clasp Efficient Appliances for People & the Planet

Global Water Efficiency Scoping Study

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Executive Summary

Water efficiency standards represent a major, untapped global opportunity to mitigate CO_2 emissions, address water scarcity, and promote resource efficiency policies, therefore playing a major role in advancing sustainable development. CLASP, supported by philanthropic funds, conducted a global scoping study exploring how water efficiency standards can mitigate the impacts of climate change in several economies around the world.

Our objective was to evaluate the opportunity to reduce CO_2 emissions from water efficiency standards for faucets and showerheads and prioritize countries for engagement. In particular, efficient showerheads and faucets both save water and reduce CO_2 emissions by reducing demand for hot water. A comprehensive scoping approach involved consideration of the following factors:

- **Impact Assessment** to investigate of the presence of "concurring factors" which would influence the potential impact of implementing water efficiency standards. These factors include hot water consumption, pressure on water resources (water scarcity and water crises), and projected urban population increase.
- **Policy Environment Assessment** on the viability of successfully implementing said water standards, based on policy prerequisites.
- **Geographic Diversity:** The scoping study maintained a global approach, therefore ensuring a global coverage of one country in each region.

COUNTRY PRIORITIZATION

The global study identified India, Brazil and South Africa as countries with the highest impact opportunities.

- **India** is a country where both water resources are under pressure and the policy environment is receptive to the introduction of water efficiency standards.
- **Brazil** is another priority country where recent and severe droughts have led to strict water rationing and water management and security are a top priority for policy makers.
- **South Africa** is the only African country among the top-20 carbon-emitting countries, and policymakers are beginning to examine the existing water policy framework from an efficiency and conservation standpoint.

CLASP, with the support of local partners, led in-depth assessments of each country above, analyzing the existing policy and institutional environment along with barriers and opportunities to introduce water efficiency policies. The individual reports are located on our website at clasp.ngo.

Introduction and Background

Water efficiency standards remain a major, untapped global opportunity to mitigate CO_2 emissions, address water scarcity, and promote resource efficiency policies, therefore playing a major role in advancing sustainable development

1.1. INTRODUCTION

Energy efficiency policies have successfully reduced CO_2 emissions from electrical and natural gas appliances by promoting product performance efficiency, at almost zero cost to manufacturers and consumers, and the same benefits are available for water products. Simple policies that limit the maximum flow rate of faucets and showerheads can dramatically reduce domestic hot water demand, thereby reducing the energy required for, and subsequent CO_2 emissions of, water heating. In the United States, water heating accounted for 14% of residential electricity use in 2018 – only 3 percentage points below the electricity used for air conditioning[1]. The California Energy Commission assessed that water-related CO_2 emissions are approximately 290 million metric tons, or 5% of all US CO_2 emissions, equivalent to the annual greenhouse gas emissions of 53 million passenger vehicles[2]. Seventy percent of those emissions were due to water heating.[3]

The World Bank notes that "climate change will increase water-related shocks on top of already demanding trends in water use. Reduced freshwater availability and competition from other use could reduce water availability in cities by as much as two thirds by 2050, compared to 2015 levels.[4]

Water efficiency policies reduce overall domestic water consumption, thereby delivering CO_2 reductions as well as other environmental, economic, and social benefits, especially in areas of water scarcity. Using water efficiency policies to address acute or developing water crises can also enable policymakers to pursue other appliance efficiency policies to further save energy and reduce CO_2 emissions.

1.2. BACKGROUND OF THE GLOBAL SCOPING STUDY

CLASP, supported by philanthropic funds, conducted a global scoping study to mitigate the impacts of climate change through water efficiency standards, addressing water scarcity and advancing increased sustainability in parallel. The project is composed of two main parts:

Our research[5] demonstrated the potential benefits of introducing more ambitious standards for water in the United States (US), which established standards in 1992 for faucets, showerheads, toilets, and urinals that are now obsolete[6]. The project anticipates the adoption of standards in at least two priority states in 2020 and progress in two others, setting the stage for adoption by mid-2021.

[1] For more information https://www.eia.gov/consumption/residential/
[2] California Energy Commission, California's Water-Energy Relationship, Final Staff Report, CEC-700-2005-011-SF, November 2005, p. 1. Hereinafter, California's Water-Energy Relationship.
[3] Claudia Copeland and Nicole T. Carter, "Energy-Water Nexus: The Water Sector's Energy Use," Congressional Research Service, 2017. https://fas.org/sgp/crs/misc/R43200.pdf
[4] "High and Dry: Climate Change, Water, and the Economy," The World Bank, 2016. http://www.worldbank.org/en/topic/water/publication/high-and-dry-climate-change-water-and-the-economy
[5] More details are provided under the sub-section on the Scope of products below.
[6] See section 3 for more details on the current status of water efficiency standards in the United States.

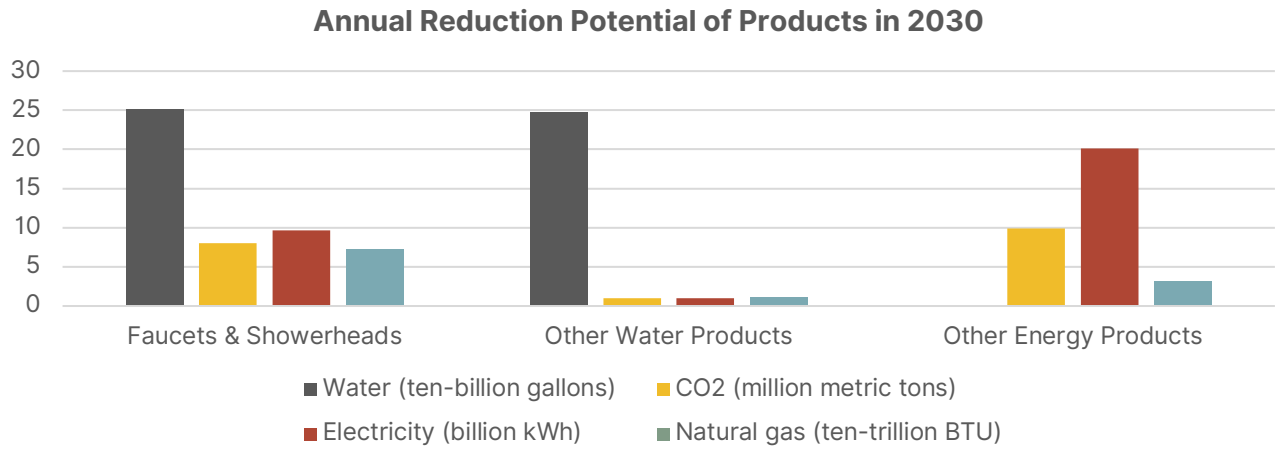
Secondly, and the focus of this study, the project investigates the potential of expanding this work, and therefore the benefits from introducing more ambitious standards, internationally. To this end, CLASP led a global scoping study to identify priority countries for engagement, aiming for geographic diversity in order to explore the viability of expanding this work to multiple regions. The methodology for product and country prioritization is explained in the following sections. Following the identification of the three priority countries, the project investigates in more detail the impact potential of introducing water efficiency policies for priority products in those countries – these individual country reports are available at clasp.ngo.

1.3. SCOPE OF RESEARCH

The research determines the products to be targeted for water efficiency standards and labeling programs and prioritizes countries where these programs are expected to be more impactful.

1.4. SCOPE OF PRODUCTS

As a result of the country's long-standing efficiency policies, the scope of products addressed in the study was based on the results of our research on the United States (US). Unlike most household water-consuming products, efficient showerheads and faucets reduce both water consumption and CO_2 emissions by reducing demand for hot water, which is heated and maintained by CO_2-intensive energy consuming devices like hot water heaters. In 2030, the expected CO_2 emissions reductions from faucets and showerheads in the US alone are eight times greater than those from all other water-consuming products and fixtures currently under consideration for new standards, and comparable to non-water-saving energy products.[7] In contrast, while efficient versions of other household water fixtures, such as toilets, urinals, and lawn spray sprinkler heads can save significant water, they do not offer the same CO_2 impacts because they only handle cold water. Greater adoption of efficient faucets and showerheads is expected to deliver annual reductions of 8 metric tons (MT) of CO_2 emissions and save more than 250 billion gallons (or almost one trillion liters) of fresh water in 2030 in the United States. Commercial food service products that use water, such as commercial dishwashers and commercial steam cookers, may not yet be numerous enough to have as large an impact.



[7] These include air compressors, air purifiers, commercial fryers, commercial hot-food holding cabinets, computers, computer monitors, high CRI fluorescent lamps, portable air conditioners, portable electric spas, residential ventilating fans, uninterruptible power supplies, and water coolers.

Figure 1 shows the annual reduction (i.e., impact) potential from the introduction of water efficiency standards for faucets and showerheads compared to all other water products and energy products[8] in 2030. As noted in the figure, water efficiency policy in the US for faucets and showerheads features both water and CO_2 emissions reductions, whereas other products garner reductions primarily from water or energy, but not both.

Efficient faucets and showerheads achieve these reductions by limiting their flow rate while maintaining both a spray force and a spray pattern to ensure that labeled products perform to buyers' expectation. While some concern exists that reduced flow rate could impact the showerhead performance, the US Environmental Protection Agency's WaterSense specification (which provide the basis for the above estimates of energy reductions from showerheads) includes both spray force and spray pattern requirements designed to ensure labeled products against these concerns. Moreover, unlike traditional showerheads, efficient showerheads can also provide pressure compensation, allowing them to achieve their full rated flow even in situations where the water utility or building provides low water pressure.

As a result of the significant water savings and energy reduction potential in the US, the study extrapolates the opportunity to 20 other countries.

1.5. COUNTRY PRIORITIZATION

CLASP used a prioritization framework to rank the top-20 CO_2 emitting economies[9] from 2018. In order to develop a country ranking, the study assessed the presence of "concurring factors" which would influence 1) the potential impact of implementing water efficiency standards, and 2) the viability of successfully implementing said water standards, based on policy prerequisites. In addition, the final prioritization considered geographic diversity as a method to ensure global coverage of one country in each region

UNTAPPED POTENTIAL FOR CO_2 EMISSIONS REDUCTION AND WATER SAVINGS THROUGH WATER EFFICIENCY POLICIES

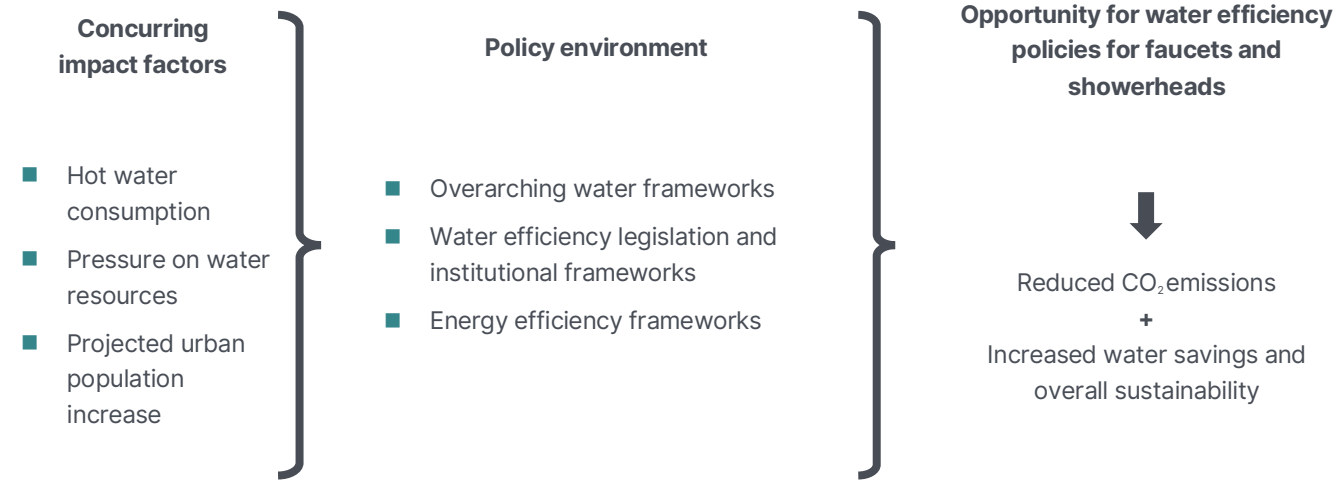


FIGURE 1 KEY FACTORS FOR INTRODUCING WATER EFFICIENCY STANDARDS

[8] These include air compressors, air purifiers, commercial fryers, commercial hot-food holding cabinets, computers, computer monitors, high CRI fluorescent lamps, portable air conditioners, portable electric spas, residential ventilating fans, uninterruptible power supplies, and water coolers.

