PLASTIC: BREAKING DOWN THE UNBREAKABLE

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Plastic is a huge component of everyday products we use and waste we produce—a lot of it ending up as pollution in the environment.[1] Both the awareness of plastic's detrimental effects and the search for solutions are rising.[2] Whether it's a plastic item used repeatedly, thrown out after its first use, or improperly disposed of, plastic is toxic and affects the environment it eventually ends up in, including our bodies.[3]

This Article is not intended to focus on the widely-discussed dangers of plastic—although an overview on them is helpful to understand the severity of the problem—but to discuss a real-life approach to understanding the legislation encompassing plastic and solutions that could bring our use of plastic and the plastic industry to a sustainable state.

The toxicity of plastic and plastic waste is a twofold problem to humans and our Earth. The issue of plastic's detrimental effects is making its way into legislation not only in Florida, but in other states and on a federal level as well.[4] However, these efforts are constantly thwarted by disagreement and partisanship.[5] Efforts can be made to encourage

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[1] *See, e.g.*, Larry Schwartz, *Toxic Traps: When These 7 Types of Plastic Are Dangerous*, ALTERNET (Mar. 22, 2016), http://www.alternet.org/personal-health/toxic-traps-when-these-7-types-plastic-are-dangerous.

[2] Cheryle Peebles, *Forth Nature Reserve Reveals Horror of Plastic Pollution Highlighted by Blue Planet II*, THE COURIER (Nov. 25, 2017), https://www.thecourier.co.uk/fp/news/local/fife/551399/forth-nature-reserve-reveals-horror-of-plastic-pollution-highlighted-by-blue-planet-ii/.

[3] *See id.*

[4] Peter Passell, *The Garbage Problem: It May Be Politics, Not Nature*, THE NEW YORK TIMES (Feb. 26, 1991), http://www.nytimes.com/1991/02/26/science/the-garbage-problem-it-may-be-politics-not-nature.html?src=pm.

[5] *Id.* For a more detailed discussion on current legislation, *see infra* Section II.

legislation promoting innovative plastic processes and, at the same time, decreasing our reliance on traditional plastic.[6] Although recent news, discoveries, and legislation are raising awareness of the extreme effects of the massive amount of harmful plastic waste, consumers should also focus on solutions for the inherent problem of plastics—their permanency, nonbiodegradability, and toxic makeup.[7] Altogether, there is a need for a public-private response to the proliferation of plastic waste. The private response must involve circular economic models and a decreased carbon footprint through utilization of innovative methods of recycling traditional plastic and creating earth-friendly plastic. The public response by our state and federal legislatures must encourage the creation of sustainable policies and statutes incorporating these new methods of producing and recycling plastic.

Part I of this Article delineates the science behind plastic, breaking it down to the molecular level and explaining how plastic products are made. It also discusses the problems with plastic, which appear at a few stages: the inherent toxicity of its composition, the waste produced by its production and its disposal, and society's lifestyle regarding the use of it. There are both scientific and social reasons that contribute to the problem; society and our way of living have molded us into thinking that the amount of plastic we use every day is sustainable.[8] Plastic has been beneficial and convenient in modern society and stimulated economic growth, but it comes with a price that is paid by the environment.[9]

Part II discusses the current legislation, statutes, and policies regarding the composition and current disposal of plastics. The current provisions in place for plastic production and recycling are relatively limited when compared to all of the proposed legislation in the 2017–2018 congressional session,[10] and only a few proposed pieces actually

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[6] *See id.*

[7] *See id.*

[8] *See, e.g.*, Kristi Gartner, *Consumerism, Mass Extinction and our Throw-Away Society*, THE ART OF (Oct. 13, 2016), https://www.theartof.com/articles/consumerism-mass-extinction-and-our-throw-away-society.

[9] Jennifer McCadney, *The Green Society - Leveraging the Government's Buying Powers to Create Markets for Recycled Products*, 29 PUB. CONT. L.J. 135, 135 (1999).

[10] *See infra* Section II. A.

endorse the current plastic industry.[11]

Part III proposes a three-prong realistic approach to resolve the plastics problem: create more biodegradable, earth-conscious plastics to curtail the amount of harmful plastics in our daily lives and ultimately in the environment; effectively recycle the old, difficult-to-decompose plastic into other uses including fuel; and bring these processes into fruition with a private response in our daily lives and through public legislation which placates both the left and right wings of the government.

I. AN OVERVIEW OF PLASTIC AND ITS HARMFUL EFFECTS

Understanding how plastic is made helps one to understand why plastic is such an environmental problem,[12] and so a review of the scientific origin of plastic is helpful. Plastic begins as crude oil, a nonrenewable resource extracted from the earth.[13] Oil is rich in carbon, and its molecular strands of carbon create polymers, which are chains of unit cells, made up of monomers, a smaller unit cell.[14] The most common type of plastic—polyethylene—consists of monomers, which are composed of one carbon atom and two hydrogen atoms.[15] Some other plastics, such as nylon, can consist of monomers composed of over thirty-eight atoms, so the range of composition varies greatly.[16] These monomers join together in repeating units to create chains by varying

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[11] *See* S. Res. 64, 115th Cong. (2017), *and* H. Res. 216, 115th Cong. (2017) (Noting the importance of investment in the plastic industry).

[12] The term "plastic" in the context of this article, as defined by the Merriam-Webster Dictionary, can be both an adjective describing objects made of plastic or the ability of an object to be deformed without breaking, and also a noun for an organic, synthetic material. "Plastic (n): Organic synthetic or processed materials that are mostly thermoplastic or thermosetting polymers of high molecular weight and that can be made into objects, films, or filaments." *Plastic*, MERRIAM-WEBSTER DICTIONARY (2018).

[13] Craig Freudenrich, *How Plastics Work*, HOW STUFF WORKS (Dec. 7, 2007), http://science.howstuffworks.com/plastic.htm.

[14] *Plastics*, AM. CHEMISTRY COUNCIL, INC., https://plastics.americanchemistry.com /How-Plastics-Are-Made/. A monomer is a group of atoms which vary in composition, but the most plastic monomers contains carbon, which is derived from oil and natural fossil fuels, burdening the Earth's natural resources.

[15] *Id.*

[16] *Id.*

chemical processes, which form into different polymers—the backbone of most plastics.[17] Polymers are then mixed with additives, including colorants, stabilizers, fillers, and reinforcements, creating different types of plastic.[18]

The inherent toxicity of plastic begins here. The plastic polymer itself is not toxic; it is the toxic chemical additives, which do not completely bind to the carbon-based plastic polymers, that leach toxins into the surrounding environment.[19]

A. The Toxicity of Plastic

Plastic is toxic to the environment surrounding it, whether it is a plastic product kept in your home for years or plastic improperly disposed of on land or in the ocean.[20] The chemicals found in plastic as well as chemicals which attach themselves to plastic in the environment can cause serious health conditions to not only humans, but all life on land and in our waterways.[21]

Toxic chemicals such as lead, cadmium, zinc, and copper are common additives in plastic and can be released in the surrounding environment over time.[22] There are also known carcinogens in plastics such as diethylhexyl phthalate ("DEHP")[23], formaldehyde, styrene, and o-nitrotoluene.[24] Plastics have also been known to cause disruption in

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[17] *Id.*

[18] Anee Marie Helmenstine, *What Is Plastic? - Definition in Chemistry*, THOUGHTCO (Nov.15, 2016), http://chemistry.about.com/od/polymers/f/What-Is-Plastic.htm.

[19] Anita Fors, *Plastic Products Leach Toxic Substances,* UNIV. OF GOTH (May 16, 2011), http://science.gu.se/english/News/News_detail/plastic-products-leach-toxic-substances.cid991256.

