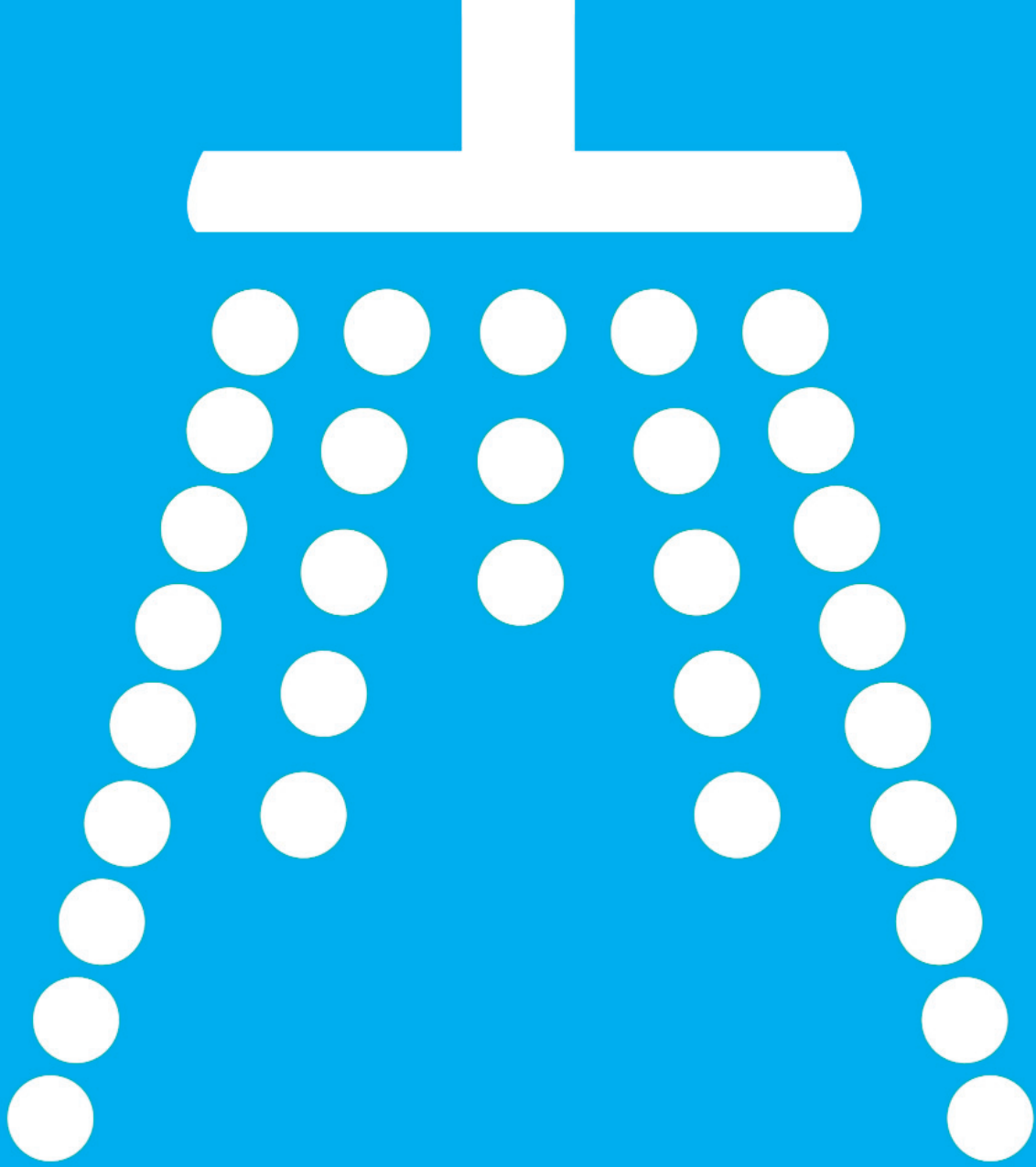

Rating System for Water Efficient Fixtures

A Way to Sustainable Water Management in India

CENTRE FOR SCIENCE AND ENVIRONMENT
New Delhi

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We are grateful to the Ministry of Urban Development, Government of India for their support to CSE as a Centre of Excellence for Sustainable Water Management.

Prepared by
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Abbreviations

AWWA	American Water Works Association,
BCM	Billion Cubic Meters
BEE	Bureau of Energy Efficiency
BIS	Bureau of Indian Standards
BWR	Basic Water Requirement
CSE	Centre for Science and Environment
CUWCC	California Urban Water Conservation Council
DEFRA	Department for the Environment, Food and Rural Affairs
EPA	Environment Protection Agency
EWS	Economically Weaker Section
GPM	Gallons Per Minute
GRIHA	Green Rating for Integrated Habitat Assessment
IPA	Indian Plumbing Association
HET	High Efficiency Toilets
IGBC	Indian Green Building Council
IS	Indian Standard
LEED	Leadership in Energy & Environmental Design
LPCD	Liters Per Capita per Day
MCM	Million Cubic Meters
MLD	Million Litres per Day
MoRD	Ministry of Rural Development
MoUD	Ministry of Urban Development
NAPCC	National Action Plan on Climate Change
NBC	National Building Code
NWM	National Water Mission
PUB	Public Utilities Board
PWD	Public Works Department
TCE	Tata Consulting Engineering
WELS	Water Efficiency Labelling Scheme (Singapore)
WELS	Water Efficiency Labelling and Standards

Executive Summary

Water is under pressure from increasing demand stemming from growing development pressures, with its manifestations in the form of deteriorating water quality, declining availability and unregulated groundwater extraction. The pace of decline is likely to continue with estimates pointing at a figure of 1,500 cubic meters per year by the year 2025, which is well below the level water stress is considered to occur.

Urban water situation deteriorating on the account of declining quality, distribution losses, demand supply mismatch, changing lifestyle etc. are leading to a severe conflict situation both at the intra and inter city levels. Big cities are home to millions of people; attract both large and small commercial/ institutional establishments every year besides substantial residential development. This trend is now increasingly been followed by the medium and small towns as well. As more and more people, businesses move into the city, water crisis is going to accelerate and worsen with increased water demand, plagued with increasing intra city inequity, discharge of waste water in the city environs.

Building water use constitutes a very high percentage of the total city water use profile. Although nature of building water use is governed by the functions of the building, type of equipments installed etc. But generally, maximum water use which is approximately 45- 50% is used in the toilets and around 30% is accounted for washing (clothes, utensils, hands etc.). Within the toilets majority water is used by the plumbing fixtures like toilets, urinals, faucets and showers. There may be varying estimates for water use for per person per day, but there is hardly any argument that toilets and bathrooms are the biggest water guzzlers within the buildings. And, as a result large amounts of grey and blackwater released from the kitchens, baths and toilets ends up polluting the water sources.

Reducing water consumption and improving water efficiency in buildings is a major step towards sustainable water management. According to the American Water Works Association (AWWA), by installing more efficient water fixtures and regularly checking for leaks, households can reduce daily per capita water use by about 35%. Water efficient fixtures have been widely accepted and are been used across the world especially in the countries like Australia, USA, parts of Europe etc. Fixtures like dual flush toilets, low water using/ sensor based/ waterless urinals, sensor faucets/faucets with flow restrictors, water efficient showers etc. are some of the available technologies.

The rapidly growing international water efficient fixtures technologies and market, has made an impact on the Indian manufacturers as well. There are an increasing number of low water using fixtures that are now being manufactured and sold in the markets for the retail and wholesale consumers. The Indian sanitaryware and wellness products market is growing leaps and bounds, with an impressive market value of approximately Rs.

2500 crores. But there still exists a considerable scope for developing a niche for the water efficient fixtures market.

Thus labeling and rating of water efficient fixtures would facilitate consumers to identify products that are more water efficient without compromising on performance and the manufactures can benefit in the marketplace by offering rated water efficient fixtures that perform at power or better than available models using more water. In addition, to installing water efficient fixtures, setting standards for performance and measuring water efficiency of these fittings would provide credibility and widen its adoption across the building sector. Labeling and rating has proved to be an effective process in guiding consumers interested to conserve water but have little information and even for those who may be motivated by other benefits especially from an economic perspective.

Even though product standardization system exists in the Bureau of Indian Standards (BIS), the premier standard setting agency in India, there are no standards or specification for water efficiency in water using fixtures in toilets and kitchens.

Several countries across the world are already established standards for labeling and ratings for water efficient fixtures and appliances with robust supportive legislations. The Water Efficiency labeling System (WELS) in Australia, WaterSense in USA, Water Efficiency Labeling Scheme (WELS) in Singapore, ANQIPS labelling system in Portugal are only a few examples of these reforms. The green building concept over the years have accorded importance to water efficiency, savings and reuse besides energy efficiency and materials as key attributes in awarding ratings to buildings. In the green building ratings stipulated points are awarded to buildings which install water efficient fixtures and through it achieve water use reduction.

Rating efficiency is not a new concept in India, the Bureau of Energy Efficiency (BEE) established in 2002 has a standards and labeling programme for electrical appliances. The procedure is very similar to that followed in US, Australia and other countries for rating water efficient fixtures.

CSE through this paper has made an attempt to foster discussion on this critical issue. The discussions would be vital in evolving a roadmap for implementation (standardization and mainstreaming) based on consultation with a wide range of stakeholders. CSE is hopeful that the proposed discussion and the subsequent roadmap would facilitate the Ministry of Urban Development to formulate related policies in the immediate future to effectively tackle the water efficiency and conservation issues.

Rating System for Water Efficient Fixtures

SECTION 1: THE ALARMING STATE OF WATER CRISIS IN INDIA

The water situation in India can no longer be eluded and calls for urgent and appropriate actions. Often referred to as a crisis, and rightfully so, it now figures on the national agenda prominently but often not addressed adequately. Water is under immense pressure from increasing demand, with its manifestations in the form of deteriorating water quality, declining availability and unregulated groundwater extraction. The agricultural, industrial and the domestic sectors today are at constant struggle to secure more water. With more than a billion plus population and estimates indicating doubling of population in the coming few decades the situation is a serious cause of concern beyond doubt. It is estimated that the overall water demand will increase from 552 to 1050 BCM by 2025, which will require the use of all the available water resources in the country. Of that 395 BCM, 82 per cent goes to irrigation and agricultural purposes, while only 18 per cent is divided between domestic and industrial.

In 1989, the global availability stood at 9,000 cubic meters (1 cubic meter equals 1,000 liters) per person per year and is estimated to drop to 5,100 cubic meters per person by the year 2025 as another 2 billion people would join the world's population. But, the situation in India is far worse, with water availability drooping to a mere 2,000 cubic meters per year in 1997 from 5,000 cubic meters per year in 1947. The pace of decline is likely to continue with estimates pointing at a figure of 1,500 cubic meters per year by the year 2025, which is well below the level water stress is considered to occur.

