Introduction

This report on industrial water reuse policy options for the State of Rio de Janeiro was prepared by a consulting team from the Sol Price School of Public Policy at the University of Southern California (USC Price) in cooperation with the International Directorate (DINT) of the Getulio Vargas Foundation (FGV). The report is the principal product of an International Lab, which is a graduate level course (PPD 613a,b) offered by USC Price. This year’s Brazil Lab is itself a significant element of a broader, ongoing institutional collaboration between USC Price and FGV DINT. On-the-ground preparation for the 2015 Brazil Lab was spearheaded energetically and capably by Professor Yann Duzert of FGV DINT, with insightful guidance and support from DINT Director Professor Bianor Cavalcanti. Other key FGV colleagues -- including Dr. Eduardo Marques, Pedro de Seixas Correa and Lilian Rose Secron de Sant Anna -- worked skillfully and thoughtfully on the project’s behalf.

It was through this active collaboration with FGV DINT that the 2015 Brazil Lab secured as its client the State Institute for the Environment (INEA) of the Secretariat for the Environment (SEA) in the State of Rio de Janeiro. INEA President Isaura Maria Ferreira Frega, together with senior staff members Rosa Maria Formiga Johnsson and Bruno de Hollanda, were ideal clients as they undertook an active part in formulating the terms of reference for this project and providing essential information and professional contacts to facilitate the Lab’s work.

Siemens of Brazil also took an active interest in the Lab. We are grateful to Jorge Barros, its Vice President for External Relations, Government & Regulatory Affairs, for arranging for this report to be translated into Portuguese, to facilitate its wider circulation and reach within Brazil.

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EXECUTIVE SUMMARY

Water is an essential natural resource whose supply and demand is impacted by environmental factors and human use. A contemporary issue for many countries includes responding to growing demands for water, as a result of population growth, and decreasing supply of water, due to environmental and geographic factors. In light of changing patterns in water supply and demand, an increasing proportion of the global population has been forced to examine water policies and regulations that address long term use of this resource. Water reuse methodologies are the most sustainable long-term solutions. Sustainable water reuse initiatives require a paradigm shift to ensure long-term solutions, which must include increased public awareness, management strategies, and explicit accountability. As a result of the diversity in types of water supply and environmental conditions that affect supply, the most successful strategies have been those that have developed and implemented policies specific to local industries and constituencies in response to water use management.

Globally, water reuse and management policies are primarily advanced at the state level. Within the United States, the state of California provides a compelling framework to contextualize water management. California has a long history of drought, which has permitted the state time to develop, implement, and adapt policies and legislation that enable ongoing reform, water reuse, and conservation efforts. As with California, water management is at the forefront of policy needs within the state of Rio de Janeiro, and the country of Brazil at large. The first steps in policy reform include careful analysis of stakeholders and key players in water reuse measures. At the federal, state, and municipal levels, there is interplay between vested stakeholders in water reuse reform. For this reason, identifying and engaging community and industry leaders at an early stage, as well as leaders in all facets of media who can help disseminate information, is a large consideration.

Current state interests are moving towards water reuse in the sector of industry. Approaching reform with a focus on industrial water reuse legislation has the potential to lead to a broader discussion within local communities and all sectors. Beginning with policies for big industries and narrowing down into local communities allows for time to garner local support and strengthen networks that sustain long-term reform. This analysis proposes the enactment of legislation within the state of Rio de Janeiro that enables agencies at a state level to set clear goals and collaborative efforts, establish water quality standards, monitor and evaluate output, and create incentives for industry participation and community support. Broad goals for this legislation include clearly defining and sharing objectives; creating an industrial water recycling task force; establishing water reuse mandates; defining criteria for monitoring, reporting, and
enforcing measures; and formulating pricing and quality standards that can be supported by incentives.

Reform measures enacted now will evolve and support future efforts. Immediate successes set the foundation for long-term strategies, such as desalination, effluent reuse, and potable water reuse.

CALIFORNIA CONTEXT

State of Regulations
California is currently experiencing the worst drought in the last half century, and has therefore developed regulative solutions to both reduce the effect of the drought, and to promote the use of recycled water. Over the last few years, the state has authorized measures that empower local agencies to manage groundwater usage, such as SB-1168 and AB-1739. In addition, the 2014 Sustainable Groundwater Management Act ended the long-existing decentralized water management approach in California, and has since set a true framework for identifying priority water basins, a responsible groundwater sustainability agency, and deadlines for creating and adopting comprehensive, measurable, and enforceable groundwater sustainability plans. This year, Governor Jerry Brown’s Executive Order B-29-15 further mandated a 25% reduction in water use across the state over one year. Water agencies were enabled to determine the methods used to reduce usage.

Concurrently, water reuse guidelines and regulations in California have been updated to meet the increasing need for water reuse. For example, AB 1406 (2007) changed California Water Code to allow recycled water for indoor uses (toilets, cooling towers for buildings, etc.); SB 283 (2009) adopted design standards in state plumbing codes for outfitting buildings with the extra set of recycled water piping and any related recycled water systems; AB 2398 (2012) and AB 803 (2013) proposed streamlining recycled water permit processes. Currently, the California Water Reuse Guidelines oversee the following types of water reuse: Urban Reuse (Restricted and Unrestricted), Agricultural Reuse (Food Crops, Processed Food Crops and Non-Food Crops), Impoundments (Restricted and Unrestricted) Environmental Reuse, Industrial Reuse, Groundwater Recharge (Nonpotable Reuse), and Indirect Potable Reuse. To date, California is the only state that has technology-based regulations for disinfection.

