

# Plastics, Pollution & Solutions

Recycling programs and solutions

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## I. Executive Summary

Plastic pollution is a problem that affects the entire world, polluting both land and water. According to Earthday.org: “Every minute, one garbage truck of plastic is dumped into our oceans ... The amount of plastic in the ocean is set to increase tenfold by 2020.”<sup>1</sup>

Huge plastic islands are floating in the ocean and coming ashore on small island nations. Some of the plastic can be recycled (PET or PETE – polyethylene terephthalate), some plastic cannot be mass recycled (food packaging), and some plastic contains chemicals that should not be used again (BPA – bisphenol-A).

Some start-ups and organizations are coming up with solutions to plastic pollution that benefit poverty-stricken communities overwhelmed by plastic debris.

Since pollution from plastic waste affects the entire world and continues to grow, and China, which had been recycling around half of the world’s waste, is now refusing to accept some recyclables from other countries, solutions are needed to recycle the world’s plastic pollution washing up on all of the world’s shores.

Some countries are working toward a solution. “The governments of 187 countries have agreed to control the movement of plastic waste between national borders, in an effort to curb the world's plastic crisis -- but the United States was not among them,” according to a recent CNN article.<sup>2</sup>

Individuals are concerned as well. “Nearly 1 million people signed a global petition this week [5/11/2019] urging the governments of the Basel Convention to take action, by preventing western countries from ‘dumping millions of tonnes of plastic waste on developing countries instead of recycling it.’”<sup>3</sup>

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<sup>1</sup> “EARTH DAY 2018 | END PLASTIC POLLUTION - Fact Sheet: Plastics in the Ocean,” Earthday.org, accessed on Feb. 10, 2019

<sup>2</sup> “Over 180 countries -- not including the US -- agree to restrict global plastic waste trade,” CNN.com, May 11, 2019

<sup>3</sup> Ibid.

## II. Plastic Pollution – Facts and Challenges

1. Some facts about plastic pollution:
  - a. According to a NationalGeographic.com article<sup>4</sup>: “The prediction that by mid-century, the oceans will contain more plastic waste than fish, ton for ton, has become one of the most-quoted statistics and a rallying cry to do something about it.”
  - b. Most ocean plastic pollution comes from China, India and Indonesia.<sup>5</sup>
  - c. “In the United States, the EPA [Environmental Protection Agency] estimates that only 12 percent of plastic waste gets recycled. The plastic materials that don’t end up recycled typically get sent to landfills where they may take as many as 1,000 years to decompose.”<sup>6</sup>
  - d. “A staggering 32% of plastic packaging escapes collection systems, generating significant economic costs by reducing the productivity of vital natural systems such as the ocean and clogging urban infrastructure.”<sup>7</sup>
  - e. “Today, 95% of plastic packaging material value, or \$80– 120 billion annually, is lost to the economy after a short first use. ... Plastics that do get recycled are mostly recycled into lower-value applications that are not again recyclable after use. The recycling rate for plastics in general is even lower than for plastic packaging, and both are far below the global recycling rates for paper (58%) and iron and steel (70–90%). In addition, plastic packaging is almost exclusively single-use, especially in business-to-consumer applications.”<sup>8</sup>
  - f. Pacific island nations deal with rising sea levels, overfishing and “remote islands are increasingly awash in plastic trash.”<sup>9</sup>
  - g. According to a WashingtonPost.com headline on 1/20/2016: “By 2050, there will be more plastic than fish in the world’s oceans, study says.”
  - h. “Microplastics – plastic particles smaller than 5 mm in diameter – have been shown to be contaminated with toxic chemicals. These microplastics are small enough to be ingested by

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<sup>4</sup> “A Whopping 91% of Plastic Isn't Recycled,” NationalGeographic.com, Dec. 20, 2018

<sup>5</sup> “Ocean plastic tide 'violates the law',” BBC.com, Feb. 20, 2018

<sup>6</sup> “Is it Really Worth the Convenience? 6 Ways Plastic is Harming Animals, the Planet and Us,” Onegreenplanet.org, April 11, 2018

<sup>7</sup> “The New Plastics Economy: Rethinking the future of plastics,” World Economic Forum, Weforum.org, 2016 report

<sup>8</sup> Ibid.

<sup>9</sup> “How Small Island States Are Transforming Themselves Into Big Ocean Powers,” Newsdeeply.com, June 22, 2017

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marine species, potentially affecting species' and human health as they enter the food chain."<sup>10</sup>

