

Environmental Justice Beyond Flint

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The U.S. Environmental Protection Agency (EPA) faces three crises that require urgent attention from federal and local regulators for years to come. First, in Flint, media-driven Congressional inquiries and a Presidential visit focus on lead in the city's drinking water.

Second, decades of uranium mining and processing waste widely spread over the 27,000 square-mile Navajo Nation Reservation and other parts of the Four Corners area.

Third, massive non-compliance with landfill regulations threatens neighborhood's health throughout the Commonwealth of Puerto Rico, a U.S. Territory — and more beyond that.

The common thread is the disadvantaged socioeconomic status of each community. EPA claims environmental justice as a top priority¹ and is seeking public comment (from May 23, 2016 to July 28, 2016) on *EJ 2020 Action Agenda: Environmental Justice Strategic Plan 2016-2020 (EJ2020)*. *The EJ2020 Preface* says the document “is EPA's environmental justice strategic plan for 2016-2020,” and “is comprised of strategic goals.”

What Criteria?

The crises seem to meet logical criteria for urgent EPA action — **but no criteria exist**. No EPA mission statement mentions them, nor does EJ2020². Writing them should have been job number one. Such criteria would include, at a minimum, racial, social, and economic descriptors. Those might convince people that a poverty-stricken minority population in a highly polluted area with no action pending had suffered environmental injustice.

But not necessarily; changes over time matter, as well. For example, about 45 years ago, U.S. Naval Air Stations began getting complaints from neighbors about noise and various activities. Analysts³ dug through photo libraries and decades-old maps, and found that when the stations were established, no one lived within miles. Newcomers followed employment opportunities. No environmental injustice there.

Similarly, most oil refineries are far older than surrounding communities. People moved after Chevron built its second (El Segundo) California refinery. The refinery shares its name with a clean seaside town with low taxes, good schools and close proximity to Los Angeles Airport. People love it, and do not claim environmental injustice.

1 Administrator (2009-2013) Lisa Jackson said in her EPA bio-sketch that “environmental justice” is one of her top priorities, but neither the EPA Mission Statement nor “EPA's Themes — Meeting the Challenge Ahead” use the term. EPA's Office of Environmental Justice seeks public comment on *EJ 2020*, which nowhere mentions criteria or any strategic plan structure. In part this paper will test logical criteria to prioritize the three environmental crises.

2 “EJSCREEN: Environmental Justice Screening and Mapping Tool: Frequent Questions about EJSCREEN,” EPA, 2016, Frequent Questions about EJSCREEN.” Asks about the criteria for including environmental indicators, and responds, in direct response to the question, “Can EJSCREEN be used as the basis for an official EPA decision?” “No.” So tools are being developed, but apparently not yet to set Environmental Justice priorities.

3 The Center for Naval Analyses went through Naval Air Station archives, and showed neighborhood growth over the years. The Navy did find ways to ease the noise at various times of day, and to move some activities to other parts of the Station.

So criteria, quantification and timing are important. Degree of danger can also make a difference. The absence of parties responsible for the damage must be considered, the economic viability of any party still involved, the role of government agencies in fomenting or repairing the damage, and the possibility of restoring compliance with EPA regs. Some quantification, some subjective evaluation.

Real-Life Tests for EPA

First: Flint's lead-poisoned drinking water is a major, two-year old health problem in a very poor city.⁴ EPA is responsible for Safe Drinking Water Act compliance. Delegation of authority enables state or local officials to handle problems or questions, so after approving a plan by the State, EPA delegated responsibility to Michigan — which switched the source of Flint's drinking water for cost reasons — and without hearings or approvals.

The danger was apparent to some; one EPA staff expert wrote repeated warnings to agency officials. He was reassigned and forbidden to discuss it.⁵ Flint's Mayor and Michigan's Governor get most of the blame, but two Michigan Department of Environmental Quality officials and a Flint water official have been charged with authorizing permits wrongly, tampering with evidence, altering and falsifying evidence. Michigan's Attorney General promised charges against other officials, who face jail time if found guilty.

President Obama visited Flint in May 2016 to boost morale among the citizens. He drank filtered water from the Flint system and provided \$10,000 for repair work, which will cost millions and take years, as will the legal proceedings.