**California Mandates**

Within California’s current drought, unprecedented mandates have become necessary in order to curb the use of the state’s limited water resources. Governor Brown’s recently issued Executive Order (B-29-15), mandating an immediate reduction in potable urban water use statewide, was adopted as an emergency regulation by the State Water Resources Control Board on May 5th, 2015. In addition, more specific mandates exist that pertain to water reuse at the national, state, or local level. For example, at the state level, the California State Water Board issued a statewide mandate, in 2009, that directed the increase of recycled water “by 200,000 afy (acre feet per year) by 2020, and by an additional 300,000 afy by 2030.” This resolution identifies specific agencies to collaborate with and outlines the need to advocate for federal funding to be used in new projects. The 2009 mandate also includes the stipulation that when recycled water is available for use, the use of potable water will be deemed “an unreasonable use,” and the Water Board may prosecute offenders. Other mandates at the state level stipulate that water treatment facilities must supply reused water to new industrial and commercial subdivisions that are within their service boundaries. Additionally, power plant cooling systems may not use potable water. Regulations may also pass at a local level; for example, the county of Santa Barbara mandates that golf courses and other large landscape and green space irrigation be done with recycled water, when such water is available.

**California Incentives**

By implementing a wide range of incentive programs, California is moving towards a more sustainable level of water use. These incentive programs offer financial support mainly to those engaged in water recycling. Most recently, in March of 2014, the state approved 800 million USD in financial incentives for recycled water projects. These recent incentives provide 1% loans for water recycling projects that can be completed within three years. The State Water Board has funded recycled water projects for over 35 years. Between 2011 and 2014 it awarded 400 million USD in funding applied to water recycling planning and construction projects. Other incentive programs include grants that finance up to 50% of the cost for planning studies; rebates that provide financial support for up to 50% of project costs for commercial, industrial, and institutional businesses that meet the minimum criteria for water reuse; and sliding scale payments to water agencies that award cash per acre-foot of water recycled. Many of
these incentive programs help fund the research and development phases of projects, a vital aspect of bringing the projects to fruition. A variety of tactics are employed at the state, county, and municipal levels that target water users in all sectors, from industrial to residential.

**Funding Allocations**
In 2014, California passed the Water Bond (Bill 1471, Proposition 1), a legislation that facilitates the establishment of long-term efforts to address drought conditions via the enactment of the Water Quality, Supply, and Infrastructure Improvement Act of 2014. The Bill authorizes 7.12 billion USD for state water supply infrastructure projects including water storage, recycling, treatment, management, protection, and restoration. For this project, 38% of the fund will be spent on water storage projects, 23% on water recycling and treatment, 20% on watershed protection and restoration, and 16% on containment prevention and resource management. To ensure transparency of money spent, the state has strict accountability standards including annual audits, oversight, public disclosure, and money from the General Fund to be appropriated to pay off bonds.¹⁰

**Reporting, Monitoring and Enforcement**
Following the federal Clean Water Act and the Environmental Protection Agency’s (EPA) guidelines, many states have created long-term comprehensive monitoring strategies. The Clean Water Act has established a comprehensive framework for reporting and monitoring. In California, reporting, monitoring and enforcement responsibilities fall to the California Water Resources Control Board and the nine Regional Water quality Control Boards. In 2001, in order for the California Board and Regional Boards to comply with the federal Clean Water Act 106(e)(I), which allows the EPA to enforce that states monitor the quality of navigable water as well as compile and analyze data on water quality, California introduced an extensive monitoring program: the Surface Water Ambient Monitoring Program (SWAMP). This program is a long-term strategy with a ten-year implementation plan. To further ensure that states comply with federal requirements, the EPA created the Elements of a State Water Monitoring and Assessment Program, which includes ten basic elements in water quality monitoring. SWAMP was designed to meet and exceed the mandated federal requirements and ensure a strong framework of practices that enhance the monitoring, assessment, and reporting of California’s water quality.¹¹

In 2007, the California EPA and California Natural Resource Agency signed a Memorandum of Understanding (MOU) to establish the California Water Quality Monitoring Council, mandated by the CA Senate Bill 1070 passed in 2006. It requires the Monitoring Council to develop specific strategies to improve the existing monitoring structures, to have an integrated system between all agencies and to improve public

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¹⁰ California Proposition 1, Water Bond (2014).
accessibility to monitoring data. To aid in reporting and monitoring, federal, state, municipal, and private entities utilize large data collection systems to accurately monitor water quality. Of such systems, EPA’s STORET is one of the largest ambient water quality data systems. The Clean Water Act 305(b) and 303(d) requires states to report their data to the EPA every two years. The EPA, in turn, compiles a national report for Congress known as the National Water Quality Inventory.

Education and Public Awareness in California
In February 2014, Governor Jerry Brown signed a 687 million USD relief package after declaring California’s current drought a State of Emergency. Included in the package was money intended for infrastructure improvements and farmworker aid. Additionally, the measure included 1 million USD for a public awareness campaign highlighting water conservation. In 2015, Save Our Water, a partnership between the California Department of Water Resources and Association of California Water Agencies (ACWA), launched a new public awareness campaign highlighting conversation and the California lifestyle. This statewide marketing campaign features an interactive website detailing drought facts, current news, and tips on saving water. The website also includes an innovative feature allowing users to calculate personalized water savings reports. Lastly, Save Our Water’s social media campaign features its own Facebook, Instagram and Twitter pages for easy access. The organization launched a series of four public service announcements encouraging California residents to conserve water. These public service announcements are short and attention grabbing, featuring celebrities such as Lady Gaga, in order to promote conservation efforts.

BRAZILIAN CONTEXT

State of Regulations
Initial discussions regarding the formation of a national water resources management system commenced in 1987 at the Brazilian Water Resources Association (ABRH) meeting. This conference established a context for discussing water management. Subsequent dialogue resulted in legislation such as Federal Law 9.433, a 1997 mandate that called for decentralized water management, established several policies, and created various agencies to regulate water use. State level legislation has also been enacted to regulate water use, and is more location-specific than federal regulation. For example, in 1999 Law 3.239 bolstered the establishment of the State Water Resources Policy and the State Water Resources Management System in the

state of Rio de Janeiro. Although the Rio de Janeiro State Agency is seeking to establish regulatory framework for water reuse, there is currently no formal regulation to address the growing needs of water reuse.

