into new markets and commercialization agreements without the need for major capital or operational expenses required to build and operate the required facilities, focusing instead on the continuous R&D of its technology.

- Aduro is led by a highly experienced management team with extensive experience in the chemical, petrochemical, renewable energy, and environmental technology industries.

- As of February 29, 2024, Aduro had cash and cash equivalent of C$2.156 million and on June 17, 2024, closed a private placement for gross proceeds of C$3.525 million.

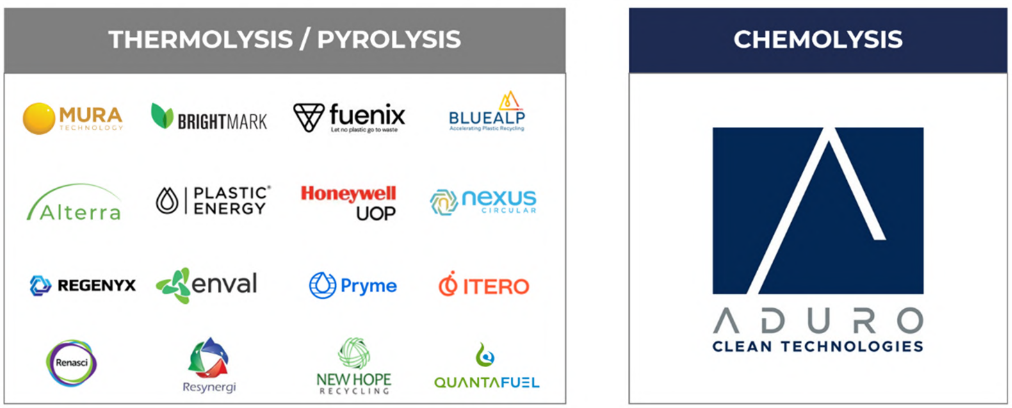
Competition

The waste plastic recycling market is a highly dynamic one, including the following developments:

- rapid advancements in plastic waste sorting technology pushing the boundaries between mechanical and chemical recycling;
- many announcements of scale-up facilities employing competitive pyrolysis technology, but at the same time increasing skepticism about the financial viability of pyrolysis; and
- pressure from cheap virgin fossil products, driven by overcapacity.

Aduro believes it has a differentiated position in this market because of its unique, patent-protected technology, whereas all direct competition builds on pyrolysis technology (Figure 30) with numerous fundamental disadvantages.

Figure 30
COMPETITION



Source: Aduro Clean Technologies Inc.

Aduro believes that the use of HCT, its proprietary chemical recycling technology platform, provides significant competitive advantages derived from HCT's key operational advantages over legacy operations:

(1) its ability to operate with mixed feedstock with higher rates of contamination.

(2) its ability to produce a product that requires much less costly post-treatment.

(3) Its ability to conduct a process that results in lower input losses due to milder conditions.

(4) Its ability to operate at lower temperature and thermodynamic heat demand, resulting in reduced energy cost.

(5) Its ability to operate at smaller scale.

The combination allows high configurability to address a variety of feedstocks (i.e., feedstock flexibility) at varying operational sizes and scalability. In addition, HCT's flexibility and configurable platform allows the Company to scale their process and required installation to fit both large and smaller production requirements, unlike the massive facilities required by other competitors to achieve the needed economies of scale.

The potential competition that Aduro may face, profiled in the accompanying section, is not intended to be an exhaustive collection of the Company's competitors; however, it is believed to be a sample of the type of competition that Aduro may face as it strives to commercialize its technologies and product offerings.

PLASTIC RECYCLING MARKET COMPETITORS

Alterra Plastics LLC
https://alterraenergy.com/

Alterra is the developer, operator, and licensor of a thermochemical liquefaction process technology that renews discarded plastic back into its original building blocks for the manufacturing of new plastic products. Currently, Alterra operates an industrial-scale, fully continuous 20,000 tons per annum recycling facility in Akron, Ohio. The facility utilizes its proprietary technology to convert end-of-life discarded plastics into feedstock for new plastic products and other valuable products. In February 2023, the company announced a license arrangement with a subsidiary of Freepoint Eco-Systems Holdings LLC for a proposed 192,000 tons per annum advanced plastics recycling facility to be sited in the Gulf Coast region. This facility will be one of the largest advanced recycling plants in the world with the potential to increase the capacity to 288,000 tons per annum. In 2020, Neste Oyj, an oil refining and marketing company located in Espoo, Finland, acquired a minority stake in Alterra and secured the European rights to Alterra's liquefaction technology, further solidifying the company's efforts to expand its technology globally. Alterra is headquartered in Akron, Ohio.

BlueAlp Holdings B.V.
www.bluealp.nl

BlueAlp focuses on transforming plastic waste into valuable resources. The company's technology, known as BlueAlp Technology, is a pyrolysis-based process designed to efficiently transform plastic waste, which cannot technically or economically be recycled or re-used, into valuable oil, which can then be used as a fuel or as a feedstock for future plastics and chemicals. The company is engaged in the construction of plastic-to-chemical installations worldwide on BlueAlp™ Technology. The first successful demonstration of BlueAlp Technology involved the construction and operation in 2014 of a pilot production plant with capacity of 3 kt/year. The company then proceeded to develop its technology to a commercial scale, with its first commercial prototype plant in 2020 located in Ostend (Belgium). This prototype can process around 24.5 kt of plastic feedstock per year. BlueAlp, based in Eindhoven, the Netherlands (NL), was founded in 2015 by the Eindhoven-based engineering firm Petrogas with ownership stakes by Mourik (NL), Renasci (BE), Den Hartog (NL) and Rumali (NL). Mourik invested in the development of technology, while Renasci and Den Hartog invested in the commercial-scale pyrolysis plant. In 2022, Shell Ventures BV and BlueAlp announced a strategic partnership to develop BlueAlp's Technology to further improve and scale-up the technology's capacity to recycle larger volumes of plastic waste. As part of the partnership, Shell obtained a 21.25% equity stake in BlueAlp.