Issues like quality, availability, access etc. are not new to India, but the degree and the extent to which they occur now are definitely a matter of grave concern. Degraded water quality can in effect contribute to water scarcity as it limits its availability for both human use and the ecosystem and this is reiterated by the fact that almost 70 per cent of surface water resources and a growing number of its groundwater reserves are already contaminated by biological, toxic organic and inorganic pollutants. The blame for polluting the water sources is not exclusive to one sector but is shared varyingly by the three competing sectors. The fact of the matter is that modest and weak regulations on pollution continue to exist, along with lenient regulatory enforcement. Wastewater generation from the industrial sector has been estimated at 55,000 Million Cubic Meter (MCM) per day, of which 68.5 MCM is dumped directly into the local rivers and streams without prior treatment. In both the urban and rural areas across India untreated human and animal waste, sewage is drained into the water bodies or seeps into the groundwater from faulty septic tanks, latrines etc. The poor management of sewage treatment plants is an important reason for ineffective wastewater treatment. Besides more than half the population in the cities on an average is not connected to sewage and thus it is directly discharged in the water sources. As a result the downstream water treatment cost is subsequently increased along with increased threat from serious health hazards arising from poor water quality.

The shrinking supplies from the surface water sources has over the past few decades led to unsustainable levels of groundwater extraction leading to rapid depletion of groundwater table, particularly where withdrawal exceeds the aquifer replenishment rate. The blame is to be also shared by the inefficiencies in the supply system that leads to reduce water availability and access. There exists a considerable difference between the amount of water supplied and water available for use due to transmission losses, leaky pipes/taps and wasteful use of water at the consumer end. In almost all the major and medium cities unaccounted for water is almost to the tune of 40-50 per cent of cities water supply, mainly due to poor management of pipes, deficient leak detection systems, lack of urgency to repair the leaks etc. Reducing inequity, restraining wasteful utilization and water conservation efforts are being seriously marred by the fact that fair and effective water pricing is resisted and underrated across the agricultural, industrial and domestic sectors both by the government and consumers. Stemming misuse, inefficiencies and inequity is a sizable task but one that cannot be ignored or delayed any longer. The government's commitment to holistic development of the country's water resources is well stated in the National Water Policy document of 2002 and several other edicts. But still lots of ground needs to be covered to actually employ these recommendations in the decision-making process. Similarly, enforcement of regulations related to development and protection of water requires stringent steps to reduce its abuse and ensure abidance.

Sustainable and smart water management could be instrumental in combating the water crisis to a large extent. Attention to water legislation and regulation including water valuation, water conservation, water use efficiency, water recycling/reuse and infrastructure can go a long way in achieving this imperative goal. Across the country, decentralized management, encouraging people's participation, awareness and attention to capacity building is fast gathering momentum. Sector experts have reiterated on several occasions that effective legislations are essential to regulate unsustainable and inequitable use of water resources. The subsidy issue in the water and electricity, for irrigation and domestic water supply requires a sincere review to ascertain the real and intended beneficiaries. The water charges should be considered for revision to incorporate cost of augmentation, operation, treatment, transmission etc. to stem unregulated high consumption, wastage and insufficient cost recovery. Increasing efficiency in the water sector would go a long way in promoting the concept of 'getting more from less'. Optimal and efficient use through implementing conservation measures such as plugging leaks, reducing wastage, demand regulations, low-flow technologies, wastewater reclamation and reuse, etc. should be widely disseminated and promoted.

Water harvesting as a means to augment water supply should be accorded the high priority that it deserves in India's water management initiative. Some states are already in the process of implementing rainwater harvesting through legislative measures and incentives in order to more efficiently tap into the huge quantity of monsoon rains. Traditionally, rainwater harvesting has proven its efficacy in improving water availability and recharging the plunging water tables and striving to make a comeback across cities and villages.

SECTION 2: WATER INTENSIVE CITIES

The urban population has doubled over the past 30 years and accounted for nearly 30 per cent of the total population in 2009. It is expected to reach 41 per cent by 2025, with over 575 million people from the present level of 286 million (MoHUPA- GoI & UNDP 2009). In 2005, the official water demand for India's largest cities of Delhi and Mumbai was a massive 3973 and 3900 Million Litres per Day (MLD) and the per capita demand was estimated at 268 and 307 Litres per Capita Per day (LPCD) respectively. However the water supply is often no

match to the ever increasing demand as a result these cities are constantly facing demand supply gap which leads to conflicts. The shortfall in this case was about 600 and 900 MLD in Delhi and Mumbai respectively. The situation is worsened by the fact that almost 30-40 per cent of water is lost during transmission and supply in almost every city in India, which is audacious and disgraceful. As a result cities are on a constant expedition for augmenting supply by tapping distant water sources which are often meant for rural areas or some other uses.

The problem is not merely of water supply in the cities, but of end use also. Take Delhi, as a typical instance. Yamuna is Delhi's main sewage drain. Yamuna enters Delhi at Wazirabad, where the city draws its water supply - and after this an estimated 1,800 MLD of untreated sewage flows through 18 drains into the river. In the last four decades, the total sewage output has increased rapidly. Untreated sewage has grown even faster. In 1999, the Central Pollution Control Board estimated that Delhi produces over 4,300 MLD of sewage of which only 885 MLD is collected through the sewage network for treatment. While the bulk of which is over 75 per cent flows into stormwater drains and then into the river. By late 2000, treated sewage had increased to 1,333 MLD as had the quantity of sewage - still over 50 per cent of the city sewage was dumped into the river (CSE 2009). Thus, clearly as the water demand and use in increases there is a consequent rise in the wastewater generation and instances of water contamination.

Besides increasing population, the rising water demand is also attributed to the changing lifestyle and consumption patterns across the country especially in the urban centers. The large urban centers like Delhi, Mumbai, Bangalore etc. are home to millions of people, attracts large and small commercial and institutional establishments like offices, IT parks, malls, hospitals, schools, colleges, hostels, hotels etc every year. Due to the amenities now considered essentials for typical urban life, such as flush toilets, showers, washing machines, cooling plants etc., city dwellers tend to lead a more water intensive lives. The medium and the small cities are also following similar trends towards urbanization and development, with big cities as their role models. As more and more people and businesses move into the city, water crisis is going to accelerate and worsen, plagued with increasing intra city inequity, discharge of waste water and waste into the water sources and environment. To accommodate this migration and development, the cities are opening up their green belts, wetlands, rural hinterlands etc. generally preserved as cities breathing spaces. This to a large extent coincides with growth of the construction sector in India, which is experiencing a boom similar to the IT industry in the 90's. Presently, construction is the second largest economic activity after agriculture, and accounted for 8.5 per cent of India's GDP in the 2008 financial year. Construction industry is multi segmented inclusive of infrastructure, industrial and real estate divisions. The infrastructure segment involve construction projects in different sectors like roads, rails, ports, irrigation, power etc., while the real estate construction can be sub-divided into residential, commercial, malls/multiplexes etc. (Research and Markets, 2008).

SECTION 3: NATURE OF WATER USE IN BUILDINGS

In buildings meant for residential, institutional and commercial purposes there are four main types of water and wastewater categories that need to be considered, these are potable water, greywater, blackwater and stormwater. As it is clear that, potable water is generally referred to as drinking water, while, greywater is the domestic wastewater from bathroom fixtures (taps, showers and baths), laundry fixtures (washing machines) and kitchen facilities (such as sinks and dishwashing machines). Blackwater contains 'waste discharges from the human body, which is collected through fixtures such as toilets and urinals, while stormwater refers to run-off due to rainfall collected from roofs, impervious surfaces and drainage systems (Corr & Adams, 2009).

In commercial buildings water use is related to and governed by the functions of the building, type of equipments installed, plumbing fixtures type etc. A building with restaurants, commercial kitchens, cafes etc. and a facility that operates hydronic cooling systems use a greater percentage of processed water. Although a considerable amount of water is used for these systems, the major water guzzlers in the buildings are the restroom plumbing fixtures like toilets, faucets¸ urinals and showers. A few agencies have attempted to estimate the percentage of water use for various domestic purposes in buildings in the United States of America (USA). The U.S. Department of Energy estimates that restroom plumbing fixtures account for approximately 60 per cent of the total water use in office and administrative buildings; the remaining 40 per cent is estimated to be used by the heating and cooling systems. According to a study performed by the Boston-based Massachusetts Water Resources Authority, plumbing fixtures account for approximately 47 per cent of commercial building water use, with cooling systems and kitchens trailing at 34 per cent and 14 per cent, respectively (Gilmer and Hughel 2008).

Narrowing down to the per capita statistics for water use, a range of 20 - 40 liters of freshwater per person per day is generally considered to be a necessary minimum to meet needs for drinking and sanitation alone (see table 1), according to Peter Gleick, President of the Pacific Institute for Studies in Development, Environment and Security. If water for bathing and cooking is included as well, this figure varies between 27 to 200 LPCD (Gleik, 1997).

Table 1: **Recommended basic water requirements for human needs**

Purpose	Recommended Minimum (lpcd)	Range (lpcd)
Drinking water	5	2-5
Sanitation Services	20	0 - over 75
Bathing	15	5 to 70
Cooking and Kitchen	10	10 to 50
Total recommended BWR	50	

Source: Gleick. H, 1997

According to Gleik, recommended basic water requirement (BWR) for human needs to sustain in moderate climatic conditions with average activity levels at 50 liters of water per capita per day. In addition, Gleik had also provided the range across the moderately developed countries and developing nations.

But, in several developed countries of Europe, USA, Canada etc. domestic water use far exceeds the BWR. In countries of Western Europe the recommended BWR is typically less than 25per cent of average domestic use and in US and Canada, a BWR of 50 LPCD is infact less than 10 per cent of the total current water use (Gleik 1997). According to the Department for the Environment, Food and Rural Affairs (DEFRA), average household demand for water in United Kingdom has increased dramatically over the last 25 years; and an average British today uses 55 per cent more water than he/she did in 1980, mainly due to changes in lifestyle, home comfort and an increasing range of water-using appliances (DEFRA 2006). Today, almost a decade later, water use in US continues to be on the higher side. According to the AWWA, daily indoor per capita water use in the typical single family home is 69.3 gallons (1 gallon is equivalent to 3.78 liters) or 262 LPCD (AWWA 2009). Table 2 provides the break up of domestic water use in an average US household and the percentage of each use to total daily use.

Table 2: **Daily Water Use for a typical US household**

Purpose	Gallons per capita per day	lpcd	Percentage of Total Daily Use (per cent)
Showers	11.6	43.8	16.8
Clothes Washers	15.0	56.7	21.7
Dishwashers	1.0	3.8	1.4
Toilets	18.5	69.9	26.7
Baths	1.2	4.5	1.7
Leaks	9.5	35.9	13.7
Faucets	10.9	41.2	15.7
Other Domestic Uses	1.6	6.0	2.2

Source: American Water Works Association, 2009

The premier standardisation agency in India, Bureau of Indian Standards (BIS) as per the standard IS:1172-1993 states that the minimum water supply of 200 LPCD should be provided for domestic consumption in cities with full flushing systems. It also mentions that the amount of water supply may be reduced to 135 LPCD for the Lower Income Groups (LIG) and the Economically Weaker Sections (EWS) of the society and in small towns. On the other hand, the Planning Commission has categorized the water requirement estimations for different income groups, 130 LPCD for lower-income groups, 150 LPCD for middle-income groups, and 200 LPCD for higher-income groups, their average being 160 LPCD (Singh 2005).