**Variability of Supply and Increasing Demand**

The water supply system in Rio de Janeiro is adversely affected by a multitude of factors, such as drought, water scarcity, and decreased amounts of wastewater collection. Discrepancies within supply management on the federal, state, and local levels also contribute to variation of water supply within the state of Rio de Janeiro and the country of Brazil as a whole. That is, variability in supply is largely attributed to discrepancies within the distributional framework. Along with supply, the demand for water in Rio de Janeiro is increasing. This is primarily due to population increase, which has shifted from approximately 8 million in 1980, to approximately 12 million in 2014.

**Water Pricing**

Price significantly impacts the supply and demand of water, and is an important factor to consider when establishing water use regulation. Furthermore, water pricing affects the amount of water consumed by the industrial sector. Various entities have alluded to raising water prices in order to decrease water usage within the industrial sector. Furthermore, such notions also prompt discussion on the status of decentralization of pricing this commodity.

**STAKEHOLDERS**

**State Secretariat of the Environment**

The Secretary of State for the Environment, Secretaria de Estado do Ambiente (SEA), provides environmental management in the state of Rio de Janeiro. Its mission is to coordinate and formulate state policy that not only protects and conserves the environment, but also aids in water resource management and sustainable development in the state of Rio de Janeiro. While SEA creates policies designed to alleviate and

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18 "INEA" Presentation on Monday, May 25th.
regulate harmful environmental impacts, the State Environment Institute, Instituto Estadual do Ambiente (INEA), enacts and enforces these policies. SEA will necessarily be a key stakeholder when considering water reuse legislation, since the agency designs and creates policies that regulates industrial water reuse.

**State Environment Institute**

In 2007, Rio de Janeiro’s regional government created an environmental agency called the Instituto Estadual do Ambiente (INEA). This government agency protects, preserves, and restores the environment. The organization’s infrastructure includes nine regional agencies that decentralize licensing and reporting to meet the demands of society on environmental issues in the state’s 92 municipalities. INEA is responsible for three phases of environmental licensing (preliminary, installation, and operations) and water permitting for industries in Rio de Janeiro. Currently, no state or federal legislation exists to regulate the supply and/or use of reused water, including graywater and treated sewage water. While industries voluntarily include water reuse plans in their license applications, INEA seeks statewide legislation to regulate the industrial use of recycled water to ensure quality standards, environmental impacts, and the price of water. As a governmental organization responsible for environmental impacts and safety, INEA is vested in the development of legislation that regulates industrial water reuse and highlights public awareness. Following the establishment of such legislation, INEA may seek additional manpower and capacity to regulate industrial water reuse that is in accordance with state laws.

**State Company for Water and Sewage**

The State Company for Water and Sewage (CEDAE) was formed on August 1st, 1975. CEDAE was created as a result of the merging of the Company Guanabara State Waters (CEDAG), the Guanabara Sanitation Company (ESAG) and the Sanitation Company of State of Rio de Janeiro (SANERJ). CEDAE is responsible for operating and maintaining the collection, treatment, and distribution of water networks in Rio de Janeiro. Additionally, CEDAE collects, transports, treats, and disposes of sewage water of those municipalities in Rio de Janeiro who hire their services. There are twenty-one wastewater treatment plants across the state that treat collected sewage. The largest seven plants receive over 450 L/s, and include: ETE Alegria, ETE Pavuna, ETE Sarapuí, Penha, ETE Ilha do Governador, ETE São Gonçalo, and ETE Barra da Tijuca. Of the seven largest plants, Alegria and Penha provide water for reuse. Currently, Penha provides water to the Rio de Janeiro Municipal Solid Waste Company, where it is reused in street cleaning. In 2014, Penha provided 66,000 cubic meters of recycled water. Additionally, Alegria provides reused water to Consortium Porto Rio, where it is reused for the revitalization of the Port of Rio Janeiro. Last year, Alegria treated 8,500 cubic meters of recycled water.

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27 “CEDAE: Rio de Janeiro State Water & Wastewater Company” Presentation on Wednesday, May 27th.
Similar to INEA, CEDAE is also interested in water reuse regulation. Because CEDAE controls Guandu, the largest water treatment plant in the country, the company is primarily concerned with water quality matching specific sectors and particular uses. Because quality of water is a big consideration, another of CEDAE’s interests is in policy that regulates the demand for recycled water. Once reused water demands are identified, CEDAE may need to invest in additional infrastructure to ensure the safe transportation of recycled water to industries across the state of Rio de Janeiro.

**Federation of Industries of Rio de Janeiro**
The Federation of Industries of Rio de Janeiro (FIRJAN) represents the interests of the industrial class in Rio de Janeiro. FIRJAN, in collaboration with the Industrial Center of Rio de Janeiro (CIRJ), Industry Social Service (SESI), National Service of Industrial Education (SENAI), and Euvaldo Lodi (IEL) work to ensure the social, political and economic well being of industries across the country. FIRJAN is comprised of 80,000 companies, and conducts research and projects that guide industry actions and promote investment in the state. Additionally, the organization provides guidelines to support company actions, and seeks to increase company productivity. FIRJAN is interested in industrial water reuse legislation, and is primarily concerned with the quality of water that is put back into the system. Additionally, FIRJAN is concerned with prevention and government action. The federation believes that additional responsibility could and should be given to industries in order to increase timeliness and accountability. As a result, FIRJAN will likely favor specific legislation that incorporates a closed market-trading platform that encourages communication, collaboration and water reuse between and among industries.