Brightmark LLC
www.brightmark.com

Brightmark is a circular innovation company developing plastic renewal technology solutions intended to reduce plastic waste. The company's established anaerobic digestion and proprietary Plastics Renewal® technologies use pyrolysis to convert mixed stream waste plastics into materials to create new circular plastic products, diverting waste otherwise bound for landfills, incinerators, and waterways. Brightmark uses its technology to build Circularity Centers that allows them to process waste quickly and effectively, including waste plastic and natural gas recycling centers, across the U.S. In April 2024, it announced a deal with the city of Thomaston, GA, to invest $950 million to develop a 2.5-million-square-foot plastics Circularity Center facility with capacity to repurpose more than 400,000 tons of plastic per year. Brightmark works across multiple sectors, including agriculture, healthcare, manufacturing, and transportation, to decarbonize operations, displace reliance on virgin fossil fuels, and solve circularity challenges at scale. The company is headquartered in San Francisco, California.

Honeywell UOP (Part of Honeywell International Inc.—HON-NASDAQ)
www.uop.com

Honeywell International is an American publicly traded, multinational conglomerate corporation that primarily operates in four areas of business: aerospace, building automation, performance materials and technologies (PMT), and safety and productivity solutions (SPS). Honeywell UOP, part of Honeywell's PMT strategic business group, is a leading international supplier and licensor of process technology, catalysts, adsorbents, equipment, and consulting services to the petroleum refining, petrochemical, and gas processing industries. Among its product offerings, Honeywell UOP commercializes its proprietary UpCycle Process Technology, which utilizes industry-leading molecular conversion, pyrolysis, and contaminants management technology to convert waste plastic back to recycled polymer feedstock, which is then used to create new plastics. The UpCycle Process technology expands the types of plastics that can be recycled to include waste plastic that would otherwise go unrecycled, including colored, flexible, multilayered packaging, and polystyrene. When used in conjunction with other chemical and mechanical recycling processes, along with improvements to collection and sorting, Honeywell's UpCycle Process Technology has the potential to increase the amount of global plastic waste that can be recycled to 90%. Honeywell International Inc. was founded in 1885 and is headquartered in Charlotte, North Carolina.

Mura Technology
https://muratechnology.com/

Mura Technology is a technology company focused on the commercialization of its HydroPRS™ advanced plastic recycling platform. Pioneered by Mura Technology, the HydroPRS™ process, unlike pyrolysis, utilizes supercritical water (water under high pressure and high temperature) to convert post-consumer, multi layered plastic waste into high yields of stable, premium hydrocarbon feedstocks for use in the manufacture of virgin-quality recycled plastics. The technology is able to process contaminated and mixed plastics, such as flexible and rigid food packaging, largely considered unrecyclable through conventional methods. Mura Technology is developing a pipeline of own-build sites in the UK, Europe, and the U.S., while its licensing and engineering Partner, KBR, sells licenses to the technology globally. In October 2023, Mura Technology opened the world's first commercial-scale HydroPRS™ advanced plastic recycling plant in Teesside, UK. Mura Technology, formerly known as Armstrong Chemicals Limited, is based in London, UK, and was founded in 2016.

Plastic Energy
www.plasticenergy.com

Plastic Energy is a global leader in advanced recycling, offering a sustainable solution to help prevent plastic waste, transforming previously unrecyclable plastic waste into a valuable resource. Its patented and proven TAC™ process converts end-of-life plastic waste into an optimal feedstock (TACOIL™) for making virgin-quality recycled plastics. Plastic Energy currently has two chemical recycling plants in Spain and is one of the few companies worldwide that has sold TACOIL™ from the conversion of end-of-life plastic waste to replace fossil oils in the manufacturing of new plastics. Plastic Energy was founded in 2011 and is headquartered in London, UK.

Quantafuel AS (Acquired by Viridor Limited)
www.quantafuel.com

Quantafuel is a Norwegian technology recycling company that develops, designs, and operates production facilities to produce synthetic fuels and chemical products based on plastic waste. The company's plastics-to-liquids chemical recycling process converts waste plastic into a low-carbon synthetic oil raw material, replacing virgin oil products, which can be used for the production of new plastics. According to the company, its proprietary technology differentiates itself from alternatives through the use of proprietary catalytic process that results in a recycled raw material free from impurities. Quantafuel opened the world's first plastic-to-liquid plant in Skive, Denmark, in September 2020, and plans to establish several plants throughout Europe and beyond. On February 2024, Viridor, a UK-based plastics recycling and waste-to-energy company, finalized its acquisition of Quantafuel. Viridor Limited is a recycling, renewable energy and waste management company in the United Kingdom owned by KKR.

BITUMEN AND RENEWABLES MARKET COMPETITORS

In addition to individual companies listed on pages 49 and 50, Aduro faces competition from multinational oil companies, such as ExxonMobil, which participates in the extraction of heavy oil, as well as companies currently operating in the oil sands in Canada, such as Syncrude's Mildred Lake, Suncor's U1/U2, CNRL's Horizon, the Scotford Upgrader (operated by Shell), and Sturgeon, among others.

Historical Financial Results

Figures 31, 32, and 33 (pages 52-54) provide a summary of Aduro's most recent key financial statements for the quarter ended February 29, 2024.