2. Different types of plastics before recycling – These can be recycled:
  - a. #1 plastics known as PET or PETE (polyethylene terephthalate) are usually made into water bottles and peanut butter containers, and can be recycled into carpets and furniture.<sup>11</sup>
  - b. #2 HDPE (high-density polyethylene) plastics are usually made into milk jugs and shampoo bottles and may be recycled into pens and picnic tables; #5 polypropylene plastics are in yogurt cups and syrup containers and may be recycled into brooms and signal lights.<sup>12</sup>
3. Different types of plastics before recycling – These either pose problems for recycling or cannot be recycled:
  - a. #3 PVC (polyvinyl chloride) plastics are not usually picked up for recycling, can be harmful when incinerated, contain toxic dioxins, and may be recycled into flooring and park benches among other items.<sup>13</sup>
  - b. #4 LDPE (low-density polyethylene) is used for grocery bags and bread bags and are usually not recycled.<sup>14</sup>
  - c. #7 are plastics that contain chemicals not in categories 1-6 (#6 includes Styrofoam products) and may contain BPA (bisphenol-A) which has been linked to health issues such as obesity and infertility.<sup>15</sup>
4. According to Livestrong.com, there are certain plastic items that cannot be recycled, and they include plastic grocery bags, take-out food containers, and Styrofoam.<sup>16</sup> The list included bottle caps, but recycling has advanced to include these as well.
5. China, which has had some controversy over its recycling practices, stopped accepting<sup>17</sup> some plastics for recycling from outside the country for various reasons starting on Sept. 1, 2017:

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<sup>10</sup> "Action needed to reduce toxic contamination from ocean plastics – IUCN," IUCN.org, May 4, 2018

<sup>11</sup> "What Do Recycling Symbols on Plastics Mean?," Goodhousekeeping.com, Nov. 25, 2008

<sup>12</sup> "The Numbers on Plastic Bottles: What do Plastic Recycling Symbols Mean?," Naturalsociety.com, Feb. 6, 2013

<sup>13</sup> "Recycle Numbers On The Bottom Of Plastics," Naturalhomebrands.com, accessed on April 25, 2018

<sup>14</sup> "How to Recycle Number 4 Plastic," Homeguides.sfgate.com, accessed on April 25, 2018

<sup>15</sup> "Recycle Numbers On The Bottom Of Plastics," Naturalhomebrands.com, accessed on April 25, 2018

<sup>16</sup> "Biologists at the U.K.'s University of Portsmouth," Livestrong.com, Jan. 28, 2015

<sup>17</sup> "China Notifies WTO of Intent to Ban 24 Types of Solid Waste Imports," July 19, 2017

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- a. “China had been processing at least half of the world’s exports of waste paper, metals and used plastic — 7.3 million tons in 2016, according to recent industry data. Last July, China notified the World Trade Organization that it intended to ban some imports of trash, saying the action was needed to protect the environment and improve public health. ... Chinese officials also complained that much of the recyclable material the country received from overseas had not been properly cleaned or was mixed with non-recyclable materials.”<sup>18</sup>
  - b. “‘Plastic China’, an award-winning documentary released in late 2016, ignited further public outrage by highlighting the human and environmental costs of the under-regulated, Wild West-style recycling industry.”<sup>19</sup>
6. Solar power solutions from plastics
    - a. “An Hungarian company called [Platio](#) developed pavement tiles with solar panels integrated into them, made from recycled plastic.”<sup>20</sup>
    - b. A NGO in Argentina, [Sumando Energias](#), shows people how to make a solar heating system using discarded plastic bottles.

### III. Plastics Recycling and Its Applications

1. “Plastic waste has three fates — recycling, thermal destruction and landfills.”<sup>21</sup> Plastics that are recycled for other uses may be separated, washed then chopped, but there are different ways of dealing with plastic pollution.
2. Plastic flake is made when certain types of plastics are chopped up in the recycling process. For example, a bottle cap and a bottle have to be separated because they are two different materials. The chopped materials are flakes and each have separate uses. Companies are finding new uses for plastic flakes:
  - a. “Dark colored plastic flake is generally utilized in products that just get dyed black. For this reason, darker colored plastic has a narrow end-use, which results in low demand in the world market. ... Thread was able to bring a customer, HP, to the table and create a demand for dark colored flake. This meant the price of that dark colored plastic increased.

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<sup>18</sup> “Plastics Pile Up as China Refuses to Take the West’s Recycling,” [Nytimes.com](#), Jan, 11, 2018

<sup>19</sup> “Southeast Asian plastic recyclers hope to clean up after China ban,” [Reuters.com](#), Jan. 15, 2018

<sup>20</sup> “SOLAR-PANEL PAVEMENT MADE FROM RECYCLED PLASTIC,” [Materia.nl](#), March 17, 2017

<sup>21</sup> “Humans have made 8.3 billion tons of plastic. Where does it all go?,” [PBS.org](#), July 19, 2017

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Furthermore, we were able to negotiate on behalf of the collection center owners for an additional two cents per pound. As that higher price flows through the entire collection network, more volume is collected. In fact, the recycling center that HP is purchasing from reported a 15% increase in collection volume shortly after the price increase. That increased volume means that more cash is being infused into the collection network, which allows collection centers owners to reinvest in their businesses or use the profits to further support their families. Thread and HP were able to increase the value of material that was priced so low it was barely being collected. In turn, that same material that was polluting the environment is now being picked up because of the higher price. Both of these factors come together to result in an increased amount of plastic moving through the system.”<sup>22</sup>