[20] *Adverse Health Effects of Plastics*, ECOLOGY CENTER, http://ecologycenter.org/factsheets/adverse-health-effects-of-plastics/ (last visited Nov. 25, 2017).

[21] *Id.*

[22] Danielle Beurteaux, *Heavy Metal: The New Toxic Danger Posed by Ocean Plastic Trash*, NEWS DEEPLY (Apr. 8, 2018), https://www.newsdeeply.com/oceans/articles/2018/04/03/heavy-metal-the-new-toxic-danger-posed-by-ocean-plastic-trash.

[23] *Adverse Health Effects of Plastics*, *supra* note 20.

[24] Rejendrani Mukhopadhyay, *Government Cites Some Plastic Components as Carcinogenic*, POLYMER SOLUTIONS INC. (June 15, 2011), https://www.polymersolutions.com/blog/government-cites-some-plastic-components-as-carcinogenic/.

the endocrine and reproductive systems, leading to cancers, insulin resistance, decreased sex hormones, birth defects, immune suppression, and developmental delays. These effects are especially prevalent in children due to increased dosage per unit body surface area.[25] Researchers from the University of Ghent in Belgium have found that microplastic waste ends up in the seafood we eat, and harmful chemicals found in plastic likewise enter our bloodstream through the consumption of seafood.[26] It has been calculated that by the end of the twenty-first century, people who regularly eat seafood will consume 780,000 plastic pieces a year, 4,000 of which could be absorbed from their digestive systems, in turn exposing the human body to these toxic plastic chemicals.[27]

The most common transfer of plastic toxins to humans, however, is through direct contact with plastic products.[28] Human exposure to these chemicals occurs not only during the manufacturing of plastic, but also during the use of it, most notably through plastic packaging.[29] This is most prominently seen as a result of the ability of said chemicals to travel from the packaging to the food they contain, thus ending up the human body via digestive consumption.[30]

A notable component of plastic food packaging is bisphenol A ("BPA").[31] BPA is a toxic industrial chemical used to make a clear, rigid plastic called polycarbonate, found in many products of everyday use.[32]

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[25] *E.g.*, *Adverse Health Effects of Plastics, supra* note 20.

[26] Margi Murphy, *BIT FISHY Seafood Lovers Eat 11,000 Pieces of Toxic Plastic Every Year Thanks to This Dirty Habit*, THE SUN (Jan. 25, 2017 at 4:02 PM), https://www.thesun.co.uk/news/2703686/seafood-lovers-eat-11000-pieces-of-toxic-plastic-every-year-thanks-to-this-dirty-habit/.

[27] *Id.*

[28] *Adverse Health Effects of Plastics*, *supra* note 20.

[29] *Id.*

[30] *Id.*

[31] *NCSL Policy Update: State Restrictions on Bisphenol A (BPA) In Consumer Products*, NAT'L CONFERENCE OF STATE LEGISLATURES (Feb. 2015), http://www.ncsl.org/research/environment-and-natural-resources/policy-update-on-state-restrictions-on-bisphenol-a.aspx.

[32] *Bisphenol A (BPA): Use in Food Contact Application*, U.S. FOOD AND DRUG ADMIN., https://www.fda.gov/NewsEvents/PublicHealthFocus/ucm064437.htm (last updated Feb. 2016).

BPA is also found in epoxy resins, which are used as a protective lining in some food and beverage cans.[33] Though the resin may be protecting the food from contact with the metal can, it also leaches BPA into the food that is later consumed.[34] The Food and Drug Administration ("FDA") has regulated this chemical since the 1960s, but has only recently amended its regulation to completely prohibit the use of BPA in certain products.[35] In 2012, the FDA amended its regulations to full prohibition of BPA-based polycarbonate resins in baby bottles and sippy cups; in 2013, the FDA extended this prohibition to coatings in packaging for infant formula as well.[36] Other plastic products produced and sold, across all sectors, do not fall within this FDA regulation.[37]

Recent research has shown a connection between BPA exposure and adverse health problems such as diabetes, cancer, male impotence, heart disease, impaired brain function, asthma, and accelerated puberty.[38] BPA disrupts the body's endocrine system, which regulates, produces, transports, and secretes natural hormones.[39] When BPA enters the body, it mimics natural hormones, which can be hazardous to one's health. This is especially true for young children and babies, as previously discussed, due to their smaller body size.[40] A study by the Centers for Disease Control and Prevention found that ninety-five percent of adult human urine samples and ninety-three percent of children samples contained BPA.[41]

The toxicity of plastic also affects land and water, including the soil and surrounding groundwater. Florida's Department of Environmental Protection works to monitor the amount of contaminants in the state's drinking water supply, including the contaminants from plastic.[42] The

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[33] *Id.*
[34] *Id.*
[35] *Id.*
[36] *Id.*
[37] *Id.*
[38] Christian Nordqvist, *Bisphenol A: How Does it Affect Our Health?*, MEDICAL NEWS TODAY (May 25, 2017), https://www.medicalnewstoday.com/articles/221205.php.
[39] *Id.*
[40] *Id.*
[41] *Id.*
[42] *See Source & Drinking Water Program*, FLORIDA DEP'T. OF ENVTL. PROT.,

department publishes data on the chemicals found in Florida's drinking water (tap water), including organic synthetic compounds that come from plastic.[43] The department's most recently published data on drinking water contaminants from 2016 shows multiple toxic and carcinogenic chemicals that are associated with plastic.[44]

Aside from drinking water, Florida's groundwater, surface water (i.e., lakes, rivers), and wastewater are also contaminated.[45] According to a chemist for the Miami-Dade Department of Environmental Resource Management, "[g]roundwater, surface water and wastewater show traces of phthalates, polychlorinated biphenyl ("PCB"), and haloacetic acids, which are all known toxic pollutants and carcinogens. These compounds make their way into our state's water systems due to ecosystem change caused by human interaction, including plastic products, pesticide use and pollution."[46]

Plastic contamination is cyclical; it begins as new products come into contact with humans and continues to the plastic waste that is disposed of on land and our waterways, which contaminates water, land, wildlife, and humans.[47]

B. The Pollution

Ironically, plastic's notable characteristic is its durability and inability to degrade, but it is often used for a plethora of single-use items and products designed to be disposed of quickly. Although its

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http://www.dep.state.fl.us/water/drinkingwater/chemdata.htm (last updated Feb. 8, 2018).

[43] *See id.*

[44] *See id* (including phthalates, Di(2-ethylhexyl)phthalate, polychlorinated biphenyl (PCB), and bis(2-ethlhexyl)adipate).

[45] The Miami- Dade County Environmental Resources Management monitors and regulates land management programs to protect water and air quality, drinking water supply and natural resources. Regulatory & Economic Resources Environment, MIAMI-DADE CTY, http://www.miamidade.gov/environment/ (last updated Feb. 8, 2017); Interview with Claudia Mancini, Chief Chemist from 2008-2014, MIAMI-DADE CTY. DEP'T. OF ENVTL. RES. MGMT., (Mar. 10, 2017).