Figure 31

CONSOLIDATED STATEMENTS OF LOSS AND COMPREHENSIVE LOSS

Expressed in Canadian Dollars

	Three months ended February 29, 2024	Three months ended February 28, 2023	Nine months ended February 29, 2024	Nine months ended February 28, 2023
	$ 103,628	$ 58,290	$ 235,266	$ 58,290
Expenses				
Research and development (Note 17)	656,739	436,018	1,908,118	1,233,803
General and administrative (Note 16)	872,190	545,077	2,345,361	1,502,482
Share-based compensation expense (Note 18)	481,084	877,182	1,331,281	1,477,164
Depreciation and amortization	113,982	41,645	307,258	93,086
Finance costs (Note 15)	2,958	4,264	9,368	13,788
Foreign exchange	4,058	17	6,532	3,166
	2,131,011	1,904,203	5,907,918	4,323,489
Loss before other items	(2,027,383)	(1,845,913)	(5,672,652)	(4,265,199)
Other items				
Loss on sale of vehicle (Note 6 & 9)	-	-	(2,512)	-
Loss and comprehensive loss	$ (2,027,383)	$ (1,845,913)	$ (5,675,164)	$ (4,265,199)
Basic and diluted loss per share	$ (0.03)	$ (0.03)	$ (0.09)	$ (0.08)
Weighted average number of common shares outstanding	67,209,509	57,527,446	65,256,477	55,565.596

Source: Aduro Clean Technologies Inc.

Figure 32

CONSOLIDATED STATEMENTS OF FINANCIAL POSITION

Expressed in Canadian Dollars

	February 29, 2024	May 31, 2023
ASSETS		
Current		
Cash and cash equivalents	$ 2,156,359	$ 4,046,634
Deposits and prepaid expenses (Note 4)	431,316	392,114
Other receivables (Note 5)	321,808	464,906
	2,909,483	4,903,654
Non-current		
Property and equipment (Note 6)	3,118,552	2,553,702
Right of use assets (Note 7)	135,859	122,104
Intangible assets (Note 8)	-	1,366
	3,254,411	2,677,172
Total Assets	$ 6,163,894	$ 7,580,826
LIABILITIES AND SHAREHOLDERS' EQUITY		
Current		
Trade payables and other current liabilities (Note 12)	$ 375,599	$ 455,048
Lease liability – current portion (Note 10)	39,309	34,765
Debt - current portion (Note 9)	3,911	27,478
	418,819	517,291
Non-current		
Lease liability – non-current portion (Note 10)	108,527	95,734
	108,527	95,734
Shareholders' equity (Note 11)		
Share capital	19,461,164	15,396,907
Warrant reserve	1,882,430	2,557,918
Contributed surplus	5,427,333	4,472,191
Accumulated deficit	(21,134,379)	(15,459,215)
	5,636,548	6,967,801
Total Liabilities and Shareholders' Equity	$ 6,163,894	$ 7,580,826

Source: Aduro Clean Technologies Inc.

Figure 33

CONSOLIDATED STATEMENTS OF CASH FLOWS

Expressed in Canadian Dollars

		Nine months ended February 29, 2024		Nine months ended February 28, 2023
Operating Activities				
Net loss for the period	$	(5,675,164)	$	(4,265,199)
Items not affecting cash:				
Depreciation and amortization		307,258		93,086
Share-based compensation expense (Note 18)		1,331,281		1,477,164
Interest expense accrued		8,039		10,540
Loss on sale of vehicle		2,512		-
Changes in non-cash working capital (Note 21)		137,356		(319,467)
Cash used in operating activities		(3,888,718)		(3,003,876)
Financing Activities				
Issue of common shares, net of issuing costs (Note 11)		3,012,630		3,628,306
Finance lease repayments (Note 10)		(40,468)		(46,729)
Term and working capital loan repayments (Note 9)		(23,449)		(23,002)
Cash provided by financing activities		2,948,713		3,558,575
Investing activities				
Property and equipment acquired		(961,270)		(1,248,531)
Sale of vehicle		11,000		-
Cash used by investing activities		(950,270)		(1,248,531)
Change in cash during the period		(1,890,275)		(693,832)
Cash and cash equivalents, start of period		4,046,634		2,110,785
Cash and cash equivalents, end of period	$	2,156,359	$	1,416,953

Source: Aduro Clean Technologies Inc.

Recent Events

08/16/2024—Aduro Clean Technologies Inc. ("Aduro" or the "Company") announced that it intends to consolidate the common shares of the Company on the basis of three and one quarter (3.25) pre-consolidation Shares for one post-consolidation Share. The Consolidation will become effective at the opening of the market on August 20, 2024. The symbol "ACT" will remain the same. The new CUSIP number is 007408206. Currently, a total of 88,316,467 Shares are issued and outstanding. Accordingly, upon the Consolidation becoming effective, a total of 27,174,297 Shares, subject to adjustments for rounding, will be issued and outstanding.

08/07/2024—Announced that it granted an aggregate of 2,685,000 stock options to purchase up to 2,685,000 common shares of the Company to certain directors, officers, employees and a consultant of the Company. The Options are exercisable for a period of 5 years from the date of Grant at a price of $2.00 per common share. The Options will vest on a monthly basis over a period of two years from the date of the grant.

07/30/2004—Announced a new collaboration with TotalEnergies SE (TTE-NYSE). This collaboration follows previously announced technical evaluations and underscores the growing interest in the Company's Hydrochemolytic™ Technology (HCT). After positive preliminary technical evaluations by TotalEnergies, Aduro is entering a research and development (R&D) collaboration phase. This phase will focus on a more diverse range of waste plastic materials, particularly those with higher concentrations of polyolefins, polyurethane, metals, and other challenging contaminants. TotalEnergies will provide both financial and in-kind support, including access to technical resources. This collaboration aims to lay the groundwork for a commercial process, as well as to generate valuable data to assist Aduro's technology development.