[9] The study used the term "economies" instead of countries, because it also embraced the countries of the European Union as one economy.

1.5.1. IMPACT ASSESSMENT

The study examined the presence of concurring impact factors to assess the potential impact of water efficiency standards for both faucets and showerheads from a socio-economic and environmental point of view. These factors include hot water consumption, pressure on water resources (water scarcity and water crises), and projected urban population increase.

TABLE 1 IMPACT FACTORS

IF	IMPACT FACTORS (IF)	IMPACT FACTORS' DETAILS	EXPECTED RELEVANCE TO THE GOVERNMENTS
IF1	**Hot water consumption**	Represents an important factor of residential energy use for a range of countries, contributing to their CO_2 emissions.	Addressing CO_2 emissions related to water heating is a cost-effective solution to respond to the priority for Governments to mitigate climate change.
IF 2	**Pressure on water resources**	Includes both water scarcity (intended as a long-term condition), and water crises (including extreme weather events, draughts and floods) which result in economic losses and societal emergencies.	Reducing pressure on water resources is a priority for those countries that are prone to water risks. Water efficiency standards represent a low-cost policy measure which, among others, contributes to improved sustainable water management while increasing the adaptive capacity of societies to a changing climate without reducing their access to water resources.
IF 3	**Increasing urban population**	Contributes to adding pressure on the water use and on the competitive uses of water resources. The study researched urban instead of overall increasing population as it was expected to allow for a more balanced comparison across countries at the global level.	Countries with high urban population increase would benefit from introducing water efficiency standards as these ensure long term affordable access to water resources while mitigating the risks associated with competitive water uses related to increasing population.

1.5.2. POLICY ENVIRONMENT ASSESSMENT[10]

As a second step, the research investigated the presence of policy and institutional frameworks that were considered enabling or hindering the introduction of water efficiency standards. The identification of water and energy policy frameworks and efficiency standards at the national level was used to determine the viability of introducing water efficiency standards in each country and resulted in 4 prerequisites. The prerequisites were ranked through a point-based assessment explained in Annex A.

[10] Other factors, including the market and technology readiness, along with incentives and rebate programmes could be contributing factors to assess country potentials. However, these will not be considered at this stage of the study due to resource limitations.

TABLE 2 POLICY ENVIRONMENT ASSESSMENT

P	PREREQUISITES (PS)	POLICY DETAILS	EXPECTED RELEVANCE TO THE GOVERNMENTS
P1	**Existence of overarching water-related policies at the national and/or regional levels**	Frameworks covering water quality and conservation, but also sustainability and environmental priorities.	Advancing water policy frameworks can be guided by socio-economic, environmental, and cultural priorities. These can all contribute to justify the introduction of water efficiency standards because of their positive interlinkages with economic, environmental and social aspects.
P2	**Preexisting water efficiency standards and labeling programs**	Existence of specific national test standards for evaluating water efficiency or other water efficiency policies such as labeling programs; Lack of meaningful water efficiency standards, including out of date standards.	A country that previously introduced some water standards could benefit from introducing new ones or update existing ones at a lower cost and more easily. In particular, the country has a supporting structural policy framework and is backed by an understanding of the benefits involved through the use of standards.
P3	**Existence of energy efficiency (EE) standards and labeling (S&L) programs.**	Existence of S&L programs within the country.	The presence of EE S&L programs may suggest a country is familiar with, and willing to invest in efficiency generally, which may increase the likelihood to introduce water efficiency policies. The country would also have an established institutional structure, supportive for introducing efficiency standards.

Results of the Prioritization Framework

2.1. RESULTS OF THE IMPACT ASSESSMENT

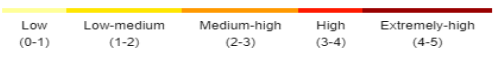
Economies were assigned points on a scale of 0-2 based on the presence of impact factors[11]. According to the scale explained in Annex A, a total of 3 points or more indicated that water efficiency policies would have a significant impact—13 out of 18 economies meet a total of at least 3 points. Following the ranking, 13 economies were further assessed to determine whether they have the policy prerequisites for developing ambitious water efficiency policies. Despite a total point score of 2, Europe was further assessed as the European policy framework was considered informative for the scoping study. The countries with a low total impact factor score were not assessed further.

TABLE 3 ECONOMY RANKING BASED ON IMPACT FACTORS

#	Country/Region	Hot Water Consumption in 2014 (PJ) IF1[13]	Aqueduct Water Stress Score[12] IF2[14]	Urban Pop. Growth Rate (2020-2030) IF3[15]	Points IF1	Points IF2	Points IF3	Total IFs
1	China	4027	2.22	1.52%	2	1	2	5
2	USA	2431	1.85	0.95%	2	0	1	3
3	India	2298	4.12	2.32%	2	2	2	6
4	Brazil	438	0.24	0.78%	2	0	1	3
5	EU	2555	1.74	0.29%	2	0	0	2
6	Indonesia	377	2.07	1.88%	2	1	2	5
7	Canada	205	0.61	0.94%	1	0	1	2
8	Australia	136	3.07	1.23%	0	2	2	4
9	South Africa	302	2.89	1.62%	2	1	2	5
10	Japan	738	1.66	-0.30%	2	0	0	2
11	Russia	1200	1.22	0.08%	2	0	0	2
12	Republic of Korea	294	2.55	0.31%	2	1	0	3
13	Thailand	101	2.98	1.31%	0	1	2	3
14	Mexico	455	3.86	1.32%	2	2	2	6
15	Pakistan	522	4.05	2.52%	2	2	2	6
16	Philippines	148	1.55	2.07%	0	0	2	2
17	Turkey	388	3.56	1.07%	2	2	2	6
18	Argentina	118	1.6	0.93%	0	0	1	1

[11] For details regarding the ranking system, see Annex A.

[12] Aqueduct Baseline Water Stress Score



[13] See Annex B1 for details on the hot water use

[14] See Annex B2 for details on Aqueduct Baseline Water Stress Score

[15] See Annex B3 for details on projected urban population growth

Figure 2 shows the results of the impacts factor analysis, with the bubble size indicating energy for water heating, the urban growth rate on the vertical axis and water stress on the horizontal axis. The countries are color-coded by continent.

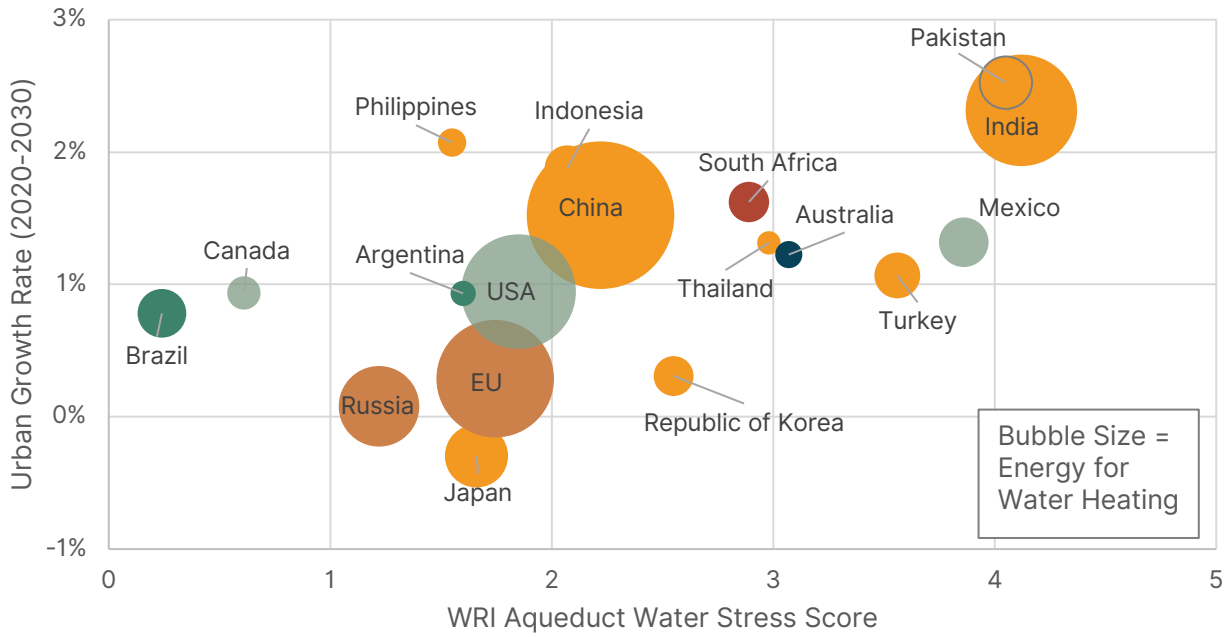


FIGURE 2 VISUALIZATION OF THE THREE IMPACT FACTORS: HOT WATER ENERGY CONSUMPTION, WATER STRESS, AND URBAN GROWTH RATE.

2.2. COMBINED RESULTS OF IMPACT FACTORS AND OF THE POLICY ENVIRONMENT ASSESSMENT

Figure 3 shows the total impact factors for the 13 countries that passed the first assessment (total impact factor greater than or equal to 3) and the total policy prerequisites for an ambitious water efficiency program (discussed later in this study).

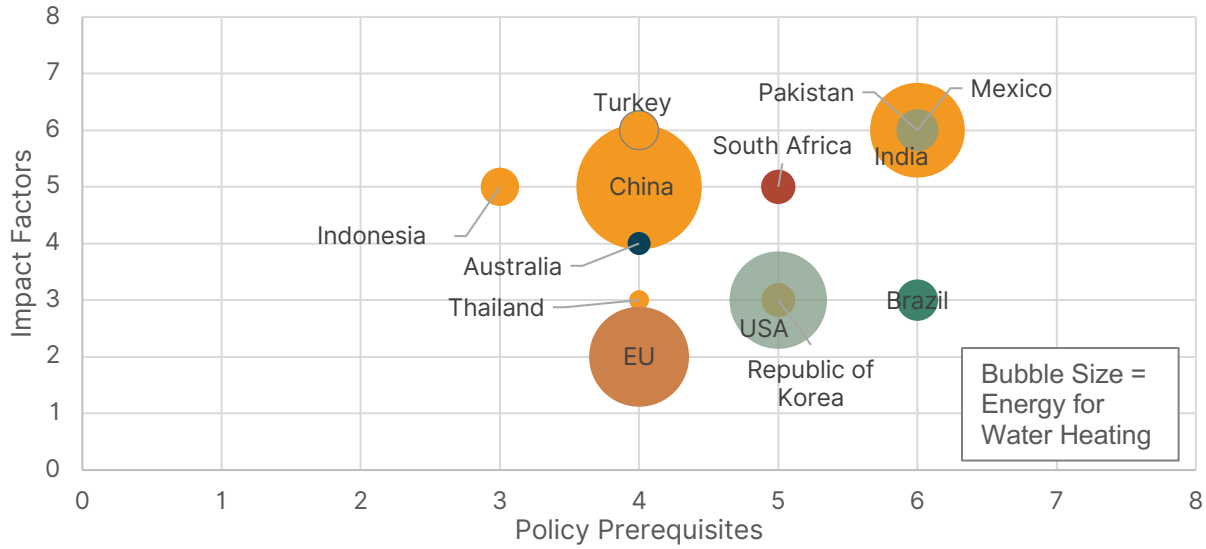


FIGURE 3 VISUALIZATION OF THE THREE IMPACT FACTORS: HOT WATER ENERGY CONSUMPTION, WATER STRESS, AND URBAN GROWTH RATE.

The size of each circle in the chart indicates the country's water-heating energy use, which is the basis for reducing CO_2 emissions through water efficiency standards. However, a high energy use did not automatically lead us to select that country as a priority. In addition to validation from both of the impact factors (vertical axis) and policy prerequisites (horizontal axis), this study further considered global representation as a factor. In the case of nearby countries, we then looked into more strategic reflections regarding CLASP's activity in those countries.