[46] *Id.*

[47] Thompson et al., *Plastics, the environment and human health: current consensus and future trends*, Phil. Trans. R. Soc. B (2009) 364.

composition can be ideal for many uses, whether properly or improperly disposed of, it does not degrade.[48] CNN put it into perspective: "[n]early every piece of plastic still exists on Earth, regardless of whether it's been recycled, broken down into microscopic bits or discarded in the ocean."[49] Plastics never fully biodegrade; over time they only photodegrade into smaller and smaller pieces.[50]

Consider these statistics: Americans use 2.5 million plastic bottles every hour.[51] Americans generate 10.5 million tons of plastic waste each year but recycle only one to two percent of it.[52] Approximately fourteen-billion pounds of trash, most of it plastic, is dumped into the oceans every year.[53] Comparatively, the plastic products intended for single use, such as a plastic plate or cutlery, are even more of an environmental threat than plastics designed to be used repeatedly.[54] About fifty percent of the plastic produced is used only once before being disposed of.[55] A large amount of the plastic you may encounter loses ninety-five percent of its value after a single use, such as plastic beverage containers, plates, and cutlery.[56] What gives plastic its value is its inability to biodegrade, which is exactly the cause of the environmental harm done by our use and disposal of it.[57]

Plastic waste and the leaching of its chemicals into surrounding water and ecosystems is troublesome for our oceans, land, and all of the life that inhabits them, with dangerous consequences scientists have yet

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[48] Madison Park, *How much are we trashing our oceans*?, CNN (Feb. 12, 2015), http://www.cnn.com/2015/02/12/world/ocean-trash-pollution/.

[49] *Id.*

[50] *Save the Plastic Bag Coal. v. City of Manhattan Beach*, 52 Cal. 4th 155, 163, 127 Cal. Rptr. 3d 710, 715, 254 P.3d 1005, 1010 (2011).

[51] *Recycling Facts,* RECYCLE ACROSS AMERICA, http://www.recycleacrossamerica.org /recycling-facts (last visited Nov. 27, 2017).

[52] *Marine Debris and Plastics*, SEASTEWARDS, http://seastewards.org/projects/ healthy-oceans-initiative/marine-debris-and-plastics/ (last visited Nov. 27, 2017).

[53] *Id.*

[54] *Single-Use Plastic*, MARINE SAFE (2015), http://www.marinesafe.org/the-problem/ single-use-plastic/.

[55] Charles Grosenick, *The Price of Plastic*, 42 ADMIN & REG. L. NEWS 34 (2017).

[56] Jacob Prisco, *Turning Plastics Into Fuel*, CNN (July 26, 2016 at 8:45 AM), http://www.cnn.com/2016/07/21/world/turning-plastic-into-fuel/index.html.

[57] BARRY COMMONER, THE CLOSING CIRCLE 164 (1971).

to fully determine.[58] Plastic pollutes waterways and oceans and, often, is later consumed by birds and marine life.[59] One example that has recently gained widespread attention, although it has posed as a threat to the environment for years, is the Great Pacific Garbage Patch—a giant vortex of floating plastic in the Pacific Ocean.[60] Large and small pieces of plastic, plastic textiles, ropes, and other products have made their way to our oceans, and have traveled with ocean currents to accumulate in a massive "patch" in the Pacific.[61] A lot of these plastics break off into smaller and smaller particles, as they can never fully degrade, which creates microplastics.[62] There are more than five-trillion pieces of microplastic in the world's oceans.[63]

Microplastics as well as larger pieces of plastic are not only consumed by marine and coastal life, but also pose a threat by simply being there, leaching toxic chemicals into the ocean.[64] Neither land animals nor ocean wildlife can distinguish plastics from other types of food sources. The health effects to these animals are at best harmful, at worst fatal.[65] When ingested, plastic can cause lacerations to internal organs and block the digestive system, preventing the animals from properly feeding and causing severe harm if not death.[66] Plastic debris such as bags, beverage packaging, and fishing gear can also cause animals to become entangled or suffocate.[67] Grim reports of dead animals found entangled in debris or with pounds of plastic waste and bags in their stomach and intestines are constantly being discussed.[68]

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[58] *See* Claire LeGuern Lytle, *When the Mermaids Cry: The Great Plastic Tide*, COASTAL CARE (Jan. 2017), http://coastalcare.org/2009/11/plastic-pollution/.

[59] *Id.*

[60] *Id.*

[61] *Id.*

[62] Microplastics are particles of plastic less than five millimeters in length. Katie Forster, *Microplastics in the Sea a Growing Threat to Human Health, United Nations Warns*, INDEPENDENT (May 21, 2016), http://www.independent.co.uk/environment/microplastics-microbeads-ocean-sea-serious-health-risks-united-nations-warns-a7041036.html.

[63] Murphy, *supra* note 26.

[64] Forster, *supra* note 62.

[65] *Id.*

[66] Gold, *supra* note 22.

[67] *E.g.*, *id.*

[68] *E.g.*, *id.*

Aside from the toxicity and the actual waste plastic creates, the manufacturing, production, and transportation of plastic pollutes the air and places a huge burden on the Earth's natural resources.[69] The Environmental Protection Agency ("EPA") has confirmed that during plastic production, toxic pollutants—including methane, styrene, and butadiene—are released into our air.[70] The transportation of finished plastic products, such as plastic water bottles, releases millions of gallons of global warming pollution into the air every year.[71] Plastic manufacturing also requires the use of millions of barrels of oil every year.[72] For example, every year, the oil used to manufacture plastic water bottles in the United States is enough to fuel approximately 1 million cars.[73] Our use of oil reduces the Earth's non-renewable resources and plays a significant role in climate change, according to environmental activists.[74] A harmful cycle is created: dwindling resources are used to create an unsustainable product, in turn creating copious amounts of waste and pollution that does not degrade, with which our current waste management systems cannot keep pace.[75]

C. The Benefits of Plastic and its Relation to Our Lifestyle

Although there are a number of problems with plastic, we cannot neglect the fact that it has delivered us benefits that have made our modern society possible.[76] Plastic polymers were designed for its plasticity and can therefore be formed into any desired shape.[77] Its

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[69] Dawn Gifford, *Avoiding Toxins in Plastic*, SMALL FOOTPRINT FAMILY, https://www.smallfootprintfamily.com/avoiding-toxins-in-plastic (last visited Nov. 27, 2017).

[70] *Id.*

[71] *Id.*

[72] James McAuley, *France Becomes the First Country to Ban Plastic Plates and Cutlery*, THE WASHINGTON POST (Sept. 19, 2016), https://www.washingtonpost.com/news/worldviews/wp/2016/09/19/france-bans-plastic-plates-and-cutlery/?utm_term=.7032649509e9.

[73] Gifford, *supra* note 69.

[74] *Id.*

[75] Park, *supra* note 48.

[76] Doug Woodring, *How Plastics-to-Fuel Can Become the Next Green Machine*, LIVESCIENCE (Sept. 21, 2015), http://www.livescience.com/52249-tech-exists-to-turn-plastic-to-fuel-if-communities-demand-it.html.

[77] *See* COMMONER, *supra* note 57, at 163.

inexpensive cost and versatile qualities have made it applicable for many uses, which continue to increase.[78] Consider the plastics we may encounter every day: beverage and food containers, medical equipment, eyeglasses, contact lenses, furniture, vehicle components, electronics, photographic film, appliances, flooring, housing insulation, clothing materials and household textiles, shoes, cosmetic containers, and many more. Plastic has been shown to be a favorable choice for products across many sectors, including technology, science, medicine, infrastructure, and more. Advancements in these areas would not have made it as far as they have without the help of plastic products.[79] Taking a closer look at the medical field, modern healthcare would not be possible without plastic.[80] People are generally living longer lives due to life-saving advances that utilize plastic, such as intravenous bags, disposable syringes, tubing, sterile packaging, artery valves, catheters, prosthetics, contact lenses, hearing aids, and plastic pill capsules, to name a few.[81] We can take advantage of the advances plastic has given our society, but can minimize its uses to areas such as modern medicine, in which is necessary, as opposed to plastic bags or disposable eating utensils.

The convenience and disposability of plastics has created a "throw-away society" in our country.[82] Individuals are no longer inclined to keep products for a long period of time, even if those items are still usable.[83] A number of factors contribute to this phenomenon, including the media, advertisements, and the constant desire for something more convenient, easier, or newer.[84] In general, Americans are consumers that have adapted to a hurried lifestyle.[85] This way of being is based upon unsustainable thought processes, which contribute to the desire for more

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[78] Ciera Dye, *The Pelagic Plastic Problem*, 19 OCEAN & COASTAL L.J. 117, 117 (2013).