Second: This massive issue dates to World War II. From 1944 to 1986, 3.9 million tons of uranium were mined and processed on lands in the Navajo Nation or the Four Corners area. The Nation held 1,000 of the 4,000 mines, and Navajos worked in both areas since there was no other work. Atomic Energy Commission contractors were told the dangers, but the Navajo were not — and they were paid less than the others for their work.⁶

At least 3,000 to 5,000 Navajo men lived and worked at mines and processing plants for decades.⁷ Often they moved their families to live near the work. A 1950 U.S. Public Health Service study made the first direct correlation between cancer and uranium mining. Later studies showed disease incidence-growth over time, and a 2000 study showed that Navajo miners were 28.6 times more likely than control group members to get cancer. By then the mines and mills were closed and abandoned, but uranium contamination remains throughout the area and in drinking water worse than Flint's.

Long after most activity was over (July 1979), a tailings pond dam in New Mexico burst and 1,000 tons of radioactive waste ran 80 miles downriver to Navajo County, Arizona, clogging sewers, damaging aquifers and leaving

4 Flint's population (2000 Census) of 124,434 was down almost 20%, to 102,434 in 2010, and to 99,002 by 2014, the last year data are available. The racial composition in 2000 was 41.4% white 53.25% African American, and a wide variety (Asian, Hawaiian, American Indian and others making up the difference. By the 2010 Census the African American population had fallen by 8,260 (12.95%), but its presence had risen from 53.25% to 56.65%. The White population had shrunk to 38,328, or 25.94%, but still in second place. Racial figures are not available after 2010. Employment/unemployment figures are very sketchy, but "Persons in Poverty" is listed at 41.6%, and the Census Board notes that "This geographic level of poverty and health estimates are (sic) not comparable to other geographic levels of these estimates." Lead in drinking water is a particular problem for young children, whose mental development can become impaired as a result of such exposure.

5 In Feb. 2015 *The Detroit News* reported that "the [EPA's] top official in the Midwest was aware that the drinking water in Flint, Mich., was likely contaminated, but failed to bring that to the public's attention because she said her "hands were tied" by uncertainty and the fact that authority had been delegated to Michigan's Department of Environmental Quality." An EPA expert had notified officials of the problem in Feb, Apr and Jun, 2014, but his repeated warnings went unheeded. He was told to stop meeting and discussing the issue with officials and citizens from Flint and from Michigan. Later the Medical Center in Flint began to detect high levels of lead in the drinking water, reported that to the US Centers for Disease Control and Prevention (CDCP), which made it public. Only then did State environmental officials begin to take action.

6 Brugge, D., T. Benally, and E. Yazzie-Lewis, *The Navajo People and Uranium Mining*, Albuquerque, U. of New Mexico Press, 2006. USPHS statistics on uranium mining and cancer: Brugge, *Op. Cit.*, and Dawson, S. E. and G. E. Madsen, *Half Lives & Half Truths: Confronting Radioactive Legacies of the Cold War*. Santa Fe: School for Advanced Research, 2007. The Department of Labor set the Navajo's wages in the mines and processing plants.

contamination all along the way. This largest radioactive accident in U.S. history surpassed the Three Mile Island event earlier that year.

Sick workers sought compensation, without success. Senators Ted Kennedy (D-MA) and Orrin Hatch (R-UT) worked the issue for 20 years and in 2000, President George H.W. Bush signed the Radiation Exposure Compensation Act into law. It covered those exposed to radiation and fallout in 200 A-bomb tests; and all mining and processing activities. By March 2016 the government had paid 19,555 downwinders, 3,963 on-site participants, 1673 miners and 328 ore transporters and spouses more than \$2 billion for their pains.

The huge area was designated as a Superfund site by 2007, with cleanup to be run by an inter-agency group: EPA, the Bureau of Indian Affairs, Nuclear Regulatory Commission, Department of Energy and the Indian Health Service. After years and two Five Year Plans, a 2016 contractor's accident spewed uranium waste and fluids over acres of land and hundreds of drinking wells. The cleanup, considerably more complex now, has restarted.

Third: another long-running crisis. EPA is involved, but the Puerto Rico's⁸ landfills crisis has worsened. The Commonwealth, a U.S. Territory, is subject to the U.S. Congress, which enacts laws and policies, and to agencies whose power comes from those laws. As the Puerto Rico Chamber of Commerce notes, "Although an island paradise, Puerto Rico is far from an economic one. In fact, it and its people are on the brink of poverty."⁹ The Territory receives poorer U.S. trade and tax treatment than do independent nations.