3. There is the possibility of energy as a by-product of the plastics recycling process:
  - a. Recycling Technologies created a machine in which “plastics are turned into the new oil called Plaxx. The energy needed to run the machines will partly be supplied by the gas emitted during processing and the Plaxx produced will be sold on for reuse.”<sup>23</sup>
  - b. “EcoFuel technologies’ (EFT) portable plastics-to-fuel technology can create about a gallon of diesel from 10 pounds of plastic. ... Two proof-of-concept units designed to produce 20 gallons per day are available for observation, examination and sample processing.”
4. The downside of plastics recycling
  - a. “After downcycling, plastic is generally unfit for another round of recycling. This means that it ends up in a landfill despite having seen a secondary use as a less useful product. Downcycling simply delays the process, and manufacturers have the same demand for new plastics.”<sup>24</sup>
  - b. “The same people who are removing plastics from their lives, who know that plastic bottles contain estrogenic-releasing toxins, may not be aware they are wearing those same plastic bottles. ... Instead, wear a long sleeve cotton shirt under the fleece or polyester fabric so there is a buffering layer between potential leaching BPA or other plastic toxins and the skin that absorbs these toxins.”<sup>25</sup>

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<sup>22</sup> “PLASTIC WASTE NOT WASTED: THREAD + HP,” Threadinternational.com, June 19, 2017

<sup>23</sup> “Recycling Technologies turns problem plastic into fantastic fuel in depots,” Express.co.uk, Jan. 31, 2017

<sup>24</sup> “The Disadvantages of Recycled Plastics,” Sciencing.com, April 24, 2017

<sup>25</sup> “Could Your Clothes be Damaging Your Health?” Westonaprice.org, Nov. 21, 2016

## IV. Some Organizations & Technologies Dedicated to Plastic Pollution Solutions

### A. Organizations

1. [4Ocean.com](#)

“Through worldwide support and the purchase of 4ocean Bracelets, we’ve pulled 3,773,196 pounds of trash from the ocean & coastlines to-date.”<sup>26</sup>

2. [Ecodom.mx](#)

“Ecodom is a social and environmental enterprise dedicated to prefabricated ecological dwelling development to provide safety and sustainable life. Our products are developed with recycled elements such as plastics and cardboard to the end of reducing waste in our surroundings.”<sup>27</sup>

3. [Lego / Sustainable Materials Center](#)

“Lego pumped \$155 million into a new Sustainable Materials Center, ... About 25 different Lego shapes, many of them plants, will now be made from sugarcane-based polyethylene rather than oil-based plastic. ... By the end of the year, under two percent of Lego bricks will use the new polyethylene ... While the percentage sounds small, keep in mind that Lego sells 75 billion elements every year.”<sup>28</sup>

4. [Liter of Light](#) – NGO

“Liter of Light was born from an original idea by Alfredo Moser in 2002, and consists of giving plastic bottles full of water and bleach (to prevent algae from growing in the water) to households and schools in areas without access to electricity. This method can also be of use in areas where the regular network is faulty, or where being connected to the grid is simply too expensive. One bottle is inserted into a [sic] hole made in the roof of the house, and provides the equivalent of a 55-Watt bulb during the day, with the sunlight refracting through the water in the bottle and into the house.”<sup>29</sup>

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<sup>26</sup> 4Oceans.com, accessed on Feb. 10, 2019

<sup>27</sup> “About Us,” en.Ecodom.mx, accessed on Feb. 10, 2019

<sup>28</sup> “LEGO BUILDS A SUSTAINABLE FUTURE, ONE BRICK AT A TIME,” Wired.com, March 11, 2018

<sup>29</sup> “ILLAC DIAZ, LIGHT BY THE LITER,” Climateheroes.org, accessed on April 26, 2018

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5. [MacRebur](#)

“In the case of recycled plastic roads, the future is now. U.K. startup is already working with a number of local municipalities on enhancing asphalt roads with tiny pellets of plastic made from recycled bottles, thereby reducing the amount of fossil fuel bitumen in the mix. The company claims the result is 60 percent stronger, longer-lasting, and more eco-friendly than traditional roads.”<sup>30</sup>

6. [NOAA Marine Debris Program](#)

“The NOAA Marine Debris Program is authorized by Congress to work on marine debris through the Marine Debris Act, signed into law in 2006 and amended in 2012.”<sup>31</sup>

7. [Ocean Conservancy’s ‘Trash Free Seas Alliance’](#)

“Ocean Conservancy has mobilized millions of people around the world to remove trash from our ocean and waterways. But removal is just one part of the solution. We must also prevent trash from reaching our waterways and the ocean, which is why in 2012 Ocean Conservancy launched the Trash Free Seas Alliance®. The Alliance unites industry, science and conservation leaders who share a common goal for a healthy ocean free of trash. The Alliance provides a constructive forum focused on identifying opportunities for cross-sector solutions that drive action and foster innovation.”<sup>32</sup>

8. [Ocean Recovery Alliance](#)

“The Ocean Recovery Alliance is also a founding member of the Ocean Conservancy’s ‘Trash Free Seas Alliance’ which was announced at the Clinton Global Initiative in 2011. ... We are the founder of the unique Plasticity Forum, focused on the future of plastic, and where the leaders are going with design, innovation, materials, recycling and solutions, for a world with reduced waste.”<sup>33</sup>