[79] *See e.g.*, COMMONER, *supra* note 56, at 143-47; *Use of Plastics, Medical and Health*, PLASTICSEUROPE, http://www.plasticseurope.org/en/about-plastics/what-are-plastics (last visited Nov. 25, 2017).

[80] *Use of Plastics, supra* note 79.

[81] *Id.*

[82] Brittany Ayers, *A Throw Away Society*, RCL AND CIVIC ISSUES BLOG, PENN STATE UNIV., (Feb 6, 2014), http://sites.psu.edu/brittanyblogs20132014/2014/02/06/a-throw-away-society/.

[83] *Id.*

[84] *Id.*

[85] *Id.*

disposable, unnecessary items, creating more waste, making the United States the number one trash-producing country in the world.[86]

II. CURRENT PLASTIC LEGISLATION AND POLICIES

Recent legislation and policies enacted in the United States as well as around the world have attempted to limit the harmful effects of plastic. On a global level, a few countries have passed forms of plastic bag legislation as a tax, a regulatory action, or an outright ban.[87] These countries include China, India, Australia, Chile, Mexico, Canada, some European and East African countries, and a number of local governments in United States.[88]

In September of 2016, France passed a law banning plastic plates, cups, and utensils, with exceptions for compostable, biosourced materials.[89] This is the first time an entire nation has embraced a sweeping ban on plastic, and it is poised to go into full effect by 2020.[90] This law stems from France's Energy Transition for Green Growth Act, a law recently enacted with aims of reducing climate change by utilizing renewable resources and clean transport as well as promoting jobs in the energy renovation sector.[91]

A. Federal Legislation on Plastic in the United States

On a federal level in the United States, there is limited legislation relating to plastic. In December 2015, President Obama signed into law the Microbead-Free Waters Act of 2015, which requires the FDA to ban the sale, distribution, and manufacture of products that contain intentionally-added plastic microbeads.[92] The Act banned the

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[86] *Id.*

[87] *Plastic Bag Bans: A World Survery*, REUSETHISBAG.COM, https://www.reusethisbag.com/reusable-bag-infographics/plastic-bag-bans-world.php (last visited Nov. 27, 2017).

[88] *Id.*

[89] Mcauley, *supra* note 72.

[90] *Id.*

[91] *E.g.*, Sophie Eastaugh, *France Becomes First Country to Ban Plastic Cups and Plates*, CNN (Sept. 20, 2016), http://www.cnn.com/2016/09/19/europe/france-bans-plastic-cups-plates/.

[92] Microbead-Free Waters Act of 2015, Pub. L. No. 114-114, 129 Stat. 3129 (2015).

manufacturing of these products as of July 1, 2017, and banned the introduction of the products into commerce as of January 1, 2018.[93] Because plastic microbeads do not dissolve, they are washed down the drain and into our country's waterways.[94] More than eight-trillion microbeads make it into our waterways every day, which in turn poses a threat to the environment.[95] The Microbead-Free Waters Act is intended to reduce the amount of the microbeads disposed of into the oceans and waterways, which have a detrimental effect on the surrounding ecosystems and the Earth as a whole.[96]

The 20172018 federal legislative session has a number of pending plastic-related legislation; some promote the current traditional plastic industry and some propose to curtail this plastic epidemic.[97] House Resolution 216 and Senate Resolution 64 congratulate the Plastics Industry Association on its eightieth anniversary and note the importance of investment, revenue, and jobs in the current plastic industry.[98] On the

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[93] *Id.*

[94] *See* Jareen Imam, *Microbead Ban Signed by President Obama*, CNN (Dec. 13, 2015), http://www.cnn.com/2015/12/30/health/obama-bans-microbeads/index.html.

[95] *Id.*

[96] Forster, *supra* note 62.

[97] *See generally* U.S. CONGRESS, https://www.congress.gov/search?q={%22congress%22:%22115%22,%22source%22:%22legislation%22,%22search%22:%22plastic%22}&searchResultViewType=expanded (stating there are 17,803 pieces of legislation currently in session, fifty-five contain the term plastic, two support the current plastic industry, and five suggest sustainable ideas involving our use of plastic) (last visited Oct. 6, 2018).

[98] *See* Congratulating the Plastics Industry Association on its 80th Anniversary, https://www.congress.gov/bill/115th-congress/house-resolution/216/all-info?r=74 (2017); *see also* A resolution congratulating the Plastics Industry Association on its 80th Anniversary, https://www.congress.gov/bill/115th-congress/senate-resolution/64/all-info?r=70 (2017) (these Resolutions were introduced respectively in the House and the Senate by Congressman Larry Bucshon (R-IN) and Senator Ron Johnson (R-WI); *id*. Although these resolutions have no legal impact due to their status as "non-binding" resolutions, their significance should not be underestimated due to the potential conflict of interest that both members of 115th Congress have with regards to the plastics industry. United States Senate, *Glossary, Simple Resolution*, U.S. SENATE, https://www.senate.gov/reference/glossary_term/simple_resolution.htm. Senator Johnson, for example, is listed as a co-founder of Oshkosh-based polyester and plastics manufacturer PACUR, LLC, and was the Chief Executive Officer of the company prior to his election to the US Senate. In addition, Congressman Bucshon's home district of

other hand, House Bill 3768 encourages the recycling and reduction of plastic water bottles in the National Park System;[99] Amendment 3052 to House Bill 5895 provides funds to reduce plastic straws in facilities under the care of the Architect of the Capital;[100] Senate Bill 1980 and related House Bill 3149 propose a tax credit for the production and investment of renewable bio-based chemicals that are used in producing chemical products including plastics;[101] Senate Bill 1460 proposes the modernization of our energy and natural resource policies, including a study conducted to determine how the United States can make progress to a cost-effective and environmentally-conscious system through which innovative processes are used to convert non-recycled plastic into other uses such as fuel, such as pyrolysis.[102]

Outside of Congress, the EPA has introduced regulations for the production of plastic waste and the effects of plastic production through the Trash-Free Waters Projects,[103] the Clean Air Act standards for plastic

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Indiana's 8th Congressional District, is, according to the Plastics Industry Association, home to both plastic manufacturers and establishments dependent on plastic processing that employs over 100,000 people. *Ron Johnson U.S. Senator for Wisconsin*, https://www.ronjohnson.senate.gov/public/ (last visited Nov. 25, 2017). When analyzing the campaign contributions made by the Society of the Plastics Industry, Inc. Political Action Committee (Plastics PAC) (the political and fundraising arm of the Plastics Industry Association), a combined $15,000 has been given to the political campaigns of Senator Johnson and Congressman Bucshon since 2010. PLASTICS INDUSTRY ASSOCIATION, http://www.plasticsindustry.org/factsheet/in08, (last visited Nov. 25, 2017). This presents evidence for the assertion that the reason for the presence of pro-plastic legislation is derived from an expectation that the contributions from the PAC supporting the campaigns of Senator Johnson and Congressman Bucshon are being "repaid" through action in their respective Houses of Congress; *id.* This demonstrates the political and legislative hurdle that befall many environmental efforts: if you can't pay to play, there's no room on the team for you; *see Facts and Figures of: Indiana*; *Disbursements*, FED. ELECTION COMM'N, https://www.fec.gov/data/disbursements/?cycle=2012&two_year_transaction_period=2010&data_type=processed&committee_id=C00309716&min_date=01%2F01%2F2009&max_date=12%2F31%2F2010&line_number=F3X-23 (last visited Nov. 25, 2017).