In 1996 Congress ended a decades-old incentive that drew business to the island (most pharmaceutical firms did their manufacture there). As the incentive phased out, businesses left; many that replaced them provided fewer jobs. The phase-out ended in Fiscal Year 2006, as the Great Recession was starting around the world. The island economy has only gotten worse since then.

The Governor of Puerto Rico has been urging Congress to allow him to initiate Chapter 9 (bankruptcy) proceedings and reorganize the way out of the economic abyss; \$70 billion in municipal and Commonwealth bond debt. In May, 2016, with no support, the Governor announced default on \$442 million in municipal and Territorial bonds. He said that without Chapter 9, he must default \$770 million in June and \$2 billion in July.

But the U.S. Supreme Court ruled (Jun 13, 2016) that Puerto Rico cannot declare bankruptcy — in 1984 Congress enacted a federal law provision that bars Puerto Rico and DC from doing so. Municipalities and agencies in all U.S. States can do so, but not the Commonwealth or the District. Congress never debated the change or left a legislative history. Puerto Rico is totally at the mercy of Congress.

EPA is not responsible for bond failures, but 27 landfills serve 78 municipalities in Puerto Rico today. At least twenty are non-compliant (most without leachate liners). Legal actions, reports, news photos and satellite pictures show huge piles of uncovered waste, sewage, garbage and vermin, leachate poisoning communities, metal and glass by the ton, methane gas emissions and frequent fires. EPA has "ordered" dumps

7 There are no hard statistics for Navajo unemployment rates. Information about them is more likely to be "living on the edge of poverty," or other verbal evaluations — but the picture is clear.

8 Puerto Rico's population was 3.62 million in 2010, down from 3.8 million in 2008. From May, 2015 through April 2015 the unemployment rate has varied sharply from month to month: 12.4%, 12.6%, 11.2%, 12.4%, 12.2%, 14.2%, 11.7%, 10.3%, 11.2%, 11.7%, 12.2%, and 11.4%. The average was 13.6% from 1990 until 2016, with an all-time high of 23% in 2013 and the record low of 8.9% in 1996. All these figures far exceed the US rates for the same times.

9 **The National Puerto Rico Chamber of Commerce, Puerto Rico's Economy — a brief history of reforms from the 1980s to today and policy recommendations for the future.** San Juan, 3/18/2015. The Chamber's elucidates: "Puerto Rico's economy has been stagnating or contracting for nearly a decade, while unemployment remains more than double the rest of the U.S., leading to migration from the island at a rate higher than any state in the country." Strong words for a Chamber of Commerce.

closed but has never enforced its own orders, and now Puerto Rico's next crisis breeds in the landfills.

Zika, a horrible threat to infant health in much of Africa, has crossed the Atlantic and now threatens South and Central America, the Caribbean and the southern United States. A virus carried and spread by mosquitoes that breed in standing water, causing illness for which there is no cure or vaccine yet. According to the U.S. Centers for Disease Control and Prevention, 1996 cases had been reported in the U.S. mainland (1305) and Territories (691) by Jun 15, 2016. Of those, there were 21 Zika virus indications.

Pregnant women, the unborn and infants are in the most danger. Children can be born with Hydrocephaly (a small, misshapen skull, serious brain damage and likely death follow), a danger wherever Zika is — including Rio de Janeiro, where the Olympic Games take place in August.¹⁰ Puerto Rico's first Zika fatalities were in May; there will be more.¹¹

President Obama has asked for \$1.9 billion to fight Zika. Some in Congress want cuts to offset the new spending; others say \$612 million in unspent Ebola funds could meet that purpose. Mainland States have travel-related cases, yet nowhere in all the discussion of Zika in Puerto Rico has there been a mention of the landfills crisis. With 20 seriously non-compliant sites on the island, logic might seem to demand immediate action to eliminate such a major threat to a widespread population.

The Municipal Solid Waste Management Act and Resource Conservation and Recovery Act make EPA responsible for compliance, and in 1994 EPA delegated authority to Puerto Rico's Environmental Quality Board (EQB), whose plan

would close non-complying landfills. Within a year, however, a new Governor cut all funds for enforcement, and since 1994 only 3 of 27 landfills have been closed. Over the same years, many landfills have been enlarged, but rarely in compliance. Puerto Rico has not lived up to its plan; nor has EPA.

Section 7003 of RCRA authorizes it to take legal actions to remedy "imminent and substantial endangerment of health or the environment." But, and this is vital — there are five compliant landfills in Puerto Rico!¹² Those compliant facilities can be vital to efforts that must be undertaken ASAP. Cleaning the landfills will vastly reduce the threat of epidemic and provide some jobs and economic benefit. This could be the model for EPA priority action, and could save lives in Western Hemisphere nations.