9. [PagaBags](#) and French NGO Couleur Baobab and

“PagaBags was born from plastic bags. ... the founding members of the French NGO Couleur Baobab, Françoise Chevallier and her husband Jacques, ... connected PagaBags with an association of women farmers in Boussouma. ... The technique involves prodding

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<sup>30</sup> “5 futuristic ways to pave roads, from solar panels to recycled plastic,” Curbed.com, Sept. 20, 2017

<sup>31</sup> [Marinedebris.noaa.gov](#), accessed on April 25, 2018

<sup>32</sup> [Oceanconservancy.org](#), accessed on April 25, 2018

<sup>33</sup> “Ocean Recovery Alliance,” [Oceanrecov.org](#), accessed on April 25, 2018

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small chunks of pre-cut plastic onto a metal stick. The stick is then slowly rotated over a fire until the plastic softens. It does not take long but it does take skill and concentration.”<sup>34</sup>

### 10. [Parley.tv](#)

“American Express joins the movement to stem the tide of marine plastic pollution with a plan to introduce the first credit card made primarily using Ocean Plastic and new corporate commitments that embody Parley AIR ... Parley AIR is the strategy to end the fast-growing threat of marine plastic pollution. We believe plastic is a design failure, one that can only be solved by reinventing the material itself. To create change, we can stop producing more plastic right away and use up-cycled marine plastic waste instead. Everyone has a role to play.”<sup>35</sup>

### 11. [Plastic Oceans](#)

“Our Mission: Inform on the topic of plastic pollution.; Inspire people to care about the issue and desire to be part of the solution.; Incite action on real solutions that will shift the global reliance on plastic.”<sup>36</sup>

### 12. [Plastic Bank](#)

“The company, formed in 2013, pays people to collect plastic waste and take it to recycling markets in Haiti and, more recently, the Philippines. (There are plans to expand to Brazil and Indonesia, followed by South Africa, the Vatican, Panama and India). Collectors can receive payment in money, of course, but they also can draw on the credit to buy stuff, like cook stoves or fuel, at special stores.”<sup>37</sup>

### 13. [Plastics For Change](#)

“In most developing economies, the informal sector is responsible for recycling the majority of plastic waste. However, this informal supply chain is very exploitative and dysfunctional, which makes accessing markets challenging. ... To address these issues, Plastics for Change has developed an ethical sourcing platform to facilitate a mutually beneficial deal process for all stakeholders. The deals are designed in advance to reward socially and environmentally responsible behaviour through the supply chain. Our mobile platform creates transparency and accountability for all stakeholders participating in the

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<sup>34</sup> “PLASTIC BAGS, BOTTLE TOPS AND CREATIVE REUSE,” Pagabags.com, accessed on April 26, 2018

<sup>35</sup> Parley.tv, accessed on Feb. 10, 2019

<sup>36</sup> “About,” PlasticOceans.org, accessed on Feb. 10, 2019

<sup>37</sup> “The Plastic Bank: Using Plastic Refuse To Create A Global Currency For The Poor,” Forbes.com, Nov. 29, 2017

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deal. The middleman's commission is based upon the price received by those at the base of the supply chain.”<sup>38</sup>

### 14. [Plastic Pollution Coalition](#)

“PPC was founded in 2009 as a platform to amplify a common message through strategic planning and communication. Our more than 500 member organizations and a growing coalition of individuals seek to increase understanding of the plastic pollution problem and to find sustainable solutions. We aim to empower more people and organizations to take action to stop plastic pollution and to live plastic-free.”<sup>39</sup>

### 15. [Recycling Technologies](#)

“The recycling startup has built a machine that vaporizes all types of plastics and petroleum-based products like carpeting through thermal cracking into a product it calls Plaxx. Plaxx is actually a catch-all name for a number of different products, ranging from Plaxx-8, a feedstock for producing new plastics, to Plaxx-30, for heavy fuel oil.”<sup>40</sup>

### 16. [Renewlogy](#)

“Renewlogy (new branding for PK Clean) solves the problem of plastic waste entering landfills and oceans by turning it into fuel. While reduction, reuse, recycling and single-use plastic bans are the best answers, these answers can sometimes be slow to enact on the large scale needed to address the plastic pollution problem. ... We are currently fundraising to get a portable plastic to fuel converter to the Haitian people as a means to cleanup the island and provide clean fuel that otherwise has to be imported.”<sup>41</sup>

### 17. [Sumando Energias](#)

Argentinian NGO: “Things have changed thanks to ingenious but very simple solar panels made from recycled plastic bottles. ... The homemade system is made of used soda cans, plastic bottles and milk cartons. As the sun heats the tubes of the solar collector, hot water flows into the storage tank. Volunteers paint the pipes black to adsorb heat from the sun. In this way, the solar collector keeps water hot all night long without the need for electricity or gas.”<sup>42</sup>

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<sup>38</sup> “ACCELERATING THE DEVELOPMENT OF RECYCLING INFRASTRUCTURE,” [Plasticsforchange.org](#), accessed on April 26, 2018

<sup>39</sup> [Plasticpollutioncoalition.org](#), accessed on April 25, 2018

<sup>40</sup> “7 Startups Recycling Plastic with New Technology,” [Nanalyze.com](#), Feb. 21, 2018