[99] H.R. 3768, 115th Cong. (2017).

[100] S.AMDT. TO S.AMDT.2910, 115th Cong. (2018).

[101] S. 1980, 115th Cong. (2017); H.R. 3149, 115th Cong. (2017).

[102] *See* S. 1460 115th Cong. (2017). For a discussion on this innovative process, *see infra* Section III.B.

[103] *See Trash-Free Waters Projects*, ENVTL. PROT. AGENCY, https://www.epa.gov/trash-free-waters/trash-free-waters-projects (last updated Sept. 27, 2017).

products,[104] and the Organic Chemicals, Plastics and Synthetic Fibers Effluent Guidelines ("OCPSF").[105] The Trash-Free Waters Projects creates projects around the United States to reduce trash in different waterways, such as the San Francisco Bay Area Trash Capture or the Hayward Youth-Based Trash Capture.[106] The Clean Air Act includes standards for the air pollution created by the foam, fiber, plastic, and rubber industries.[107] Plastic-related industries that are currently regulated in the Clean Air Act include acrylic and modacrylic fiber production, flexible polyurethane foam fabrication, polystyrene foam manufacturing, reinforced plastic composites production, spandex production, and synthetic fiber production.[108] The OCPSF covers wastewater discharges from over 1,000 chemical facilities and places standards for the release of known toxic chemicals, including those found in plastic production and manufacturing.[109]

However, the life of these positive programs and regulations are not guaranteed and these guidelines could be altered to allow higher levels of contaminants even if the programs are not removed.[110] EPA regulations are enforced under the Agency's statutory authority using a public notice-and-comment procedure.[111] This allows the regulation to be challenged in court by another agency or revoked by a congressional act.[112] Current EPA regulations such as those cited above are vulnerable to the current

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[104] *See Clean Air Act Standards and Guidelines for Foam, Fiber, Plastic and Rubber Products*, ENVTL. PROT. AGENCY, https://www.epa.gov/stationary-sources-air-pollution/clean-air-act-standards-and-guidelines-foam-fiber-plastic-and (last updated March 22, 2017).

[105] *See Organic Chemicals, Plastics and Synthetic Fibers Effluent Guidelines*, ENVTL. PROT. AGENCY, https://www.epa.gov/eg/organic-chemicals-plastics-and-synthetic-fibers -effluent-guidelines (last updated June 30, 2017).

[106] *Trash-Free Waters*, *supra* note 102.

[107] *Clean Air Act*, *supra* note 103.

[108] *Id.*

[109] *See Organic Chemicals, Plastics and Synthetic Fibers Effluent Guidelines*, *supra* note 104.

[110] *See Regulatory Reform in the Trump Era*, THE ENVIRONMENTAL LAW INSTITUTE (Mar. 2017), https://www.eli.org/sites/default/files/eli-pubs/regulatory-reform-trump-era.pdf.

[111] *Id.*

[112] *Id.*

presidential administration and may get revised or altogether revoked.[113]

The current presidential administration had proposed to slash the EPA's budget by thirty-one percent in 2017, but House Resolution 165 keeps EPA's 2018 spending budget at $8.1 billion—the same as the Agency's budget for 2017.[114] The EPA budget for 2019 is still threatened, however, as Trump's 2019 budget proposal includes a reduction of 34%.[115] Such a steep reduction could eliminate 15,000 EPA jobs and nearly fifty programs.[116] The current EPA administrator, Scott Pruitt, was selected by President Trump and has stated that budget cuts would eliminate wasteful spending.[117] However, many environmental groups and activists are outraged and worried, claiming such cuts would wreak havoc on the health of our country and planet.[118] According to environmental groups, the EPA is already underfunded and Scott Pruitt does not acknowledge the severity of climate change and the need for cleanup programs.[119]

B. State and Local Legislation on Plastic

On a state level, some state governments have taken the initiative to regulate the use of plastic materials, but most of this legislation only pertains to plastic bags. In 2014, California enacted the Single-Use Carry Bag Ban, S.B. 270, which bans retailers from using single-use carry-out bags, unless the retailer makes the bag available for ten cents and other conditions are met.[120] A handful of other jurisdictions have enacted

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[113] *Id.*

[114] *Compare* H.R. 1625, 115th Cong. (2018) *and* Brandy Dennis, *Trump's 'Scorched Earth' EPA Budget Draws Swift Reactions*, THE WASHINGTON POST, March 16, 2017, https://www.washingtonpost.com/news/energy-environment/wp/2017/03/16/trumps-scorched-earth-epa-budget-draws-swift-reactions/?utm_term=.5273a42f93f7.

[115] Colin Staub, *EPA's Recycling Funding Untouched in Final Budget*, PLASTICS RECYCLING UPDATE, March 28, 2018, https://resource-recycling.com/plastics/2018/03/28/epas-recycling-funding-untouched-in-final-budget/.

[116] *Id.*

[117] *Id.*

[118] *Id.*

[119] Andrew Abramson, *Trump's Proposed EPA Cuts Endanger Florida and the Nation*, SUN-SENTINEL, March 17, 2017, http://www.sun-sentinel.com/opinion/fl-aacol-trump-epa-cuts-20170317-story.html.

[120] *State Plastic and Paper Bag Legislation*, NAT'L CONFERENCE OF STATE

similar legislation, either banning plastic bags, placing a tax on plastic bags, or enforcing recycling or labeling requirements on plastic products.[121] These jurisdictions include Hawaii, Arizona, Idaho, Missouri, New York, Maine, Delaware, Rhode Island, and Washington D.C.[122]

In Florida, there are a handful of statutes already in effect that regulate the use and disposal of plastic.[123] Section 403.708 of the Florida Statutes limits the disposal of any waste (including plastics) or the burning thereof, except in a manner previously approved of by the Florida Department of Environmental Protection.[124] Section 823.145 of the Florida Statutes states polyethylene agricultural plastic may be disposed of by open burning, provided that it causes no public nuisance, creates no adverse effect to the environment and public health, and stays within the state or federal national ambient air quality standards.[125]

More specifically for consumer plastic, a person may not distribute or sell any plastic bottle intended for single use unless the bottle has a molded label near the bottom indicating what type of plastic resin was used in producing the bottle.[126] The label must consist of a number placed inside of a triangle formed by three curved arrows.[127]

Regarding recycling, the only mandate in Florida to use recyclable materials, when available, applies to state agencies or political subdivisions using state funds, but does not apply to private entities or citizens of Florida.[128]

In Florida, promise for a serious approach to this plastic epidemic has begun to show. The first plastic bag ban in the state was recently

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LEGISLATURES, Nov. 11, 2016, http://www.ncsl.org/research/environment-and-natural-resources/plastic-bag-legislation.aspx.

[121] *Id.*

[122] *Id.*

[123] *The Florida Handbook of Solid and Hazardous Waste Regulation: Special Waste Disposal*, ELECTRONIC DATA INFORMATION SOURCE, http://edis.ifas.ufl.edu/fe776.

[124] FLA. STAT. § 403.708(1)(a)-(b) (2017);

[125] FLA. STAT. § 823.145 (2017).

[126] FLA. STAT. § 403.708(7) (2017).

[127] This statute does not apply to some smaller sized bottles and battery casings. *Id.*

[128] FLA. STAT. § 403.7065 (2017).

enacted in the city of Coral Gables.[129] The ordinance prohibits retailers from using plastic bags in Coral Gables and at special events in the city.[130] Violators of this ban, including retailers and those at special events, will be fined from $50-$500.[131]

In the 2018 Florida legislative session, there were a few proposed bills pertaining to plastic.[132] Florida Senate Bill 348 encouraged coastal communities to establish pilot programs to regulate or ban disposable plastic bags and Senate Bill 1856 established a refund value for specified beverage containers including plastic, but both of these died in legislative subcommittees before becoming law.[133]

III. A SOLUTION: THREE-PRONG APPROACH

When it comes to reducing the destructiveness of plastic and the amount of it in our environment, there are at least three ways options: change the actual composition of plastics to a safer and more biodegradable form, recycle or provide safer reuses of the harmful traditional plastics, and advocate these solutions to legislative bodies.

