2016 Top Markets Report Environmental Technologies Country Case Study

Brazil

Brazil's ample market size and growing scope of opportunity for U.S. environmental technology producers is juxtaposed by varying levels of technical capacity, enforcement and finance for environmental project development. Persistent tariff and non-tariff barriers impede U.S. firms' abilities to access the Brazilian environmental market.

Overall Rank	Air Pollution Control
4	5
Water	**Waste & Recycling**
6	4

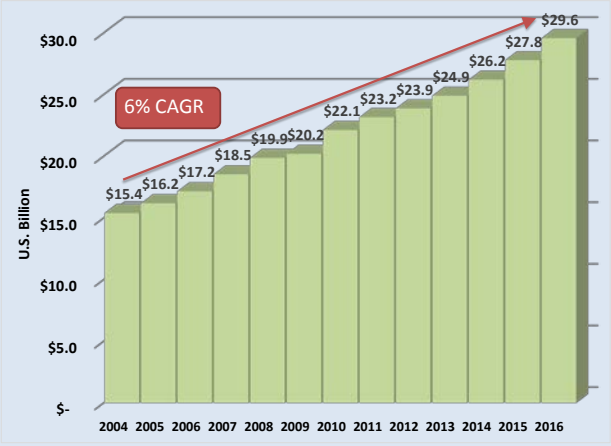
Brazil ranks fourth overall on the 2016 *Top Markets Report* with a composite environmental technologies score of 29.4. The Brazilian environmental technologies market, including goods and services, is valued at U.S. USD 29.6 billion,[1] making Brazil the largest single market for environmental technologies in Latin America. Brazil ranks fourth, with a score of 3.64, for waste and recycling; fifth for air pollution control markets, with a score of 15.3; and sixth for water, with a score of 10.5 (see Appendix 1 for global rankings).

The scale of Brazil's market is due predominantly to its population of 204.3 million[2] and its growing middle class rather than to strong adherence to environmental laws. As this report will delineate, there is high variability within Brazil in terms of the capacity to implement and finance advanced environmental systems.

State of the Environmental Regime

The Brazilian government has high ambitions in terms of environmental policy development but limited means at this time to fulfill that ambition. Enforcement shortfalls, variable technical capacity to implement environmental rule, and limited public finance for environmental projects continue to hobble market potential.

Figure 1: Brazil Environmental Technologies Market



Source: Environmental Business International with OEEI Analysis, 2016.

Figure 2: ETTAC Illustrative Examples of Market Barriers

Certification Type	Brazilian Agency	U.S. Product(s)	Reported Costs to U.S. Business	Associated Unnecessary Delays
ISO 17025	Inmetro	Monitoring and testing instrumentation	$250,000	1 -2 Years
Generic New Technology Accreditation	Inmetro	Various	**Per Product:** $3,000 $250 per semester recurring $1,750 per inspection **Laboratory expenses:** $17,500	-
Transmitter Technology Certification	ANATEL	Satellite Transmitter to remotely transmit environmental/metrology data	$7,500	4 – 6 Months

Source: Environmental Trade Advisory Committee (ETTAC) 2012-2014 Charter

Nonetheless, recent Brazilian government efforts to improve the environmental regime have made a noticeable impression on the private sector. The Environmental Business Journal-OECD Environmental Stringency Survey, which ranks environmental regimes on a scale from 1 to 7 (with 1 being lax and 7 being among the most stringent, scored Brazil a 4.1 in 2012, a 1.6 point improvement from its 2005 score of 2.4.

These figures echo the U.S. EPA's assessment of the Brazilian environmental regime, which notes that the scope of environmental laws is improving while enforcement and compliance remain a challenge. The lag effect on enforcement of new rules can also be seen in Brazil's score on the World Economic Forum's 2011 Index for Regulatory Stringency, which scores Brazil quite high on regulatory quality with a score of 5.19 (on a similar scale to that of EBJ-OECD) while Brazil's score in the same survey for enforcement is just 3.94.

Brazil's enforcement and implementation woes emanate from the fragmentation of environmental authority among federal, state and municipal entities. As a result, the capacity to adopt advanced environmental solutions varies greatly between states, with generally higher capacity in the southeast of the country in areas such as Rio de Janeiro, São Paulo and Minas Gerais and lower capacity in more rural states.