According to Tata Consulting Engineering, an average family of five in Mumbai consumes about 920 liters per day, which amounts to 184 LPCD (Shah 2009). The average was derived on the basis of a small survey conducted in sample households in a posh Mumbai locality and the breakup of the household consumption provides usage pattern for BWR like showers, faucets, laundry, toilet and leaky fittings (see table 3).

Table 3: **Daily Water Use for a typical Indian household**

Purpose	Liters per day (household of 5 members)	Liters per capita per day (lpcd)	Percentage of total daily use (per cent)	Observations
Showers	400	80	43	An average shower head with mains pressure uses at least 10 liters of water per minute.8 minutes/day and 7 number of showers per week are considered.
Running taps in Kitchen	212	42.4	23	This part measures water used for rinsing vegetables, dishes, washing hands etc. The table assumes the flow rate for each use is 2.83 liters per minute. Average duration a tap runs a day/person is 15 minutes.
Laundry	140	28	15	Top loader uses about 140 liters of water per load. It is assumed that the washing machine is loaded 5 times a week.
Toilets	135	27	15	The average single flush toilet uses 9 liters per full flush. A household with 5 occupants flushes, on average, 15 times per day which is 135 liters per day.
Leaking fitting	32.4	6.48	4	It has been found that there is a leakage in one pipe with a rate of flow 0.0225 liter/minute. Leakage may vary with pressure of flow and time taken to repair it.
Total	920	184	100	

Source: Tata Consulting Engineering 2009

Another recent study titled *Water Poverty in Urban India: A Study of Major Cities* interviewed nearly 2800 households across seven major cities in India and provided a figure of 92 LPCD as an average water use across the cities. The study also provides a breakup of average water use at a household level according to various activities. According to the report, bathing consumes highest amount of water. Together, in all the seven cities, it consumes about 28 per cent of the total water at household level. Consumption in toilets (20 per cent), washing clothes (18.6 per cent) and washing utensils (16.3 per cent) follow the consumption in bathing. On an average, less than 10 per cent of the total water in a household is used for drinking and cooking.

Although there are varying standards and estimates of average water use per capita per day by different agencies, but there is hardly any argument in the fact that toilets and bathrooms are the biggest water guzzlers in a house, with flushes, taps and showers devouring more than 60-70 per cent of total water use. And, the grey and blackwater released from the kitchens, baths and toilets goes into an equally expensive sewage system, which all ends up polluting more water - invariably our rivers and ponds.

Reducing water consumption and improving water efficiency in buildings is a major step towards sustainable water management. Water efficiency involves conserving water by operationalising water saving technologies and actions. The benefits of implementing water efficiency initiatives in buildings may include, cost savings on water bills, water conservation and improving the image of the a business/building as a water efficient facility. With water using fixtures accounting for the majority of residential/ commercial building water consumption, the best opportunities for increasing efficiency are also found there. In several countries, high efficiency plumbing fixtures are being promoted and accepted in an endeavor to reduce water consumption levels. According to AWWA, by installing more efficient water fixtures and regularly checking them for leaks, households can reduce daily per capita water use by about 35 per cent to about 45.2 gallons (170.8 liters) per day, the break up for which is provided below in table 4.

Table 4: **Average water savings in an US household by installing water efficient fixtures**

Purpose	Gallons per capita	Percentage of Total Daily Use
Showers	8.8	19.5
Clothes Washers	10.0	22.1
Toilets	8.2	18.0
Dishwashers	0.7	1.5
Baths	1.2	2.7
Leaks	4.0	8.8
Faucets	10.8	23.9
Other Domestic Uses	1.6	3.4

Source: American Water Works Association, 2009

In the Indian context, TCE's household survey in Mumbai also provided a rough estimate of amount of water saving that can be achieved if simple replacement or installation of water efficient fixtures is adopted (see table 5).

Table 5: **Average water savings in an Indian household by installing water efficient fixtures**

Purpose	Water that can be saved in litres/day*	Water that can be saved in litres/Week	Recommendations
Showers	200	1400	Decreasing shower duration and by using low flow showers can save water up to 50per cent Sensor light arrangement on the water shower outlet, stopping the water flow after the preset duration.
Running taps in Kitchen/ Faucets	106	742.5	Changing habits of washing utensils and using smart fixtures like aerator faucets can save water up to 50per cent.
Laundry	14	100	When buying a new washing machine, choose the one that is water efficient. Front loaders use about half the water that top loaders use. Improved washing machines use between 45 and 120 liters per load.
Toilets	60	420	Modern dual flush toilets use only 3/6 liters of water per flush. This is 30per cent less than older dual flush cisterns and up to 9 liters less than single flush toilets. Water closet flush tanks with a smaller volume
Fittings	32	226.8	Have a tap that requires the user to press a handle and keep it pressed, for water flow. The moment the user releases the handle, the tap closes and water stops. A sensor light can be installed below/above the tap/sink. When the user puts hands below the tap, the sensor light operates and opens the tap. Water flows. When the user removes the hands, the sensor closes the tap. The water flow stops. Keep optimum pressure in water supply system. Fixing leakage saves huge amount of water.
Total	415	2889.3	

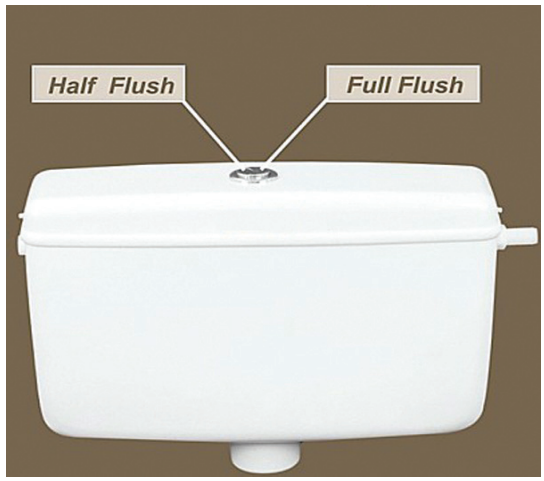
Source: Tata Consulting Engineering 2009
* Family size considered is five

Thus reducing water use leads to reduction in wastewater, increase in water and energy savings, reduced pressure on water treatment systems besides efficiency improvement. In buildings, water efficiency and usage can be improved through the involvement and instilling a mindset change amongst the various stakeholders by awareness generation, capacity building, placing options etc.

SECTION 4: EFFICIENCY IMPROVEMENT

Traditionally, water using plumbing fixtures in a building would include toilets (cisterns and commodes), faucets, showerheads, urinals etc. apart from other appliances like washing machines and dishwashers. Over the years, significant technological improvements have been accomplished aimed at improving water efficiency with minimum compromise on performance. Listed below are the specifications and improvements in the water using fixtures normally in use in toilets, kitchens.

a. Improvements in Fixtures Technologies



Source: www.precitechplastics.com

Dual Flush Cistern

1. Toilets

a. *Dual-flush toilets*- A significant way to save water in buildings is to replace existing single-flush toilets with dual-flush toilet. The current standard dual-flush toilets use 6 liters on full and 3 liters on a half-flush'. The most common dual-flush toilet is the 6 liters full flush/3 liters half flush, although a 4.5/3 litres dual-flush toilet is now available in select models.

b. *Interruptible Flush Cistern*- The flushing action can be interrupted at will and the discharge begins once the button is pressed and a second press interrupts it, so using just the amount of water necessary.

c. *High Efficiency Toilets (HET)* - High-efficiency toilets goes beyond the standard 6 liters and use 4.8 liters per flush.

d. *Waterless toilets or composting or ecosan toilets*- Although not very common for commercial buildings, urine-separating toilets separate the waste at the source and reduce the nutrient load by composting. They require little or no water for flushing reduces nutrient and strength of wastewater for treatment.

e. *Pressure Assist Toilets*- These toilets use either water line pressure or a device in the tank to create additional force from air pressure to flush the toilet. The water used for a single flush varies from 4.1 – 4.5 liters per flush.

f. *Power Assist Toilets*- operate using a pump to force water down at a higher velocity than gravity toilets. Power assist toilets require a 120V power source to operate the small fractional horsepower pump. Typical flush volumes are between 3.78 – 4.9 liters per flush and dual-flush models are also available.

2. Urinals

a. *Low water use urinals*- In some of the standard systems water is applied automatically through a continual drip-feeding system or by automated flushing at a set frequency, 24x7, regardless of whether or not the urinal has been used. Water consumption varies with the system model at an average of 4 liters per flush. While water-efficient urinals uses 2.8 litres per flush and in recent times. Smart Flush systems using 0.8 litres per flush have also been launched.

b. *Sensor operated* - urinals detect the presence of people through movement sensors or door switches (combined with an electronic delay to stop flushing for a set period after flushing)

c. *Waterless urinals*- there are various technologies available for waterless urinals. In oil barrier technology the urinals operate through the use of an oil wall between the urine and the atmosphere, preventing odours from escaping. While in the other technology the barrier has been replaced by a seal with a collapsible silicone tube that closes after the fluid has passed through it, to prevent gases attempting to flow from the sanitary pipe work, into the room. A third system uses biological blocks which include microbial spores and

Source: www.zeroflush-asia.com

Waterless Urinal

surfactants which can be placed into any urinal thus eliminating water use. Therefore, by breaking down the urine into components, the build up of sludge and crystals which causes blockages are prevented. The potential water savings from a waterless urinal compared to a 2.8 liters per flush, is almost 100 per cent.

3. Faucets/ Taps

a. *Aerators*- Modern taps often have aerators at the tip to help save water and reduce splashes. Without an aerator, water usually flows out of the tap in one big stream. An aerator spreads the water flow into many small droplets. Conventional faucet aerators don't compensate for changes in inlet pressure, so the greater the water pressure, the more water you use. New technology compensates for pressure and provides the same flow regardless of pressure.

b. *Flow Fixtures*- controls, deliver a precise volume of water in faucets, showerheads, and hose outlets, typically 5.6 – 8.3 liters per minute (1.5 -2.2 GPM), irrespective of varying line pressure. Flow controls work differently than faucet aerators, as aerators add air to the water stream to make the flow feel stronger, while flow controls, on the other hand, work by producing dozens of parallel streams of water.

Tap with aerators

Tap with flow fixtures

Source: www.bathroom-kitchen-faucets.com

c. *Sensor taps*- are automatic shut-off taps, such as push-button or lever-operated taps that shut off automatically after a set time to reduce the potential for taps to be left running too long or not turned off (e.g. a 6-star WELS-rated tap has a running time set between 5 to 10 seconds at a flow rate of 4 litres per second). Sensor taps with a flow rate of 2 litres/minute can also be installed. These taps cut off water supply when the hands are removed from under the tap, or when the preset timing of 30 or 60 seconds is reached, whichever is earlier.

d. *Thermostatically controlled electronic dual-purpose mixing or diverting valves*- are used within industrial and commercial applications (hotels, corporate office etc.) to automatically provide liquids as required.