07/23/2024—Announced that it has publicly filed a registration statement on Form F-1 with the Securities and Exchange Commission (SEC) relating to a proposed Initial Public Offering (IPO) of its common shares in the U.S. In connection with the offering, Aduro has also applied to list its common shares on the NYSE American exchange (NYSE). The number of shares to be offered and the offering price have not yet been determined. The offering is expected to take place after the SEC completes its review process, subject to market and other customary conditions, and there can be no assurance as to whether or when the offering may be completed. EF Hutton LLC is acting as sole book-running manager for the proposed offering.

07/16/2024—Provided updates on its Next Generation Process (NGP) for waste plastics. Following the successful completion of a series of tests and work done over the last 6 months, the Company is now conducting semi-industrial scale experiments to finalize reactor configurations. These experiments are crucial for determining the necessary configurations for the NGP. Aduro aims to begin constructing the NGP by the end of 2024. Initial engagements with design, engineering, and fabrication firms have begun.

07/09/2024—Announced that it has entered into an investor relations and digital services agreement Kanan Corbin Schupak & Aronow, Inc. dba KCSA Strategic Communications (KCSA) of New York City, New York. KCSA will provide investor relations and digital services, including building and managing Aduro's brand through their AmplifIR digital IR platform, for an initial term of six months beginning July 15, 2024, which Services shall continue thereafter unless either the Company or KCSA provides written termination notice not less than 30 days prior.

06/18/2024—Announced that, further to its news release dated May 29, 2024, it has closed its non-brokered private placement by issuing 2,711,077 units at $1.30 per Unit for gross proceeds of $3,524,400.10. The Company intends to use the net proceeds from the LIFE Offering to fund the research and development of the Company's chemical recycling technologies and for general administrative and working capital expenses.

06/11/2024—Announced that, further to its news release dated May 29, 2024, due to strong investor demand, it has increased the size of its non-brokered private placement of units up to a maximum of 2,711,538 Units, at a price of $1.30 per Unit, for gross proceeds of a maximum of $3,525,000.

05/29/2024—Announced a non-brokered private placement consisting of a minimum of 1,538,462 units of the Company and a maximum of 1,923,080 Units, at a price of $1.30 per Unit, for gross proceeds of a minimum of $2,000,001 and a maximum of $2,500,004. Each Unit will consist of one common share in the capital of the Company and one-half (1/2) of one Common Share purchase warrant exercisable into one Common Share at a price of $1.60 per Warrant Share for a period of two (2) years. The Offering is anticipated to close on or about June 14, 2024.

05/16/2024—Shared results from its preliminary tests deconstructing crosslinked polymers using its HCT conducted in collaboration with a building materials manufacturing company as part of its Customer Engagement Program (CEP). Preliminary tests resulted in yields of up to 84% of lower-molecular-weight hydrocarbons, confirming the effectiveness of HCT in breaking down complex polymers like XLPE, which have high thermal stability and complex decomposition pathways, into valuable hydrocarbons.

05/09/2024—Announced it was invited to participate in the upcoming Chemelot Circular Hub event on May 15, 2024, at the Brightlands Chemelot Campus in Geleen, Netherlands. The Canadian Trade Commission Service has organized a delegation of key figures in government, institutional bodies, and companies active in sustainability and circular economy solutions to attend the World Hydrogen Summit 2024. As part of the program, the delegation will attend company presentations from a select group and tour the facilities of the Chemelot Industrial Park. Out of 130 companies located at the Brightlands Campus, Aduro is one of four companies invited to present to the delegation. Eric Appelman, the Company's Chief Revenue Officer (biography on page 12), will present Aduro's chemical recycling technology to this influential audience, highlighting its potential to contribute to global sustainability goals.

04/30/2024—Announced that it filed its interim consolidated financial results for the three and nine months ended February 29, 2024, and provided operational highlights. The Company achieved record revenue and maintained a strong cash position during the last operational quarter.

04/24/2024—Announced it joined a delegation of observers from civil society, environmental groups, academics, and business at the fourth meeting of the Intergovernmental Negotiating Committee on Plastic Pollution (INC-4) in Ottawa, Ontario, Canada from April 23 to 29, 2024. INC-4 welcomes over 4,200 delegates who will discuss an agreement that encompasses various aspects of plastic management to promote a circular economy for plastics, emphasizing recycling and reusability. Aduro is attending the event and will hold one-on-one discussions with industry delegates to promote its HCT platform.

04/11/2024—Announced its participation at two industry conferences focused on the advancement of advanced chemical recycling and renewable materials: CHEMREC I – 2024: 1st International Conference on Thermochemical Recycling of Plastics (April 28-May 2, 2024, in Malaga, Spain); and the Renewable Materials Conference 2024 (June 11-13, 2024, in Siegburg/Cologne, Germany).

04/04/2024—Provided an update on its research project titled "Tuning Supercritical Fluids for Polymer Recycling to Monomers and Chemicals" in partnership with Western University. The current phase will investigate the behavior of contaminants under HCT and pyrolysis conditions in a methodical approach to expand the Company's database so that when engaging with real-life waste feedstocks, the information generated becomes more useful in predicting issues when providing customer solutions.

03/27/2024—Announced the onboarding of a leading, multinational building materials company with extensive manufacturing operations across over 20 countries and a global distribution reach, generating multi-billion-dollar annual revenues to its Customer Engagement Program (CEP). The engagement is expected to begin with a technical evaluation project focused on assessing the potential of HCT for recycling cross-linked polymers, a key material in the client's product range. The test samples will be sourced from waste streams at the client's production facilities.

03/05/2204—Announced the onboarding of a leading, global multinational food packaging company, a prominent player in the global food processing and distribution sector operating in over 15 countries and boasting an attractive portfolio of well-known brands, to its CEP program. The technical evaluation project is focused on assessing the potential of HCT for recycling the client's plastic waste from food packaging.