One issue that affects environmental compliance in Brazil is that environmental authorities conduct investigations *ex post facto,* based upon a direct complaint of contamination or after the closure of an industrial facility. As a result, the incidence of oil spills, gas leakages and inadequate storage of hazardous wastes are frequent and reported widely in the Brazilian media.[3] Imposing regular monitoring of industrial sites would improve compliance.

Funding gaps for environmental infrastructure are also prevalent in Brazil. While the government has prioritized the provision of sanitation services, including water, wastewater, drainage and waste management services, many of the planned projects have faltered for lack of funding. For example, the Ministry of Cities reports that the average annual investment in sanitation is around USD 4.5 billion, which is a USD 2.5 billion shortfall from the USD 7 billion the Government of Brazil (GOB) estimates is necessary annually to meet the government's goal of universal access to sanitation services by 2030.[4]

Market Barriers

Market barriers in Brazil are persistent and prohibitive for U.S. exporters in many cases. In its most recent charter, the Department of Commerce's Environmental Technologies Trade Advisory Committee (ETTAC) identified the following barriers as most problematic for U.S. environmental technologies companies attempting to export to or work in Brazil:

1. **Tariff escalation tied to local content requirements or disqualification of imported components.**
   The ETTAC observed minimum local content requirements ranging from 40 percent to 60 percent of a product's total value; this is applied mostly by government-owned monopolies for fossil fuel production and public procurement sectors, such as municipal water treatment. In the absence of domestic content, much higher tariffs are applied, such as a 22 percent tariff for water pumps. There is evidence that goods that fail to meet local content requirements may be disqualified from competition altogether.
2. **Tendering practices favor local competition.**
   Small Brazilian businesses benefit from preferential treatment in public tenders. Typically, small local businesses are afforded additional points on commercial evaluation, and small business set-asides are commonly available for public bids below the USD 40,000 threshold per decree 42.063/2009, Act 123/2006. Small local businesses also benefit from tax advantages such as Brazil's "Simple Tax Scheme," which eliminates taxes for companies below a certain annual revenue threshold.
3. **Local certifications and safety approvals fail to recognize international equivalents.**
   Local electrical and safety approvals are applicable to most products which have electrical components and mechanical products. Brazil does not accept certification from equivalent U.S. certification and testing organizations, imposing additional and onerous costs on U.S. businesses for redundant testing and certification.
4. **Failure to recognize international standards.**
   Despite certification from relevant and globally accepted international certification bodies, products that have transmitting and/or receiving devices must obtain approvals from ANATEL (Brazil's National Telecommunications Agency). ETTAC advisors also highlight a Brazilian preference for ISO standards even where other equivalent international certifications exist. Complications with the certification of transmitting and receiving devices handicaps the sale of U.S. continuous monitoring and automated control devices and systems, an area of competitive advantage for U.S. providers.

Market Opportunities

Air Pollution Control

Air Quality Monitoring

Given Brazil's heavy reliance on hydroelectric power and relatively low use of conventional combustion in its electricity sector, air pollution in Brazilian cities primarily originate from industrial and mobile sources.[5] Addressing air pollution has become a priority for Brazilian national and local governments and has generated demand for gas emission monitoring technologies, gas analyzers and air pollution control technologies.

CETESB, São Paulo region's environmental agency, is currently expanding its air monitoring program through the acquisition of 10 new monitoring stations destined for the interior of the state. Imported instruments in demand for these new stations include ozone analyzers, nitrogen oxide analyzers, multi-calibrators, air purifiers, inhalable particle analyzers at particulate matter (PM) 2.5 and 10, wind sensors, humidity and temperature sensors, barometric pressure sensors, and UVA sensors. According to CETESB, the principal industrial sources of air pollution in the region include sugar and alcohol plants, laundries, foundries, oil storage terminals, waste and sewage treatment facilities, aluminum smelters, chlorine and soda plants, glass and paint plants, pulp and paper plants, cement plants, and fertilizer plants.

In 2013, the state of São Paulo established "New Standards for Air Quality," which is similar to the EPA NAAQS (only for the State of São Paulo). CETESB, the São Paulo state environmental agency, published a study called Emission Reduction Plan for Stationary Sources – PREFE, which was released to the public in January 2015. The plan evaluates the ambient air quality and lists the state regions that do not comply with new standards as well as the priority sectors. The PREFE also has a sector program for vapor emission control generated by gas stations as well as a program for the industries in the Santa Gertrudes Ceramic Pole.