**Secretaria de Estado de Saúde**
The Secretaria de Estado de Saúde (SES) of Rio de Janeiro is the state government agency responsible for enforcing regulations set by the federal government. SES is also responsible for creating, implementing, effectively managing, and organizing public plans and health policies to promote citizens' well being. The SES fulfills such responsibilities through establishing health programs and advising municipalities. In accordance with their objectives to ensure the public safety and health of state residents, SES is especially concerned with the quality of urban potable water and hygiene, especially as it relates to water reuse. Their main concern is centered on the health implications of water reuse.

**Environmentalists**
Environmentalists are priority stakeholders when considering legislation for a natural resource such as water. These stakeholders include local, state, national, and global actors who are committed to regulations aimed at conservation of the natural and built environment. Within the context of Rio de Janeiro, environmentalists raise community

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28 “Meet the FIRJAN.” Sistema FIRJAN. Retrieved June 1, 2015, from [http://www.firjan.org.br/data/pages/2C908CE9215B0DC401216AFC0AD551E3.htm](http://www.firjan.org.br/data/pages/2C908CE9215B0DC401216AFC0AD551E3.htm)
awareness regarding water management and reuse practices. The need for awareness is propagated by the high rate of water contamination within Rio de Janeiro’s rivers and bays.  

**Guandu River Basin Committee**

Within the framework of water pricing in the country of Brazil at large, river basins are the sole unit of planning and management. Within the state of Rio de Janeiro, the Guandu River Basin Committee is the chief stakeholder that decides the price of water and where to invest its resources. The committee’s jurisdiction is restricted to the state level, thereby limiting its ability to set prices at the federal level. The Guandu River Basin Committee specializes in the reuse of potable water. With respect to water reuse for industrial purposes, the committee notes that reused water for industry is a small part of the current hydraulic problems in the state of Rio, and the country of Brazil at large. However, the committee further notes that establishing regulations for industrial water reuse is an important stepping-stone to addressing water reuse regulation throughout all sectors. Furthermore, the committee contends that efficient legislation will reduce the demand for water and reduce the loss of water within the state of Rio's current system. Legislation regarding water use in the industrial sector will increase awareness of water conditions, onus of individuals to conserve water, and reuse of water for equitable purposes.

**Public Outreach and Community Support**

While the support of state agencies, community partners and local committees is critical to the success of water reuse reform measures, longevity and sustainability of new water reuse policies relies heavily on public support. The success or failure of a water reuse project can depend on public perceptions of how the project impacts public health, public finance, land use, environmental protection, and economic growth. Ideally, building the support of the public begins prior to implementation of the reform project. This allows for adequate time to establish transparency, educate constituents, and build trust.

Public awareness campaigns revolving around education and transparency have proven effective in garnering support from local community members. The depth of people’s interest in public decisions correlates to the potential impacts on their health, security, and quality of life. Water reuse potentially impacts all three, making public outreach and involvement essential to the success of water reuse programs. One example of community outreach that played a hand in a project’s success took place in Orange County, California. Over the course of several years, the Orange County Water District (OCWD) gave presentations, sometimes many in one day, to hundreds of diverse

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community organizations to provide education on a proposed groundwater replenishment system before soliciting support. The effort to educate potential supporters on the purpose and value of the program paid off, and along with the support of the majority organizations that ended up supporting the system, OCWD was also able to list supporting organizations on their website and in educational materials to further solicit support.33

In another case in Los Angeles County, the West Basin Municipal Water District (WBMWD) faced the challenge of providing five different types of recycled water to 17 cities within the County. WBMWD faced this challenge by carefully crafting it’s clear core messages used in community outreach, investing in public and private entities to inform about recycled water, creating a public information committee (consisting of local agencies, water utilities, municipalities and legislative offices) to educate and receive feedback, and investing in public affairs activities that hosted global seminars and raised awareness in community events. WBMD cites continuous interaction and education with the public as a vital component of the success of the West Basin’s recycled water program. The interaction led to continuous appraisal of public concerns, which ensured success of the program.34 Although extended and consistent public awareness campaigns can take a considerable amount of time and manpower, the benefits that they afford become invaluable components in policy formation and project success.

KICKSTARTING LEGISLATION

In 1991, California passed the Water Recycling Act, which created necessary momentum for recognizing the importance of water reuse and set the framework for establishing water reuse standards and implementation strategies. The following recommendations are based on useful and transferable sections of this establishing law for the purposes of creating a regulatory framework in the state of Rio de Janeiro. They have been organized into possible Articles for new legislation based on the aspect of water reuse legislation they cover. These recommendations are completely flexible and subject to the consideration of lawmakers in what is relevant or useful to the current state of Rio de Janeiro.

Good legislation is a critical starting point for many of the changes that active stakeholders in Rio need in order to affect water reuse reform. Such legislation has the capacity to enable and empower actors to build water reuse systems by naming entities, such as alternative/dual plumbing systems in all relevant water and plumbing codes, regardless of whether or not the public network has reached all arenas. Furthermore, basic legislation enables and authorizes municipalities, water wholesalers, and retailers to engage in feasibility studies with each other, enabling them to identify sources of

33 Ibid.
recycled water provision within their jurisdiction. As such, water-recycling laws identify necessary actions as well as which agencies or groups are responsible for them.