<sup>41</sup> [Plasticoceanproject.org](#), accessed on April 25, 2018

<sup>42</sup> “Creating solar energy from trash,” [Euronews.com](#), April 26, 2018

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### 18. [The Ocean Cleanup](#)

“The Ocean Cleanup's team consists of more than 70 engineers, researchers, scientists and computational modelers working daily to rid the world's oceans of plastic. ... The Ocean Cleanup's passive system is comprised of a floater with a solid screen underneath, concentrating the debris and leading it to a collection system. The system is slowed down by a drift anchor suspended at an approximate depth of 600 meters, making the system move slower than the plastic and therefore catching it. ... The Ocean Cleanup has estimated to be able to remove 50% of the Great Pacific Garbage Patch in just 5 years' time.”<sup>43</sup>

### 19. [U.K.'s University of Portsmouth](#)

“Biologists at the U.K.'s University of Portsmouth were studying the structure of an enzyme that can break down polyester when they found a way to tweak it. The result, according to a study published this week in the Proceedings of National Academy of Sciences, is a ‘mutant enzyme’ that can degrade plastics 20 percent more efficiently than its original form. ... So, in theory, if McGeehan’s accidental discovery proves successful, the world could see a future in which we no longer need to dig up more oil to make plastic bottles.”<sup>44</sup>

### 20. [VolkerWessels](#)

“By recycling the plastic into sturdy, hollow road segments, not only are we putting an invaluable and hardy material to good use, but being more environmentally (and economically) responsible by giving plastic a second life.”<sup>45</sup>

### 21. [Waste2Weave](#)

Founder Monique Maissan: “It is a very new concept to link third-world production and products directly to first-world consumer markets. By collaborating with a famous Dutch designer, Monique Collignon, we created The Conscious Collection, high-end fashion made from recycled plastic fabrics. The collection debuted in Amsterdam's 2016 Fashion Week in summer 2016. People were amazed!”<sup>46</sup>

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<sup>43</sup> Theoceancleanup.com, accessed on April 25, 2018

<sup>44</sup> “New 'Mutant Enzymes' Could Solve Earth's Plastics Problem,” Citylab.com, April 18, 2018

<sup>45</sup> “VolkerWessels Wants to Roll Out PlasticRoad,” Minipakr.com, March 3, 2017

<sup>46</sup> “Can the Fashion Industry Take Women Out of Poverty, Plastic Out of the Environment?,” Inc.com, June 27, 2017

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### 22. Separating mixed materials for recycling:

- a. German company [Saperatec](#) “has “raised about €4.3 million (about \$5.3 million) to tackle one of the toughest problems of plastic recycling—mixed materials...”<sup>47</sup>
- b. “[Shred-Tech](#)® has engineered and manufactured custom systems to shred, separate and recover the component materials that make up these electronic products.”<sup>48</sup>

## B. Portable and local plastics recycling machines

### 1. [Precious Plastic](#)

Dave Hakkens, the Dutch founder, makes portable plastics recycling machines from which people make coasters and tiles. According to [FastCompany.com](#): “One set of instructions explains how to build a low-cost machine that shreds plastic into flakes. Another modular machine extrudes plastic that can be used for 3D printing; an injection machine and a compression machine can form plastic into molds. A series of videos explain how to build the machines using basic materials and universal parts.”<sup>49</sup>

Online retailer [Bazar.preciousplastic.com](#) was created by Precious Plastics for people who use these portable plastics recycling machines to sell their products.<sup>50</sup>

### 2. [Trashpresso](#)

“The TRASHPRESSO machines are housed on a 40-foot container platform that is movable anywhere by trailer truck. It is powered by a solar-charged energy storage unit housed on a separate 20-foot container platform. ... The TRASHPRESSO can upcycle up to 50KG of waste per hour. Waste is converted into architectural tiles that have both a utilitarian and raw material value. ... The TRASHPRESSO can upcycle any thermoplastic that has a melting point lower than its burning point.”<sup>51</sup>

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<sup>47</sup> “7 Startups Recycling Plastic with New Technology,” [Nanalyze.com](#), Feb. 21, 2018

<sup>48</sup> [Shred-tech.com](#), accessed on Feb. 10, 2019

<sup>49</sup> “These DIY Machines Let Anyone Recycle Plastic Into New Products,” [Fastcompany.com](#), Oct. 30, 2017

<sup>50</sup> “These DIY Machines Let Anyone Recycle Plastic Into New Products,” [Fastcompany.com](#), Oct. 30, 2017

<sup>51</sup> [Miniwiz company](#), [Trashpresso.com](#), accessed on April 25, 2018

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### 3. [Protoprint](#)

“Protoprint [founded by environmental engineer Sidhant Pai and his parents] partnered with SWaCH, a Pune-based cooperative wholly owned by waste pickers. Together they have set up a low-cost filament production facility at a local rubbish dump in Pune operated by SWaCH waste pickers to convert plastic waste – specifically high-density polyethylene (HDPE) mostly used for plastic bottles – into 3D printing filament to eventually be sold to Indian or international 3D printing companies. Protoprint buys filament from SwaCH for 300 rupees (£3.50) per kg – if waste pickers sold the plastic waste directly to scrap merchants the pickers would receive around 19 rupees (23p) per kg, says Pai.”<sup>52</sup>