4. Showers

a. *Water efficient showerheads*- deliver water at 9 litres per second or less than that. Further, showers can also be fitted with digital read-out meters that show the user the amount of water being consumed and the duration of the shower.

5. Washing Machines

a. *Front loading* - In general, front loading washing machines are much more water efficient than top-loading machines.

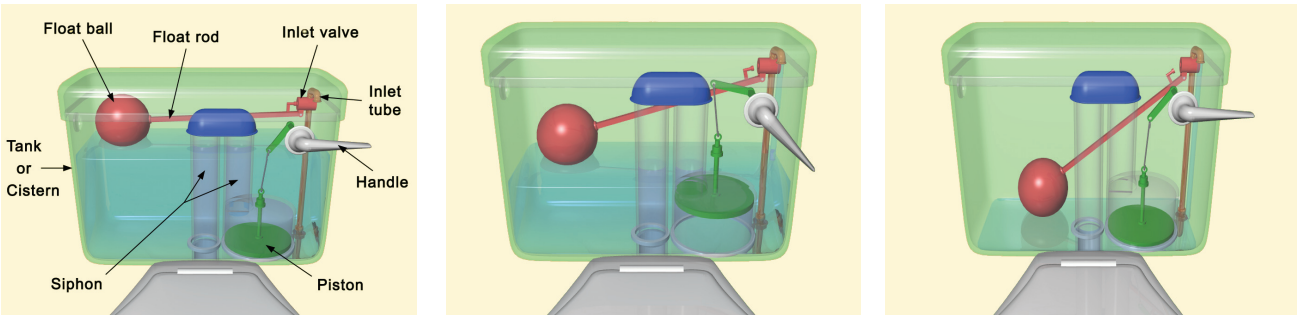
B. Technology that governs a Standard and an Efficient Toilet

A toilet is made up of several interrelated components like tank with flushing and refill mechanism, bowl siphon, outlet sewer pipe etc. that together work to make a toilet functional.

The top portion consists of a cistern or a tank and the bottom unit is called a bowl or a commode with inlet and outlet respectively. The handle or a button is pressed to flush the toilet which is stored in the cistern. The tank contains some important parts which includes, an inlet valve which controls the water supply coming into the tank and it lets water in when the tank is empty, and stops water coming in when the tank is full. The float ball rises as the tank fills with water.

Typical components of a toilet system

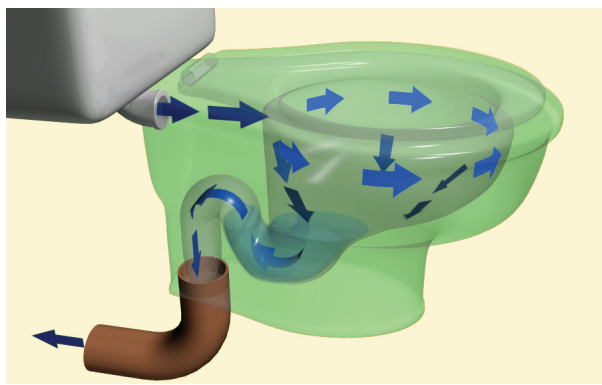
As it rises, the float rod attached to it presses against the inlet valve. When the tank is full, the rod is pressing against the inlet valve hard enough to turn the water off. This stops the tank from overflowing. When the handle is pressed, a lever inside the tank pulls the piston up, forcing some water through the siphon. This provides suction in the siphon, and the rest of the water follows, emptying the tank. The tank empties quite quickly, and the float ball floats to the bottom. That means the float rod is no longer pressing against the valve, so water begins to flow into the tank, filling it up again.



Working mechanism of a flushing tank or cistern

Source: www.en.wikibooks.org

The water which left the tank goes through a short pipe to the toilet bowl. It sloshes around the rim, down the sides of the bowl, and out through the drainpipe, cleaning the bowl and carrying the waste with it. Some of the clean water coming behind remains at the bottom of the toilet bowl. That's because modern toilets have an 'S' bend which remains filled with water between flushing. The water in the 'S' bend stops bad odours escaping from the drainpipe. During flushing the 'S' bend also provides siphon action which helps speed up the flushing process (Wikibooks 2010).



Bowl Outlet Mechanism

A dual-flush toilet looks like any other toilet, except that it doesn't have a flush lever. Instead, the user chooses one of two buttons, depending on the type of waste. One button is for the reduced or half flush, while the other marked button releases the full flushing water volume (Elliott 2008).

Dual-flush toilets are currently available in three different flushing mechanisms; washdown, washdown siphonic action and power assisted. Siphonic toilets swirls water around the bowl to create a vacuum or siphon in the

Source: youtube.com/watch?v=_z6pymOet7g

Siphon Flush *Washdown Flush*

trapway, so water leaves the bowl first, pulling waste out afterward. While this system works very well when large qualities of water are allowed, it is much more problematic when water is limited to 6 litres. To still be able to create the siphonic action, trapways had to be reduced to generally around 2 inches. Naturally, the reduced trap size made clogging common. Wash down systems donot have to create a siphon in the trapway. A steeper pitched bowl coupled with an open rim design pushes the water very quickly through the trapway, forcing the waste out first, followed by water. Because of the steep sides, only a small amount of water is required in the bowl. Splashing during use isn't a problem and any staining of the walls is usually washed away in the flush. As with any toilet, an occasional scrubbing is necessary. Dual flush toilets employ a larger trapway (the hole at the bottom of the bowl) and a wash-down flushing design that pushes waste down the drain. Because there's no siphoning action involved, the system needs less water per flush, and the larger diameter trapway makes it easy for waste to exit the bowl. Combined with the savings from using only half-flushes for liquid waste, the dual flush toilet design can save up to 68 percent more water than a conventional low flow toilet. There are several advantages to wash down. Because they do not have to create a siphon, trapways are able to stay much larger. And larger the trapway, the less likely the toilet will clog. There are international companies like Caroma which uses a 4-inch trapway- compared with the 2" industry standard. This innovation virtually eliminates clogging. The Caroma system cleans in one flush, 95 per cent of the time.

Finally the last design is the power or pressure assisted system which uses compressed air to force the water to flush the waste. There is no freestanding water in the bowl. The water is held in a pressure tank which is inside the toilet tank. This system gives a powerful flush but it is more expensive and relatively noisier than a gravity-fed system.

C. Nature of Water Savings

Water efficient fixtures have been widely accepted and are in use across the world especially in the countries like Australia, USA, parts of Europe etc. Regular activities that require water like sanitation, bathing, washing etc. can be realized by using reduced amount of water by replacing standard fixtures with installation of water efficient fixtures, thus leading to considerable water savings. Table 6 on the next page provides a snapshot of the latest cisterns and faucets fixtures available and the prospective savings in water use.

Developing and promoting water efficient technology for these water using fixtures would lead to increased water use reduction across all building types. In addition, to installing water efficient fixtures, setting standards for performance and measuring water efficiency of these fittings would provide credibility and widen its adoption across the building sector. Thus labelling and rating of water efficient fixtures, the consumers can identify products that are more water efficient without compromising on performance and the manufactures can benefit in the marketplace by offering rated water efficient that perform at power or better than available models using more water.

Table 6: **Details of the water efficient cisterns and faucets and estimated water savings**

Fixture	Operation	Water Savings
CISTERNS		
D2D 3/6 liters Dual flush cisterns Fittings	Two concentric buttons, pressing the circular button discharges 3 liters only and pressing both the buttons discharges 6 liters.	Savings 4 - 7 liters/ flush (Standard flush uses 10-13 liters/flush)
Interruptible Flush Cistern Fittings	The flushing action can be interrupted at will and the discharge begins once the button is pressed and a second press interrupts it so using just the amount of water necessary.	Savings 3 -6 liters/ flush (Standard flush uses 10-13 liters/ flush)
URINALS		
Sensor operated	Water is applied automatically through a continual drip-feeding system or by automated flushing at a set frequency, 24*7, regardless of whether or not the urinal has been used. Uses around 2.8 – 4 liters of water per flush.	Savings 2.2 – 10 liters (Standard urinal uses 4 liters and can go up to 10-13 liters when toilet pan with flush is used for urinating)
Waterless	Biological blocks, Sealant liquid traps and membrane traps	Savings 4- 13 liters
FAUCETS		
Single lever mixer- Eco Disk Cartridge	If the mixer tap is fitted with this type of cartridge, only the ecodisk devise has to be activated turning it through 180° and the flow is reduced by 50per cent. At the same time, or independently, by turning it slightly to the left (anti clockwise) the maximum temperature of the mixed water is lowered to the desired point, with consequent saving of water and energy.	50 per cent (from taps without regulators)
Single lever mixer- Plus Cartridge	It incorporates a simple system of water control that permits discriminating between the economical and full flow zones. On raising the handle to increase the flow, an elastic stop that offers a slight resistance advises of passing to the maximum flow zone. It also has a limiter for the maximum temperature of the mixer.	50 per cent
Single lever mixer- Star Cartridge	As well as the hydro control system (separating the economical flow zone from that of the full flow), this new generation cartridge include another novelty; on opening the tap in the front position, in the zone of the economical flow, cold water runs and not the mixture. On turning to the left an increasingly warmer mixture is gradually obtained. Opening the tap completely and going beyond the elastic stop takes it into the maximum flow zone. In this case, with the handle in the front position, it now works like a traditional cartridge and mixed water is obtained.	50 per cent
Thermostatic Mixers	Can select the desired temperature for the mixture. They are fitted with a flow regulator button (50per cent saving) and temperature limiter button (energy savings)	40 per cent
Electronic mixers	Mixers or non mixers, powered by alkaline batteries or from the electricity mains. They are opened or closed by the proximity detectors. Putting the hands near the taps opens it and withdrawing them closes it.	50 per cent
Flow regulators	They limit the maximum flow from the tap in the washbasin, kitchen and shower as indicated, whatever the pressure of the installation and also mix air. Available in 3 variations Regulator of 6 liters/ min Regulator of 8liters/minute Regulator of 10liters/minute	 6 liters/ min- 65 per cent 8 liters/minute- 55 per cent 10 liters/minute- 30 per cent
Flow Restrictors	They regulate the flow rate in the fittings between 7.5 and 9 liter, depending on the system pressure Restrictors of 9 liters/minute (@ 3 bar) Restrictors of 9 liters/minute with a check valve system	9 liters/minute with a check valve system- 45per cent

The table is also to an extent reflective of the similar brands or the ones in the same league offered in the market.
Source: Various Sources (Including document of Roca Solutions for Saving Water and Energy, Version 1, June 2008)

SECTION 5: SANITARYWARE MARKET SCENARIO IN INDIA

The first manufacturers of sanitaryware in India were the Parasuram Pottery works. Earlier to that, until 1940's the only sanitaryware available in India was imported from England and the clientele included wealthy urban residents in the major cities. In the 1960s, companies like EID Parry, in collaboration with Royal Doulton of UK and Hindustan Sanitaryware in collaboration with Twyford of UK, started production of vitreous china sanitaryware. Other major players who joined the organized sector were Madhusudan Ceramics and Neyveli Ceramics. 1980's saw the entry of few other players in the market, but most of them have since been taken over by larger brands.