**LEGISLATION OPTIONS**

**Article 1: Intent, Purpose, and Goals for Water Reuse**
We recommend Rio de Janeiro state legislation commence by establishing the intent of the law and enabling recycled water use. This includes defining the goals of the law within the introduction of the text, stating the benefit of reusing water as public use, and setting the tone for why this legislation is necessary.\textsuperscript{35} The legislation intends to promote the efficient and safe use of recycled water for the State of Rio de Janeiro, particularly within the industrial sector. The legislation states that the people of the State of Rio de Janeiro have an interest in minimizing the impacts of growing demand for new water on sensitive natural water bodies and supplement existing water supplies, so that the development of facilities to recycle water may economically meet future water requirements in the state. This involves recognizes the existing volatility of water supply and increasing demand of water use. The law can establish numerical goals in specific measurements of recycled water use by the industrial sector of Rio de Janeiro over 10 year intervals, over the course of the 30 or more years.\textsuperscript{36} It is important that there is consistency with the powers of the Rio de Janeiro State Secretary of Health (SES) and existing regulations concerning potable water quality standards and uses, as well as the general mission of ensuring public health.\textsuperscript{37}

**Article 2: Industrial Water Recycling Task Force**
We recommend the State of Rio de Janeiro commission a Task Force early in the reform process, with representatives of environmental agencies, water utilities, municipalities, industry leaders, public health officials, and civil society representatives. With an emphasis on the future of broader reuse, meetings may also include leaders of agriculture, commercial, and real estate sectors that participate as observers. The early benefit of this is that they may assist in spreading awareness of water recycling potential in their own sectors and so they may witness how precedents are established, with future potential of participating in Task Force meetings as necessary. As an example, the original California Recycled Water Task Force consisted of members of the following governmental agencies and departments: public health, environmental protection, watershed protection, food and agriculture, building standards, universities, environmental advocacy, consumer advocacy, water wholesalers, water retailers, nonprofits, real estate, land development, and industrial interests.

The Task Force will have a large role in reaching water reuse policy goals. It will establish categories of standards for recycled water quality as compared to its uses

\textsuperscript{35} Recommendations are referenced from the California Water Code and the California Water Recycling Act of 1991.
\textsuperscript{36} Recommendation is referenced from the California Water Code section 13577.
\textsuperscript{37} California Water Code, Section 13050 (n) defines recycled water as “Water which, as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and is therefore considered a valuable resource.”
within a set period of time, after which it will report to SEA on its progress and its findings. The Task Force will determine tiered thresholds for industrial company sizes, which will in turn determine the laws they need to follow and with what intensity. Thresholds, which determine the size of a company, can be based on elements such as site square footage, number of employees, industrial designation type, and any other relevant parameters. A Task Force will also establish a tiered system for levels of participation. Not all industries use much water as inputs for their products or for cleaning, but may still be able to participate in water reuse via cleaning water, toilets, cooling towers, HVAC, etc. It will create “Recycling Criteria” that considers constituents and matches water quality with industrial use, and assures reliability of safe recycled water. For monitoring purposes, the Task Force will be expected to report to the Secretary of Environment at SEA and/or any relevant legislative committees in set period intervals to be determined by SEA.

**Article 3: Mandates**

It is our recommendation that the legislation explicitly state that any entity proposing to use recycled water within Rio de Janeiro, or materially change the character of recycled water or its use, for any industrial purposes for which Recycling Criteria have been established, must file an “Application” for approval by INEA and other relevant state agencies according to existing law.\(^{38}\) This legislation will clearly state that no industrial entity may use recycled water for any industrial purposes that pose harm to the public health for which Recycling Criteria have not been established.

Applicants will agree to the supplier’s conditions on the use of recycled water, which may be based in Rio de Janeiro state laws and standards, or any stricter/more efficient standards set by the local provider. Applicants would be required to designate a specific employee position “Site Supervisor” who oversees the water recycling system and its adherence to municipal and state standards. The must also submit to the licensing governmental agency proof of that Site Supervisor’s qualifications and training. Applicants would declare the use type of recycled water used on their site, provide maps with boundaries of their site, the locations of the potable and recycled water piping systems, the locations of water outlets accessible to the public, including approaches and systems to prevent mingling or backflow of recycled water with potable water.

We recommend INEA and any relevant governmental agencies reinforce best practices for recycled water use, such as employee certification regulations, potable water source buffer zones, shutting of recycled water during sufficient rainfall, odor and mosquito control, proper warning signage, and more\(^{39}\). The law should also reinforce or establish new, separate marking systems for pipes installed above or below the ground, barrels used for carrying recycled water, or any other conduit of recycled water. This is to make

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\(^{38}\) Recommendation is referenced from California Water Code section 13522.5 (a & b).

\(^{39}\) Best practices listed are referenced from the Los Angeles County Sanitation District Recycled Water Users Handbook, Requirements for Recycled Water Users, Section 5.
clear the separate marking systems between types of water and to avoid dangerous mixing of recycled and potable water.\textsuperscript{40}

**Article 4: Monitoring, Reporting, and Enforcement**

The proposed legislation will enable INEA to establish and enforce rules or regulation, for recycled water users, and govern the design and construction for recycled water use facilities, in accordance with the Recycling Criteria on water quality and use standards in industrial settings. The legislation may encourage intersectoral government collaboration amongst relevant agencies, including CEDAE and other water utilities, on third-party technical reviews of design and construction plans for recycled water use facilities.

This legislation will require the Site Supervisor to submit an annual report summarizing the total amount of recycled water supplied and used at each industrial site that requires INEA license approval, including site location and relationship to hydrologic areas underlying the recycled water use sites. It will enable INEA to require each licensed industry site to conduct periodic inspections of the recycled water facilities, administered by the Site Supervisor, and monitor compliance of recycled water quality and uses as specified in the Recycling Criteria as established by the Task Force, and approved by the State of Rio de Janeiro, and in coordination with existing Rio de Janeiro SES health regulations wherein the use of recycled water involves the protection of the public health.\textsuperscript{41}

The legislation will empower INEA, SES, and any relevant inspecting agencies to order any identified contamination resulting from the use of recycled water to be abated in accordance with existing environmental remediation state and federal law. Failure to submit the Application for water recycling will result in the withholding of licensing approval by INEA or other relevant licensing agencies.

**Article 5: Water Use & Quality**

The Task Force will establish what levels of recycled water quality will be appropriate for different types of industrial use in the State of Rio de Janeiro. This section provides some examples of recycled water uses, as well as basic regulations for the discharge of recycled water, which might reflect the new Rio de Janeiro legislation. Recycled water generally undergoes different levels of treatment - primary, secondary, and tertiary, with tertiary being the most advanced level of treatment. Uses for recycled water after disinfected tertiary levels of treatment include flushing toilets and urinals; priming drain traps; industrial process water that may come in contact with workers; structure fire fighting; decorative fountains; commercial laundries; consolidation of backfill around potable water pipelines; use for industrial or commercial cooling or air condition that involves the use of a cooling tower, evaporative condenser, spraying or any mechanism

\textsuperscript{40} Referenced from the California Safe Drinking Water Act, Article 7, Section 116815.