2.3. IDENTIFYING PRIORITY COUNTRIES

In order to ensure geographical representation, countries were further analyzed against others in their same continent according to their impact assessment and additional factors. The complete assessment identified India, Brazil, and South Africa as priority countries where water efficiency standards were expected to be more viable and impactful, and which were therefore chosen for in-depth scoping assessments on the ground. A detailed justification for each country's selection is below and more information on the non-priority countries can be found in Section 3.

India represented a high score on both axes and requires significant energy for water heating, signifying a high national water-heating energy use. The country therefore seems to be a location both where water resources are under pressure and the policy environment is receptive to the introduction of water efficiency standards. A focus on India meant the elimination of other geographically-adjacent countries in Asia such as Pakistan, the Republic of Korea, and Indonesia. Similarly, despite a high national water-heating energy use level in China, its policy environment and water stress score proved to be much lower than India.

Brazil emerged as another priority country despite its relatively low water stress score. Brazil was chosen over Mexico, which had the same policy score, because it has almost twice the population, is four times larger, and has the largest water resources in the world. The country has a historic dependence on hydroelectricity, but recent and severe droughts have led to strict water rationing. These factors make water management and security a top priority for policy makers in Brazil. In addition, CLASP has an existing constructive relationship with Brazilian policymakers. The United States was excluded from consideration as CLASP's partner the Appliance Standards Awareness Project (ASAP) is already pursuing efficiency policy opportunities at the state level.

Our final priority country is South Africa, which is the representative country for engagement in Africa as it is the only African country among the top-20 carbon-emitting countries, and policymakers are beginning to examine the existing water policy framework from an efficiency and conservation standpoint. As a result, the country is best placed for the introduction of water efficiency standards both from an economic and environmental point of view.

A comprehensive overview of these priority countries and their respective assessments is provided in Section 4.

Policy Environment Assessment by Economy

3.1. INTRODUCTION

The following section provides a preliminary assessment of the thirteen countries that received the prerequisite scores. In-depth assessments for the chosen priority countries, India, Brazil, and South Africa, are available at clasp.ngo. Assessments are divided according to the four prerequisites described in Section 1:

- "Existence of overarching water-related policies at the national and/or regional levels" to assess P1;
- "Preexisting Water Efficiency Standards and Labeling Programs" to assess P2; and
- "Existence of energy efficiency (EE) standards and labeling (S&L) programs" to assess P3.

Countries are ordered according to their water-heating use as shown in Table 3.

3.2. CHINA

3.2.1. OVERARCHING NATIONAL WATER FRAMEWORK (P1)

The overarching water policy framework is set under the *Water Law of the People's Republic of China* which was first established in 1988 and revised in 2002, 2009, and 2016. The Law aims to regulate the development, usage, conservation, and protection of water resources, and to prevent and mitigate flooding disasters. Under the Water Law, the country prioritizes water conservation and allocation, and promotes the use of efficient domestic water-using fixtures. Also, the Government of China supports the development of a circular economy and resource efficiency through the *2009 Circular Economy Promotion Law of the People's Republic of China*. Through this law, China advances the development of a circular economy, along with resource efficiency, environment protection and overall sustainable development. Water conservation is a key part of the Law, which provides for the development and improvement of water efficiency standards and labeling programs under a specialized agency.

Through the *National Water Conservation Action Plan* of 2019, the National Development and Reform Commission (NDRC) and Ministry of Water Resources aim at reducing water use at the national level. Targets set under the Plan include reducing water use per GDP and water use per industrial added value by 23% and 20% respectively by 2020 against 2015; and by 30% and 28% respectively by 2022. Also, the total national water use should not exceed 700 billion cubic meters by 2035. In order to achieve these targets, the plan looks at water efficiency measures, such as the promotion of the water efficiency labeling; implementation of the Leading Water Efficiency Programme and the certification of water conservation; and international cooperation and mutual recognition in water efficiency labeling, certification, and testing results etc.

3.2.2. WATER EFFICIENCY TESTING STANDARDS & LABELING PROGRAMS (P2)

Standards
Various standards were defined in China and are relevant to the scope of this study. These include:

Faucets standards:

- GB 25501-2010 Minimum allowable values of water efficiency and water efficiency grades for faucets
- GB 18145-2014 Ceramic cartridge faucets

Shower heads:

- GB 28378-2012 Minimum allowable values of water efficiency and water efficiency grades for showers
- GB/T 23447-2009 Shower outlets for bathing

Toilet standards:

- GB 25502-2017 Minimum Allowable Values of Water Efficiency And Water Efficiency Grades For Water Closets
- GB 6952 – 2015 Sanitary wares

Labeling

Three main labeling programs are currently in place in China. The country introduced the *Leading Water Efficiency Program* in 2016. The program has three categories:

- High water efficiency products, such as faucets, toilets, and washing machines;
- High water efficiency enterprises in high water consumption industries (e.g. petro-chemical, textile, steel manufacturing, or power plants);
- Irrigation and farming water efficiency;

Products or enterprises qualifying for the *Leading Water Efficiency Program* can affix the program label to product packages or use the labels for advertising and dissemination purposes. The label is reported in Figure 3.

FIGURE 4 EXAMPLE OF THE LEADING WATER EFFICIENCY PROGRAM LABEL

FIGURE 5 EXAMPLE OF THE WATER EFFICIENCY LABELING PROGRAM LABEL

The Labeling Program provides for relevant government agencies to promote products and enterprises qualified for the program, and to prioritize these products and enterprises for government procurement programs. Currently, only one product category (toilets) is in the Leading Water Efficiency Program.

The ***Water Efficiency Labeling Program*** was introduced in 2017 and became effective on March 1, 2018. This program is a mandatory and categorical labeling program. A product catalogue is expected to be created under this program, and products part of the catalogue are required to be registered and approved by China National Institute of Standardization (CNIS). The program has similar features to the China's energy labeling program and the efficiency label design is very similar to the energy labels (Figure 5).

Only the toilet product category is in the labeling program. However, with minimum water efficiency standards for faucet and showerhead already in place, it is expected that the labeling program will cover faucets and showerheads in the future.

A ***Water Conservation Certification*** has been in place since 2002 and was established under the China Quality Certification Center (CQC). The Certification covers more than 7000 water-using products, including water closet, faucets, and showers and it is a voluntary endorsement labeling scheme. The Water Conservation Certification scheme is very similar to the Energy Conservation Certification scheme, which is also run by CQC. Figure 5 reports the label of the Certification.

3.2.3. ENERGY EFFICIENCY S&L PROGRAMS (P3)

Energy efficiency labeling and standards program are in place in China, as showed by the over 200 policies available in the CLASP policy database.

3.3. EUROPEAN UNION

3.3.1. NATIONAL WATER EFFICIENCY POLICY (P1)

The overarching policy framework at the European Community level is the Water Framework Directive (WFD) and Water Blueprint of 2000. The WFD offers a legal basis to protect and restore clean water across Europe and ensure the sustainable use of the resource. The Blueprint provides Member States with a set of potential tools to improve water management at national, regional, and river basin levels. Priority areas include a better implementation of current water legislation, integration of water policy objectives into other policies, and filling the gaps in particular as regards water quantity and efficiency.

The implementation of legislation, agreements, and labels at the Member State level varies. Overall, it was observed that mandatory legislation is not in place or that it is applied at regional or municipal level, in accordance with the national building code. Also, taps and showers normally follow voluntary environmental labelling schemes. Labelling schemes can be based on pass/fail criteria or on water- and energy-saving/efficiency rating systems.

3.3.2. WATER EFFICIENCY TESTING STANDARDS AND LABELING PROGRAMS (P2)

A set of standards is available at the EU level to assess technical specifications of products. One of the most relevant standards is EN 200:200824 that applies to draw-off taps used in toilets, bathrooms, and kitchens. The EN 200 standard allows taps to be classified based on certain characteristics (e.g. supply system, type of tap, intended use, mounting method). In terms of type, a distinction is made between pillar taps, bib taps, and single-hole/multi-hole combination taps. The main standard for shower outlets is EN 1112:200825. However, the energy use associated with

water flow rates is not considered in EN standards. In particular, standards are based on the delivery of water, which is then associated to the consumption of energy.

Several voluntary labelling initiatives focused on resource consumption exist in Europe for this product group, such as:

- the ANQIP label
- the European Water Label (the most widely adopted)
- the Swedish Energy Efficiency Label
- the Swiss Energy Label for Sanitary Fittings
- the Water Efficiency Label

Beyond water-specific labeling schemes, an Energy Efficiency Obligation (EU) exists for EU countries to set up an energy efficiency obligation scheme. The scheme requires countries to generate "Energy Efficiency Certificates" for a set of energy efficiency measures which can also be related to water efficiency. For example, the installation of water saving taps and showerheads is part of the energy efficiency measures for the issuing of "Titoli di Efficienza Energetica" in Italy. Similar measures are being considered in France and Portugal.

Furthermore, the European Commission (EC) is currently considering various policy options, including a European mandatory label. The Label would be able to accelerate the market transformation towards water- and energy-saving products without limiting consumers. These results would align with the EC priorities and result in benefits at EU level in terms of water, energy and cost savings and reduction of GHG emissions. CLASP is working to support the EC and standardization bodies to develop a test method that could underlie mandatory standards and labeling.

3.3.3. ENERGY EFFICIENCY S&L PROGRAMS (P3)

The EU has 104 EE S&L policies recorded in the CLASP database. Among these, 8 policies cover dishwashers and clothes washers. MEPS were set under the Ecodesign Directive, indicating additional linkages and data available regarding water and energy use. Also, through the Energy Labelling Directive, consumers can be informed on the use of other resources, including water consumption. So far, energy labels are mandatory for water-related products, such as washing machines, dishwashers and water heaters.

3.4. UNITED STATES OF AMERICA

3.4.1. OVERARCHING NATIONAL WATER FRAMEWORK (P1)

The overarching water policy framework is the Federal Water Pollution Control Act of 1948, which was the first federal water law in the United States. Initially, the Law was poorly implemented, but it was amended in 1972 to become the Clean Water Act (CWA), which the Environmental Protection Agency (EPA) administrator was tasked to enforce. Although the CWA didn't mention appliance standards or specific water-saving technologies, it laid the groundwork for federal considerations of water conservation. The Clean Water Act states that the EPA Administrator shall give consideration to "effective utilization and conservation of fresh water and other natural resources."

The Energy Policy Act of 1992 (EPAct 92) was the first rule to directly address water-using appliance efficiency, specifying 1.6 gallons per flush (gpf) for toilets, 1.0 gpf for urinals, 2.2 gallons per minute (gpm) for kitchen and bathroom faucets, and 2.5 gpm for showerheads. Under the federal preemption law, states are not allowed to enact rules that conflict with the federal government. However, the EPAct92 specified that states could set their own water efficiency standards if the federal government refused to publish more stringent standards after five years. Federal government formally exercised this waiver in 2010.

3.4.2. WATER EFFICIENCY TESTING STANDARDS & LABELING PROGRAMS (P2)

3.4.2.1. STANDARDS

In 2006, the EPA started WaterSense, a voluntary standards program. In 2007 and 2009 (before the Federal Government officially waived the preemption on toilet and urinal standards), California and Texas respectively moved to require WaterSense standards for toilets and urinals sold in the state. Georgia followed in 2010. In 2014 and 2015, the California Energy Commission adopted more stringent standards for faucets, showerheads, toilets, and urinals. Since then, Colorado, Vermont, Hawaii, Oregon, Connecticut, and Washington have followed, variously requiring toilets, urinals, faucets, showerheads, lawn spray sprinklers, and other appliances to meet WaterSense standards or California standards.

According to EPA, the agency is currently "reviewing existing WaterSense product specifications for tank-type toilets, flushing urinals, bathroom faucets, showerheads, and irrigation controllers" in line with the requirements of the America's Water Infrastructure Act of 2018. For the time being, the standards described below exist at a federal level or are voluntary WaterSense standards.