Bringing those landfills into compliance will require solving many complex problems:

Junk autos, trucks, plastics and tires breed germs, viruses — and mosquitoes that carry Zika. Non-compliant junkyards are breeding ground heaven for Zika.

If ignited, tires and plastics burn at intense temperatures that are hard to extinguish, and that spread poisonous smoke and ash for miles.

Decomposing garbage, trash and human and animal wastes mix with rainwater and transmogrify into "leachate" that pollutes soil, groundwater streams and possibly drinking water. Leachate can be passed/absorbed through trees and plants in a process called "phytoremediation," then treated with other chemicals. It's a slow process, and then non-compliant dumps must have leachate lining installed.

10 As a precaution, the U.S. Olympic Committee has moved the U.S. Swim Team tryouts from Puerto Rico to Atlanta. Separately, one of the favorites on the U.S. Bicycle Team has withdrawn from the team because his wife is pregnant.

11 *The Washington Post*, Jun 2, 2016, page A-11 ran a story, "Girl born at N.J. hospital is 2nd in U.S. with birth defects linked to Zika." The mother contacted the disease at home in Honduras and went to New Jersey, where she had relatives, for treatment. The first such infant was born in Hawaii, but had lived in Brazil, where "the Zika epidemic in the Americas began." During May, 2016, 9 stories and one op-ed on Zika ran in the *Post*. The coverage was probably similar around the country.

12 The five compliant facilities: Carolina, a Municipal Landfill operated by Landfill Technologies; Humacao, Privately owned and operated by Waste Management/EC Waste; Mayaguez, also privately owned and operated by Waste Management/EC Waste; Ponce, a Municipal landfill operated by Allied Waste, Ind.; and Peñuelas, also a Municipal Landfill operated by EC Waste.

Trash and garbage decompose and create natural gas or methane (CH₄) — an explosive, toxic, major Greenhouse Gas. It can be drawn from (covered) landfills through wells, as natural gas is produced through oil and gas wells drilled into the ground. It can then be turned into fuels.

Toxic substances such as gasoline, oil, battery acids and paints are illegally thrown into landfills, where they add to leachate. Non-compliant dumps thus can burn, explode, attract and breed insects, mosquitoes and vermin, and spill over into the general area. It is likely that mosquitoes carrying the Zika virus are now breeding in Puerto Rico's landfills. Female mosquitoes can lay 100 eggs in a bottle cap of water.

In 2010 the Puerto Rican Solid Waste Authority said that by 2014 there would be 14 landfills operating, and only four by 2020. That has not happened, nor will EPA order 4 landfills closed by the end of Jun, 2016.

Criteria and Crisis Priorities

The cases considered here center on racial minorities who lived for years in poverty, with no near-term hope of improvement. Each area is barren and/or losing population due to lack of economic opportunity and a doubtful future. Government had played a significant part in the damage in each case, and hope of a better future was slim.

In Flint, some local government officials may go to jail. Apparently no federal officials will, though they knew of the abuses and the dangerous quality of the water. Repair work on the drinking water system has begun, but will take years to undo what has been done.

In fact, an EPA letter on Jun 12 laid out for the Flint Mayor and the Michigan Governor, dim hopes for the future. Administrator Gina

McCarthy cited major challenges to the “long-term goal of reliable and sustainable clean drinking water,” and blamed poor staffing, a (now oversized) distribution system, and no money to fix things.¹³

In the Navajo Nation, federal agencies lied to and mistreated the workers. Once they began to get sick and filed lawsuits, the courts rejected their claim. No federal officials were even rebuked. Finally, 50 years after most of the U.S. Government-inflicted damage was done, legislation recognized **the** numbers of people sickened or killed. Most of those have been given compensation, and those cases will continue.

In Puerto Rico, the people live in poverty and have been leaving the island; there are neither jobs nor “extra” money to initiate change. Congress ended one tax incentive and crushed the economy. It enacted a laser-focused anti-bankruptcy law that hurt only Puerto Rico and DC. For 10 years the island economy has been horrible and cannot get better. So: 1) Flint's water is getting better, but may not continue; 2) Navajo Nation repair might take forever, but is starting, and 3) in the Commonwealth things are cratering. Puerto Rico faces bankruptcy at the mercy of Congress.¹⁴ And Zika is much deadlier. Without immediate action, Puerto Rico may become the major source of an international epidemic, for which there is no cure and no vaccine. There have already been Zika deaths on U.S. soil.