02/22/2024—Shared its upcoming conference attendance schedule. Additionally, the Company has entered into a new marketing and consulting agreement with Outside the Box Capital Inc. to provide marketing and investor relations services.

02/15/2024—Shared sample test results from its continuous flow unit experimentation and optimization program. Since commencing the commissioning of its continuous flow R2 Hydrochemolytic Plastic Upcycling reactor in 2023, Aduro has conducted over 240 test runs on a variety of feedstock compositions, with the longest test stretching to 36 hours. Key results on tests runs of waste polypropylene include: (1) less than 5% of input ends up as non-recyclable material (carbon and fuel gas); (2) up to 95% of the carbon in polyolefin feedstock is converted into potential hydrocarbon feedstock for the production of new plastics and/or other chemicals; and (3) all feedstock is highly saturated, avoiding the need for costly post-hydrogenation.

02/08/2024—Announced its feature in the upcoming Viewpoint with Dennis Quaid documentary series. This special segment will highlight the innovative solutions and sustainable advancements Aduro is making in the chemicals and energy sectors, offering Aduro a recognized platform to showcase its patented HCT to a global audience. This opportunity will highlight the Company's commitment to addressing some of the most pressing environmental challenges of our time, such as waste plastic pollution and the sustainable utilization of natural resources.

01/30/2024—Announced that it has entered into a marketing and consulting agreement with Crystal Research Associates, LLC., to create and distribute an Executive Informational Overview and Quarterly Updates on the Company through Crystal Research Associates' social media channels and online media distribution.

01/16/2024—Announced that it will participate in the 10th Annual CEM AlphaNorth Capital Event in Nassau, Bahamas from January 19-21, 2024, hosted by Capital Event Management Ltd (CEM). During the event, Aduro will conduct one-on-one meetings with interested investors and other stakeholders. The Company has also extended its engagement with Arrowhead Business and Investment Decisions, LLC (Arrowhead), originally announced on May 4, 2023, regarding the provision of investor relations services to the Company.

11/30/2023—Announced the expansion of its Phase 1 testing scope with a major global energy company which recently joined the Company's Customer Engagement Program (CEP) on October 11, 2023. The additional testing will include a more diverse range of waste plastic materials, specifically targeting those with higher concentrations of PET, polyurethane, metals, and other challenging contaminants. The expanded scope will provide important data that will support the Company's development and scale-up program as well as increase the respective project funding committed for Phase 1 testing by 450%.

11/14/2023—Announced its participation in the 7th Annual Florida Capital Event in Aventura, Florida, from November 17-19, 2023, hosted by Capital Event Management Ltd. (CEM). Aduro's Chief Executive Officer (CEO) Ofer Vicus (biography on page 11) and Chief Revenue Officer Eric Appelman (biography on page 12) will highlight the Company's recent advancements in its commercialization path.

11/08/2023—Announced the appointment of Marie Grönborg as a Director of the Company. Marie Grönborg holds an M.Sc. in Chemical Engineering and has almost 30 years of global experience in the chemical and clean-tech industries (biography on page 14).

10/31/2023—Announced that the Company has upgraded its trading tier on the OTC Markets to the OTCQX® Best Market from the OTCQB® Venture Market, trading under the symbol "ACTHF". The Company believes that this marks an important milestone for Aduro and is expected to increase visibility, liquidity, and investor access, thereby providing an excellent platform for Aduro to enhance its prominence among U.S. investors.

10/11/2023—Announced the addition of two new participants to its Customer Engagement Program (CEP). The confidential participants are global leaders with billions of dollars in annual sales, representing a significant influence in the chemicals and plastics sector and extending into the global energy market. As part of the paid engagement, the participants will contribute funding to support the work being conducted by Aduro.

10/05/2023—Announced its Chief Technology Officer, Marcus Trygstad (biography on page 12), as a speaker at the Advanced Recycling Conference 2023 (ARC23). Scheduled for November 28-29 in Cologne, Germany, and online, ARC23 is set to tackle the gamut of advanced recycling technologies—from extrusion and dissolution to pyrolysis and gasification.

09/12/2023—Announced the appointment of Eric Appelman as its new Chief Revenue Officer, effective September 1, 2023. The addition of Mr. Appelman to the executive team signifies Aduro's strategic move towards commercial engagement and strategic partnerships.

09/05/2023—Announced that it has passed the midpoint of its project as part of the Shell GameChanger Accelerator Program, an accelerator that provides non-dilutive funding and technical expertise to help Aduro optimize the HCT technology for commercial implementation. Aduro was selected by the Shell GameChanger program to apply its novel HCT platform to produce sustainable naphtha cracker feedstock derived from waste polyethylene and polypropylene, either separately or on a mixed basis.

08/17/2023—Announced the visit of Karen Scholz, Business Development Manager at Brightlands Chemelot Campus during the week of August 21, 2023, underscoring the Company's strengthening alliance and mutual commitment to sustainable waste plastic recycling solutions. Brightlands Chemelot Campus is one of Europe's premier industrial innovation hub for the chemical industry emphasizing upscaling.

07/06/2023—Provided an update on the Company's recent progress and achievements. In the first half of the calendar year 2023, the Company has made significant progress in several key areas of its operational and strategic plans: The Pilot scale continuous flow R2 Hydrochemolytic Plastic Upcycling reactor is operational and has successfully turned waste polymers into higher-value liquid hydrocarbons. In addition, there has been substantial progress on the pilot-scale continuous flow Hydrochemolytic Bitumen Upgrading R2 reactor. Furthermore, the Company's newly expanded laboratory facility in London, Ontario is nearing completion, expected to be completed in Q3 2023.

06/15/2023—Announce the establishment of its European subsidiary, Aduro Clean Technologies Europe BV (ACTE), based in Geleen, Netherlands. The formation of ACTE marks an important expansion of Aduro's international footprint, demonstrating the Company's dedication to its global growth strategy.