\textsuperscript{41} According to California Water Code, Article 4, Section 13521, the state’s Department of Health Services establishes uniform statewide recycling criteria for each varying type of use of recycled water where the use involves the protection of the public health.
that creates a mist; and commercial truck washes, including hand washes if the recycled water is not heated, where the general public is excluded from the washing process.

The following are examples of uses for recycled water after disinfected secondary recycled water treatment: industrial boiler feed; nonstructural fire fighting; backfill consolidation around nonpotable piping; soil compaction; mixing concrete; dust control on roads and streets; cleaning roads, sidewalks and outdoor work areas; and industrial process water that will not come into contact with workers; and use for flushing sanitary sewers.42

Recycled water discharged after industrial use into state water bodies should comply with all existing federal and state water, environmental, and health quality standards. Recycled water discharged after industrial use into sewage systems and other water treatment, supply, or waste systems should comply with all existing federal and state water, environmental, and health quality standards.43 Recycled water after industrial use enters a system or a use where it may come into contact with humans or animals should comply with existing federal and state water, environmental, and health quality standards.44

The Recycling Criteria will adhere to existing public health laws established by the Rio de Janeiro Secretariat of Health, or its equivalent, and relevant agencies wherein use involves the protection of the public health. If the use of recycled water for industrial purposes is not addressed by the Recycling Criteria established by the Task Force, then INEA should consider the appropriate industrial use and corresponding water quality standard, on a case-by-case basis.

Article 6: Pricing & Incentives
This section assesses financial incentives and pricing issues, in order to set the framework and goals for achieving widespread and economically viable use of recycled water that will be attractive to users.

Our proposed legislation explicitly states that the price of recycled water should reflect an equitable sharing of the costs and benefits associated with the development and use of recycled water; and will outline that the goal of recycled water pricing should be at or below the equivalent price of potable water to enable economic rationality by industry and enhance economic activity.45 It will establish that the price of recycled water should be composed of the recovery of costs, both fixed and variable, generated by the production, distribution and general administration of recycled water activities.

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42 Recommendation is referenced from the California Water Code, Article 3. Uses of Recycled Water, Section 60306 & 60307.
43 Recommendation is referenced from the California Health and Safety Code, Article 7, Section 116551, wherein an engineering evaluation is required that evaluates the proposed treatment technology.
44 Recommendation is referenced from the Federal Water Pollution Control Act, Section 311(b)(2), which governs possible hazardous substance discharge to surface water or groundwater sources.
45 Recommendation is referenced from the California Water Code section 13576.
The legislation should authorize statewide programs of financial assistance, such as loans, or additional economic incentives for water quality control facilities providing optimum use of recycled water. Legislation should authorize INEA or other financial assistance providers to identify incentives for public and private industrial sites to retrofit existing water systems for water recycling. Other incentive possibilities include an annual award program established by INEA to recognize companies and industrial sites maximizing efficient recycled water reuse, and an open, published list of industries or companies participating in water recycling.

**Other Considerations and Ideas**

Not all water recycling initiatives will be directly related to founding legislation. There are other programs and options to consider when creating a sustainable water reuse system. For instance, within the Application process for a new industrial site, to be reviewed and approved by INEA, information regarding the annual volume of on-site recycled water use and potential should be provided and shared with CEDAE, in an effort to collect reuse water demand data. This will help water utilities and water reuse planners project future demand for recycled water by industry, which leads to better long-term planning of capital projects for large-scale distribution of recycled water to industry sites. For the proposed recycled water distribution network or marketplace, operated by FIRJAN or another suitable entity, buyers and sellers can rely on trucking operations to transport recycled water. As trucks are a large emitters of emissions, businesses can be required or incentivized through tax breaks and recognition, to use fuel-efficient or hybrid truck fleets for their recycled water distribution to reduce carbon emissions. SEA, SES, and other regulating agencies of this law may establish an annual or bi-annual meeting agenda with CEDAE and other water providers to coordinate policy with technical expertise as the recycled water system expands. Whether mandated in the law or not, government agencies should recognize governmental responsibility in public outreach, communication, and transparency of operations and identify possible outreach and education programs with businesses for industrial water reuse.

**A GLOBAL PERSPECTIVE**

The California State Water Resources Board establishes policy goals in the form of mandates to achieve higher targets of recycled water use over 10-20 year periods. Similar to the state of California, various nations within the global community have developed regulations to address water reuse. A few such global regulations are presented.

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46 Recommendation is referenced from the California Water Code sections 13527(a), and Chapter 6, Articles 1 and 2. California makes loans to public agencies and provides financial assistance for recycled water supply and use.

Mandates
Within Australia there are specific targets regarding the use of treated wastewater along with set mandates on water efficiency for new residential construction that include using grey water recycling. Industry specific examples include Canada’s water reuse obligations on proposed projects in oil sands with a 100% reuse obligation as well as California’s mandates on power plants. These types of mandates can be found within the water code, but can also be found in other laws and building codes under different agency jurisdictions. Along with California, Spain also mandates “true cost” pricing and in some areas of Arizona and California potable water prices subsidize costs for recycled water.

Incentives
Considering incentives, Australia provides a 10% tax credit on eligible up-front capital costs for qualifying water reuse projects. Spain, Singapore, and Mexico offer varying levels of tax incentives as well. Within the United States, New Jersey and Texas also offer tax incentives. Rebates are another form of incentive available in Australia, California, Texas, and Colorado defraying costs of installation of water reuse and conservation technologies. Funding through grants and/or subsidized financing for larger scale projects in the commercial and industrial sectors is offered in New Jersey, Florida, California, Singapore, Italy, and Australia.