All three cases are horrible botches, but Zika changed everything. Landfill cleanup is tied to Zika. Puerto Rico alone faced one major threat as its economy failed. Zika is an existential threat, and again Puerto Rico is alone. They cannot wait much longer for federal approval for bankruptcy funds. Then they must fact the battle against Zika, and its timing and speed. The landfills can kill thousands of people, hundreds of miles away.

¹³ Administrator Gina McCarthy to Mayor Karen Weaver and Governor Rick Snyder, Jun 12, 2016. The tone seems as damaging as the message itself.

¹⁴ In fact, Congress must act to do it. On June 13, 2016 the Supreme Court rejected Puerto Rico's bid to use Chapter 9 bankruptcy to restructure its debt. The court said that the Bankruptcy Code unambiguously preempts any attempt by Puerto Rico or DC to initiate bankruptcy reorganization: a 1984 vote of Congress precluded DC and Puerto Rico from acting as every other state, municipality and agency in the US is empowered to do. Congress never debated the change and left no record (legislative history) to explain its reasoning. So the bankruptcy will not be settled without new US law — nor will Puerto Rico's newest crisis — Zika.

“Never waste a crisis,” is today’s truth to live by. The U.S. must do all it can, as fast as it can. It must help Puerto Rico with bankruptcy — and must fund the battle against Zika. We cannot undo the past; we must save lives that are threatened now.

Salient Facts and Conclusions

- 1 Zika has changed the situation; landfill cleanup is vital to kill that epidemic-virus. Puerto Rico stands alone against Zika and speed with which it may spread to the Mainland.
- 2 The crisis is the island’s landfills and consequences if they are not cleaned up STAT.
- 3 An EPA “Environmental Justice” publication wants public comment. It does not contain a single priority project. We need people to write to with a challenge — Prioritize ZIKA.
- 4 In June, 1900 cases of Zika were reported, including deaths in Puerto Rico and the U.S.. Two states have “travel” Zika; others have move-in-medical care cases.
- 5 EPA’s new Director of Caribbean Environmental Protection takes office in July. When Bill Ruckelshaus was appointed first EPA Administrator, he made a list of priority projects and got it funded. Ms. Perez should present such a list.
- 6 Congress rarely moves fast, but years ago it forced the FDA to speed up AIDS testing. They should speed debt relief to Puerto Rico and help with Chapter 9 — and Zika.

- 7 Mosquitoes carrying Zika bite 4 or 5 persons per trip, and spread the disease much faster than was earlier known.
- 8 The U.S. Olympic Committee has moved the Swim Team tryouts from Puerto Rico to Atlanta. A U.S. biker quit that team. All cited Zika.
- 9 Pregnant Americans stand as much as 13% risk of Zika under current circumstances.
- 10 The municipalities own the landfills that are breeding Zika. They also own or use 5 compliant landfills. Municipalities should use some of the bankruptcy money to partner with companies that run the compliant landfills.

The long-term Puerto Rican landfills issue is finally ripe for corrective action, full EPA commitment and significant funding.

The time is NOW.

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Appendix: Technical and Process Approaches

I. Repurpose as many non-compliant sites as possible

Most past compliance orders had no hope of adequate funding to close or remediate the sites. We believe that making agreements to use the currently compliant landfills would make the process go much faster and smoother. In that way a combination of public and private capital could allow continued waste processing during interim remediation. Compacting and covering should alleviate debris drifting and allow leachate and rainwater collection and treatment; perhaps even landfill mining of recyclables at some sites.

The remediation could be done while creating some waste processing. It could include a transfer station, Waste to Energy (Landfill Gas), and Alternative Energy (wind and solar) on available footprint. Those would generate some income to support the remediation activities.

Given that many of these landfills have extraordinary leachate issues, it is likely to be necessary to acquire adjoining land to use as buffers, through either eminent domain or long-term leases. Unlike in the U.S., the “taking” procedures should not arouse great opposition since the leachate problems have made the land unusable for anything else. Moreover, the additional land acquired can be put to work producing energy from the landfills.

There will be engineering challenges, such as mounting solar panels on improperly managed landfill elevations with continuing settling. But strategically placed pole-mounted directional solar panels along with lower-height wind turbines [see below] can make it possible. Directional solar panels offer far better ability to withstand hurricanes, and low-height wind turbines do not require large bases; they can be set in place with easily available equipment.