São Paulo also recently launched an online self-reporting protocol for companies operating in São Paulo state to report their greenhouse gas (GHG)

emissions and climate change mitigation strategies, including benchmarks, targets and timetables. Executives from DOW, Toyota, Unilever and GE expressed their support for the protocol and their general willingness to participate in the reporting mechanism.

Rio de Janeiro region's environmental authority, INEA, has a continuous monitoring network of 21 stations that are supplemented by fence-line monitoring applications at high-emissions industrial sites. Monitors assess criteria pollutants and their pre-cursors, including ozone, nitrogen oxide (NOx), sulfur dioxide (SOx), carbon monoxide, Volatile Organic Compounds (VOCs), hydroflorocarbons and particulate matter. Additionally, several climate change initiatives, including the September 2011 Climate Decree issued by the Rio de Janeiro State Environmental Secretary, will require improved capabilities to measure and control greenhouse gases.

Legislation related to vehicle emissions and air quality: CONAMA Resolution 18/86 established the Vehicle Air Pollution Control Program (PROCONVE) complemented by other CONAMA resolutions, and Federal Law #8723 of October 2003 defined the emissions limits for light and heavy duty vehicles. As of 2012, Brazil's diesel engines must follow the Euro V emission parameters, corresponding to the Automotive Air Pollution Control Program (PROCONVE P-7).

Resolution ANVS/DC #176 of October 24, 2000 provided reference standards on indoor air quality; CONAMA Resolution #4 of June 15, 1989 established the "National Air Quality Control Program" (PRONAR); CONAMA Resolution #3 of June 28, 1990 defined air quality standards for air pollutant concentrations.

Technologies and Services in Demand:

- Continuous emissions monitoring systems
- Ambient air quality monitoring equipment
- Source emissions measurement technologies
- Analytical and laboratory testing goods and services
- Air pollution control equipment
- Fuel vapor control systems

Water and Wastewater Treatment

Municipal Water and Wastewater Treatment

There are currently 27 state-owned water utilities that serve 76 percent of the population and a number of municipal and private sector utilities that serve about 10 percent of the population. Approximately 86 percent of Brazil's population is served by a water utility, leaving the remainder without access to piped drinking water and sanitation services.

The Brazilian sanitation law and implementation plan, *Plansab*, is attempting to bridge the sanitation gap and sets a formal target of universal sanitation services by 2030. Much needs to be achieved in sewage treatment alone; currently 70 percent of sewage in Brazil is disposed untreated.[6] Correspondingly, *Plansab* has forecasted that investments of USD 57.5 billion in drinking water and USD 86 billion in wastewater transmission and treatment technologies and services are needed to meet the goal of universal access.[7] The Government of Brazil has provided USD 221 billion of federal funds to municipalities and states governments to develop projects in wastewater treatment and sewerage.

The government has required that states and municipalities develop local plans to implement *Plansab* but has stopped short of penalizing municipalities that failed to do so by the federal deadline.[8] The breach in plan development among municipalities is attributed to a lack of technical capacity to develop and implement such plans. Meeting universal sanitation goals are also put at risk by financial shortfalls for project development. Fifty-nine percent of Plansab is financed by the federal government, with the remaining 41 percent of financing left to municipalities and regional governments.[9] Data received from the Brazilian Ministry of Cities show that average annual investments in basic sanitation are around USD 4.5 billion. This is significantly less than the annual spending goal set by the Government of Brazil (GOB) of USD 7 billion, which it estimates is required through the year 2030 in order to reach the GOB's goal of providing basic sanitation services to every citizen.[10]

Growth in this area is nonetheless expected to be aggressive, with an estimated Combined Annual Growth Rate (CAGR) from 2010 to 2015 of 12.3[11] percent, with revenues estimated to reach USD 189.3

million in[12] 2015 from a base of USD 94 million in 2010.[13] At the writing of this report, total contract values of concessions and other tenders announced for 2016 are estimated to be worth USD 2.2 billion.[14] The National Bank for Economic and Social Development (BNDES) estimates that USD 14 billion will be invested in the water treatment sector between 2015 to 2018.[15] Investments in infrastructure will include design and construction of wastewater collection systems and treatment facilities as well as upgrades to existing equipment, pumps and asbestos contaminated pipes.

This finance gap in Brazil has led to some creative and fairly successful public private partnerships (PPP) for the provision of municipal services. It has also led to several prominent market failures where planned projects have remained "planned" indefinitely due to failures, again, in technical capacity and shortfalls in available private sector finance.