- Kitchen Faucets: Federal standard: 2.2gpm; No WaterSense specification; CEC specification: "1.8 gallons per minute flow rate and may have capability to increase to 2.2 gallons per minute momentarily for filling pots and pans," according to 2015 CEC news release.
- Showerheads: Federal standard: 2.5 gpm; WaterSense: 2.0 gallons per minute. ASME A112.18.1/CSA B125.1; CEC specification: 1.8 gallons per minute.
- Residential Bathroom Faucets: Federal Standard: 2.2gpm; WaterSense: October 1, 2007, specification for bathroom faucets. No more than 1.5 gallons per minute. ASME A112.18.1/CSA B125.1 and NSF/ANSI Standard 61, Section 9; CEC standards: 1.2 gpm.
- Public lavatory faucets Federal Standard 2.2 gpm; No WaterSense standard; CEC standard: 0.5 gpm Note: Metered faucets (which shut off after a few seconds) are also subject to federal standards similar to those for residential bathroom faucets (they must discharge no more than 0.25 gallons per cycle), but have no WaterSense standards.
- Residential Toilets Current federal standard 1.6 gpf; WaterSense: In June 2014, revised version of the *WaterSense Specification for Tank–Type Toilets* (Version 1.2) specified 1.28 gallons per flush; Single flush: ASME A112.19.2/CSA B45.1; Dual flush: ASME A112.19.14.
- Urinals: Current federal standard: 1 gallon per flush (gpf); WaterSense: 0.5 gpf. ASME A112.19.2/CSA B45.1, ASME A112.19.3/CSA B45.4, or IAPMO Z124.9; CEC standards: 0.125 gpf.

- Lawn spray sprinklers: WaterSense: Standard published September 2017. Section 302 of ASABE/ICC 802-2014, Sprinkler and Circler Design Requirements.

FIGURE 6 EXAMPLE OF A WATERSENSE LABEL

3.4.2.2. LABELING

The Environmental Protection Agency's voluntary WaterSense is the primary water efficiency labeling program in the United States. WaterSense was introduced in 2006 as a corollary to the EnergyStar program and it promises to deliver 20 percent more water efficient products than the average product in that category (Example label in Figure 6).

3.4.3. ENERGY EFFICIENCY S&L PROGRAMS (P3)

The United States has a solid EE S&L program. Based on the CLASP database, the country has over 180 energy efficiency S&L policies enforced. These include those covering washing machines and dish washers.

3.5. INDIA

3.5.1. OVERARCHING NATIONAL WATER FRAMEWORK (P1)

The overarching national policy framework is set through the National Water Policy (NWP), which was initially introduced in 1987 and revised in 2002 and 2012. Through the NWP, India is looking to advance water efficiency in relation to irrigation and water supply management. However, no programs or measures were defined to improve water efficiency for domestic products. A revision of the NWP is expected for release in 2019, which aims to introduce changes in the overall water governance structure and regulatory framework, while responding to criticism regarding the effectivity of the current NWP[16]. In addition to this, a National Bureau of Water Use Efficiency will be established. Finally, a mechanism for water efficiency labelling in municipal and household sectors is currently being investigated.

The main institution responsible for water resources management is the Ministry of Jal Shakti which was established by merging the Ministry of Water Resources and the Ministry of Drinking Water and Sanitation[17].

3.5.2. WATER EFFICIENCY TESTING STANDARDS & LABELING PROGRAMS (P2)

Currently, the Government of India is planning on advancing with standards for taps and showers, which are intended to be incorporated into the water efficiency requirements by the Bureau of Indian Standards (BIS). Also, water efficiency standards exist for flushing cisterns for water closets and urinals.

A relevant initiative is the Water Efficient Products–India (WEP-I) Program. The WEP-I is a voluntary labeling program jointly developed by IAPMO Plumbing Codes and Standards India Private Limited (IAPMO India) and the India Plumbing Association (IPA). Through the WEP-I, various codes were introduced starting in 2011 and revised in 2013 and 2017. The intended objective of the WEP-I is to reduce water usage through efficient fixtures. The categories of products covered by the Program include water closets, faucets and showerheads. In order for products to be certified, manufacturers of high-water efficiency products need to test their products in IAPMO certified laboratories and send their test results to IAPMO. A product-registry is available for the certified products on the IAPMO website. Following the certification, manufacturers can apply the WEP-I labels to their products[18].

[16] Chetan Pandit and Asit K. Biswas. (2019). "India's National Water Policy: 'feel good' document, nothing more". International Journal of Water Resources Development.

[17] Department of water resources, river development and ganga rejuvenation, Ministry of Jal Shakti. http://mowr.gov.in/policies-guideline/policies/national-water-policy

[18] IAPMO. http://www.iapmo.org/india/product-certification/plumbing-and-mechanical-products

FIGURE 7 EXAMPLE OF A WEP-I LABEL

3.5.3. ENERGY EFFICIENCY S&L PROGRAMS (P3)

India has an extensive energy efficiency S&L policy framework, also covering washing machines as reported the CLASP S&L database. This suggests that the country would have a supportive policy and institutional environment that meets the prerequisites for further investigation.

3.6. PAKISTAN

3.6.1. OVERARCHING NATIONAL WATER FRAMEWORK (P1)

The National Water Policy[19] was established by the Ministry of Water Resources in 2018 with the objective to provide a comprehensive framework and plan of action to address the country's water crisis. The policy provides a national framework at the federal level, and each province can develop its own master plans for implementation.

Demand management is specifically mentioned in Section 26 of the National Water Policy. In particular, Section 26.3 requires Demand Management Plans to be prepared and targets to be set and enforced; and Section 26.4 requires water use efficiency in all sectors to be vigorously pursued. Also, the Policy requires for water quality standards and effluent standards, but it does not specifically mention standards related to water efficiency.

3.6.2. WATER EFFICIENCY TESTING STANDARDS & LABELING PROGRAMS (P2)

No water efficiency standards and labels for faucets, showerheads, or toilets are found in preliminary research.

3.6.3. ENERGY EFFICIENCY S&L PROGRAMS (P3)

According to the CLASP S&L database, Pakistan has 33 EE S&L policies in place. Also, CLASP worked previously with Pakistan and supported the Province of Punjab on a Ceiling Fan S&L project in collaboration with the World Bank

3.7. MEXICO

3.7.1. OVERARCHING NATIONAL WATER FRAMEWORK (P1)

The National Water Law[20] **was first established i**n 1992 and revised in 2016. The Water Law governs the development, use, and protection of the water resources of the Nation, as well as its administration. The National Water Commission (CONAGUA) is the main government agency responsible for monitoring and developing water resources in the country.

As part of the National Development Plan, the **National Water Plan 2008-2014 (Progama Nacional Hídrico, 2014-2018)**[21]**,** includes water conservation and efficient use of water resources as part of several strategies. However, the plan does not specifically mention standards and labeling programs for water efficiency.

[19] https://mowr.gov.pk/index.php/national-water-policy-2018/
[20] https://www.ecolex.org/details/legislation/ley-de-aguas-nacionales-lex-faoc003015/
[21] National Water Plan 2014-2018. Available at:
http://www.conagua.gob.mx/CONAGUA07/Contenido/Documentos/PROGRAMA_Nacional_Hidrico_2014_2018_ingles.pdf

3.7.2. WATER EFFICIENCY TESTING STANDARDS & LABELING PROGRAMS (P2)

No water efficiency standards and labeling programs for faucets, showerheads, and toilets were found in preliminary research.

3.7.3. ENERGY EFFICIENCY S&L PROGRAMS (P3)

The country developed EE S&L programs and over 90 policies are enforced based on the CLASP database

3.8. BRAZIL

3.8.1. OVERARCHING WATER POLICY FRAMEWORK (P1)

Brazil is the country with the widest water availability globally. This makes the sustainable management of water resources a priority for the Brazilian Government[22].

Under the **Brazilian Water Law, Law No. 9,433 of 1997,** the National Water Agency (ANA)[23] is the designated regulatory agency to enforce the objectives and guidelines of the Water Law. Also, the 1997 Water Law instituted the **National Policy of Water Resources (PNRH)**, which is the first plan created by a country in Latin America to manage water resources sustainably. The PNRH sets out key principles for the management of federally-owned water resources (those crossing more than one state or border). Under the PNRH, water is a public domain good, and the plan outlines 10-year programs to secure water for Brazilians, while safeguarding aquatic life.

3.8.2. WATER EFFICIENCY TESTING STANDARDS AND LABELING PROGRAMS (P2)

No water efficiency standards and labeling programs for faucets, showerheads, and toilets are found in preliminary research.

3.8.3. ENERGY EFFICIENCY S&L PROGRAMS (P3)

Brazil initiated its S&L program in 1984, covering both voluntary and mandatory labels and standards for domestic, industrial, and commercial products. CLASP is currently collaborating with the Brazilian government, at both the Brazilian Metrology Institute (INMETRO) and the National Electrical Energy Conservation Program (PROCEL), to support decision makers in revising or expanding the energy performance labels for street lighting and cooling appliances.

3.9. TURKEY

3.9.1. OVERARCHING NATIONAL WATER FRAMEWORK (P1)

The Turkish water policy framework is set under the Law Concerning Water (Sular Hakkinda Kanun), No. 831 of 1926. The Law, does not sufficiently address a number of subjects, such as water-related construction (e.g., dams), industrial water needs, groundwater usage, irrigation, and pollution of the receiving environment. Through the 1953 Law on the Establishment of the General Directorate of State Hydraulic Works (referred as DSI), No. 6200[24], the duties and powers of the DSI and the organizations were defined. The DSI is responsible for the planning, management, development, and operation of all water resources in Turkey Also, water conservation is part of DSI's responsibilities[25].

[22] http://www.brazil.gov.br/links/factseet-world-water-forum.pdf
[23] https://www.ana.gov.br/
[24] http://www.dsi.gov.tr/kurumsal-yapi/hakkimizda
[25] https://www.loc.gov/law/help/water-law/turkey.php#_ftn29

Overall, there are over 100 laws and regulations related to water resources management, water sanitation, and agriculture irrigation etc[26]. However, our preliminary review did not show specific national level water policies that focusing on water conservation and water efficiency.

3.9.2. WATER EFFICIENCY TESTING STANDARDS & LABELING PROGRAMS (P2)

No water efficiency standards and labels for faucets, showerheads, and toilets were found in a preliminary research.

3.9.3. ENERGY EFFICIENCY S&L PROGRAMS (P3)

The country has energy efficiency S&L programs in place, suggesting that a supportive policy framework and institutions exist for the potential expansion to water efficiency standards.

3.10. INDONESIA

3.10.1. OVERARCHING WATER POLICY FRAMEWORK (P1)

The framework to establish the principles and objectives of water management, conservation, and development[27] is provided under the **Law on Water Resources Development (Law No. 11 of 1974).** In 2004, the 1974 Law was revised through the **Law on Water Resources (Law No. 7 of 2004).** However, the 2004 Law was controversial since it allowed private sector companies to sell packaged tap water while the Indonesian Constitution defines the right to water as a basic right, and the control of water resources as a government mandate[28]. For this reason, the 2004 Law was overturned by Indonesia's Constitutional Court in 2015. As a result, the 1974 Water Law was re-introduced and remains in effect until a new measure is adopted.

3.10.2. WATER EFFICIENCY TESTING STANDARDS AND LABELING PROGRAMS (P2)

No water efficiency standards or labeling for faucets, showerheads, or toilets are found in preliminary research.

3.10.3. ENERGY EFFICIENCY S&L PROGRAMS (P3)

Only 4 energy efficiency policies have been enacted in Indonesia. These cover MEPS and comparative labels for air conditioning and lighting. Currently, the country is at the early stage of framing and revising its energy efficiency standards framework with CLASP support.