Reporting, Monitoring, and Evaluating
Singapore implemented an advanced reuse technology where a portion of reuse water is treated for direct potable use (NEWater) as well as indirect potable use. Successful water reuse has been attributed to strict enforcement of related policies. Reporting, monitoring, and enforcement falls on the National Environmental Agency that specifically monitors industrial wastewater discharge into waterways while the Public Utilities Board monitors all wastewater discharged into public sewage system. Water quality is also strictly regulated by the Environmental Public Health (EPH) (Quality of Piped Drinking Water) Regulations 2008. Industrial wastewater that generate large quantities of pollutants are required to install monitoring systems to prevent pollutant effluent into public sewers.

In Australia, industrial water quality needs to be continuously verified, both at the source and end use. This will involve monitoring and testing, but only as appropriate (not necessarily continuous online monitoring). Verification monitoring and testing programs should be developed based on the risk assessment and can be reflected in the appropriate document (for example, by either suppliers as part of their supply agreement, or end users as part of their EIP and risk management).^53

**FUTURE CONSIDERATIONS**

It is evident that the state of Rio de Janeiro is establishing itself as a global entity in water reuse. Upon consideration of current initiatives and the vested interest of numerous agencies at a multiple levels, our recommendations are rooted in legislation that empowers stakeholders to define their standards and policies and monitor and enforce them accordingly. These stakeholders include, but are not limited to, SEA, INEA, CEDAE, and FIRJAN. The recommended legislation enables all stakeholders to clearly define water reuse policies and goals; establish a Task Force of key leaders; define reuse mandates; enable consistent monitoring, evaluating, and enforcement; match water quality with use; and create pricing and incentives for industries to benefit from water reuse. Individuals within the Task Force will determine all relevant details of the legislation, while considering the state of Rio de Janeiro’s current infrastructure and capabilities. Furthermore, the level of each entity’s involvement is variable and contingent upon preference.

The most effective policy option is one that implements both short-term and long-term changes within water regulation. To ensure the long-term sustainability of water reuse reform, a perspective shift in Rio that reduces overall water demand and highlights the practicality and safety of reuse of graywater use is required. Such a shift will strengthen legislative measures and bolster support of reuse programs. This paradigm shift will be best achieved through the implementation of legislation that is transparent, clearly defined, and raises public awareness through education, as collectively evinced by the above-mentioned analysis.

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### Appendix A: Global Perspective Case Study Matrix

<table>
<thead>
<tr>
<th>Legislation consideration</th>
<th>Type</th>
<th>Country/US State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task force</td>
<td>Stakeholder collaboration</td>
<td>Canada</td>
<td>Water efficiency coordinators work with industry and residents to provide ideas and resources.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Australia</td>
<td>Country’s leading organizations on water reuse and desalination forum to enable dialogue between stakeholders.</td>
</tr>
<tr>
<td>Mandates</td>
<td>Mandatory increasing of reused water</td>
<td>California</td>
<td>California requires local and private entities to produce recycled water within the boundaries of a local agency in 10 years.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Florida</td>
<td>State law requires water management districts to assess their water resources and designate caution areas where the water supply is limited.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Australia</td>
<td>Water restrictions are currently in place in all major cities of Australia.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Germany</td>
<td>Law requires operators of public water supply systems to take measures to reduce potable water consumption.</td>
</tr>
<tr>
<td></td>
<td>Industry Specific Mandates &amp; Policies</td>
<td>California</td>
<td>Dept of General Services/Dept of Transportation are required to install purple piping for landscape irrigation projects.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Canada</td>
<td>The Energy and Utilities Board has imposed 100% water reuse obligations projects in the oil sands.</td>
</tr>
<tr>
<td>Incentives</td>
<td>Tax Breaks</td>
<td>Australia</td>
<td>One election policy of the newly elected government involves a 10% water tax credit.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spain</td>
<td>Investments are entitled to a corporate tax deduction on investments/assets used to protect the environment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Singapore</td>
<td>Singapore has a tax credit equal to a percentage of fixed capital expenditure on projects or activities that reduce the consumption of potable water.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New Jersey</td>
<td>Corporate business tax credits are offered for the cost of treatment and/or equipment for the purpose of beneficially reusing wastewater effluent in industrial processes.</td>
</tr>
</tbody>
</table>