05/30/2023—Announced that is set to participate in three industry conferences in June 2023. The Company will be showcasing the potential of its HCT platform at these events and engaging with key stakeholders: CIAC Ontario Responsible Care Workshop (May 31, 2023, Toronto, Ontario), Plastics Recycling LATAM 2023 (June 7-8, 2023, Mexico City, Mexico), and Petrochem Canada Conference 2023 (June 20-21, 2023, Sarnia, Ontario).

05/23/2023—Announce the successful exercise of warrants by its shareholders. The Company has received total proceeds of $1,490,035 from the exercise of 1,862,544 warrants between November 9, 2022, and May 12, 2023. Accordingly, the Company issued 1,862,544 common shares upon exercise of the warrants.

05/11/2023—Announced the addition of Stefanie Steenhuis to its team as the new Head of Brand and Marketing. Ms. Steenhuis is a globally experienced professional with expertise in marketing, communication, and change management, and has a passion for people and brands. With her extensive leadership experience managing international and remote teams and effective project management, she has successfully positioned brands, such as Siemens and IBM, in the global Oil & Gas and IT markets, respectively.

Risks and Disclosures

This Executive Informational Overview® (EIO) has been prepared by Crystal Research Associates, LLC ("CRA") with the assistance of Aduro Clean Technologies Inc. ("Aduro" or "the Company") based upon information provided by the Company. CRA has not independently verified such information. Some of the information in this EIO relates to future events or future business and financial performance. Such statements constitute forward-looking information within the meaning of the Private Securities Litigation Act of 1995. Such statements can only be predictions and the actual events or results may differ from those discussed due to the risks described in Aduro's statements on forms filed from time to time.

The content of this report with respect to Aduro has been compiled primarily from information available to the public released by the Company through news releases and other filings. Aduro is solely responsible for the accuracy of this information. Information as to other companies has been prepared from publicly available information and has not been independently verified by Aduro or CRA. Certain summaries of activities and outcomes have been condensed to aid the reader in gaining a general understanding. CRA assumes no responsibility to update the information contained in this report. In addition, for year one of its agreements, CRA has been compensated by the Company in cash of fifty thousand dollars and three hundred thousand options for its services in creating this report and for quarterly updates.

Investors should carefully consider the risks and information about Aduro's business, as described below and more fully detailed in the Company's recently filed Interim MDA, filed with The System for Electronic Document Analysis and Retrieval (SEDAR) on April 29, 2024. Investors should not interpret the order in which considerations are presented in this document or other filings as an indication of their relative importance. In addition, the risks and uncertainties covered in the accompanying sections are not the only risks that the Company faces. Additional risks and uncertainties not presently known to Aduro or that it currently believes to be immaterial may also adversely affect the Company's business. If any of such risks and uncertainties develops into an actual event, Aduro's business, financial condition, and results of operations could be materially and adversely affected.

This report is published solely for information purposes and is not to be construed as an offer to sell or the solicitation of an offer to buy any security in any state. Past performance does not guarantee future performance. For more complete information about the risks involved of investing in the Company, as well as for copies of this report, please contact Aduro by calling (226) 784-8889.

RISKS FACTORS

There are a number of risks that may have a material and adverse impact on the future operating and financial performance of the Company and could cause Aduro's operating and financial performance to differ materially from the estimates described in the forward-looking statements relating to the Company. These include widespread risks associated with any form of business and specific risks associated with the Company's business and its involvement in the clean energy technology industry. Aduro's management considers the following risks to be most significant for potential investors in the Company, but such risks do not necessarily comprise all those associated with an investment in the Company. In addition, other risks and uncertainties not discussed to date or not known to Aduro's management could have material and adverse effects on the valuation of the Company's securities, existing business activities, financial condition, results of operations, plans, and prospects. An investment in securities of the Company involves significant risks, which should be carefully considered by prospective investors before purchasing such securities.

The Company is an early-stage technology business.

Aduro's strategy is to focus on developing its clean energy technology platform. The Company's technology platform is an early-stage technology platform developed to upgrade renewable oils, waste plastics, rubber, and bitumen into higher value products. Aduro has invested and continues to invest a significant portion of its resources into this segment and will need to raise additional financing to pursue its business strategy. As with other comparable early-stage technology businesses, Aduro faces the risks of product and technology failure, unforeseen research and development delays, weak market acceptance, possible change in government regulations, and competition from new entrants. Realization of any of these risks could have a significant negative impact on the Company's anticipated future cash flows and its growth strategy.

Aduro has a limited operating history and no assurance of profitability.

The Company is a start-up business with a limited operating history and no established brand recognition. Aduro will be subject to all the business risks and uncertainties associated with any new business enterprise, including the risks that it will not establish a market for its services, achieve its growth objectives, or become profitable. The Company anticipates that it may take several years to achieve cash flow from operations. There can be no assurance that there will be demand for the Company's products or services or that Aduro will ever become profitable.

The Company development plan could result in liquidity concerns and future financing requirements.

The Company is in the development phase and has not generated any substantial revenue. It will likely operate at a loss until its business becomes established and will require additional financing to fund future development of its technology and operations. Aduro's ability to secure any required financing to sustain its operations will depend in part upon prevailing capital market conditions, as well as the Company's business success. There can be no assurance that Aduro will be successful in its efforts to secure any additional financing or additional financing on terms satisfactory to it. If additional financing is raised by issuing common shares from the treasury, control of the Company may change, and shareholders will suffer additional dilution. If adequate funds are not available, or are not available on acceptable terms, Aduro may be required to scale back its business plan or cease operating.

Aduro could be affected by operational risks.