3.11. SOUTH AFRICA

3.11.1. OVERARCHING WATER POLICY FRAMEWORK (P1)

Under the **National Water Act (Act 36 of 1998)** and the **Water Services Act (Act 108 of 1997),** the Department of Water Affairs (now Department of Water and Sanitation – DWS) was mandated as the public trustee of the nation's water resources. The objective of the mandate is to ensure that water is protected, used, developed, conserved, managed, and controlled in a sustainable and equitable manner, for the benefit of everyone. The Water Act provides for the establishment of a **National Water Resource Strategy.** The first NWRS was developed in 2004 by the Department of Water Affairs and revised in 2013, known as NWRS2. The NWRS2 builds on the first strategy and acknowledges that South Africa is a water-stressed country, facing a number of water challenges and concerns,

[26] Aysegül Kibaroglu. Legislative Framework for Water Management in Turkey. Available at: http://www.mpfpr.de/fileadmin/media/Water_Law/Nationales_Recht/Treaties_Turkey/Kibaroglu_Turkish_Water_Law_English.pdf
[27] For more information https://www.ecolex.org/details/legislation/law-on-water-resources-development-law-no-11-of-1974-lex-faoc001336/
[28] For more information https://www.loc.gov/law/foreign-news/article/indonesia-water-law-overturned-by-court/

including security of supply, environmental degradation and resource pollution, and the inefficient use of water[29].The overall goal of this plan is to ensure that "water is efficiently and effectively managed for equitable and sustainable growth and development". Water conservation and demand management is part of the strategy. The strategy priorities include significant reduction in water use by all sectors, and a 50% reduction in water loss to be achieved by 2017. More recently, the National Water and Sanitation Master Plan (DWS, 2018) recognizes that 17% more water will be required in 2030 than is currently available. This unsustainable path is driven by consumption habits of 237 liters per capita per day against a global average of 173. This has prompted national government to focus on both supply and demand side measures to manage the pending shortfall.

In November 2019, the DWS introduced a 23-point national water and sanitation and master plan[30] which specifically targets residential water efficiency (page 12) *"average domestic consumption must be reduced to 175 liters per person per day by 2025 …must include a focus on water use efficiency."*

3.11.2. WATER EFFICIENCY TESTING STANDARDS AND LABELING PROGRAMS (P2)

Based on a 2019 Report[31], the Department of Trade, Industry and Competition (DTIC) has initiated the process to include water efficiency standards aspects in The National Building Regulations and Building Standards Act which to be released for public comments in 2019. Otherwise, no water efficiency standards and labeling programs for faucets, showerheads, or toilets are found in preliminary research.

3.11.3. ENERGY EFFICIENCY S&L PROGRAMS (P3)

South Africa has an existing energy efficiency standards and labeling program which include washing machines and dish waters, and water consumption was part of the metrics used to evaluate these two products. 26 energy efficiency policies are part of the CLASP database. The S&L project team, which resides within the Department Minerals Resources and Energy (DMRE) has recognized that it has a role to play and has start preparing and sensitizing industry to the introduction of a mandatory cap on water consumption for laundry and dishwashers.

3.12. REPUBLIC OF KOREA

3.12.1. OVERARCHING WATER POLICY FRAMEWORK (P1)

The Republic of Korea's water policy was first developed in the 1960s with the first *10-year Comprehensive Water Resources Development Plan of 1966-1975*. In 1990s the country introduced the concept of eco-friendly water resources management. Since 2000s, the country introduced sustainable water management including stream environment preservation, and then evolved to focus on coping with climate change and advancing the water management system.

In terms of water efficiency, through the **Comprehensive Plan on Water Savings[32] of 2000** the country prioritized 3 objectives: (1) expanding water-saving devices and greywater systems;(2) restructuring the water billing system to promote water saving; (3) replacing the old water pipes. Through the plan, 930 million tons l tap water savings were reached by 2012. The **Comprehensive Plan on National Water Demand Management** built upon the Comprehensive Plan and was established in 2007**.** The plan aimed to save 1,021 million tons of tap water from 2007 to 2016.

Also, **the Water Supply and Waterworks Installation Act** provides for public restrooms and sports facilities to install the water-saving devices and water-saving performance requirements.

[29] For more information https://cer.org.za/news/national-water-resource-strategy
30 https://www.gov.za/sites/default/files/gcis_document/201911/national-water-and-sanitation-master-plandf.pdf
[31] https://www.greencape.co.za/assets/Uploads/WATER-MIR-2019-WEB-01-04-2020.pdf
[32] Ministry of Environment: http://eng.me.go.kr/eng/web/index.do?menuId=288

3.12.2. WATER EFFICIENCY TESTING STANDARDS AND LABELING PROGRAMS (P2)

Standards

Water efficiency standards for ROK include:

- Korea Eco-label Standards EL221: 2012 for Water-Saving Faucet including maximum flow rate between 5.5 L/min or less or as much as 6.0 L/min for kitchen, face washing, shower, public restrooms and other kinds of faucets.
- Korea Eco-label Standards EL222: 2012 for Water-Saving Showerhead and Water Saving Components for Faucet. The standard establishes that the total water flow rate from a showerhead shall be 7.5 L/min or less at the water pressure of 98 kPa.
- Korea Eco-label Standards EL223: 2013 for Water-Saving Toilet. The standard establishes that the water use for feces should use less or as much as 6 liters and urine less or as much as 4 liters.

Labeling

The Republic of Korea has a long-running Eco-Label program which covers faucets, showerheads, and toilets. The Eco-Label program is run by the Eco-Label Certification Office & the Environmental Standard Management Office, both of which are under the Korea Environmental Industry & Technology Institute (KEITI). KEITI is a quasi-government organization, affiliated with the Ministry of Environment[33]. The Eco-Label program is a voluntary certification program which aims to provide environmental information to consumers and encourage manufacturers to develop and produce environment-friendly products in line with consumers' preferences by affixing the Eco-Label on products. Once companies satisfy all certification requirements, such as product testing and audit, the Eco-Label (as shown below) can be affixed to the certified products.

3.12.3. ENERGY EFFICIENCY S&L PROGRAMS (P3)

The Republic of Korea has a well-established energy efficiency S&L program 103 policies in the CLASP S&L database, including policies for washing machines and dish washers.

3.13. AUSTRALIA

3.13.1. OVERARCHING WATER POLICY FRAMEWORK (P1)

The National Water Initiative[34] is the blue print of Australia's national water reform. The national government of Australia and the governments of local states and jurisdictions entered into an agreement to implement the National

[33] http://el.keiti.re.kr/enservice/enindex.do
[34]Intergovernmental Agreement on a National Water Initiative Between the Commonwealth of Australia and the Governments of New South Wales, Victoria, Queensland, South Australia, the Australian Capital Territory and the Northern Territory. Available at: http://www.agriculture.gov.au/SiteCollectionDocuments/water/Intergovernmental-Agreement-on-a-national-water-initiative.pdf

Water Initiative (NWI) to increase the productivity and efficiency of Australia's water use and to ensure the health of the water systems. In particular, the NWI specified two policy measures to achieve its overarching goals:

- To implement the Water Efficiency Labelling Scheme (WELS) nationally by 2005, including mandatory labelling and minimum standards for agreed appliances;
- To develop and implement a 'Smart Water Mark' for household gardens, including garden irrigation equipment, garden designs and plants;

Through the Water Efficiency Labelling and Standards Act 2005[35], the country formed the legal basis of Australia's WELS (Water Efficiency and Labeling and Standards) program. This Act was first introduced in 2006 and amended multiple times over the past decade. The latest version of this Act was registered in 2016. This Act, administered by the Ministry of Agriculture, was intended to establish a national water efficiency labelling and standards scheme with the overall objectives to:

(a) to conserve water supplies by reducing water consumption;
(b) to provide information for purchasers of water-use and water-saving products;
(c) to promote the adoption of efficient and effective water-use and water-saving technologies

The Water Efficiency Label and Standards Act 2005 is also supported by a series of supporting legislations as well state and territory level legislations, including:

- Water Efficiency Labelling and Standards Regulations 2005
- Water Efficiency Labelling and Standards Determination 2013 (No.2)
- Water Efficiency Labelling and Standards Declaration 2016
- Water Efficiency Labelling and Standards (Registration Fees) Act 2013
- Water Efficiency Labelling and Standards (Registration Fees) Determination 2013
- Australian Capital Territory: Water Efficiency Labelling and Standards (ACT) Act 2015.
- New South Wales: Water Efficiency Labelling and Standards (New South Wales) Act 2005.
- Northern Territory: Water Efficiency Labelling and Standards (National Uniform Legislation) ACT 2014.
- Queensland: Water Efficiency Labelling and Standards (Queensland) Act 2005.
- South Australia: Water Efficiency Labelling and Standards (South Australia) Act 2013.
- Tasmania: Water Efficiency Labelling and Standards Act 2013.
- Victoria: Water Efficiency Labelling and Standards Act 2005.
- Western Australia: Water Efficiency Labelling and Standards Act 2006.

The WELS scheme website provides a complete list of these legislation and summaries of the legislation scope[36].

3.13.2. WATER EFFICIENCY TESTING STANDARDS AND LABELING PROGRAMS (P2)

Standards
Various standards are in place in the country.

[35]Water Efficiency Labelling and Standards Act 2005. Available at: https://www.legislation.gov.au/Details/C2016C00901
[36] https://www.waterrating.gov.au/about/legislation

- Australian Standard 6400:2016 Water efficient products — Rating and labelling[37]
- This Standard specifies requirements for the rating and labelling of products for water efficiency, and, where applicable, specifies minimum water efficiency standards. Products covered by this standard include: showers, tap equipment, flow controllers, lavatory equipment, urinal equipment, dishwashers, clothes washing machines, and dryer function of combination washer/dryers, where they use water to dry a load. All regulated products must be tested, rated, and labelled in accordance to the Australian Standard 6400:2016. Furthermore, the products have to meet the product-specific requirements. For showers, taps, and toilets, the product-specific standards are as follows[38]:

- **Showers:** AS/NZS 3662:2013 Performance of showers for bathing
- **Tap equipment:** AS/NZS 3718:2005 Water supply — Tap ware
- **Toilets:** AS 1172.1:2014 Water closets (WC) Pans
- AS 1172.2:2014 Water closet (WC) Flushing devices and cistern inlet and outlet valves
- ATS 5200.021-2004 Technical Specification for plumbing and drainage products, Part 021: Flushing valves for water closets and urinals-For use with break tank supply
- ATS 5200.020-2004 Technical Specification for plumbing and drainage products, Part 020: Flushing valves for water closets and urinals-For use with mains supply
- ATS 5200.030-2012 Technical Specification for plumbing and drainage products Solenoid valves

Labeling

The Water Efficiency Labeling and Standards (WELS) scheme is a mandatory labeling program for regulated water-using products, which include showerheads, taps, urinals, toilets, flow controllers, washing machines and dishwashers. Regulated products need to be tested and labeled. The Water Rating Label (see below) is a categorical label which provide information of water efficiency performance of a product. More stars indicate a higher water efficiency level for a product. The label also provides information on water consumption specifications as well as the registration details of the product.

FIGURE 8 EXAMPLE OF A LABEL UNDER WELS

[37]Australian Standard 6400:2016 https://infostore.saiglobal.com/en-us/Standards/Product-Details-100970_SAIG_AS_AS_212146/?ProductID=100970_SAIG_AS_AS_212146
[38]https://www.waterrating.gov.au/about/standards#product-specific

All regulated products are also required to be registered in the WELS Product Registration Database[39]. According to the WELS scheme, over 22,000 products have been registered in the database[40].

3.13.3. ENERGY EFFICIENCY S&L PROGRAMS (P3)

Australia has a well-established energy efficiency standards and labeling program with 37 documented policies on the CLASP database.

3.14. THAILAND

3.14.1. OVERARCHING WATER POLICY FRAMEWORK (P1)

Water is managed by the National Office for Water Resources, which was established in 2017 as an encompassing organization to cover water issues in the country and ensure cooperation among multiple government agencies that manage water. Among these, key agencies include the Royal Irrigation Department which focuses on water used for agriculture, the Department of Energy Development and Promotion, which manages the pumping schemes, and the Department of Mineral Resources, which manages and controls the use of groundwater.

In terms of policies, water management has been included in the scope of the National Economic Development Plans (NEDP) starting in 1962. Initially, the priority area was on water used for irrigation to support agriculture and the focus was on supply-side management. More recently, the focus shifted to ensuring water quality and availability to respond to higher competing demands through a demand-side approach, along with water basin management strategy and the creation of a river basin authority.

Another relevant regulation is the Enhancement and Conservation of National Environmental and Quality Act, B.E. 2535 (A.D.1992), which prescribes environmental water quality standards and wastewater treatment.