## V. Plastic Pollution Solutions Around the World

Some countries are working toward a solution. “The governments of 187 countries have agreed to control the movement of plastic waste between national borders, in an effort to curb the world's plastic crisis -- but the United States was not among them,” according to a recent CNN.com article. “...Nearly 1 million people signed a global petition this week [5/11/2019] urging the governments of the Basel Convention to take action, by preventing western countries from ‘dumping millions of tonnes of plastic waste on developing countries instead of recycling it.’”<sup>53</sup>

### 1. Australia

- a. “Yet another initiative that repurposes plastic waste into much-needed housing is the NevHouse, an initiative by Australian surfer and entrepreneur Nev Hyman. Speaking at the Plasticity Forum, Hyman outlined an effort by his company to build houses in the Pacific island nation of Vanuatu from recycled plastic materials, agricultural waste, and even electronic waste, which has been turned into construction panels.”<sup>54</sup>

### 2. Haiti

- a. Locals are paid by Plastic Bank to harvest plastics: “After bringing plastic to a recycling center that’s managed by a local entrepreneur and staffed by local employees, people receive

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<sup>52</sup> “Could 3D printing help tackle poverty and plastic waste?,” Theguardian.com, Nov. 6, 2016

<sup>53</sup> “Over 180 countries -- not including the US -- agree to restrict global plastic waste trade,” CNN.com, May 11, 2019

<sup>54</sup> “5 ways to win the war on plastic pollution,” Eco-Business.com, Nov. 7, 2017

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payments on a mobile Blockchain app that they can then use toward goods. This method is used because it's more secure and can be better monitored by Plastic Bank to ensure accurate payments, according to the company. ... The recycling centers then turn the plastic waste into pellets that are sold to multinational brands that repurpose the pellets into products. Over the past several years, growing demand for plastic pellets of this kind has greatly expanded the market potential for recyclers.”<sup>55</sup>

- b. Ramase Lajan [Picking Up Money]: “Through our program, local collection centers will increase the number of opportunities for Haitians to have competitive paying jobs to provide for their families, clean up the streets and help reduce the disease spread from unsafe water in the canals. We also expect to see the behavior of people change. Once plastics are seen as money rather than garbage, they will gradually and forever, disappear from the otherwise beautiful landscapes and beaches of Haiti.”<sup>56</sup>
- c. Retailers use the plastic collected by locals for making their products: “Thread International plans to recycle plastic bottles collected by workers in Haiti, Honduras and Taiwan into fabric and use it to manufacture shoes, clothing and a new line of high-end backpacks, reports Trib Total Media. The company's founder and CEO is Ian Rosenberger, who appeared on the reality show Survivor in 2005. Rosenberger founded Thread in 2012 and has been selling fabrics to the likes of Timberland, Reebok, Marmot and Aerie.”<sup>57</sup>
- d. “What if pieces of plastic strewn across the world’s beaches ended up in brand new computer boxes, not floating in the middle of the ocean or lodged inside seabirds? That’s what computer company Dell has set out to do, testing a supply chain that sees litter picked up from Haiti’s beaches and worked into recycled packaging. Anyone now buying the XPS 13 2-in-1 laptop can expect to find the machine sitting on a tray that’s 25 per cent ocean plastic – complete with an image of a whale and a link that leads to information about marine litter.”<sup>58</sup>
- e. “Reyel Bonhomme is the foreman at Arris Desrosiers, a small company founded by two Haitians who decided to do something about the plastic waste that was invading their town. ... Bonhomme, his sons and many residents of the town now collect any stray plastic they find – especially bags – and turn it in at the factory. Thousands of plastic bags are now transformed every month into backpacks and lunch boxes for local students.”<sup>59</sup>

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<sup>55</sup> “In Haiti, People Can Exchange Plastic for Money and Goods at the ‘Plastic Bank’,” Globalcitizen.org, Nov. 29, 2017

<sup>56</sup> Haitirecycling.org, accessed on April 26, 2018

<sup>57</sup> “Thread International: Turning Garbage Into Jobs,” AssemblyMag.com, Sept. 11, 2018

<sup>58</sup> “Ocean plastics from Haiti’s beaches turned into laptop packaging,” Newscientist.com, June 12, 2017

<sup>59</sup> “A Plastic Recycling Plant in Haiti Attracts Workers and Helps the Environment,” GlobalPressJournal.com, Dec. 12, 2018

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### 3. Japan

- a. Zero Waste Academy is “a nonprofit that works toward Kamikatsu's sustainability goals.” “Now 80% of the town's garbage is recycled, reused, or composted, with the rest going to a landfill. The process saves the village a third of its former costs from waste incineration. By 2020, Kamikatsu hopes to be completely zero-waste.”<sup>60</sup>

### 4. Maldives

- a. “On 7 June [2017], the Maldivian government announced an ambitious plan to fight back against the floating menace, working with the islands’ 1200 pole-and-line, handline and longline fishing boats. Fishermen will sweep plastic rubbish from the sea while they fish, shipping the rubbish back to the capital, Malé, where it will be transferred to long-distance ships for recycling into plastic-based fabrics. ... Working with sportswear giant Adidas, the government has already transformed 5 million plastic bottles into flip flops, running shoes, and sports clothing, including shirts for the Spanish football club Real Madrid.”