Since, then the sanitaryware and wellness products market in India is growing leaps and bounds and has an impressive market value of approximately Rs. 2500 crores. The sanitaryware industry in India is essentially comprises of two key sectors namely, organized and unorganized. Of this nearly half that is around 55 per cent is accounted by the branded segment and is growing at a respectable rate of 20 per cent per annum. The non branded sector has reduced to 45 per cent growing at lesser pace of 8-9 per cent.

The organized sector consists of around five key players (M/s Hindustan Sanitary Industries Limited/ Hindware, Parryware-Roca, M/s Cera Sanitaryware Limited, M/s Swastik Sanitaryware limited and M/s Neycer India limited) and who have established their brand image. The organized sector produce fully vitrified sanitaryware using the latest technology and better quality ceramic raw materials available in India. The unorganized sector on the other hand has adopted local Indian technology to manufacture the basic sanitaryware product. Since availability of raw material is in abundance and also very cheap in the state of Gujarat and Rajasthan, various companies have established their factories in these areas. They are producing the basic sanitaryware in various brands.

The unorganised sector includes many small and local manufacturers, who tend to price their products generally 25-30 per cent cheaper than organised players. Since they are tagged as small sector these manufacturers avail the benefits of excise duty and sales tax exemption, thus giving them cost advantage. Their competitive prices offer them with an edge over the large manufacturers and provides with a substantial market in rural areas, small towns and in low income areas of big cities.

Parryware-Roca and Hindaware are the market leaders in India, accounting for about 40-45 per cent market share each amongst the organised sector players, with Parryware Roca marginally ahead of Hindware. Cera Sanitaryware Limited (erstwhile M/s Madhusudan Industries limited) with around 20-25 per cent market share in the organized market occupies third and Classica from Swastik sanitaryware is placed at the forth position.

The sanitaryware sector has greatly benefited from the consistent and strong growth that has been registered in the building and construction sector over the last decade fuelled by the boom in the housing and infrastructure business. The sanitaryware market is mainly driven by institutional and individual consumers. The institutional consumers procure for apartments, commercial and office complexes etc. Whereas the individual buyers generally purchase it for their own residential requirement from the retail outlets.

The largest branded sanitaryware manufactures is the Parryware-Roca group with around 42 per cent market share and with an annual turnover of Rs. 500 crores. Infact, Parryware prides itself as the first company to

launch 3/6 liters flush unit in India in 2000 and today almost all their toilets are available with 3/6 liters lush cisterns. The price of their dual flush cistern ranges between Rs. 1300-5500 for 3/6 liters model, while for 4/2 liter system the consumer has to pay Rs. 1200. A single flush system which is advertised as *water saving* is priced between 890-1300 depending on the model quality. But the urinals with sensor technology and waterless models are dearly priced at Rs. 6500 and Rs. 2531- 9625 respectively. While a regular flush based urinal from Parryware would come at a cost of Rs. 500-800.

According to Pankaj Rai, Senior Sales Manager-North, the production of 10 liters single flush toilets has declined but there is still a considerable demand for these units across India especially in parts of Northern India. The regional difference in adoption of low water using toilet is primarily due to the fact that consumers especially in North India associate water with hygiene and are reluctant to install 6/3 liters toilets. They generally prefer bulky high capacity flush cisterns with 10-13 liters capacity as opposed to the new improved models using half that amount. But western India, has given promising response to this new improved efficient technology and infact Bombay and Pune were amongst the first cities to adopt this technology in India. The Mumbai Municipal Corporation was instrumental in promoting 6/3 liters technology and disallowed the use of high capacity flushing cisterns. According to Rai, Parryware has also introduced 4/2 liters flush toilets in India, but its major demand is from the green building sector since the people at large are generally skeptical of low flush toilets. This is also the reason why the response to their water less urinals has been relatively less encouraging. Other factors for the slow response include the sealant /eco trap technology used by Parryware which is very difficult to maintain especially in public urinals and the cost of the water less urinal which is Rs. 5000-6000 per unit.

Hindaware, controlling around 40 per cent share in sanitaryware market in India manufactures products ranging from urinals (water based and waterless), flush based systems (cisterns, commodes) and ceramic ware including basins, bath tubs and other toilet/bathing accessories. Hindware had introduced the dual flush cistern (3/6 liters) in the Indian market few years ago and has ever since received a good response. According to Manish Titerway from Hindware's product marketing division, all attached units (cisterns and commodes) are available in 3/6 liters capacity, while the company offers single and dual flush options in pvc plastic cisterns sold separately. He further adds that the company still produces single flush cistern using 10 liters of water as the demand still exists for these high water using cisterns. The average cost of a pvc cistern varies from Rs. 690-950, while a single flush with 8-10 liters in similar material would cost somewhere around Rs. 580- 940 respectively. While a concealed dual flush cistern would be upwardly priced between Rs. 6200-5800. The company also produces urinals ranging from sensor operated and waterless. The flush based urinals have the auto flush and the nozzle technology. The auto flush system flushes after every flush or is timed for a fixed interval. While the nozzle based technology requires manual flushing and has a piped connection with an overhead tank and has no attached cistern. According to Hindware, 90 per cent of the companies still manufacturer this technology and are is wide circulation. Although the production has come declined, they are still stocked and are supplied on demand.

The microwave control inductive sensing technology is the Hindware latest in their water efficient urinal products. These systems can either be set for time or distance or both for pre or post flush. The system adopts the micro computer control, with self adjusting urinal flush and best detection zone. Simply stated, the system can be timed for flush pre or post or both) and can sense human movement (with adjusted distance sensor) to automate flush. Once the pressure of urine is directed on the bowl the flushing system is activated. It is also functioned to use flush automatically every 24 hours to avoid the odour from returning once the trap dries. The

auto spray flush releases 10 liters of water for perfect spray flushing. While the pre and post flush uses 250 milliliters (ml) and 500 ml respectively. The company takes pride in its waterless urinal systems which according to them leads to a massive water saving of approximately Rs.22,000 due to reduction in maintenance cost and water use. Hindware supplies waterless urinal units as well as the cartridge that can be retrofitted in existing urinals. The unit requires replacement of cartridge after around 10,000 uses and replacement of hygiene seal after 20,000 uses. But its high cost & maintenance, along with zero water use has not gone down well with an average consumer who usually considers water essential for cleaning toilets and urinals.

The third major player Cera, has also introduced twin flush cisterns in both ceramic and plastic versions and had launched them in India around 2005. Cera also credits itself for launching innovative and water saving products in the Indian market like the other two known brands. According to their website, the twin flush model launched in India by Cera was aimed at reducing water use for the consumers considerably. Cera is manufacturing cisterns which use just 4 liters of water for flushing.

The products range for Classica Sanitaryware mainly includes ceramic ware like washbasins, closets, cisterns etc. The company now manufactures cisterns that can be fitted with a single flush or dual flush mechanism. The manufactured products of the company are in sale across the country except for western India. Classica's flushing mechanisms (especially the dual flush) are imported from Korea and according to Anil Sinha, head of marketing are custom made for Indian plumbing conditions and water quality (e.g. hard water). Thus the flushing mechanism can be adjusted since the cisterns are designed in a way to accommodate them.

SECTION 6: ENFORCEMENT AND REGULATION – *THE WEAK LINK*

The concept of water efficiency is fast gaining significance as a means to reduce pressure on water sources and conserve water. To promote this initiative and to ensure effective compliance governments and non governmental agencies across the world are taking significant steps in this regards. There have been long drawn efforts to improve building's water efficiency by reducing water use, harvesting rainwater and recycling wastewater by developing green building concepts and ratings. On the other hand, several appreciable acts and programs have been enforced that provides for water efficiency rating for fixtures and appliances. Over the past few years, the eco friendly building concept has also experienced a considerable change, as the concept has expanded to incorporate water efficiency, savings and reuse as key attributes in awarding ratings to green buildings besides energy efficiency and materials. In the green building ratings stipulated points are awarded to buildings which install water efficient fixtures and through it achieve water use reduction.

Green Star (Australia, New Zealand, South Africa), LEED Canada, DGNB certification system (Germany), LEED USA, BREEAM (UK) etc. are some of the examples of popular building certification and rating systems. Besides the environmental concerns, the rising cost of supplying water and water treatment has also contributed to its inclusion. The green building rating systems is proving to be crucial in guiding stakeholders in the construction industry to incorporate components for improving water efficiency in planning, developing and operating new and existing buildings.

The water efficiency component in these green buildings include several elements like rainwater harvesting, reuse through wastewater technologies, water efficient landscaping etc. Reduction in building water use is a very significant step for reducing water intake and thus minimising wastage and wastewater. Thus reducing

water use leads to reduction in wastewater, increase in water and energy savings, reduce pressure on water treatment systems besides promoting efficiency. In homes, commercial and institutional settings, highest percentage of water use is diverted for domestic activities which include kitchens, restrooms etc. Water Conservation Guide for Commercial, Institutional and Industrial users, New Mexico Office of the State Engineer, July 1999.

According to the United States Geological Survey, per person usage of water at home varies from 80-100 gallons (1 gallon equates to approximately 3.78 liters) or 300-380 liters per day. Often, highest percentage of water is used in toilets for flushing, almost five times a day. Toilets in USA, use around 1.6 gallons of water per flush which is nearly 6 liters. In Australia, old style toilets were high on water consumption, as they required 12 liters of water per flush; however the latest dual flush toilets uses less than half of that amount.

Installing or replacing water efficient fixtures and fittings is the single most essential means to reduce water use. The water use in buildings is generally related to the fixtures and fittings in toilets, kitchen etc. Sanitary fixtures in residential, commercial or industrial buildings include toilets, urinals, basin taps, and showerheads. In commercial buildings for example, around 30-40 per cent of total building water use is used for domestic/bathroom applications in commercial or public office buildings. This can be much higher, depending on the building type and while part of this will be for water used in kitchens, the majority is likely to be for the plumbing or sanitary fixtures.

Several countries across the world are already established standards for labelling and ratings and have strong supportive legislations well in place. The efficiency certification system developed and adopted around the world, can be broadly divided in two categories. In some countries efficiency is not graded, but an efficiency label is awarded when consumption is less than a specific amount. It is in use in USA and the Nordic nations, while Australia, Ireland, Portugal and Singapore use the label indicating a classification that varies with the product's efficiency. The following section provides account of the significant initiatives in the form of acts and programs launched by various countries to certify and rate water efficiency of water using fixtures and appliances.

a. Acts and Rating Systems

WELS in Australia: Champion for Water Efficiency

Water Efficiency Labelling and Standards (WELS), is Australia's water efficiency labelling scheme, which requires certain products to be registered and labelled with their water efficiency in accordance as per the national *Water Efficiency Labelling and Standards Act 2005*. The products that are listed include showers, tap equipments, flow controllers (optional); sanitary ware like toilet equipments, urinal equipments; and finally white goods like clothes washing machine and dishwashers. Therefore under the scheme, for example, the manufacturers and retailers cannot supply toilets that have a higher flow rate than 5.5 litres per average flush volume. From, July 2006 the government has made the WELS Scheme mandatory, therefore product that has been manufactured or imported on or after 1 July 2006, must be registered and labelled before sale.