3.14.2. WATER EFFICIENCY TESTING STANDARDS AND LABELING PROGRAMS (P2)

A Thai Green Label for faucets and water saving devices was introduced in 2011 and revised in 2017. The Thai Green Label program is an endorsement voluntary label, whose 2017 requirements are as follows.[41]

- **Sink faucets**: water flow rate not more than 4.5 L/min at pressure of 0.1 ± 0.01 megapascal.
- **Wash basin faucets**: water flow rate not more than 4.5 L/min at pressure of 0.1 ± 0.01 megapascal.
- **Self-closing faucets for wash basins**: water flow rate not more than 0.32 L and the average time for water flow not less than 2 second at pressure 0.1, 0.2, 0.3 megapascal
- **Automatic faucets for sanitary wares**: water flow rate not more than 5 L/min at pressure of 0.1 ± 0.01 megapscal.
- **Showers:** water flow rate not more than 6.5 L/min - 7.0 L/min at not less than 0.5 L/min at pressure of 0.1 ± 0.01 megapascal.
- **Rinsing sprays (toilette):** water flow rate not more than 5.0 L/min at pressure of 0.1 ± 0.01 megapascal.
- **Flush valves for urinals**: water flow rate not more than 1.6 L/flush (size 15); 3.0 L/flush (size 20);
- **Flush valves for toilets**: water flow rate not more than 4.8 L/min at pressure of 0.1 ± 0.01 megapascal.

Categorical labels and water efficiency standards programs were not found during this preliminary research.

39 https://wels.agriculture.gov.au/wels-public/action/search-product-load?src=menu
40 Based on infographics displayed on https://www.waterrating.gov.au/
41 An English version of the 2017 policy was not available at the time of writing. The 2017 Thai version is available at http://www.tei.or.th/greenlabel/download/TGL-11-R3-17.pdf

3.14.3. ENERGY EFFICIENCY S&L PROGRAMS (P3)

Thailand has a well-established energy efficiency S&L framework, and CLASP is working closely with the Energy Generating Authority of Thailand for providing recommendations for an impactful AC labeling.

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Conclusion

4.1 PRIORITIZED COUNTRIES

The study examined the interrelations between impact factors of water efficiency standards, and the policy environment to understand the viability of introducing such standards in 18 economies. The final results of the study identified three priority countries for engagement to investigate the applicability of US-based assumptions at the global level: Brazil, South Africa, and India.

India

TABLE 4 INDIA POLICY PREREQUISITES

Country	Number of EE Policies	P1	P2	P3	Total
India	58	2	2	2	6

India is one of the most water-scarce countries in the world with high exposure to extreme weather events and increasing population. In a recent interview, the Minister Jal Shakti emphasized that the country needs to conserve water and recharge aquifers[42]. This statement was in response to recent events, such as the 2019 water crisis in Chennai (the sixth most populous city in India), which resulted in 3 water reservoirs to almost run dry[43]. Ground water levels have been decreasing drastically over the years due to over extraction, poor water management, increasing urbanization. The current policy framework for water efficiency standards is supportive for advancing programs at the national level (P1 is 2 points). This would allow the country to go beyond the voluntary WEP-I program for water-consuming products. Also, India's Government is looking at advancing an official water efficiency program through the BIS. In particular, recent news reports suggested that the Ministry of Jal Shakti is in the process of creating a Bureau of Water Efficiency, similar to the Bureau of Energy Efficiency[44]. As a result, the country's prioritization of a water efficiency framework along with India's experience in running a successful energy efficiency S&L program (P3 is 2 points), seem to suggest the country meets prerequisites for complementing a water efficiency program under the scope of this project.

Brazil

TABLE 5 BRAZIL POLICY ASSESSMENT

Country	Number of EE Policies	P1	P2	P3	Total
Brazil	49	2	2	2	6

Water management seems to be one of the priorities of the Brazilian Government. The country recently introduced a water policy framework to sustainably manage Brazilian water resources, and to increase water security (P1 is 2 points). In comparison to Brazil's long-standing energy efficiency program, such as the energy efficiency labeling program and the PROCEL program, no similar water efficiency labeling programs are in place. However, EE S&L programs constitute a solid basis to pursue water-related standards and labeling programs (P3 is 2 points and P2 is 2 points). As a result, it seems opportunities exist to implement similar water efficiency labeling programs in Brazil under the scope of this project.

42 https://www.thehindubusinessline.com/news/national/not-chennai-bangalore-but-a-majority-of-india-could-face-water-scarcity-jal-shakti-minister/article29833803.ece#
43 https://www.cnn.com/2019/06/22/india/chennai-india-water-crisis-intl/index.html
44 https://www.deccanherald.com/national/now-water-fixtures-to-be-rated-by-efficiency-758334.html

South Africa

TABLE 6 SOUTH AFRICA'S POLICY ASSESSMENT

Country	Number of EE Policies	P1	P2	P3	Total
South Africa	25	2	2	1	5

South Africa is a water-scarce country and has been facing various water challenges related to water availability. For example, Cape Town suffered severe water shortage in the Western Cape region, most notably affecting the City of Cape Town during the period between mid-2017 to mid-2018. Water level of major dams fell below 13.5% and municipal water supply was rationed to 50 liters per person per day for all usage (sanitary, washing, bathing etc). In certain areas residents even had to queue for their daily ration of water[45]. Water efficiency is a key strategic focus under the NWRS2 (P1 is 2 points). Also, the Department of Water Affairs is well-positioned to develop any water efficiency regulations and policies, since its roles and responsibilities include setting norms and standards across all water sectors. In addition to this, 50% water reduction target was set in the NWRS2, which along with a strong reliance of the country on coal in its energy mix, is expected to be a strong driver for introducing water efficiency standards to reduce emissions (P2 is 2 points). As a result, even if no water efficiency S&L were introduced so far but only investigated for introduction, and EE are being currently improved (P3 is 1 point), the country seems well positioned as a candidate for further investigation under the scope of this study.

4.2 OTHER COUNTRIES ANALYZED

China

TABLE 7 CHINA'S POLICY ASSESSMENT

Country	Number of EE Policies[46]	P1	P2	P3	Total
China	215	2	0	2	4

Through the policy assessment, it emerged that China has a fairly complete framework for water efficiency. Various policies encourage water conservation and water efficiency at the national level (P1 is 2 points). Water efficiency standards were developed for key water-consuming products in the past decades. Currently, China is on a path to promote its water efficiency labeling program and the Leading Water Efficiency Program (P2 is 0 points). It appears these latest programs heavily borrowed the success of the energy efficiency programs that have already been implemented in China for decades (P3 is 2 points). As a result, even if the water heating use is the highest among the 12 countries, it seems the potential for introducing or complementing existing water efficiency programs under the scope of this study are quite limited.

[45] https://en.wikipedia.org/wiki/Cape_Town_water_crisis
[46] This and all the following EE numbers are from the CLASP S&L Database https://clasp.ngo/policies. The policies considered were only those enforced or under revision – not those under development. Policies are counted based on the product type. Last accessed on Nov. 12, 2019

European Union

TABLE 4 EUROPEAN UNION'S POLICY ASSESSMENT

Country	Number of EE Policies	P1	P2	P3	Total
European Union	104	2	0	2	4

The EU is increasingly recognizing the importance of advancing the sustainable use of water resources and the severity of water scarcity in the region. Countries are increasingly creating a supportive framework for the introduction of water efficiency policies at the regional level (P1 is 2 points). Also, in the last few years progress was made on both EE S&L (P3 is 2 points) and on water efficiency standards and labeling programs making the program mature with little potential for complementing it under this project (P2 is 0).

United States of America

TABLE 8 USA'S POLICY ASSESSMENT

Country	Number of EE Policies	P1	P2	P3	Total
United States of America	185	2	1	2	5

The US has a comprehensive water policy framework, which targets environmental concerns and conservation directly (P1 is 2 points). In particular, the country has a thorough and well-established voluntary standards program, and nearly a dozen of the US' 50 states (as well as New York City) have made those voluntary standards mandatory. California, one of the nation's largest states, has adopted water efficiency standards that are even more ambitious than the voluntary standards described by the WaterSense program. Although national standards for faucets, showerheads, toilets, and urinals exist, they are nearly three decades old. Recent movement by a handful of states to adopt standards suggests that there could be some momentum for new standards at a national level. One hurdle for a better national standard is the discrepancy between the widely supported WaterSense standards and the California standards. WaterSense standards have the advantage of high market share, but California standards are more forward-thinking in a world of climate change and drought (P2 is 1). Energy efficiency standards are also advanced and comprehensive (P3 is 2 points). Overall, the United States has potential for improvement of water efficiency standards, which will be addressed for the US part of the project by the Appliance Standards Awareness Project (ASAP).

Pakistan

TABLE 9 PAKISTAN'S POLICY ASSESSMENT

Country	Number of EE Policies	P1	P2	P3	Total
Pakistan	21	2	2	2	6

Pakistan has recently established a water policy framework to respond to the water crisis and to improve the overall water management and water conservation. This suggests the existence of a supportive policy framework and confirms the impact of water efficiency policies could be high (P1 is 2 points) even if standards are not in place yet. Furthermore, the National Water Policy is only a broad policy framework, and the federal government relies on individual provinces to

launch their own policies and initiatives. Also, the country has energy efficiency S&L programs that could facilitate the introduction of water efficiency standards. In addition to this, CLASP collaborated with the Province of Punjab on ceiling fans S&L programs. This suggests that venues might exist for a similar effort on water efficiency (P2 and P3 are both 2 points).

Mexico

TABLE 10 MEXICO'S POLICY ASSESSMENT

Country	Number of EE Policies	P1	P2	P3	Total
Mexico	97	2	2	2	6

Mexico is a water-scarce country and it appears that the federal government prioritized water resource management as one of the central pieces of its national development plans (P1 is 2 points). This provides the country with a supportive policy framework for advancing on water efficiency standards, along with a high expected impact from standards. The National Water Commission (CONAGUA) is well placed to run a water efficiency program in Mexico. CONAGUA can learn experiences and technical know-how from the National Commission for the Efficient Use of Energy (CONUEE), who has established a successful energy efficiency standard and labeling program in Mexico (P2 and P3 are 2). Overall, this suggests that the country could have a supportive environment for water efficiency standards.

Turkey

TABLE 11 TURKEY'S POLICY ASSESSMENT

Country	Number of EE Policies	P1	P2	P3	Total
Turkey	35	1	1	2	4

Turkey has an overarching and supporting water policy framework with some elements related to sustainability of the use of water resources. However, no mention of water conservation was found in these policies (P1 is 1). Currently, the country does not have water S&L in place, but energy efficiency frameworks are well established. These also cover EE standards for washing machines and dish washers suggesting that further assessments might lead to find data on water heating to support this work (P3 is 2). As a result, some prerequisites exist for introducing water efficiency standards exist based on the favorable water framework and supportive energy efficiency framework (P2 is 1).

Indonesia

TABLE 12 INDONESIA POLICY ASSESSMENT

Country	Number of EE Policies	P1	P2	P3	Total
Indonesia	4	1	1	1	3

Indonesia has a national level water policy, however this was overturned by court and an old policy was re-adopted. Therefore, it seems the policy prerequisites under P1 are quite weak (P1 is 1 point). No water efficiency S&L programs exist but they might be introduced (P2 is 1 point), and even if Indonesia's fresh start with EE S&L programs could represent a possibility for transferring EE-related experiences to water efficiency, the EE S&L are still in the early stages

and difficulties exist in terms of engaging the government (P3 is 1 point). Overall, it seems water efficiency policy and programs may not be of the highest priority and viable for the Indonesian government at this stage.

Republic of Korea

TABLE 13 REPUBLIC OF KOREA'S POLICY ASSESSMENT

Country	Number of EE Policies	P1	P2	P3	Total
Republic of Korea	103	2	1	2	5

The Republic of Korea has a comprehensive water policy framework that supports the sustainable use of water (P1 is 2 points). Water efficiency standards are in place (P2 is 1 point) even these are less comprehensive than the energy efficiency programs which feature both MEPS and categorical energy label (P3 is 2 points). The voluntary Eco-Label program run by KEITI includes water efficiency metrics and represents a possibility for starting a government-led water efficiency standards and labeling program (P2 is 1).

Australia

TABLE 14 AUSTRALIA POLICY ASSESSMENT

Country	Number of EE Policies	P1	P2	P3	Total
Australia	34	2	0	2	4

Based on our research, Australia's water efficiency program appeared to be one of the most advanced and complete programs in the world (P2 is 0 and P1 is 2 points). From the outset, the Government of Australia has established clear legal frameworks to establish the WELS scheme. Now the program claimed that 9 out of 10 people recognize the Water Label and the scheme covered over 7 categories of water-using products. As for EE S&L Australia has a solid framework (P3 is 2 points). As a result, given the robustness of Australia's water efficiency program, it appeared the opportunities to launch new water efficiency standards and labeling programs in Australia are low.