### 5. Micronesia

- a. The Federated States of Micronesia include the four states of Yap, Chuuk, Pohnpei and Kosrae, and these island communities have some recycling programs in place: Pohnpei State Government, including Kolonia and Sokehs communities.<sup>61</sup>
- b. Yap State Government through Yap State Environmental Protection Agency (YEPA)<sup>62</sup> “with Yap banning the use of plastic bags in retail stores in 2013.”<sup>63</sup>

“The Enhancement of the Yap Recycling Program Project focused on purchasing two pieces of needed equipment to improve the Program’s ability to process PET Plastics and collect junk vehicles and other scrap metal. ... The final purchase was a PET Plastics Granulator (or Shredder) from Shyoken Company Limited which had arrived Yap in late February 2016.”<sup>64</sup>
- c. In Kosrae: “KIRMA, in partnership with the Micronesia Eco. Corporation, is implementing a self-financing recycling program. The State is collecting a deposit fee of \$4.00 on lead-acid batteries and \$0.06 on each imported glass, aluminium, and plastic beverage container. Kosraeans can later turn in empty bottles and receive \$0.05 back per bottle, with the

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<sup>60</sup> “The simple way this Japanese town has become nearly zero-waste,” Businessinsider.com, July 10, 2017

<sup>61</sup> “Recycling of Aluminum Cans,” Pohnpeimet.fm, accessed on April 26, 2018

<sup>62</sup> “Yap Improves Recycling Program Operations through Japan’s Grant Aid Program,” Micronesia.emb-japan.go.jp, accessed on April 26, 2018

<sup>63</sup> “Fifth National Report to the Convention on Biological Diversity: The Federated States of Micronesia 2014,” accessed on April 26, 2018

<sup>64</sup> “Near completion of enhancement of Yap’s Recycling Program Project funded by the Embassy of Japan,” Kpress.info, April 24, 2016

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remaining \$0.01 per unit covering handling costs. About \$60,000 was reportedly earned in 2011 alone through this program (Asian Development Bank, 2014).”<sup>65</sup>

- d. Moana Taka Partnership: “...this MOU allows for CNCo vessels to carry containers of recyclable waste from eligible Pacific island ports, pro bono, to be sustainably treated and recycled in suitable ports in Asia Pacific [including Federated States of Micronesia]. ... Under this agreement, Pacific island countries who have insufficient or inappropriate landfill space to store waste, have inadequate waste treatment facilities, and the financial inability to ship recyclable waste are eligible for this opportunity. The types of materials that are considered recyclable include plastics, aluminium cans, waste oil and ozone depleting substances.”<sup>66</sup>
  - e. Heirs to Our Oceans (youth organization): “We started our movement to create positive change for our oceans in May 2016, and we already have additional chapters in Southern California, Northern California, and the Republic of Palau which is an island nation in Micronesia.”
6. Peru
    - a. “Visitors will no longer be allowed to carry in single-use plastics into Peru's 76 natural and cultural protected areas, from Machu Picchu to Manu to Huascarán, or national museums.”<sup>67</sup>
  7. Taiwan
    - a. According to the GlobalCitizen.org article: “Taiwan Announces Ban on All Plastic Bags, Straws, and Utensils” dated 2/22/2018: “It will be one of the farthest-reaching bans on plastic in the world, and it demonstrates the momentum of the anti-plastic movement as the scale of environmental harm caused by the substance is fully realized. ‘We aim to implement a blanket ban by 2030 to significantly reduce plastic waste that pollutes the ocean and also gets into the food chain to affect human health,’ said Lai Ying-yaun, a Taiwanese Environmental Protection Agency official, in a statement.’

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<sup>65</sup> “Fifth National Report to the Convention on Biological Diversity: The Federated States of Micronesia 2014,” accessed on April 26, 2018

<sup>66</sup> “‘Moana Taka Partnership’ unfolds exciting recycling possibilities for the Pacific islands,” Sprep.org, March 21, 2018

<sup>67</sup> “A running list of action on plastic pollution,” Nationalgeographic.com, Jan. 17, 2019

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### 8. United States

- a. On Oct. 11, 2018, President Donald Trump signed S. 3508, the “Save Our Seas Act of 2018.”<sup>68</sup> “The Save Our Seas Act, which passed the House and Senate with bipartisan [sic] support in July, reassures funding to clean-up marine debris via funding through the National Oceanic and Atmospheric Administration Marine Debris Program.”<sup>69</sup>
- b. “San Diego has joined a growing number of cities to ban containers made of polystyrene, better known as Styrofoam ... in Washington, D.C., as of January 1. By July, businesses in the district will begin receiving fines if they continue to offer plastic straws. The law follows Seattle's ban earlier in 2018 and aims to reduce the impact of plastic straws as litter. ... Branded as “No Straw November,” the campaign is a push to eliminate single-use plastic. The effort is led by the Aquarium Conservation Partnership (ACP), comprising 22 aquariums in 17 different states.”<sup>70</sup>

## VI. Conclusion

Although plastic pollution is a problem for the entire world, many organizations are tackling the problem with solutions that may benefit people in small island nations like those in Micronesia and Haiti. This paper is just a quick research project on plastic pollution, its challenges and solutions. There are so many more issues to cover and organizations and technologies to discover.