Label for WELS rating (left) and energy rating label (right) used in Australia

The WELS water rating label has been designed on the lines of the energy rating label and provides water efficiency information for water-using products. It allows consumers to compare products and rewards manufacturers and retailers who make and stock water efficient models. The label displays a zero to six star rating that enables a swift comparative assessment of the product's water efficiency and the figure showing the product's water consumption flow is based on laboratory tests. More the stars on the label, greater is the water efficiency of the product. Adequate support has been provided in terms of legislation and regulation, to effectively promote and adopt water efficient products in Australia. The Australian Government's provides the legal framework for the WELS Scheme. The , the and the are also part of the WELS legislative framework.

Box 1: WELS and WaterMark: Double Check

Australia has two well developed schemes to regulate the water efficiency of products, appliances and fixtures. WELS, is a government regulatory scheme, which undertakes product testing as the Australian Standards and displays the water efficiency star rating and the water consumption or flow rate of the product like taps, showers, toilets, urinals and flow controllers. The other regulatory mechanism in place is WaterMark, which is a product quality certification mark provided by independent certifying authorities. The mark testifies that the product complies with the requirements of the Plumbing Code of Australia and the specifications listed in relevant Australian Standards. These standards relate to the product quality, its health and safety aspects and fitness. The certification is mandatory for products to be legally installed in accordance with state and territory plumbing regulations. IAPMO R&T Oceana certifies plumbing and drainage products to use the WaterMark™ symbol, which is independent testing, research, and technical services in the plumbing and mechanical industries. The key difference between the two is that, WaterMark confirms the product complies with the requirements of the Plumbing Code of Australia and is fit for purpose for installation under that Code, whereas, WELS rating relates to the water efficiency of the product only. Consumers of the WELS labelled products with no WaterMark have to confirm legality of its installation from the local authority or plumber. Ratings are based on a six star system and more number of stars signifies more efficiency.

The WELS legislation entails establishment of a WELS regulator to administer and provides authority to the Environment and Heritage Minister, Government of Australia to enlist the products covered under the scheme and standard requirements. Third, registration and labelling requirements for WELS products and setting up the registration fee system. The legislation also facilitates monitoring and enforcement measures and finally, setting procedures for issuing and paying penalty, infringement notices as an alternative to prosecution for offences. States and territories across the country have also enacted their complimentary legislations to promote national coverage of WELS. The standards for rating the water efficiency and/ or performance of the WELS products is the Australian and New Zealand Standard *AS/NZS6400:2005 Water-efficient products—Rating and labelling*. These standards form the basis for the star ratings, water consumption and flow that are displayed on the labels.

The WELS regulator which monitors and enforces the scheme imposed by the legislation is sited in the Department of Environment and Heritage. The regulatory powers include inspecting and monitoring compliance and alleged breaches of the WELS act, imposing fines and penalties for the breaches, compelling withdrawal of non conforming products from the market, deregistering products and advertising convictions. To enable and promote compliance by the manufacturers/retailers administrative actions, awareness and education can be opted by the regulators instead of legal actions. The regulator has the option to use administrative actions and education, as an alternative to legal action depending on the severity of the non conformity, to help manufacturers, importers and retailers to meet their legal obligations under the WELS Act. Where a cooperative

solution is not possible, the regulator can act to impose penalties and enforcement provisions outlined in Part 7 of the WELS Act. The breaches and non compliance issues with WELS scheme are reviewed in accordance to the Compliance Enforcement Policy of the Department of the Environment, Water, Heritage and the Arts (WELS 2008).

WaterSense for USA

The market for water efficient products and activities in USA was boosted with the launch of WaterSense in 2006, which is sponsored by the Environment Protection Agency (EPA). WaterSense brings together stakeholders like local water utilities, manufacturers, distributors, consumers to reduce water use in non agricultural uses through behavior change and undertakes rating/ certification of products for efficiency, performance and quality to facilitate consumer choices. The products receive the water efficiency label only after independent testing and certification. Consumers of the products with WaterSense label are assured of superior efficiency (almost 20 per cent more) and performance than other similar technologies and products available in the market. The label works as a mechanism for measuring water savings by using certified products, thus contributing towards overall water conservation goal. A variety of products used in toilets, sink faucets/ accessories, flushing urinals and new homes are given WaterSense label.

WaterSense Logo

Annexure 1 provides a summary of the two major labelling systems namely WELS and WaterSense from Australia and USA respectively. The annexure table highlights the water savings, cost comparisons etc. with respect to various water efficient fixtures enlisted under the two programmes.

Box 2: EPA in US: Benchmark for Water Efficiency Improvement

1992 was a benchmark year as the ongoing efforts to improve water efficiency for fixtures, sanitary ware were recognised with passage of the federal Energy Policy Act. The act laid down uniform water efficiency standards for nearly all toilets, urinals, showerheads, and faucets manufactured after January 1994. The Act envisaged that the reduced water demand and wastewater volumes would influence policy and planning decisions of utilities. The EPA has three crucial components: the establishment of maximum-water-use standards for plumbing fixtures, product marking and labelling requirements, and recommendations for state and local incentive programs to accelerate voluntary fixture replacement. The US Department of Energy (DOE) through its Office of Buildings was made the nodal agency to administer and regulate the requirements. The American Society of Mechanical Engineers (ASME) and the American National Standards Institute (ANSI) establishes the maximum flush volume for toilets and urinals in national standard A112.19.6-1990, Hydraulic Requirements for Water Closets and Urinals. The marking and labelling requirements have to be consistent with the same standard, while the Test procedures for showerheads and faucets are subject to ASME-ANSI A112.18.1M-1989, Plumbing Fixture Fittings. But the overall authority rests with the DOE to establish more stringent codes as the technology improves and evolves, but the responsibility is with ASME-ANSI largely. It is mandatory for the toilets and urinals to display permanent legible markings indicating water use in GPF and similar markings in gallons per minute or gallons are required for showerheads and faucets. The act also entitles DOE to issue recommendations to states for establishing state and local incentive programs. The programs should be so designed to encourage the acceleration of voluntary replacement by consumers of the fixtures with standardized labeled products (Vickers, 1993).

Because of its federal structure, several states across the US have also devised and are implementing programs like the (CUWCC) in the State of California. It has been working with select water agencies to establish and promote efficiency criteria for toilet fixtures. As a result of this initiative, High Efficiency Toilets (HET) has been introduced which use less than the mandated 1.6 gallons or 6 liters water per flush. The CUWCC has grouped HET in three broad categories namely, dual flush, pressure assist and gravity fed. Similarly, the council and related agencies are working towards developing zero water urinals and High Efficiency Urinals, which uses less than mandated 1 gallon or 3.78 liters water per flush. Efforts are also ongoing to develop water efficient clothes washer and pre rinse spray valves for dishwashers which can reduce water use substantially.

The growing market for water efficient products have favoured manufactures to develop several innovative products, like the electronic control devices that power themselves using just water when the faucet is used (Green California, 2008). The above initiative for improving water efficiency is backed by laws and regulation in the state of California. In 1992, a new water-efficiency standard for restrooms became the law in California, which specified the maximum flush volume for water closets, urinals and associated flusho-meters, showerheads, lavatory and sink faucets. Regulations also exist for washing machines and commercial pre rinse spray valves to restrict maximum water use. The favorable policies like executive order S-20-04, directs and fosters the state to prioritise energy and resource efficient buildings. The government is mandated to design, construct and operate all new and renovated state owned buildings as “LEED Silver”. The LEED certified buildings are considered to be better performing facilities in terms of building practices, eco-friendly products, energy and water use, material conservation and reduced environmental impacts. The cost of these water efficient fixtures and appliances are compensated by the reduction in water and energy bills, pumping and treatment etc.

ANQIP in Portugal: Addressing National Water Efficiency

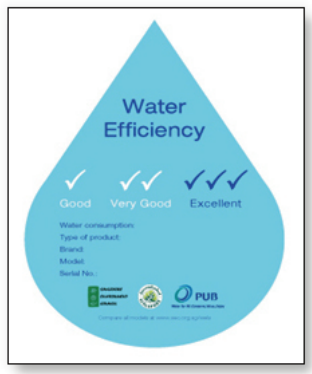
In order to reduce inefficiencies in urban water use and resulting monetary losses, the Portuguese government has decided to implement a National Plan for Efficient Water Use. The plan envisages providing water efficiency labelling for water using products and incentives to promote water efficiency in buildings across the country. The voluntary labelling plan is to be undertaken by non governmental organizations in consultations with official government bodies working in this sector.

AveiroDOMUS, an association formed by the University of Aveiro and interested companies, to design and build a “House of Future”, which uses eco friendly and sustainable building materials and technologies. In terms of water conservation the initiative, aims to optimize the hydrological cycle by techniques and applications like recycle and reuse, rainwater harvesting, saltwater installation of low flow and water efficient fixtures. A wide variety of water efficient products are been studied for their efficiency, performance, quality, cost, which include use of small volume cisterns; low-flow fixtures; timers and other automatic control devices; air emulsifiers; waterless/chemical urinals, and low consumption washing machines. Cisterns and waterless urinal for their role in water savings are been given special attention since inefficient cisterns can waste considerable amount of water (around 30 per cent of total water consumption in residential sector in Portugal is accounted to cisterns).

To encourage water efficiency, Portugal has established a non profit association called, ANQIP in 2007, with members from several universities, firms from the related sector, management organizations and self-employed technicians. The association works towards promoting and ensuring water quality and efficiency in the water supply and drainage fittings and fixtures of buildings. The ANQIP works toward developing or supporting technical and/or scientific studies; undertaking technical trainings for workers, installers, retailers; dissemination

activities like publishing articles, organizing seminars, events; improving standards and regulation; creating certification systems for water efficiency products; conducting water audits for existing building and installations and issuing opinions on projects and designs. In accordance to the proposals by the National Plan for Efficient Water Use, ANQIPS is working to introduce a product certification system and a water efficiency labelling scheme in the country. The ANQIPS labelling system indicated a rating system that varies with the product's efficiency (Afonso. A & Rodrigues. C, 2008) . Portugal has water efficiency labelling indicating a classification that varies with product efficiency, but is voluntary in nature. Each letter in the certification would be assigned standard benchmark vales through the Technical Specifications (CTA) in Portugal's ANQIP system.