The Company could be affected by several operational risks against which it may not be adequately insured or for which insurance is not available, including pandemics such as COVID-19; catastrophic accidents; fires; changes in the regulatory environment; impact of non-compliance with laws and regulations; labor disputes; and natural phenomena such as inclement weather conditions, floods, earthquakes, and ground movements. There is no assurance that the foregoing risks and hazards will not result in damage to or destruction of the Company's premises, personal injury or death, or environmental damage, resulting in adverse impacts on Aduro's operations, costs, monetary losses, potential legal liability, and future cash flows, earnings, and financial condition. Also, the Company may be subject to or affected by liability or sustain loss for certain risks and hazards against which it cannot insure or which it may elect not to insure because of the cost. This lack of insurance coverage could have an adverse impact on Aduro's future cash flows, earnings, results of operations, and financial condition.

Aduro faces technological risks.

The Company's products and services are dependent upon advanced developments in its technologies which are susceptible to the impact of rapid technological change. There can be no assurance that Aduro's products and services will not be seriously affected by, or become obsolete as a result of, such technological changes. Further, some of the Company's services are currently under development and there can be no assurance that these development efforts will result in a viable product or service as conceived by Aduro or at all.

Aduro is exposed to a competitive market.

The clean energy technology industry is highly competitive, and the Company competes with a substantial number of companies that have greater financial, technical, and marketing resources. As such, Aduro is exposed to competition which could lead to loss of contracts or reduced margins and could have an adverse effect on the Company's business.

The Company's competitors may offer better solutions or value to the Company's prospective customers or substantially increase the resources devoted to the development and marketing of products and services that compete with those of Aduro. There can be no assurance that the Company will be able to compete successfully against current or future competitors or that competitive pressures faced by Aduro in the markets in which it operates will not have a material adverse effect on the Company's business. If Aduro's competitors are successful in offering better pricing, service, or products than the Company, this could render its product and services offerings less desirable to merchant customers, resulting in the loss of merchant customers or a reduction in the price it could earn for its offerings.

The Company depends on key personnel.

Aduro's future success depends substantially on the continued services of its executive officers and its key development personnel. If one or more of its executive officers or key development personnel were unable to or unwilling to continue in their present positions, the Company might not be able to replace them easily or at all. In addition, if any of its executive officers or key employees joins a competitor or forms a competing company, Aduro may lose knowledge, key professionals, and staff members.

Commodity prices risks.

The potential profitability of the Company's operations will be significantly affected by changes in the market price of various renewable fuels and other commodity prices. The level of interest rates, the rate of inflation, world supply of these minerals, and stability of exchange rates can all cause significant fluctuations in renewable fuel and other commodity prices. Such external economic factors are in turn influenced by changes in international investment patterns and monetary systems and political developments. The price of diesel fuel has fluctuated widely in recent years, and future significant price declines could cause continued commercial production to be impracticable. Depending on the price of diesel fuels, potential cash flow from future operations may not be sufficient. Market fluctuations and the price of renewable fuels may render refining uneconomical. Short-term operating factors relating to the production of renewable fuels, such as the increased feed stock costs or drop in renewable fuel prices, could cause a proposed refining operation to be unprofitable in any particular period.

Aduro may be faced with volatility of its common share price.

The Company's common shares are listed for trading on the CSE. As such, factors such as announcements of quarterly variations in operating results, revenues, costs, and market conditions in the clean energy technology industry may have a significant impact on the market price of Aduro's common shares. Global stock markets, including the CSE, have from time-to-time experienced extreme price and volume fluctuations that have often been unrelated to the operations of particular companies. The same applies to companies in the technology and marketing sectors. There can be no assurance that an active or liquid market will develop or be sustained for the Company's common shares.

The Company does not expect to pay dividends.

Aduro has not paid dividends to its shareholders in the past and does not anticipate paying dividends in the foreseeable future. The Company expects to retain its earnings, if any, to finance growth.

The Company may be faced with failure to develop or market its products or services.

Given the highly competitive and rapidly evolving alternative energy technology environment Aduro operates in, where the Company's products and services are subject to rapid technological change and evolving industry standards, it is important for Aduro to constantly enhance its existing product offerings, as well as develop new product offerings to meet strategic opportunities as they evolve. The Company's ability to enhance its technologies, products and services and to develop and introduce new innovative products and services to keep pace with technological developments and industry standards and the increasingly sophisticated needs of its clients and their customers will significantly affect its future success.

Aduro's future success depends on the commercialization of its technology, including the ability to design and produce new products and services, deliver enhancements to its existing products and services, accurately predict and anticipate evolving technology, respond to technological advances in its industry, and respond to its customers' shifting needs. While the Company anticipates that its research and development experience will allow it to explore additional business opportunities, there is no guarantee that those business opportunities will be realized. If Aduro is unable to respond to technological changes, fails to or is delayed in developing products and services in a timely and cost-effective manner, the Company's products and services may become obsolete, which would negatively impact potential sales, profitability, and the continued viability of the business.

Since developing new products and services in the alternative energy sector is extremely expensive, Aduro may encounter delays when developing new technology solutions and services, and the investment in technology development may involve a long payback cycle. The Company's future plans include significant investment in technology solutions, research and development, and related product opportunities. The failure to effectively manage the expanding offering of products and services as well as the failure to develop and successfully market new products and services at favorable margins could have an adverse effect on the Company's business.

The reliability of the Company's technology will be critical to its success.

Aduro's reputation and its ability to attract, retain, and serve its customers are dependent upon the reliable performance of its technology, products, and services. The Company's technology is new, and as such, it has no history on which it can build or rely. The Company may experience interruptions, outages, and other performance problems related to its technology, products, or services. Such disruptions may be due to a variety of factors, including infrastructure changes, human or software errors, capacity constraints, and inadequate design. A future rapid expansion of the Company's business could increase the risk of such disruptions. In some instances, Aduro may not be able to identify the cause or causes of these performance problems within an acceptable period of time. Any errors, defects, or security vulnerabilities discovered in the Company's offerings could result in loss of revenue or delay in revenue recognition, loss of customers, and increased service and warranty cost, any of which could adversely affect the business, results of operations, and financial condition of the Company.