Technologies and Services in Demand:
- Engineering, procurement and construction services
- Operations services
- Pipes, valves and pumps
- Headworks
- Aerators and sedimentation technology
- Smart water technologies
- Advanced filtration
- Membrane filtration
- Waste to energy technology
- Biological treatment
- Anaerobic digestion
- Nitrification/denitrification
- Integrated Fixed Film Activated Sludge
- Thickeners and dewatering devices
- Sludge dryers and incinerators
- Monitoring equipment
- Testing equipment

Municipal Water Efficiency and Smart Water

Water loss issues are compounded by drought, water scarcity problems in arid regions and increased demand for affordable potable water sources in urban areas. Water lost in transmission or stolen is a serious issue for Brazilian municipalities, with non-revenue water in urban areas estimated at 40 percent.[16]

These issues have converged to increase demand among Brazil's state water companies for systems and technologies that address non-revenue water and those that enhance water efficiency, such as smart water software and monitoring equipment. Drought and water scarcity in the São Paulo region is compounding the need for greater efficiency and conservation of water resources. As of early 2015, São Paulo's Cantarieria reservoir was only 5.1 percent full. The local utility, SABESP is implementing market-based control measures, including providing discounts for water savings and surcharges for overuse. SABESP is also seeking technology based solutions to this shortage by identifying best practices in water reuse.[17] The drought is also driving interest in desalination technology; both Rio de Janeiro and São Paulo have expressed interest in developing desalination capacity to bridge the gap in freshwater demand.[18]

Technologies and Services in Demand:
- Water efficiency and reuse engineered solutions
- Water efficiency and reuse system training and maintenance services
- Smart water systems and software
- Energy efficient physical treatment
- Leak detection equipment and software
- Water loss prevention solutions
- Advanced metering technology and software
- Intelligent valves
- Rainwater collection systems
- Advanced filtration
- Membrane filtration
- Reverse osmosis
- UV disinfection

Process Water, Industrial Wastewater Treatment and Water Reuse

As Brazil's industrial base continues to grow and to become more sophisticated, there is increasing demand for water treatment to quality levels specific to the industrial process as well as that for water reuse and efficiency as industrial water consumers pay the highest rate per cubic meter for freshwater.[19] Key client industries include aerospace, electronics, oil and gas, petrochemicals, mining, metallurgy, textiles, sugar and ethanol, food and beverage, automotive, pharmaceuticals, and pulp and paper.

Process water has an expected CAGR of 6.2 percent from 2010 to 2015[20] with estimated revenue of USD 305.6 million in 2016.[21] Industrial effluent laws in Brazil impose high tariffs on companies for effluent disposal in water bodies, making on-site tertiary treatment cost effective for compliant industrial facilities. From a base

of USD 317.4 million in 2010 and an estimated CAGR of 9.4 percent,[22] the industrial wastewater market is estimated to reach annual revenues of USD 544.0 million in 2016. For example, water treatment in the pharmaceutical sector is expected to grow at 9.8 percent annually between 2014 and 2018 and is expected to reach USD 38.9 million by 2018.[23]

Water scarcity and adduction costs make desalination and water reuse attractive, particularly in water-intense extractive sectors. For instance, an average large mining project in Brazil demands approximately USD 800 million in water technology and infrastructure.[24] Correspondingly, the capital market for water in mining was estimated at USD 4.5 billion in 2015.[25] Brazil is expected to be the fastest global market for offshore water treatment in the oil and gas sector with a combined annual growth rate of 8.5 percent.[26] Global Water Intelligence estimates that capital expenditures on offshore systems for sulfate removal reached USD 190 million in 2015.[27]

Technologies and Services in Demand:

- Engineering, procurement and construction services
- Water efficiency and reuse engineered solutions
- Water efficiency and reuse system training and maintenance services
- Smart water systems and software
- Advanced filtration
- Membrane filtration
- Reverse osmosis
- UV disinfection
- Ozone disinfection
- Anaerobic digestion
- Aerators and sedimentation technology
- Incinerators and dryers
- Chemical sludge treatment
- Sludge collection systems
- Thickeners and dewatering devices

Waste Management and Recycling

Brazil's needs in terms of improved waste management are vast. According to the Brazilian Association of Urban Cleaning (ABRELPE), solid waste generation in Brazil is estimated at 62 million metric tons per year. Approximately 90 percent of solid waste is collected, with 37 percent destined for unsanitary landfills, posing a substantial threat to human health and the environment.