Singapore's WELS Model



Singapore's Water Efficiency Logo

The Water Efficiency Labelling Scheme (WELS) is an initiative of the Public Utilities Board (PUB), Singapore's national water agency. The objectives of WELS are to enable consumers to conserve Singapore's scarce water resources, and to encourage manufacturers to produce more water-efficient products. The Mandatory Water Efficiency Labelling Scheme (from 1 July 2009 onwards) applies to shower, basin and sink taps, low capacity flushing cisterns, urinals and urinal flush valves. Washing machines and showerheads are incorporated into the Voluntary WELS. The scheme is implemented through labels that indicate the water efficiency of a product. The four categories in the rating schematic are: zero tick, good, very good and excellent. The flow rate and flush capacity of a product are integral to determining its rating capacity. In addition to the products' water consumption, its brand, model and registration number are also displayed on the label. Singapore's domestic per capita water consumption has reduced from 165 liters /day in 1999 to 160 liters /day in 2005. This achievement has been accomplished by a combination of programs undertaken by the PUB including water efficient homes and buildings programmes, installation and promotion of low water using and high efficient fixtures like cisterns, thimbles/constant flow regulators and awareness building campaigns.

Water Efficiency Plan for Canada

The Toronto City Council in 2003 approved a water efficiency plan and adopted for a 15 per cent reduction in water demand by 2011. Toronto's daily average residential water consumption is approximately 253 liters per capita. The plan entails a series of initiatives that would lead to that would help cut down the demand. Which inturn would reduce wastewater flows ultimately delaying the need for costly expansion of city's water and wastewater infrastructure creation and expansion. The plan specifies steps like toilet replacement, clothes washer replacement, and system leak detection programs. The toilet replacement plan was infact found to be applicable in all sectors ranging from residential (public and private housing), industrial, commercial and institutional. The provincial government took the lead in mandating the water efficient toilets (6 liters per flush) be installed in all new buildings in 1996; the new legislation did not apply to existing toilets. The residents for example are offered cash incentives to replace high water use toilets with water efficient models. And for assisting the consumers, details of water efficient models have been provided on their website. The cash incentives were based on a cost benefit ratio on associated water savings due to the replacement. The authority tested the toilets for efficiency and performance and was surprised that nearly 50 per cent of the toilets available in the market actually didn't meet the proper performance norms. A regular monitoring program was devised by the government under which regular field inspections are conducted of upto 5 per cent of each selected toilet models every year to ensure that manufacturers meet the standards. Under the program residents are also

required to submit purchase receipts of the selected water efficient toilets. The city has developed a dedicated website that offers information, step wise replacement plan and even information of disposal of old toilets. The response to the initiative has been encouraging with nearly 112,700 toilets being replaced in the residential sector alone followed by similar response from the industrial and commercial sector. The actual cost of implementing the Water Efficiency Plan through to 2011 is expected to be $56.6 million, of which $6.4 million is dedicated to incentives and program support.

b. Is India ready for Water Efficiency Labelling: Status Check

The Bureau of Indian Standards (BIS) is the premier agency in India assigned the task of development of standardization, marking, quality certification and quality control on a wide range of products and processes. Over the years, BIS has formulated nearly 18,000 standards in different technology areas ranging from product specifications, testing methods, codes (practices, guidelines, etc.), terminologies and basic standards. At present there are a few BIS standards that prescribe guidelines and certify sanitary products like cisterns, commodes, faucets etc. For example, standard for cisterns (plastic and non plastic) which includes specifications on flushing capacity, discharging etc. IS 774: 2004 is the standard for flushing cistern for water closets and urinals (non plastic) cisterns, IS 2326: 1987 is for automatic flushing cisterns for urinals and IS 7231: 1994 is the specification for plastic flushing cisterns for water closets and urinals. These standard covers discharge rate, discharge capacity, size, quality, pressure, coating, manufacturing process etc. Taps on the other hand are tested for leakages, pressure etc. At present, there are no standards for waterless urinals, since all are imported and imported products are not liable to BIS certification except under very specific conditions.

However, applying for these standards is also completely voluntary and there is no regulation that mandates a manufacturer to adhere to them while producing fixtures. So very few manufacturers actually apply to BIS for certification, mainly since consumers in India generally associate BIS's ISI mark as a synonym for quality and safety. And, while applying for certification the manufacturers would have to declare their product capacity and BIS's license document mentions the discharge capacity, but its voluntary nature makes the entire process far less effective than it should be. Thus, it may be acceptable to conclude that although product labelling system does exist in BIS (though voluntary) but there are no standards or specifications for water efficiency in water using fixtures in toilets and kitchens.

Therefore, often details on water savings and water efficiency are not quantified and certified by BIS or any independent agency. Thus unverified statements rather than actual water saving are provided by the manufacturers on these products. However, the manufacturers do agree that a certification and verification of their water savings claims would be useful since it would validate their claims, disqualify bogus assertions, provide incentives to manufacturers and sellers and enable consumers to make informed decision making.

In the past few years, India has witnessed remarkable growth in infrastructure and construction development. But as the sector is growing there are accompanying environmental challenges and threats which calls for attention and significant action. The National Building Code of India (NBC) provides guidelines for regulating the building construction activities across the country. The provisions of this code are intended to serve as model for adoption by Public Works Department (PWD) and other government construction departments, local bodies and other construction agencies. Existing PWD codes, municipal bylaws and other regulatory media could either be replaced by the NBC or suitably modified to cater to local requirements in accordance with the provisions

of the code. Unfortunately, the NBC does not include energy, water or material efficiency standard and offers only guidelines for construction.

On the other hand, programs like green building designs and concepts, research and development of eco friendly building materials and technologies, green building rating systems are some of the crucial steps in making the construction industry environment sensitive. There are several internationally adopted green building rating programs like LEED India, IGBC Green homes and factory ratings and the homegrown GRIHA rating system developed under the aegis of Ministry of Non Renewable Energy, Government of India. The stages that are included for evaluation are the preconstruction, building design and construction and building operation and maintenance stages. All the four rating systems have integrated water efficiency and savings as a key component of its rating systems beside energy, pollution, materials, environmental quality etc. (see Annexure 2). The water section mentions the requirement of designing, replacement and installation of fixtures, technologies etc. with some minor variations. Like all the ratings mentions rainwater harvesting, wastewater treatment, reuse of treated water for landscaping and flushing, management of irrigation systems, drought tolerant species and water efficient fixtures (see Annexure 3). Therefore to be eligible and to gain rating points the buildings are required to fulfill all these requirements. Although, none of the green building rating systems are mandatory, thus very few buildings in India have actually received or applied for these ratings. Therefore, it's builders and developers prerogative to sought green building ratings and improves water efficiency and use in the buildings.

To cater to these requirements the branded sanitary ware manufacturers have actually identified fixtures and products that are generally supplied to the buildings applying for green ratings. Parryware supplies water efficient fixtures like toilets with 4/2 liters flush, sensor/waterless urinals, taps/faucets to the architects, builders who are engaged in green building designs and construction. According to them, since water saving is an important component of green building ratings, therefore there is a rising demand for their green products in this market. There is no government organization that provides certification for the amount of water savings at present to the sanitaryware manufacturers. For the green building certification, the builders request the manufacturers to supply the water saving products which are tested by the manufacturers themselves and not certified by an independent third party or an accredited laboratory. The manufacturers generally are aware of the green building norms and deliver the required products to the respective builders and developers after internal testing.

According to Pankaj Rai, Parryware would welcome a mandatory labelling and rating system that would provide some certification and acknowledgement for their improved technology and water saving initiatives. At present they are getting no incentives in the form of star ratings or efficiency labels etc. which certifies their products which according to them are best in the market for water efficiency. This would also give the consumers confidence on and information about their water efficient products and their green intentions. At present the companies like Parryware, Hindware and a few others have developed catalogues to promote their products as green products (water and energy savings) which mostly includes the fixtures used in Green buildings. But, majority of the small and local manufacturers are not even aware of the rating system for fixture's water efficiency since the certification for standard fixtures on other parameters is still not mandatory by BIS.

But, there are certain cautions that have to be administered when adopting such an important water efficiency programme. According to Pankaj Rai, almost 50 per cent of the sanitary ware market is unorganized and maximum manufacturing units are located in Gujarat and majority of these units manufacture low cost basins,

cisterns and commodes. But the real worry is that they illegally use ISI labels on their products. There are almost 300 units located in the state of Gujarat alone, which is emerging as a major hub for sanitaryware manufacturing. With price as their main concern, these manufacturers generally pay less regards to water efficiency. There are hardly any performance and efficiency checks that are conducted on their products. In addition to this Chinese products are also flooding market with low cost and high water using toilets with 9-10 liters capacity, which is also a cause of worry for the organized sector.

Despite facing severe water scarcity situation, water efficiency and reuse is still not high on agenda as far as India is concerned. As sanitation reaches more number of people, urban population is on the rise, increase in the number of buildings being constructed everyday and lifestyle of an average Indian becomes more water intensive, there is even greater need to take stock of water use and misuse in India. As far as the larger mindset is concerned a large number of Indians still equate high water volumes with hygiene, a fact, reiterated by the Pankaj Rai from Parryware. According to him, an overwhelming number of consumers especially in north India prefer to buy bulky and high water volume cisterns than the dual flush 3/6 liters flush cisterns for the same reason. Therefore companies like Hindware and Parryware still continue to manufacture 10 liters cisterns for consumers. Apart from these known brands, the smaller companies continue to manufacture 10-13 liters flush in large numbers. Online on the websites like India mart and trade mart, most of these local brands promote models with 10 liters flush cisterns and hardly any dual flush cisterns are marketed on these online portals. These flushes are designed to be particularly wasteful, as they use 10 liters of water every time to flush carrying even a small quantity of waste down the drain. According to Parryware, residential consumers are generally slow in accepting this technology but they have major share in the market (80-90 per cent). Therefore it is very important to target them to start installing water efficient fixtures.

No doubt, that there is a growing realization that water conservation and saving are crucial, still systematic and effective mechanisms to ensure efficiency are lacking. Though most of the manufacturers, especially the branded ones would highlight the water saving and consequent cost savings aspect of the product especially cisterns, urinals and faucets to some extent. However, quantity or volume of actual water savings is generally not mentioned, thus raising doubts on the process of calculating actual water use, water and monetary savings.

According to Parryware, major manufactures generally have a testing facility at their manufacturing unit where the products like cisterns, commodes, urinals, etc. are tested for performance and water efficiency. Various tests like (ball, tissues, colour test etc.) are conducted to ensure that the product's water efficiency is as per their own specifications, without compromising on performance. Hindware for example has seven critical tests for the commode flushing. It is generally accepted fact that, to achieve efficiency the cistern technology has to be compatible with commode design to ensure efficiency with performance. Therefore a low water using flushing cistern (usually branded) may not give good performance if teamed with a low grade commode with faulty design.

As it is sufficiently clear that, ratings for water efficient fixtures as means to reduce water use has not received due recognition from the relevant agencies as an independent program in India. Though water efficient fixtures installations are sighted in the sections on water efficiency in green building ratings but regulatory mechanisms are lacking to award them valid labels. As detailed in the case studies, several developed countries have already in place a well developed program for rating water using fixtures for their efficiency and are making significant water savings by using them. Although rating efficiency is not a new concept in India, the Bureau of Energy Efficiency (BEE) has a standards and labelling programme for electrical appliances. Products are tested and

rated for their efficiency and receive BEE labels which are then displayed on the products by the manufactures for the benefit of the consumer to make valid and informed choices. The procedure is very similar to that followed in USA, Australia and other countries for rating water efficient fixtures.