Thailand

TABLE 15 THAILAND'S POLICY ASSESSMENT

Country	Number of EE Policies	P1	P2	P3	Total
Thailand	78	1	1	2	4

Thailand has recently established an overarching water agency to coordinate working on water issues. Water demand-side approaches have been emerging, along with more focus on water quality (P1 is 1). A Thai green label for water efficient showers and faucets exists, but no categorical labels of MEPS exist. The country has a well-established energy efficiency program (P3 is 2) and the basis to support water efficiency policies in the future despite the absence of existing water efficiency policies (P2 is 1).

4.3 CONCLUSION

Water efficiency policies represent an urgent, untapped opportunity to address rising CO_2 emissions and water scarcity. A study led in the United States estimates that greater adoption of efficient faucets and showerheads is expected to deliver annual reductions of 8 metric tons (MT) of CO_2 emissions and save more than 250 billion gallons (or almost one trillion liters) of fresh water in 2030 in the United States. Indeed, water efficient faucets and showerheads offer not only water but also energy savings opportunities from the reduced energy needed to heat water.

Following the potential quantified in the United States, our global scoping study assessed the top 18 CO_2 emitting economies according to the viability of water efficiency policy adoption, and the potential for impact from the introduction of such policies. The intended objective was to assess if the top emitting countries in the world had a similar potential for water and energy savings as the United States, which not only support the achievement of ambitious climate mitigation goals, but would also allow increased and affordable water access, infrastructure improvements, and overall sustainability.

We led desk-based research and scored 18 top-emitting economies based on our impact factor scale. **Thirteen economies showed the potential for high impact due to high hot water use; increasing pressure on water resources and rising urban growth.** The countries that scored the highest in this part of the assessment were Turkey, Pakistan, Mexico and India (6 points); followed by China, Indonesia, South Africa (5 points) and finally by Australia (4 points), USA, Brazil, Republic of Korea and Thailand (3 points). Countries including EU, Japan, Russia, Philippines and Argentina scored 2 points or lower and were not assessed further.

We then continued the scoping by assessing the enabling policy framework for the 13 economies (both scales are explained in Appendix A). **Despite countries such as Turkey and China scoring high on potential impacts, the policy assessment indicated a lack of a conducive policy environment for water efficiency policies in those countries**. We analyzed the presence of an overarching and conducive water policy framework; the presence of water efficiency standards and the possibility of improving them, along with presence energy efficiency standards and labels to help us determine whether countries had in place the institutions and policy environment necessary to implement water efficiency standards. Turkey has been addressing overall water sustainability through policies but no water efficiency framework was developed to date, and the presence of energy efficiency policies alone did not allow the country to meet the score necessary to indicate a favorable policy environment for water efficiency standards. On the other hand, China has prerequisites for policy implementation and a wealth of water efficiency policies are already in place, precluding the need for CLASP support.

A conducive overarching policy framework that prioritized water efficiency, along with the presence of an energy efficiency institutional and policy framework made the case for prioritizing South Africa, India, Mexico, Brazil, and Pakistan. All of these countries scored high (6 points, except 5 for South Africa) on our policy environment assessment scale and were considered for in-depth scoping. In particular, we thought that a favorable policy environment for water efficiency at the high level, along with an existing energy efficiency policies could facilitate the creation of water efficiency standards. However, only three countries could be investigated further.

India, Brazil and South Africa were prioritized for in-depth scoping. We wanted a diversity of countries around the world, so we decided to choose one per region. When deciding between Pakistan and India, which are both in South Asia, we noted that both countries had prerequisites and policy environments supportive to the introduction of standards. CLASP is currently working with Pakistan on energy efficiency policies, creating a supporting environment for water efficiency standards, however our strong presence in India made the case for higher chances of success in India than in Pakistan. Next, we had to decide between Mexico and Brazil, both Latin American countries. Mexico seemed to have prerequisites necessary for water efficiency policy advancements but an unfavorable political environment did not provide us with the tools to engage at this point in time. Instead, CLASP has had positive experiences with Brazilian policymakers, increasing our possibilities of success in the country. The last remaining country, South Africa, was the only country in Africa, so it was selected to for in-depth scoping.

Following the identification of these countries, we led an on-the-ground market assessment and modeling effort to assess the actual impact and viability for introduction of water efficiency policies for water fixtures in India, Brazil and South Africa. The research was documented in three country-specific scoping reports that evaluated the path for water efficiency standards for faucets and showerheads and their potential CO_2 emission reductions. We investigated the institutional and policy environment at the national level and the process for setting and implementing standards.

In total, this project estimated the potential CO_2 emissions reduction from water efficiency standards around the world and evaluated the possibility of engaging with three high-impact countries to advance these water efficiency standards. Next steps for CLASP and other efficiency organizations include continuing engagement in India, South Africa, and Brazil as indicated in the country reports available on our website at clasp.ngo. Potential next steps in the other high-impact countries include:

- **United States and European Union:** CLASP and partner organizations are working in these two jurisdictions to advance water efficiency standards and labeling. In the US, individual states have been adopting water efficiency standards, and that work can continue at the state as well as the federal level (through the US Department of Energy). In the EU, CLASP is working to support the European Commission and standardization bodies to develop a test method that could underlie mandatory standards and labeling.
- **China, Republic of Korea, Australia**, **Thailand:** These countries have established water efficiency policy programs in place, so CLASP and other efficiency organizations should compare the impact potential of water efficiency relative to other efficiency opportunities and engage with the government agencies responsible for water efficiency (if different from energy).
- **Pakistan, Mexico, Turkey, Indonesia:** These countries do not currently have water efficiency policy, so next steps would include in-depth scoping to identify the potential processes for advancing water efficiency (whether by setting up a new program, extending energy efficiency standards to cover hot-water fixtures, or through another path, such as building codes).

Appendix A: A1 Impact-factors assessment prioritization framework

The impacting factors (IFs) were scored from 0 to 2 points each. The sum of the factors was then used to validate a further investigation in the policy framework of countries. If the sum of points of the concurring factors, and therefore the expected impact of the introduction of water efficiency standards, is of at least 3, the country was considered for further investigation according to the policy prerequisites.

TABLE 16 IMPACT-FACTORS ASSESSMENT

IF	Impact Factors	Points
IF1	**Hot water use**	0-150 = 0 points 151-250 = 1 point ≥251 = 2 points
IF2	**Pressure on water resources**	Low-Low-Medium= 0 points Medium-High= 1 point High-Extremely High = 2 points
IF3	**Urbanization growth projection**	<0.5% = 0 points ≥0.5%<1% = 1 point ≥1%≥2% = 2 points

A2 Enabling policy assessment framework

The countries whose impact factors were of at least 3 points were thought to potentially benefit from the introduction of water efficiency standards and were further assessed based on their policy framework. The framework presented in table based on the country prioritization framework introduced in Section 1. The table reflects the policy prerequisites under P1, P2, P3. Each prerequisite was given from 0 to 2 points and the total points of the categories determined the score for each country.

TABLE 17 POLICY FRAMEWORK ASSESSMENT

Prerequisites	2 Points	1 Point	0 Points
P1	A country should have at least an overarching water or water-related policy to support the development of water efficiency initiatives. If a country does not have any high-level water policies, the prerequisites of implementing water efficiency labeling programs can be limited.		
Are there overarching national/regional water policies?	Overarching water policies exist; Specifies water conservation and water efficiency as key policy measures;	Overarching water policies exist; Policies do not specify water conservation and water efficiency as key policy measures	No overarching water policies.

P2	Introducing water efficiency standards in a country that previously introduced some standards represents a prerequisite because less costly and because the country is prepared for introducing or updating new ones. However, if the country introduced a comprehensive set of standards and labeling programs, the policy framework is mature and therefore this country does not meet the prerequisites for this project.		
Is there opportunity for increased ambition in water efficiency standards and labeling?	**2 Points** Country has mandatory or voluntary water efficiency programs for certain product groups that can be expanded in coverage; or existing water standards are out of date; Country has no water efficiency standards, but a supporting overarching and energy efficiency policy framework. If either 1 or 2 are present, prerequisites to support the implementation of more standards are met.	**1 Point** Country has water efficiency testing standards or labeling programs. Surrounding policy context is unclear; potential for introduction or improvement exists but is uncertain.	**Points** Country has well-established mandatory water efficiency testing and performance standards for most key product categories; Prerequisites to implement more standards not met.
P3	If a country has a successful and effective energy efficiency standards and labeling program, it is easier for the policy makers to understand the S&L program and its effectiveness. Furthermore, experiences from the EE programs can be applied to water efficiency labeling programs, therefore providing us a better opportunity to make significant impact. This will be assessed based on the number of energy efficiency policies in the CLASP Policy Database.		
Are there energy efficiency standards and programs?	**2 Points** Country has a successful and effective labeling program, which can provide experience and know-how for the implementation of water efficiency standards and programs;	**1 Point** Country has some experience in energy efficiency S&L programs;	**0 Points** Country has limited or no experience in energy efficiency S&L programs

Appendix B: Technical Notes

B1. Hot Water Energy Use Estimate

Our primary data source for water heating energy use is from the IEA Energy Technology Perspectives 2017 report. We used the data from Reference Scenario. However, the IEA report did not cover not all countries analyzed in this scoping study, therefore, we have to estimate water heating energy use for some countries based on their population and per capita water heating energy use.

For example, Australia is not covered in the IEA report, and we used the following approach to estimate Australia's water heating energy use:

- IEA report estimated OECD countries used 5198 PJ of energy for water heating in 2014.
- The population of OECD countries in 2014 according to World Bank is 1,272,282,569.
- Therefore, the per capita energy use for water heating for OCED countries is 4.08557E-06 PJ.
- By using OECD's per capita data as a proxy, we calculated Australia's water heating energy use as follows:
- Population of 23,475,686 in 2014 X 4.08557E-06 PJ per capita for OCED countries = 96 PJ

The following two tables summarizes the results of water heating energy use per capita use as well as our estimation of water heating energy use for all countries analyzed in this scoping study.

WATER HEATING ENERGY USE PER CAPITA

	Population in 2014	Water Heating Energy Use in 2014 (PJ)	Water Heating per capita (PJ/person)
EU	508,193,856	2555	5.02761E-06
ASEAN	625,736,585	67	1.07074E-07
Non-OECD	5,983,371,312	1658	2.77029E-07
OECD	1,272,282,569	5198	4.08557E-06

ESTIMATION OF WATER HEATING ENERGY USE

Country	Population	Water Heating Energy Use (PJ)	Data Source/Proxy
China	1,364,270,000	4027	IEA Report
USA	318,386,421	2431	IEA Report
India	1,295,604,184	2298	IEA Report
Brazil	202,763,735	438	IEA Report
European Union	508193856	2555	IEA Report
Indonesia	255,129,004	377	Proxy: ASEAN
Australia	23,475,686	136	Proxy: OECD
South Africa	54,545,991	302	IEA Report
South Korea	50,746,659	294	Proxy: OECD
Mexico	120,355,128	455	IEA Report

Pakistan	195,306,825	522	Proxy: Non-OECD
Turkey	77,231,907	388	Proxy: EU

B2. Aqueduct Water Stress Score

We used Aqueduct Water Stress Score as a metric to indicate the level water stress in each country analyzed in this study. Aqueduct is an open-source water risk data tool developed by World Resources Institute (WRI). Aqueduct's baseline water stress is used to measure the ratio of total water withdrawals to available renewable water supplies. The metric ranges from 0 to 5, with 5 being extremely-high water stress.

Water stress data was available from Aqueduct for all countries covered in this study, except for European Union. We estimated the average water stress of EU by arithmetically averaging water stress scores for all EU 28 countries, except for Malta whose data is unavailable. The resulted average water stress for EU as a region is 1.74. It should be noted that this approach of estimating water stress in EU is overly simplified, only intended to provide basic information in this preliminary scoping study. It should also be noted that the water stress in EU vary greatly. For example, Spain has a very high water stress of 3.74, whereas Ireland's water stress is only 0.46.