In 2010, Brazil finalized its *National Solid Waste Policy (Law 12,305)*, a measure intended to reduce national waste production and improve solid waste management practices. The law also mandates that municipalities build sanitary landfills and supports the development of a formal recycling sector. As a result, investments in solid waste treatment technologies and waste-to-energy projects in sanitary and hazardous landfills are expanding significantly. The Brazilian government plans to invest USD 870 million in solid waste treatment projects, replacement of landfills, introduction of selective waste collection services and financing cooperatives of waste collectors.

According to BNDES's sector analysis, current technologies for waste collection (i.e., compactor trucks) and for sanitary landfills (i.e., earth moving equipment, polyethylene landfill liners with leachate and gas collection pipes) are all made in Brazil. Some new waste valorization technologies, however, are being imported. With total investments of USD 20 million, Loga and Ecourbis, two concessionaires in charge of waste management in the city of São Paulo, built two automated waste separation plants, which were the first of their kind in the country. The equipment was imported from Germany, France and Spain. São Paulo plans to build two additional plants in the near future.
Power generators above 1 MW capacity to produce energy from bio gas are also imported. The use of container mounted power modules used in landfills is relatively common in Brazil.

In addition to Law 12,305, other notable regulations include CONAMA Resolution # 5 of 1993, which determines that the residue generator be responsible for the preparation and execution of a waste management plan. Environmental Crime Law 9605 of February 13, 1998 establishes penalties for inadequate disposal of solid, liquid or gas waste. This regulation is complemented by technical standards of the Brazilian Association of Technical Standards, which provides standards for treatment and disposal of residues. There are also regulations, laws and resolutions at the federal, state and municipal levels on industrial waste treatment and disposal. The Brazilian Association of Technical Standards (ABNT/NB - 843) establishes the requirements for landfill operation, including the adequate treatment of liquid and gas effluents.

Municipal Solid Waste

In an effort to comply with the *National Solid Waste Policy*, several municipalities in Brazil are adopting measures to improve segregated collection, recycling and organic waste recycling. For example, the municipality of São Paulo recently announced that collection of recyclable waste will be extended to all of the city districts by June 2016. The municipality will invest BRL 11 million (USD 3 million) in trucks, security equipment, uniforms and warehouses. The National Bank for Economic and Social Development (BNDES) lent BRL 41 million (USD 11 million) for the construction of three waste sorting plants and the refurbishing of 10 existing plants. With investments of BRL 59 million (USD 22 million), the municipality recently opened two automated recyclable waste sorting and bailing plants, with the capacity to process 500 million tons of waste per day, a pioneer process in Latin America. Two additional plants are expected to be inaugurated in 2016, increasing the amount of segregated and bailed waste to 1,250 million tons per day.

Similar to *Plansab*, the *National Solid Waste Policy* requires that municipalities develop local solid waste management plans, but in general, development and implementation of those plans are moving slowly. Brazil's National Institute of Geography and Statistics reports that only 32 percent of the 5,565 municipalities in Brazil have some sort of selective waste collection system and that a mere 10 percent met an August 2012 deadline to present a solid waste management plan to the Environmental Ministry as articulated in the *National Solid Waste Policy*.

Market analysts have expressed pessimism that most municipalities will comply with standards set forth in the law, such as replacing dumps with sanitary landfills and implementing selective waste and recycling programs, requirements which were scheduled to be met by mid-2014.[28]

Despite this slow pace in compliance, significant opportunities remain in solid waste management. An estimated 80 percent of solid waste management in Brazil is conducted by private sector companies. Municipal waste management services are currently valued at USD 10 billion annually with the expectation that the market will be worth USD 22 billion annually by 2016 once law 12,305 is enforced. The Brazilian government expects that income from recycling activities will increase from USD 1.1 billion to USD 4.7 billion annually.[29]

Technologies and Services in Demand:
- Waste collection technologies
- Sanitary landfill systems
- Environmental monitoring and analytical equipment
- Sorting machines
- Crushing and grinding machines
- Materials handling equipment
- Collection services, containers and vehicles
- Recycling process expertise
- Waste incinerators

Hazardous and Medical Waste Management

Brazil's *National Solid Waste Policy* outlines the development of a system that compels companies that produce hazardous waste to register in the "National Registry of Hazardous Waste Operators" and prove their technical capability in managing hazardous waste streams.[30] This enhanced focus on the management of hazardous waste affords opportunities for U.S. companies capable of providing relevant hazardous waste management systems and services.