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<sup>68</sup> “Remarks by President Trump at Signing of S. 3508, the ‘Save Our Seas Act of 2018’,” Whitehouse.gov, Oct. 11, 2018

<sup>69</sup> “Trump signs ‘Save Our Seas Act’ to boost clean-up efforts in world's oceans,” UPI.com, Oct. 12, 2018

<sup>70</sup> “A running list of action on plastic pollution,” Nationalgeographic.com, Jan. 17, 2019

## VII. Appendix: Chart of the 7 Types of Plastics

There are seven categories of plastics. They are numbered and given chemical names.<sup>71</sup> Some can be recycled after use, and others may or may not be recycled.<sup>72</sup> This chart shows the different types of plastics, their uses and those that can and cannot be recycled.

<b>Plastics: Types, Uses &amp; Recycling Potential</b>			
	<b>Name / Chemical Name</b>	<b>About the Plastic</b>	<b>Can or Cannot be Recycled</b>
1.	#1 PET or PETE (polyethylene terephthalate)	#1 plastics are made into (but not limited to) water bottles and peanut butter containers, and can be recycled into carpets and furniture. <sup>73</sup>	Can be recycled
2.	#2 HDPE (high-density polyethylene)	#2 plastics are made into (but not limited to) milk jugs and shampoo bottles and may be recycled into pens and picnic tables. <sup>74</sup>	Can be recycled
3.	#3 PVC (polyvinyl chloride)	#3 plastics are made into (but not limited to) clear plastic food wrapping, cooking oil bottles, teething rings, and toys for children and pets; <sup>75</sup> not usually picked up for recycling, can be harmful when incinerated, and contain toxic dioxins. <sup>76</sup>	Cannot be recycled, but may be repurposed for non-food or non-toy products

<sup>71</sup> "Plastics by the Numbers," EarthEasy.com, May 2, 2012

<sup>72</sup> "1, 2, 3, 4, 5, 6, 7: Plastics Recycling By the Numbers," MillerRecycling.com, Feb. 10, 2019

<sup>73</sup> "What Do Recycling Symbols on Plastics Mean?," Goodhousekeeping.com, Nov. 25, 2008

<sup>74</sup> "The Numbers on Plastic Bottles: What do Plastic Recycling Symbols Mean?," Naturalsociety.com, Feb. 6, 2013

<sup>75</sup> "Plastics by the Numbers," EarthEasy.com, May 2, 2012

<sup>76</sup> "Recycle Numbers On The Bottom Of Plastics," Naturalhomebrands.com, accessed on April 25, 2018

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<b>Plastics: Types, Uses &amp; Recycling Potential</b>			
4.	#4 LDPE (low-density polyethylene)	#4 plastics are made into (but not limited to) grocery bags, bread bags, clothing and furniture, and are usually not recycled. <sup>77</sup>	Sometimes not recyclable, but may be recycled depending on the facility
5.	#5 PP (polypropylene)	#5 plastics are made into (but not limited to) yogurt cups, syrup containers, potato chip bags, plastic bottle tops and disposable diapers; may be recycled into brooms and signal lights. <sup>78</sup>	Can be recycled depending on the facility
6.	#6 PS (polystyrene)	#6 plastics are made into (but not limited to) Styrofoam containers, plastic cutlery, and egg cartons; chemicals in this plastic have been linked to some human health concerns. <sup>79</sup>	Recycling possible but limited depending on the facility
7.	#7 OTHER (BPA, Polycarbonate LEXAN, and compostable PLA)	#7 is a category of plastics not in categories 1-6; some are made into (but not limited to) baby bottles, water cooler bottles and car parts. Some category #7 plastics contain chemicals like BPA (bisphenol-A); which has been linked to health issues such as obesity and infertility. <sup>80</sup> Some #7 plastics are made from bio-based polymers like corn starch and may be compostable. <sup>81</sup>	Can or cannot be recycled depending on the product since this is a catch-all category

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<sup>77</sup> “How to Recycle Number 4 Plastic,” Homeguides.sfgate.com, accessed on April 25, 2018

<sup>78</sup> “The Numbers on Plastic Bottles: What do Plastic Recycling Symbols Mean?,” Naturalsociety.com, Feb. 6, 2013; Greg Seaman, “Plastics by the Numbers,” EarthEasy.com, May 2, 2012

<sup>79</sup> “Plastics by the Numbers,” EarthEasy.com, May 2, 2012

<sup>80</sup> “Recycle Numbers On The Bottom Of Plastics,” Naturalhomebrands.com, accessed on April 25, 2018

<sup>81</sup> “Plastics by the Numbers,” EarthEasy.com, May 2, 2012