A. Sustainable Plastic

Switching non-biodegradable plastics to more sustainable forms, such as bioplastics, is a proactive method to decrease the amount of unsustainable plastic created.[134] Bioplastics are essentially plant-based as opposed to petroleum-based.[135] Bioplastics are an alternative to traditional plastics and are sustainable on two different levels.[136] First, plastic can be considered bioplastic if it is generated from a sustainable

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[129] *Coral Gables Approves Florida's First Plastic Bag Ban*, MIAMI HERALD, May 9, 2017, http://www.miamiherald.com/news/local/community/miami-dade/coral-gables/article149542714.html.

[130] *Id.*

[131] *Id.*

[132] S. 348, 2018 Reg. Sess. (Fl. 2018); S. 1856, 2018 Reg. Sess. (Fl. 2018).

[133] *Id.*

[134] *See, e.g.*, Olga Goldberg, *Biodegradable Plastics: A Stopgap Solution for the Intractable Marine Debris Problem,* 42 TEX. ENVTL. L.J. 307, 343–44 (2012).

[135] *Id.*

[136] Manuel Matas, *The Advantages of Bioplastics*, ABENGOA, http://www.theenergyofchange.com/advantages-bioplastics (last visited Feb. 7, 2018).

source, such as starch from corn or potatoes, cellulose, soy protein, lactic acid, or vegetable oils.[137] Second, it can be considered bioplastic if it is biodegradable.[138] The different bioplastic compositions may be more sustainably produced or more biodegradable than others, and some combine both of these characteristics as well.[139] Because many bioplastics contain some non-biodegradable polymers, a problem is that the stronger the polymer is, the less biodegradable it is.[140] Nonetheless, research for more effective bioplastics continues to grow.[141]

Examples of bioplastic include polyhydroxyalkanoate ("PHA") and polylactic acid ("PLA"), which are both one-hundred percent degradable.[142] They exhibit the same strength and versatility as traditional plastic when compared and can already be found across different sectors such as agriculture and medicine.[143]

Another environmentally friendly plastic is Bio-PET—a bio-based polyethylene terephthalate ("PET"), which is a plant-derived plastic.[144] It can be derived from different sources, such as crops and forest residue.[145] However, a study by the University of Minnesota found that when compared to PET (a traditional plastic) derived from fossil fuels, some Bio-PETs derived from crops such as corn grain, stover, wheat, and switchgrass actually performed worse in environmental impact categories (which included smog, acidification, and resource depletion).[146] The good news is this research also showed that Bio-PET derived from forest residues "requires twenty-two percent less fossil fuel inputs and produces twenty-one percent fewer greenhouse gases than

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[137] *Id.*

[138] *Id.*

[139] *Id.*

[140] Goldberg, *supra* note 133, at 344.

[141] *Id.* at 341.

[142] Matas, *supra* note 135, para. 5.

[143] *Id.*

[144] *Not All Bioplastics are Created Equal: Forest Residuals Provide Cleaner Feedstock for Bio-based Plastic than Fossil Fuels or Row Crops, Research Suggests*, SCIENCE DAILY (Sept. 21, 2016), https://www.sciencedaily.com/releases/2016/09/160921162238.htm.

[145] Forest residue is what is "left after the usable part of the tree has been removed." *Id.*

[146] *Id.*

traditional PET."[147] Using this process can significantly reduce burdens placed on the environment—especially by fossil fuels—when compared to traditional plastics and could be incorporated into existing recycling systems.[148]

In January 2017, the University of Bath announced a discovery supporting the manufacture of plastic devoid of any fossil fuels.[149] A waste product from pine trees, pinene, is a chemical that gives pine trees their signature scent and is also a waste product of the paper industry.[150] Using an otherwise wasted product, pinene can be manipulated to create degradable polyesters.[151]

Another sustainable and biodegradable plastic can come from an unusual source—manure. A company in California, Newlight Technologies, has created a plastic called AirCarbon, which uses methane-based carbon emissions from waste sources such as dairy farms and landfills.[152] It also captures methane emissions from water treatment plants and energy facilities.[153] This company proposes that this new plastic is superior to current petrochemical (oil)-based plastics for two reasons: it takes pollution (methane) out of the air, and it is cheaper.[154] Methane, the primary source of this plastic, is a major cause of global warming according to many scientists.[155] Although methane accounts for

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[147] *Id.*

[148] *Id.*

[149] Megan Treacy, *Chemical That Gives Pine Trees Their Smell Could Be Used to Make Renewable Plastic*, TREEHUGGER (January 24, 2017), http://www.treehugger.com/clean-technology/chemical-gives-pine-trees-their-smell-could-be-used-make-renewable-plastic.html; *see also Scientists Make Plastic from Pine Trees,* SCIENCE DAILY (January 17, 2017), https://www.sciencedaily.com/releases/2017/01/170117140210.html.

[150] *Scientists Make Plastic from Pine Trees,* SCIENCE DAILY (January 17, 2017), https://www.sciencedaily.com/releases/2017/01/170117140210.html.

[151] *Id.*

[152] Andrew Khouri, *Start-up Turns Methane from Manure into Eco-friendly Plastic*, SUN SENTINEL (July 12, 2015, 8:00 AM), http://www.sun-sentinel.com/business/la-fi-0712-newlight-20150712-story.html.

[153] NEWLIGHT TECHNOLOGIES, *Technology, Our Technology: Greenhouse Gas to Plastic*, https://www.newlight.com/technology/ (last visited Nov. 25, 2017).

[154] Khouri, *supra* note 151.

[155] *Id.*

only ten percent of emissions in the United States, it traps much more heat than carbon dioxide (the gas most commonly associated with global warming).[156] Methane actually captures twenty times more heat than carbon dioxide, making this new methane-capturing method ideal to reduce the severity of it in our atmosphere.[157]

The EPA has honored Newlight Technologies with the 2016 Green Chemistry Award, which is given to companies that reduce or eliminate the generation of hazardous substances.[158] The EPA supports Newlight's assertions by recognizing that this plastic is net carbon negative, is cheaper than petroleum-based plastic products, and equally as strong as traditional plastic.[159] This new plastic has already been contracted with companies such as Dell, Ikea, Sprint, Virgin, The Body Shop, and more.[160]

There are a number of alternatives to traditional plastic, as mentioned above. There are some drawbacks to some of the processes, such as chemical byproducts and increased cost.[161] However, with time comes new innovations, such as AirCarbon, which do not have such negative side effects and are technically, carbon negative.

B. Recycling Plastic Into Fuel

The second aspect of this proposed solution is to utilize plastic-to-fuel technologies, which would not only reduce the amount of the harmful traditional plastic waste but also create usable fuel.[162] Because plastic is usually derived from oil or natural gas, it is essentially a form of stored energy, capable of being rearranged on a molecular level into

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[156] *Id.*

[157] NEWLIGHT TECHNOLOGIES, *supra* note 152.

[158] *See Green Chemistry,* ENVT'L PROT. AGENCY, https://www.epa.gov/greenchemistry/presidential-green-chemistry-challenge-winners (last visited Jan. 31, 2018).

[159] *Presidential Green Chemistry Challenge: 2016 Designing Greener Chemicals and Specific Environmental Benefit: Climate Change Awards*, ENVT'L PROT. AGENCY, https://www.epa.gov/greenchemistry/presidential-green-chemistry-challenge-2016-designing-greener-chemicals-and-specific (last visited Nov. 25, 2017).