In 2001, São Paolo's environmental authority (CETESB) initiated a Reference List for soil and groundwater pollution levels. CETESB publishes a list with the amount of chemical substances in the soil and groundwater. The amounts serve as a reference to determine if the area is clean, requires attention or needs intervention. This list is revised every four years and is based on the U.S. EPA model. Amounts of chemical products are based on the risk analysis for the specific area. This information is available on CETESB's website (www.cetesb.sp.gov.br).

Improved access to medical treatment in Brazil will also increase the need to address chemical and biological healthcare waste. According to the Brazilian Association of Urban Cleaning and Waste Treatment Companies, only 32 percent of the 1,059 million tons of healthcare waste generated per day in Brazil is treated. Brazil's overall goals to provide safe waste management practices society-wide will drive focus in reducing the public health risks associated with poorly managed medical waste.

Key Technologies in Demand:
- Hazardous waste handling equipment

- Hazardous waste treatment technologies
- Brownfield site remediation design and equipment
- Soil contamination testing and monitoring equipment
- Hospital and medical grade incinerators
- Industrial autoclaves

Industrial Waste Management

In Brazil, the private sector addresses waste policy compliance by setting industry standards within respective industry trade associations for the treatment and disposal of industrial wastes. Industry associations thus provide a market for feasibility studies and consulting and design for de-manufacturing and reverse logistics methods. Associations act as critical market multipliers as they will often determine where waste collection points will exist for their industries and what technologies will be deployed for industry specific waste management practices. Involvement in industry association decision making on waste management policies may provide downstream opportunities for implementation of waste management technologies and services.

Technologies and Services in Demand:
- Environmental engineering and consulting
- Waste handling equipment
- Waste management services
- Waste incinerators
- Recycling equipment

Environmental Engineering and Consulting

In Brazil, the environment is classified as a common usage asset and governed by the National Environment Policy of 1981 as outlined in Federal Law No. 6,938/81. Environmental law in Brazil stipulates that the obtainment of an environmental license is mandatory for the construction, installation, enlargement, modification and operation of facilities that use environmental resources and could cause environmental damage. Activities that may result in significant environmental impact must present an Environmental Impact Assessment and Report ("EIA/RIMA") during the licensing proceeding. The report or assessment will describe potential environmental damage or impact and proposed preventive and control measures to reduce the effects. Certain activities are required to provide a biannual assessment to the environmental agency.

Brazil is projected to experience a significant decline in the demand for construction and, correspondingly, in its market for Environmental Impact Assessment and related environmental engineering and consulting activities. The strong demographics that supported Brazilian growth appear to be reversing, leading to a plateau effect on the demand for construction over the long-term.

Key Technologies in Demand:
- Environmental Impact Assessment

ETWG Agency Initiatives and Programs

U.S.-Brazil Commercial Dialogue

In 2014, the International Trade Administration and Brazil Ministry of Industry and Trade initiated a working group to address common areas of interest in the development of environmental markets. The effort is designed to facilitate technical exchanges to improve mutual understanding of U.S. and Brazilian environmental regimes, approaches and markets.

WEFTEC International Buyer Program

WEFTEC, the largest water technology exhibition in North America, works with the U.S. Department of Commerce's International Buyer Program to encourage foreign participation in the show. This platform is leveraged to exchange relevant technical information and to advance U.S.-Brazilian water cooperation through targeted activities at WEFTEC.

WasteExpo International Buyer Program

WasteExpo, one of the leading U.S. waste management trade shows, has partnered with the U.S. Department of Commerce's International Buyer Program to encourage foreign participation in the show. This platform is leveraged to exchange relevant technical information and to advance U.S.-Brazilian waste management cooperation in ongoing bilateral and multi-lateral forums.

U.S. Environmental Solutions Toolkit

The Toolkit is an online searchable database that marries U.S. Environmental Protection Agency (U.S. EPA) expertise on solving environmental challenges and developing environmental rules with a catalogue of U.S. technology providers. In late 2014, the International Trade Administration and U.S. EPA

introduced a Portuguese version of the Toolkit. It is used as a reference tool in bilateral engagements that focus on increasing Brazilian capacity to address environmental concerns, including follow up to the U.S.-Brazil Joint Initiative on Urban Sustainability (JIUS), the U.S.-Brazil Commercial Dialogue and others.

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www.abesrio.org.br

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