B3. Urban Population Growth Rate (2020-2030)

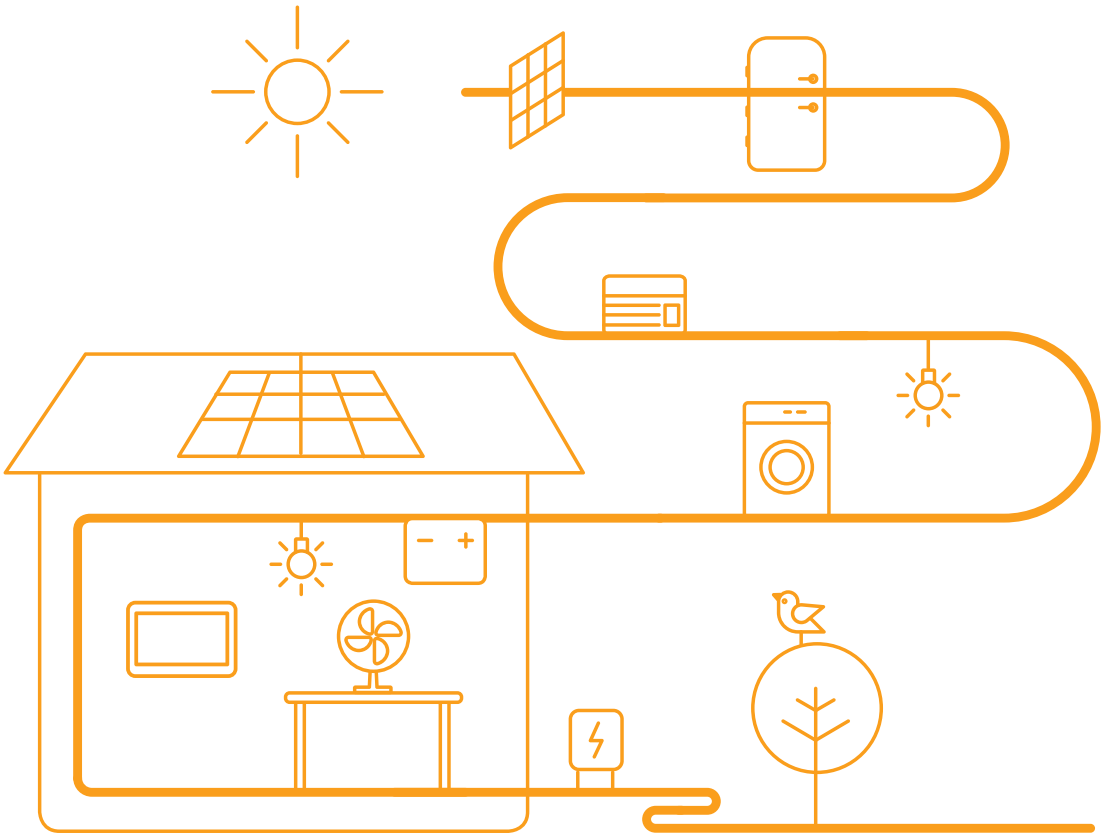
The primary data source for the urban population growth rate forecast is the United Nations World Urbanization Prospects 2018. The data files used in the calculation is available at: https://population.un.org/wup/

Specifically, we used *File 3: Urban Population at Mid-Year by region, subregion and country, 1950-2050 (thousands)* in our calculation.
The urban growth rate from 2020 to 2030 is calculated as follows:

$$Growth\ Rate_{2020-2030} = \sqrt[10]{\frac{Population_{2030}}{Population_{2020}}} - 1$$

The resulted urban population growth rates were as follows:

	Grow rate (2020-2030)
China	1.52%
USA	0.95%
India	2.32%
Brazil	0.78%
European Union	0.29%
Indonesia	1.88%
Australia	1.23%
South Africa	1.62%
South Korea	0.31%
Mexico	1.32%
Pakistan	2.52%
Turkey	1.07%



Annex

GUIDANCE ON SETTING WATER EFFICIENCY STANDARDS FOR FAUCETS AND SHOWERHEADS

CLASP has developed the following general guidance for setting new water efficiency standards based on experiences in the United States, where water efficiency standards have been in place since 1994. These recommendations should be adapted to the country context and requirements but can serve as a starting point for analysis and discussions.

Product Types for Coverage

We recommend including faucets/taps, showerheads, and replacement aerators within the scope of any water efficiency standards. Faucets and showerheads are the water fixtures/fittings that typically deliver hot water, so regulating their flow rates will deliver not just water but also CO_2 emissions reductions due to reduced energy use for water heating.

We recommend consolidating products into fewer classes/types with clear definitions to eliminate confusion and potential loopholes. Also, fewer product types will simplify manufacturer stocking, as manufacturers will only have to keep one type of aerator for all configurations of the same fixture (e.g., overhead and handheld showers).

We also recommend including replacement aerators within the scope of the standard as labeling these will promote correct replacement[47]

Pressure Conditions for Testing

We recommend testing performance across a several pressure conditions between 1 and 7 bar (0.1 to 0.7 MPa) to reflect performance across a range of pressure conditions in plumbing installations, from gravity-fed rooftop tanks (as low as 1 bar) to high-pressure water mains (7 bar).

Maximum Flow Rate Requirements

While maximum flow rate requirements will depend on local conditions, including national water, energy, and CO2 reduction goals and availability of efficient products, the following requirement levels can serve as a starting point for analysis and discussions.

FIXTURE	MAXIMUM FLOW RATE (L/min)	% OF MODELS MEETING SIMILAR VOLUNTARY REQUIREMENT IN THE UNITED STATES[48]	FLOW RATE FOR HIGH-PERFORMANCE DESIGNATION (L/min)
Faucet	6	84%	4
Showerhead	8	73%	6

As can be seen in the table above, fixtures that meet the above requirements are widely available in the global market due to popular voluntary EPA WaterSense specifications in the United States. High-performance requirements are based on the top efficiency of products in the Australia/New Zealand WELS product database.[49]

Applicability of Requirements

We recommend that fixtures meet requirements over the full range of pressure conditions in plumbing installations, as tested above. In addition to maximum flow rate requirements for water efficiency, requirements should require that fixtures maintain a minimum flow rate to guarantee performance and user satisfaction. Example requirements are shown below:

The flow rate shall be:

[47] California Code of Regulations, Title 20, Section 1605.3(h)(2)

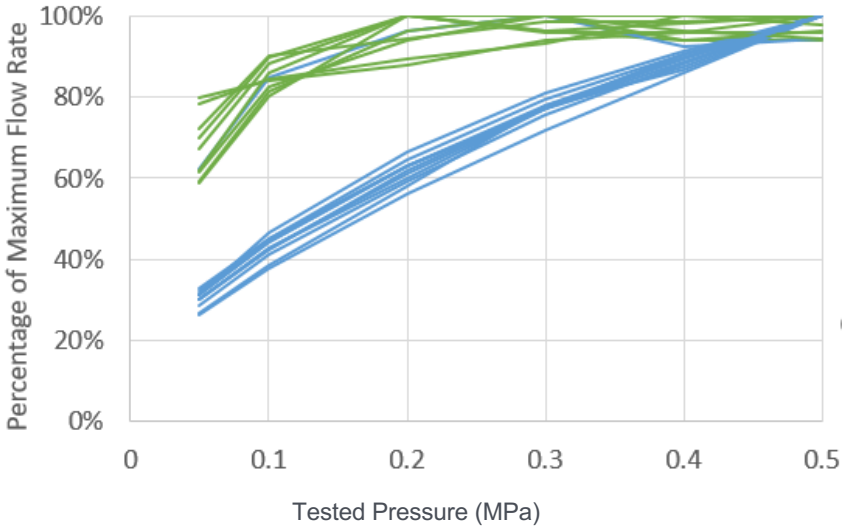
[48] Mauer, deLaski, and DiMascio. "States Go First 2020 Assumptions update".

[49] Australian Government, Water Rating Product Search, accessed August 31, 2020.

1. Less than or equal to the applicable maximum flow rate (in liters per minute) shown in <REQUIREMENTS TABLE> at all of the tested pressure conditions
2. Greater than or equal to 90% of the intended flow rate, when measured at 0.2 MPa (minimum flow rate)
3. Greater than or equal to 70% of the intended flow rate, when measured at 0.1 MPa (minimum flow rate)

Excessively low flow rate at low pressure was a concern with early water-saving fixtures using fixed-orifice aerators. This is illustrated in the figure below[50], with the green line showing the desired performance that maintains a satisfactory flow rate across a range of pressures. The blue line is a traditional fixed-orifice aerator which may meet a flow-rate specification at one pressure, but deliver unsatisfactory flow at lower pressures while wasting water at higher pressures.

In practice, satisfactory performance at a range of pressures is achieved with pressure-compensating orifices, which reduce flow at higher pressures. Pressure compensation is used by all global plumbing brands in both faucets and showerheads. Manufacturer-reported performance curves for an Indian manufacturer of lavatory faucets are shown below, showing the pressure-compensating orifices maintaining flow rate across a range of pressures (green), in contrast to fixed orifice (blue).



Other Requirements:

Spray Force and Coverage

As flow rate decreases, maintaining sufficient force and coverage will ensure customer satisfaction with water efficient fixtures. The WaterSense voluntary specification in the US has the following requirements for minimum performance for spray force and coverage, based on the American Society of Mechanical Engineers (ASME) standard A112.18.1.

[50] Gary Klein, "Flow Rates for Faucets, Showers and Tub/Shower Combination Valves", ACEEE Hot Water Forum presentation, p. 11.

1. The minimum spray force for high-efficiency showerheads and hand-held showers shall not be less than 2.0 ounces (0.56 newtons [N]) at a flowing pressure of 20 ± 1 psi (140 ± 7 kPa) at the inlet. 4.1.2.
2. The minimum spray force for high-efficiency rain showers shall not be less than 1.4 ounces (0.40 N) at a flowing pressure of 20 ± 1 psi (140 ± 7 kPa) at the inlet.
3. The total combined maximum volume of water collected in the 2- and 4-inch (50-, 101-millimeter [mm]) annular rings shall not exceed 75 percent of the total volume of water collected, and;
4. The total combined minimum volume of water collected in the 2-, 4-, and 6-inch (50-, 101-, 152-mm) annular rings shall not be less than 25 percent of the total volume of water collected.[51]

As an alternative to minimum requirements, standards organizations can consider labeling with icons depicting different ranges of spray force and coverage performance on the label to allow customers to choose showerheads to meet their preferences (e.g., harder stream versus mist).

Multiple Showerheads

The following requirement addresses the risks of a situation where multiple showerheads are added to a shower to avoid standards:

> The total flow rate for showerheads with multiple nozzles must be less than or equal to the maximum flow rate in <REQUIREMENTS TABLE> when any or all the nozzles are in use at the same time[52]

Multiple Modes

We suggest that operation of multi-function equipment be precisely specified during test to avoid ambiguity or loopholes (e.g., mist or massage settings on showers, temporary pot-filling mode on kitchen faucets). This ensures that the typical mode is tested while still allowing for some product features that may temporarily use more water.

> If the product has multiple modes of operation, the test shall be conducted in the product's normal mode, as indicated with a label, or for temporary modes, the default mode.

Anti-Tampering

We recommend adding anti-tampering requirements to ensure water savings throughout the life of the fixture. Requirements can take the form of warnings or mechanical impediments to retain the original water-efficient aerator. An example of a warning requirement is shown below

> The fitting shall not be packaged, marked, or provided with instructions directing the user to an alternative water-use setting that would override reported flow rate.
>
> Any instruction related to the maintenance of the product, including changing or cleaning faucet accessories, shall direct the user on how to return the product to its intended maximum flow rate.
>
> Accessory, as defined in ASME 112.18.1/CSA B125.1, means a component that can, at the discretion of the user, be readily added, removed, or replaced, and that, when removed, will not prevent the fitting from fulfilling its primary function. For the purpose of this specification, an accessory can include, but is not limited to lavatory faucet flow restrictors, flow regulators, aerator devices, and laminar devices.[53]

[51] EPA WaterSense, "High-Efficiency Lavatory Faucet Specification", Version 1.0, October 1, 2007, pp. 2-3.
[52] California Code of Regulations, Title 20, Section 1605.3, Table H-5.
[53] EPA WaterSense, "High-Efficiency Lavatory Faucet Specification", Version 1.0, October 1, 2007, pp. 1-2.

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