[160] *Id.*

[161] Goldberg, *supra* note 133, at 344.

[162] *E.g.*, *Conversion Technology: A Complement to Plastic Recycling*, AM. CHEMISTRY COUNCIL (Apr. 2011), https://plastics.americanchemistry.com/Plastics-to-Oil/.

fuel, just as gasoline is derived from crude oil.[163] By breaking down the original carbon plastic polymers (polymer decomposition), through a process known as pyrolysis (also known as thermal cracking or catalytic cracking if a catalyst is used[164]), liquid fuels can be created.[165] In short, pyrolysis involves heating the plastic without oxygen, breaking or "cracking" the polymer chains, cooling the gas produced, and condensing it into fuel.[166]

There are a number of companies already in existence around the world, the United States, and Florida that specialize in this technology.[167] These companies vary in terms of the size and structure of the machines, types of materials—including plastic—the systems can process (feedstock), and the type of fuel or fuel product produced, but all aim to recycle plastic into fuel.[168]

University of Central Florida researchers patented a plastic pyrolysis technology in 2011 that utilizes catalytic cracking to decompose the plastic polymers into high quality fuels.[169] This process is capable of producing an assortment of high-quality fuel products including petroleum, jet fuel, kerosene, high-octane gasoline, and diesel free of sulfur and nitrogen contamination.[170]

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[163] *See id.*

[164] In chemistry, a catalyst is any substance that increases the rate of a reaction without itself being consumed. *Catalyst*, ENCYCLOPEDIA BRITANNICA (2017), https://www.britannica.com/science/catalyst.

[165] *See, e.g.*, Débora Almeida & Maria de Fátima Marques, *Thermal and Catalytic Pyrolysis of Plastic Waste*, POLÍMEROS (Mar. 4, 2016), http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0104-14282016000100007#aff01.

[166] *See, e.g.*, *What Are Plastics-To-Fuel Technologies?*, AM. CHEMISTRY COUNCIL, https://plastics.americanchemistry.com/Product-Groups-and-Stats/Plastics-to-Fuel/What-Are-Plastics-To-Fuel-Technologies.pdf (last visited Nov. 27, 2017).

[167] *Plastic to Fuel Top Companies*, VENTURERADAR, https://www.ventureradar.com/search/ranked/pla1stic%20AND%20to%20AND%20fuel/ (last visited Nov. 27, 2017); *see also e.g.*, *Conversion Technology*, *supra* note 161.

[168] *Id.*

[169] U.S. Patent No. 9, 200, 207; *Produce Liquid Hydrocarbon Fuel From Plastic Waste*, UNIV. OF CENTRAL FLA. http://technologies.tt.research.ucf.edu/technologies/32450_produce-liquid-hydrocarbon-fuel-from-plastic-waste (last visited Nov. 27, 2017).

[170] *Id.*

In 2016, chemists from the Shanghai Institute of Organic Chemistry and the University of California developed a way to degrade plastic waste—more specifically, polyethylene (PE)—into liquid fuels and waxes in a low-energy, mild catalytic cracking process.[171] This process utilizes catalytic cracking at about 175 degrees Celsius, with an iridium catalyst and takes a total of four days.[172] The iridium can be costly compared to other catalysts, but the researchers hope to continue working on the cost-effectiveness of the process.[173] According to their research, "the degradation of real-world postconsumer PEs under such mild reaction conditions is unprecedented."[174] Due to the high efficiency of this process, lower energy requirements, and excellent control of the degradation products, this method boasts some advantages over older pyrolysis techniques.[175]

Another company in the United Kingdom, Recycling Technologies, announced its patented mini-refinery RT7000 in January 2017, which can melt various harmful plastics found in an average home into a reusable petroleum commodity called Plaxx. Plaxx can be used for a multitude of uses including paraffinic wax, feedstock for creating new plastics, and low-sulfur marine oil.[176] The fairly large machine can recycle 7,000 tons of plastic into 5,250 tons of Plaxx annually, and helps prevent plastic pollution from finding its way into the environment by tackling the problem at the source.[177] In comparison to the above-mentioned catalytic cracking method, this process utilizes thermal cracking, which uses higher temperatures to degrade the plastic and does not necessitate a catalyst.[178] The machine's advantages include eliminating the cost and

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[171] This process is called tandem catalytic cross-alkane metathesis. Xiangqing Jia et. al, *Efficient and Selective Degradation of Polyethylenes into Liquid Fuels and Waxes Under Mild Conditions*, SCIENCE ADVANCES (June 17, 2016), http://advances.sciencemag.org/content/2/6/e1501591.full.

[172] *Id*. at 6.

[173] *See id.*

[174] *Id*.

[175] *See id.*

[176] *The RT7000*, RECYCLING TECHNOLOGIES (2017), http://recyclingtechnologies.co.uk/technology/the-rt7000/.

[177] *Id.* at 4.

[178] *Plaxx,* RECYCLING TECHNOLOGIES (2017), http://recyclingtechnologies.co.uk/technology/plaxx/.

need for a catalyst, off-the-shelf component parts that allow for low capital cost, mass recycling and production, and an effective petroleum commodity end product, meaning it does not have to comply with very stringent specifications to be marketed (as opposed to diesel or similar road fuels).[179] This company is set to debut its first machine in Scotland in 2018, with eleven more to set up later across the United Kingdom.[180] They have hopes of expanding the units globally as well.[181]

Smaller than the RT-7000 is EcoFuel Technologies' new plastics-to-fuel machines, which vary from table-sized to much larger, depending on the amount of recycled plastic fuel desired.[182] These machines can also be installed in ships and configured to scoop up ocean plastics, convert them to diesel fuel, and use the fuel to power the ship on the same voyage, which helps reduce the plastic waste problem already present in the oceans.[183] Its process utilizes patented catalytic cracking to produce gasoline or diesel and varies the catalysts according to the needs of the client and fuel desired.[184] In comparison to other processes, the unique patented catalysts used here are from a family of compounds called metallocenes, and are said to perform better and be more stable than other catalysts such as the iridium catalyst in the Shanghai Institute method mentioned above.[185] The chemical reaction occurs at about 380 degrees Celsius, hotter than the Shanghai method, but takes a quarter of the time to complete, giving it a distinct efficiency advantage.[186] In just one day, plastic is broken down into high-quality gasoline or diesel (needing just a few additives to comply with state and federal mandates).[187] The

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[179] E-mail from Bronwen Jameson, Marketing Communications Manager, Recycling Technologies, Ltd., to author (Nov. 29, 2017, 12:02 EST) (on file with author).

[180] *Id*.

[181] *Id*.

[182] *Our Technology*, ECOFUEL TECHNOLOGIES, INC. https://www.ecofueltechnology.com/home/products/ (last visited Nov. 27, 2017).

[183] Jared Paben, *Equipment Spotlight: Portable Approach to Plastics-to-Fuel*, PLASTICS RECYCLING UPDATE, (Nov. 3, 2017), https://resource-recycling.com/plastics/2017/11/03/equipment-spotlight-portable-approach-plastics-fuel/.

[184] Email from Dr. Swaminathan Ramesh, Chief Executive Officer and President of EcoFuel Technologies, Inc., (Nov. 28, 11:15 EST) (on file with author).

[185] *See* Email from Dr. Swaminathan Ramesh, *supra* note 183.

[186] *See* Email from Dr. Swaminathan Ramesh, Chief Executive Officer and President of EcoFuel Technologies, Inc., to author, (Nov. 28, 20:21 EST) (on file with author).