Directional Solar Panels



Low-Height Wind Turbines

One major advantage of this repurposing approach is that private capital can leverage the multiplicity of Federal and Commonwealth tax credits and grant opportunities to make financial returns viable. Additionally, Power Purchase Agreements will be available from the Puerto Rico Electric Power Authority (PREPA). Admittedly, PREPA will likely lower the current incentive rates subsequent to their restructuring, but the incentives should still be attractive.

II. Use Waste Processing and Waste-to-Energy

Closing landfills does not solve the solid waste issue. The best solution is to use a low capex, low-tech approach to match the reality of the island waste stream. According to Cornell University Waste Management Institute, which has done extensive work in Puerto Rico, 60% of the waste stream is organic material; only 11% of the total waste is recycled.

Landfilling organic material is silly, as it is for recyclables. But with typical landfill tipping fees at about \$30 per ton, there is inadequate revenue to buy equipment and create major recycling infrastructure. It is better simply to use the existing infrastructure and install waste processing capability at the landfill sites that can provide sortation of all recyclables.

We believe an autoclave-based process is the most suitable. An autoclave is a pressure chamber in which high temperatures and non-ambient air pressure process materials in lab or industrial operations. The technology is proven; it will purify the primarily organic waste stream, reduce stream volume, and at the same time separate and clean recyclables of residues that reduce their value. Further, we believe it is highly likely that leachate at many sites can be reused beneficially in that process after some pre-treatment.

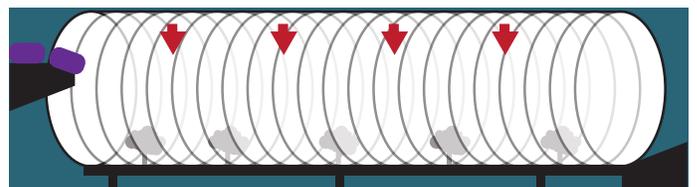
Pre-treatment would include recovery of nitrogen and phosphorous nutrients and their conversion into fertilizer. That could either provide income or be used to cultivate leachate-absorbing plants and trees (such as Azolla) around the facility to add proven environmental (natural) remediation capabilities. The picture below illustrates a Vetiver Grass buffer around a landfill with leachate problems



Vetiver Grass buffer around a landfill

Shredded waste would be fed into a pressure vessel similar to an autoclave, which rotates it and injects it with high-pressure-high-temperature steam (160 degrees Celsius). The steam reforms the waste, sanitizes it and reduces its volume by more than 60%. Landfill containment is thereby simplified and stabilized.

With the waste separated and processed, a rich organic fraction that is left can be used for energy production through anaerobic digestion, or by pelletizing for direct combustion. Anaerobic digestion seems optimal, as produced methane from the landfill can directly generate electricity, or be processed into Compressed Natural Gas for vehicle fuel (which will generate slightly more revenue).



Autoclave Cylinder

Two autoclave cylinders could process over 200,000 tons of waste annually. It would probably not be viable to have anaerobic digesters at all locations, so the dense organic fuel and recyclables would have to be transferred to a central processing facility.

We believe that since this entire process depends upon relatively low-tech solutions, all parts of the waste handling system can be fabricated on the Island, thus lowering the cost and creating well-paying jobs.

III. Follow on Economic Development

This approach will increase recycling tenfold, providing new business opportunities. Residue-free recycled plastic will allow remanufacture of plastic for products such as bottles, picnic cups, dishes and utensils, etc. The residual liquid and solids from the anaerobic digestion process can be converted to fertilizer and soil amendments. And the now-pathogen free solid material can be pressed into “take-out” food containers.

With a newly-created critical mass of recycled material, other value-added recycling activities become possible, thus creating waste-reduction through re-use. Any level of circularity that is created in an import-dependent island economy represents a high-gain economic opportunity.

IV. Conclusions on Corrective Processes

Clearly, complete solutions to landfill and solid waste problems in Puerto Rico need considerable further study. However, we believe that we have outlined in a general way the optimal approach to the problem. It leverages existing sites for useful purposes in a way that can attract private capital and takes advantage of government tax incentives. It also uses proven, low-tech approaches to every aspect of the problems, which will enable manufacture and operation of the machinery to be done in Puerto Rico.

In addition, introducing a private sector element to the problem will add a level of transparency and accountability that has been long-missed and much needed. There are issues of liability and site acquisition that must be addressed, but there are many existing policy templates that provide a resolution pathway for those problems.