If Aduro is unable to protect its intellectual property rights, the Company's competitive position could be harmed, or the Company could be required to incur significant expenses to enforce its rights.

Aduro's ability to protect its intellectual property affects the success of the Company's business. The Company relies on trade secret, patent, copyright and trademark laws, and confidentiality agreements with employees and third parties, all of which offer only limited protection. The steps the Company has taken to protect its proprietary rights may not be adequate to preclude misappropriation of Aduro's proprietary information or infringement of its intellectual property rights, and the Company's ability to police such misappropriation or infringement is uncertain. The intellectual property rights granted to Aduro, if any, may not provide it with proprietary protection or competitive advantages, and, as with any technology, competitors may be able to develop similar or superior technologies, whether now or in the future. There is no guarantee that such parties will abide by the terms of such agreements or that the Company will be able to adequately enforce its rights.

Conflicts of interest

Certain directors and officers of the Company also serve, or may serve in the future, as directors and/or officers of other companies, or have significant shareholdings in other technology companies, and consequently conflicts of interest may arise between their duties as officers and directors of Aduro and as officers and directors of such other companies. There can be no assurance such conflicts of interests will be resolved to the benefit of the Company. However, any decision made by any of these directors and officers involving Aduro must be made in accordance with their duties and obligations to deal fairly and in good faith with a view to the best interests of the Company and its shareholders. In addition, each of the directors is required to declare and refrain from voting on any matter in which these directors may have a conflict of interest in accordance with, and subject to such other procedures and remedies as applicable, under the BCBCA and other applicable laws.

Glossary

Biofuel—A fuel derived over a short time span from biomass or living matter, rather than by the very slow natural processes involved in the formation of fossil fuels, such as oil.

Bitumen—A black viscous mixture of hydrocarbons obtained naturally or as a residue from petroleum distillation. It is used for road surfacing and roofing.

Chemical Recycling—A process that uses heat, chemical reactions, or both to break down used plastics and other substances into raw materials for the creation of new plastic, fuel, or other chemicals.

Chemolysis—The decomposition of organic substances into simpler bodies, by the use of chemical agents alone.

Circular Economy—An economic system based on the reuse and regeneration of materials or products, especially as a means of continuing production in a sustainable or environmentally friendly way.

Cracking—The process where complex organic molecules, such as long-chain hydrocarbons, are broken down into simpler molecules by the breaking of carbon–carbon bonds.

Coking—Thermal refining processes used to produce fuel gas, gasoline blend stocks, distillates, and petroleum coke from the heavier products of atmospheric and vacuum distillation.

Diluted Bitumen (Dilbit)—A chemical that makes it easier to transport bitumen, the petroleum extracted from oil sands. Dilbit is made by mixing bitumen, a heavy crude oil, with other hydrocarbons, such as light crude oil or natural gas condensates.

Feedstock—A raw material used in a chemical process or plant to produce a final product.

Gasification—A process that converts biomass- or fossil fuel-based carbonaceous materials into gases, including nitrogen, carbon monoxide, hydrogen, and carbon dioxide.

Glycerol (*also called glycerin*)—A colorless, odorless, viscous liquid that is sweet-tasting and non-toxic.

Heteroatoms—Any atom that is not carbon or hydrogen.

Hydrocarbon—A compound of hydrogen and carbon, such as any of those which are the chief components of petroleum and natural gas.

Molecular Hydrogen (H_2)—A colorless, odorless, tasteless gas molecule that is also known as dihydrogen. It is made up of two hydrogen atoms held together by a covalent bond.

Oil Sands—Also known as tar sands or bituminous sands, are a natural mixture of sand, clay, water, and bitumen. Oil sands are found in 16 major deposits around the world, with the two largest being Canada's Athabasca deposit and Venezuela's Orinoco deposit.

Polyethylene (PE)—A tough, light, flexible synthetic resin chiefly used for plastic bags, food containers, and packaging. Polyethylene is the most commonly produced plastic, accounting for over one third of the total plastic market.

Polymers—A substance that has a molecular structure consisting of a very large molecules, composed of many repeating subunits. Polymers make up many synthetic organic materials, such as plastics and resins.

Polyolefin—A family of thermoplastics that includes polyethylene (PE) and polypropylene (PP).

Polypropylene (PP)—A synthetic resin that offers great resistance to high temperatures or chemical products such as acids or solvents, used in a wide variety of applications such as bottles, jars, yogurt containers, hot beverage cups, and food packing.

Polystyrene (PS)—A light, usually white, synthetic polymer used especially for protecting delicate objects inside containers from damage, or for protecting something from losing heat. Styrofoam is a branded polystyrene.

Pyrolysis—The thermal decomposition of materials at elevated temperatures, often in an inert atmosphere.

Shell Gamechanger Accelerator Program—An accelerator program that foster collaboration between start-ups with early-stage energy-related technologies and solutions, and experts within Shell, helping participating companies prove the commercial viability of their technologies and solutions. The program's team provides support, expertise, and seed funding, while the start-ups keep the independence to make their own decisions.

Solvolysis—A chemical reaction in which the solvent, such as water or alcohol, is one of the reagents and is present in great excess of that required for the reaction. During solvolysis reactions, a solvent, or substance in which other compounds are dissolved, is used to create new products.

Synthetic Crude Oil (SCO)—A light sweet crude oil that is produced by upgrading bitumen, also known as Syncrude.

Upcycling—Reuse discarded objects or material in such a way as to create a product of higher quality or value than the original.

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