[187] *Id*; *Our Technology*, *supra* note 181.

machines produce four times the fuel required for its operation, eliminate plastic waste while on land and on the ocean, eliminate the cost of returning plastic waste to port like other ocean waste clean ups, and allow marketability of the excess fuel created.[188] Dr. Swaminathan Ramesh, creator of these catalyst patents and machines, believes this unique technology is best suited to combat the plastic pollution problem as opposed to other processes.[189] Considering the short time frame for the process, small size and transportability of the machines, effective catalysts, high-quality fuels produced, and adaptability to the ocean, this process brings innovative techniques for both small and large scale implementation of not only plastic pollution clean-up, but also plastic-to-fuel technology.[190]

There are many more companies that are embarking on these exciting technologies. Adrian Griffiths, the chief executive of Recycling Technologies, beautifully summarizes that technology such as theirs, as well as all of the processes mentioned above, will "give the planet a chance to recover from something which is both a modern wonder and a terrible liability."[191]

C. Closing the Circle

Innovative plastics and the recycling of plastics can only mitigate this epidemic so much. Changes are necessary in both the thought processes and policies regarding how we produce, consume, and dispose of plastic.[192] In order for any of the proposed solutions to be maximally effective, change needs to start in the way the consumer thinks and

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[188] Paben, *supra* note 182.

[189] *See* Email from Dr. Swaminathan Ramesh, *supra* note 185.

[190] *See id*; *see* Paben, *supra* note 182; *see also* Katelyn Newman, *Small Plastic Waste Tech Could Fuel Local Communities*, U.S. NEWS (Apr. 3, 2017), https://www.usnews.com/news/national-news/articles/2017-04-03/plastic-to-fuel-tech-to-create-profit-reduce-waste-in-local-communities.

[191] Maisha Frost, *Recycling Technologies Turns Problem Plastic into Fantastic Fuel in Depots*, EXPRESS, (Jan. 31, 2017), http://www.express.co.uk/finance/city/760831/Recycling-Technologies-turns-plastic-fuel.

[192] *See* Marcus Erikson, *PLASTIC POLUTION: The Plastisphere - The Making of a Plasticized World*, 27 TUL. ENVTL. L.J. 153, 163 (2014).

behaves.[193] By accepting responsibility for necessary changes as a consumer, producer, or legislator, it will provide the framework for a successful sustainable plastic future.[194]

As a consumer, change can easily start at home. We are an affluent society, and responsibility is needed for the amount and types of goods we use, the waste we create, and how we dispose of it.[195] Avoiding plastic altogether, choosing sustainable bioplastics, encouraging the recycling of plastics, utilizing plastics-to-fuel technologies, and promoting these ideas to others are ways we can create change ourselves.

For plastic producers, Extended Producer Responsibility ("EPR") is a concept that can reduce the harm created by the products if thoroughly enforced throughout the plastic industry.[196] Under the EPR approach, manufacturers must demonstrate a successful recovery and recycling plan of the material after consumer use or it must be environmentally harmless.[197] EPR does this by imposing financial responsibility on the producers for recovery and recycling costs.[198] The producer internalizes these costs, resulting in an incentive to reduce total costs and create products that are easier to recycle, with less toxic chemicals, and to reduce operational costs.[199]

In other words, the easier it is for manufacturers to recycle their plastic products, the less it will cost them in the long run. Placing this economic responsibility on the manufacturers gives them an incentive to make a product as recyclable as possible.[200] Presently, some states have enacted EPR laws, but there are no federal EPR laws in place.[201]

Manufacturers, businesses, and infrastructure industries could also

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[193] *Id.*

[194] *Id.*

[195] *See* COMMONER, *supra* note 57.

[196] Erickson, *supra* note 191, at 162.

[197] *Id.*

[198] Robert Regan, *A Comparison of E-Waste Extended Producer Responsibility Laws in the European Union and China*, 16 VT. J. ENVTL. L. 662, 669 (2015).

[199] *Id.* at 670.

[200] Thomas Lindhqvist was the first to use the term Extended Producer Responsibility in 1990. *Id.* at 670.

[201] *E.g.*, *id.*

benefit from enforcing policies to go "green" and mandate only certain plastics be used, such as bioplastics. [202] This is appealing for a business because clients of the business can view going "green" as trendy and more importantly, because some supply chains and retailers may mandate it from them.[203] To go "green" or at minimum provide plastics made of bioplastic, the business would have to adopt specific standards of quality and ensure to buyers that their product meets those guidelines.[204] Supply contracts of businesses generally provide a warranty that the products satisfy these performance specifications.[205] To promote sustainable bioplastics, a contract could be drafted stating that all plastic parts used in the manufacturing of the product must be composed of bioplastics.[206] The term "bioplastic" in the contract could be defined as being made from renewable, benign, and compostable materials from plants, which achieve those standards.[207] This "green" approach is a way manufacturers and suppliers of plastic products can implement a change towards sustainable plastic directly, without it being mandated by legislation.

Promoting effective legislation, such as mandating EPR laws, policies on sustainable manufacturing and single-use plastic bans, is a solution that is simple in theory, but requires a lot of work, which includes advocating for sustainable plastic methods and influencing legislative member voting for related bills.[208] For example, as mentioned in Section II, pending Senate Bill 1460 in the 2017-2018 legislative session proposes a study on implementing plastic-to-fuel processes such as pyrolysis. Although some other legislation promotes the current plastic industry, Senate Bill 1460 is an exciting step in acknowledging the need for effective solutions on a federal level. Lobbying efforts could be increased across different sectors to promote sustainable plastic policies; these policies could include incentives to interests supported by the other

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[202] Stephen C. Ellis, *"Green" Supply Chain Contractual Provisions*, THE PRACTICAL LAWYER 19 (2013) http://files.ali-cle.org/thumbs/datastorage/lacidoirep/articles/TPL1306_Ellis_thumb.pdf.

[203] *Id.* at 20.

[204] *Id.* at 22.

[205] *Id.*

[206] *Id.* at 22-23.

[207] *Id*. 23.

[208] *Regulatory Reform*, *supra* note 109.

parties. For example, a policy could be adopted mandating the decrease or cessation of traditional plastic production while providing tax cuts and financial support for the traditional plastic manufacturers to transition into producing or using sustainable plastic and/or utilizing plastics-to-fuel recycling.

IV. CONCLUSION

In conclusion, the environmental effects and dangers of plastic are well known, and the limited legislation in Florida as well as in the United States is not sufficient to battle the ever-growing, toxic, and wasteful plastic problem.

Changing plastic into more earth-friendly forms, while utilizing new methods to recycle old plastic into fuel, would positively affect our environment in substantial ways. Incorporating these methods into our society and mandating them as much as possible is a necessary step in curtailing this harmful plastic epidemic.

The first prong of this proposed solution involves altering the actual composition of plastics to more biodegradable forms while still maintaining the same desired durability as traditional plastic, such as PHA or PLA as discussed above. There will likely be certain products or scenarios where bioplastic is simply not feasible or where traditional plastic is preferred, such as certain sterile medical equipment, but hopefully such instances will be limited. The second prong is utilizing plastic-to-fuel technology. This would not only decrease plastic waste but also provide a means to break down the plastic molecule bonds that would otherwise give plastic an indefinite life span. Increasing the use of these processes would reduce the need for nonrenewable fossil fuels to produce energy. The third prong is raising awareness and acknowledging the dangers of plastic on a public level, accepting new methods as effective solutions, and implementing new state and federal legislation to mandate these processes. Unified lobbying is needed across different sectors that have a vested interest in how plastics are addressed, including the environmental, health, waste management, commerce, energy, science, and technology sectors. However, it is not just the government's responsibility for these changes; these changes need support from everyone. Businesses need to be held liable for what they sell and how they package it, manufacturers for what they create and how

they create it, and ultimately every person for what they use and how they recycle it.