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| Rebates on reused water technologies | Australia  
*Rainwater Tank Schools Rebate Program* | Australia offers rebates for installing rainwater tanks in home and schools. |
| California  
*Water Efficient Technologies Program* | Rebates to commercial/industrial institutional businesses are offered to reduce wastewater discharge. |
| Texas  
*Commercial Incentive Program* | Offers rebates to industrial, commercial, and institutional water users to install new equipment and processes that conserve water at existing facilities. |
| Colorado | Commercial and industrial water users can receive rebates to install new water-saving equipment or introduce water reuse applications. |
| Financing & Grants | Australia | Grants for approved desalination, water recycling, and major stormwater capture projects are developed by the private sector, local governments, and state governments. |
| Singapore | NEWater is sold at lower rates than regular water. Water Conservation Taxes and water treatment fees do not apply to the sale of NEWater. |
| Italy  
*Emilia Romagna Region* | Emilia Romagna offers grants for the adoption of water reuse and related technologies in the petrochemical sector. |
| California | The state provides grants for facilities planning studies to determine the feasibility of using recycled water. |
| New Jersey  
*Environmental Infrastructure Financing Program* | Revolving loan programs provide loans to local government units for up to half the allowable project costs and a market rate loan for the remaining allowable costs. |
| Award program | Singapore  
*Watermark Award, Lee Kuan Yew Water Prize, etc* | Various awards given by different entities (PUB/NEA) awards are given in recognition of water usage and conservation. |
| United States (USEPA)  
*Water Efficiency Award* | Annual award and recognition programs recognize public and private entities for water conservation and recycling efforts. |
| Pricing | True Cost Pricing | New York  
*Comprehensive Water Reuse* | New York’s Comprehensive Water Reuse Program created an effective indirect subsidy for private water reuse systems. |
| Spain  
*National/autonomous regions* | Price charged to water consumers for fresh water/collection and treatment of wastewater must reflect the true costs. |
<p>| Reused water subsidized by | Arizona | Reclaimed water rates recover 73-85% of service costs, and potable water users pay the remaining amount. |</p>
<table>
<thead>
<tr>
<th>Region</th>
<th>Program/Website</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other</td>
<td>Community Awareness &amp; Education (aimed at public and/or business community)</td>
<td>California's Recycled Water Program provides information to landscaping, industrial, and agricultural businesses about recycled water uses.</td>
</tr>
<tr>
<td></td>
<td>California Recycled Water Program</td>
<td>This guide provides information on equipment and design practices that lead to water savings above regulatory requirements. Information is targeted at new commercial businesses and institutional construction.</td>
</tr>
<tr>
<td></td>
<td>Texas Water Efficient Equipment and Design Guide</td>
<td>This website contains water reuse information, including detailed guidelines such as the &quot;Reclaimed Water for Beneficial Reuse Technical Manual.&quot;</td>
</tr>
<tr>
<td></td>
<td>New Jersey Division of Water Quality Wastewater Reuse Program</td>
<td>CONAGUA is a National Water Commission comprised of both state and municipal water utility systems. It develops programs for safe public water reuse.</td>
</tr>
<tr>
<td></td>
<td>Mexico National Water Commission</td>
<td>Singapore utilizes an array of awareness and outreach programs including public officials drinking reclaimed water.</td>
</tr>
<tr>
<td></td>
<td>Singapore Public Education and Information</td>
<td>Campaigns referring to rational use have been launched in newspapers and other media by the Ministry of Environment.</td>
</tr>
<tr>
<td></td>
<td>Spain Public Awareness Campaigns</td>
<td>Hesse Water Laws require public awareness and water conservation campaigns provided by public water operators.</td>
</tr>
<tr>
<td>Desalination</td>
<td>Israel</td>
<td>25% of Israel's water supply comes from desalination at the world's largest desalination plant, which produces 627,000 m³ of water daily.</td>
</tr>
<tr>
<td></td>
<td>California</td>
<td>California is currently building a desalination plant that will provide 50 million gallons of potable water per day.</td>
</tr>
</tbody>
</table>

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Globally, water reuse and management policies are primarily advanced at the state level. Within the United States, the state of California provides a compelling framework by which to contextualize water management. California has a long history of drought, which has permitted the state time to develop, implement, and adapt policies and legislation that enable ongoing reform, water reuse, and conservation efforts. As with California, water management is at the forefront of policy needs within the state of Rio de Janeiro, and the country of Brazil at large. The first steps in policy reform include careful analysis of stakeholders and key players in water reuse measures. At the federal, state, and municipal levels, there is interplay between vested stakeholders in water reuse reform. For this reason, identifying and engaging community and industry leaders at an early stage, as well as leaders in all facets of media, is a key step in the establishment of an equitable and efficient water reuse system.

Current state interests are moving towards water reuse in the industry sector. Approaching reform with a focus on industrial water reuse legislation has the potential to lead to a broader discussion within local communities and across all sectors. Beginning with policies for big industries and narrowing down into local communities allows for time to garner local support and strengthen networks that sustain long-term reform. This analysis proposes to enact legislation within the state of Rio de Janeiro that enables agencies at a state level to set clear goals and collaborative efforts, establish water quality standards, monitor and evaluate output, and create incentives for industry participation and community support. Broad goals for this legislation include clearly defining and sharing objectives; creating an industrial water recycling task force; establishing mandate; defining criteria for monitoring, reporting, and enforcing measures; and formulating pricing and quality standards that can be supported by incentives.
Recommendations Rooted in the California & Global Experience

**Intent, Purpose and Goals**
- Legislation should promote the efficient and safe use of recycled water.
- Mandates should minimize demand and supplement existing water supplies.
- Policies should recognize the volatility of water supply and increasing demand of water use.
- Laws should establish numerical goals & target dates.

**Establish a Task Force**
- Task Force should include members representing the environment, water utilities and municipalities, industrial leaders, public health officials, and civil society.
- Members of the task force should determine water quality standards, uses, and participation.
- The Task Force should report periodically with intervals set by INEA.

**Mandates**
- Legislation should require industries to submit an application to INEA.
- Policy should mandates industries to appoint a site supervisor responsible for overseeing the water recycling system.
- Laws should establish a separate marking system or “purple pipes” to carry recycled water.

**Water Quality & Use**
- Water quality matches specific industrial uses.
- Advanced disinfected tertiary levels of treatment include: Flushing toilets and urinals, priming drain traps, industrial process water that may come in contact with workers etc.
- Disinfected secondary levels of treatment include: Industrial boiler feed, nonstructural fire fighting, backfill consolidation around non-potable piping etc.
- Legislation should address discharged recycled water compliance.

**Incentives & Pricing**
- Legislation should reflect an equitable sharing of costs and benefits associated with the development and use of recycled water.
- Reused water prices reflect recovery costs.
- Prices of reused water should be at or below alternative prices.
- Incentive preferences value optimization.

**Other Considerations**
- Applicant information shared with CEDAE can aid in projecting future reused water demands and long-term planning.
- A recycled water marketplace regulated by FIRJAN Can provide a platform for buying and selling reused water.
- As reused water systems expand, ongoing stakeholder meetings can provide a forum to exchange technical expertise.
- Outreach and public awareness campaigns are essential to long-term water conservation.

For further details, examples, and references of legislation refer to California Water Code Section 13575-13583