To provide a boost to energy conservation activities The Indian Parliament passed the Energy Conservation Act 2001. The Bureau of Energy Efficiency, an autonomous body under Ministry of Power was set up in 2002 under the act. The Bureau of Energy Efficiency, Ministry of Power has developed a scheme for energy efficiency labelling of equipment, under the Energy Conservation Act, 2001 by the Central Government. The scheme has been developed in collaboration with all the stakeholders, and aims at providing information on energy performance so that consumers can make informed decisions while purchasing appliances. The scheme provides information and procedures for the test procedures, schedule, rating & sampling plan, qualification requirements, label design, label fee and the manner of display of label in relation to the aforesaid equipment. A committee has been set up by the Bureau to oversee implementation of the scheme. The committee is chaired by the Director General, Bureau of Energy Efficiency and consisting of representatives from the Ministry of Power, Bureau of Indian Standards, consumer associations, manufacturers association, and test laboratories.

c. Key Challenges in Initiating Water Efficiency Reform

But initiating a programme like this has its obvious sets of challenges that have to be addressed before attempts to operationalise this crucial reform are undertaken. According to the A. K. Saini, Head of the BIS's Civil Engineering department, there are certain inherent problems associated with introducing standards or rating systems for water efficiency in toilets and kitchen fixtures. Although the technology of these fixtures has improved manifolds over the past few years, but the overall sewerage system which includes the pipelines, underground sewers etc. have not witnessed similar up gradation or improvements. According to Saini, sewer lines are designed according to a certain flow and therefore need to have a minimum capacity to carry the load. This implies that a specified amount of water should be available in the system to keep it operational and

Box 3: Australian Experience on Drain Carriage and Water Efficient Fixtures

Similar concerns were also placed when the Australia was in the process of implementing the WELS rating system. The report titled Analysis of Australian opportunities for more water efficient toilets prepared by the Institute for sustainable futures highlighted the concerns on performance and drain carriage usually related to low flush toilet systems. Representatives from city west water and water services association of Australia had their doubts on the low water using products. According to them, the need to keep the pan clean is crucial; therefore the improved flush toilets would be of little value to the consumers if the water efficiency is not matched with adequate performance of the pan. There were some concerns on whether reduced flush volumes have a higher likelihood of a soiled fixture.

Representatives from the Institute of Plumbing Australia have also pointed that the design of the pan allows for reduction in the area of the water seal and shape of the pan in order to achieve low flush volumes, and has resulted in some instances lower cleansing efficiency of some products. As a result people have to flush a multiple times due to poor pan clearing performance mainly a result of design compromises. As per the experience of several respondents drain carriage was the single most important technical barrier which resists introduction and promotion of water efficient toilets classes in Australia. But they also reiterated the fact that, drain line carriage was not dependent solely on flush volumes but to a large extent toilet design and performance has a vital role play.

prevent blockage. Similar issues of drain carriage as raised by Saini are coming to light in Australia also. Problems with respect to drain carriage out of homes and buildings with low flush volumes have come to notice of the authorities. It is very important that toilet flushing not only clears the refuse from the pan, but also transports waste through the drain to the main sewer lines. Therefore the performance of the entire plumbing system for the whole building has to be considered along with the toilets. But, according to the industry experts in Australia, blockages in the drain line joining the outlet of the toilets to the main sewerage line can be a result of several factors which may include damages caused to the pipe overtime, cracks or leaks that may have developed in the pipe systems etc.

In India, the prospect of relaying the present sewerage system at once is extremely bleak. Therefore, a phase wise up gradation plan for the sewerage system should be taken up gradually moving upto the city level. According to Saini, an area with decentralized system would be ideally suited for a change to less water using fixtures. The small cities currently in the development stage can also adopt a new sewerage system that would support low water using fixtures. But present state of sewerage system in the Indian cities is not fit to support to water using fixtures, as it would create more problems than solving. As concentrated sewage would lead to wastewater disposal problems and lead to increased contamination in the water bodies. Besides it was reiterated that in order to design standards and mandate them, Government has to issue a regulation, in accordance to which BIS would then be able to initiate work on standard development.

According to Sudhakaran Nair, President of the Indian Plumbing Association (IPA), water efficiency in buildings can be effectively undertaken in India, only after relevant legislations and regulations are devised and stringently implemented, on the lines of the Energy Policy Act (EPA) executed in the USA in 1992. According to Nair, sustainability and improved adoption of green building initiatives in India, requires urgent enactment of EPA type legislation, setting standards for permissible water consumption in plumbing fixtures and thereafter issue guidelines to manufactures and developers to operationalise it. The legislation should make it mandatory for all the new construction and renovation works to integrate and implement plumbing codes. He further adds that related stakeholders in the plumbing industry must come forward to initiate partnership programmes on the similar to that of “WaterSense” and “EnergyStar” in USA (Nair 2009). The dissemination of such initiative should be undertaken through awareness and capacity building amongst manufactures, plumbing professionals, architects, builders developers, government officials, general public on advantages for developing and insisting on such labelled water efficient fixtures.

IPA has identified certain barriers that need to be addressed if, water efficient sanitary and plumbing fixtures are further promoted in India. These concerns are primarily since the low water using fixtures market is very small and their use not very widespread. The efficiency and performance of cisterns using 4-6 liters water per flush. Indian manufacturers have come up with large urinal bowls to compete with the imported products. However, unlike the imported urinals, the domestic product is rarely supplied with an appropriate flushing device. For example large bowls requiring 3-4 liters of water for effective flushing are fitted with 0.5 lpf devices. Concerns are also being raised with regards to the waterless urinals in terms of formation of urine crystals over times that block the drains, overlooking venting the drainage system and regular replacement of the cartridge or liquid that prevents foul odour from escaping into living spaces needs, cost of cartridge replacement, accidental emptying of water into such a urinal will flush away the floating liquid. Interestingly, the Uniform Plumbing Codes are also not sufficiently developed to integrate these urinals in the buildings as they stipulate provision of a water connection at each waterless urinal.

A fact supported by the Kamal Khakhani, of the journal Indian Plumbing Today published by the Indian Plumbing Association or IPA. According to Khakhani, BIS publishes a National Building Code (NBC), which includes minimum plumbing requirements. But, implementation of these plumbing codes is voluntary and there is no government mechanism that enforces these codes sternly. The fact that Indian plumbing standards are lagging behind the international standards is reiterated by the reality that the Bureau of Indian Standards published the 2005 revision of the NBC, after an interval of 22 years. Although other initiatives like LEED India, GRIHA, Green Homes etc. are working towards developing and promoting concepts of green buildings which incorporates plumbing components to ensure water savings, efficiency, reuse and recycling based on international ratings and labellings. There is unfortunately, no ratings (grading for water efficient fixtures) or labelling (maximum use or flow) in India that can be used for certification. But there development and uptake is seriously restricted by the fact that, reputed plumbing consultants and contractors handle only 5–10 per cent of the total volume of plumbing works in the country. Majority of plumbing fixtures, sanitary ware like faucets, closets, urinals etc. are locally manufactured by small enterprises.

Such is the urgency of this reform that the National Water Mission (NWM) document prepared as part of the National Action Plan of Climate Change (NAPCC) has also identified water efficiency improvement as part of its recommendations to combat climate change externalities. The goal four of the National Water Mission, recommends strategies for increasing water use efficiency by 20 per cent. The NWM has developed a framework to optimize water use through efficiency improvements and has drawn provisions from the 2002 National Water Policy. The mission aims to increase efficiency in the three key sectors of agriculture, industries and domestic and has highlighted the need for devising incentives to adopt water neutral or water positive technologies. Strategy IV.6, under the goal four clearly states developing and promoting water efficiency labelling of water appliances and fixtures. The mission document had constituted advisory committees for accomplishment of each of five goals outlined, comprising of intersectoral groups of various relevant ministries and experts. The action plan and timelines have also been enlisted, with strategy IV.6 under the goal 4 been entrusted on the Ministry of Urban Development (MoUD) and Ministry of Rural Development (MoRD). The task as mentioned in the mission document has to be completed within the 5th year of the Eleventh Five Year Plan.

SECTION 7: WAY FORWARD

The imminent water crisis in terms of declining and erratic availability makes it all the more relevant to devise and operationalise this reform for the water using fixtures, which consumes maximum water in the buildings. The above paper adequately establishes the urgent need for introducing a system that would rate the water using fixtures for its water efficiency. Best practices mentioned in the paper from across the world on rating system for water efficient fixtures and the Indian model for rating of energy efficient appliances serves as a benchmark for the water sector. But it would be critical to customize these international rating systems and related protocols as per the Indian situation and requirements for its success.

The significance and the urgent need for developing and implementing a water efficiency rating system, has been reinforced internationally & now by the Indian government. Therefore in order to undertake this imperative water efficiency reform, Ministry of Urban Development, Government of India (MoUD-GoI) has requested Centre for Science an Environment (CSE) to develop a roadmap for rating system for water efficient fixtures'. This requires a systematic approach by developing a roadmap essentially to standardize and mainstream the water efficiency rating process.

The water efficiency rating system is a comprehensive mechanism with an ultimate goal of providing the consumers with informed decision making to choose water efficient products. Several instruments like legislations, regulation, licensing, pricing, awareness generation, behavioral changes etc. have been utilized in varied ways and extent to realize water efficiency and conservation.

CSE through this paper has made an attempt to foster discussion on this critical issue. The discussions would be vital in evolving a roadmap for implementation (standardization and mainstreaming) based on consultation with a wide range of stakeholders including manufacturers, government authorities, organizations, sector experts, civil society, media etc. to address this issues. And, in the process of developing a the roadmap for the future on water efficiency rating system, the following four key questions need to be discussed in detail.

- What should be rated?
- What should be the unit of efficiency?
- What should be the testing protocols?
- What should be the inspection systems?

CSE is hopeful that the proposed discussion and the subsequent roadmap would facilitate the Ministry of Urban Development to formulate related policies in the immediate future to effectively tackle the water efficiency and conservation issue. Clearly, it is the right time for India to initiate action on a rating system for water efficient fixtures.

Annexure 1: **Comparison between WELS and WaterSense Programmes**

Name of the labelling/rating system	Product Category	Details of the product in the category	Water use Ordinary product	Water use WE product	Water Savings	Cost Ordinary product	Cost WE product	Remarks
Water Efficiency Labelling and Standards (WELS)	Taps	Showers	15-20 lts/min	6-7 lts/min	14,500 lts/hh*/annum (* Household)	Gas hot water, $1500 over ten years	Gas hot water, $790 over ten years (47 per cent reduction)	
		Tap equipments	15-18 lts/min	2 lts/min	Reduce flow to less than 1/3 of standard tap			Flow & aerating model
		Flow controllers	optional					
	Sanitary ware	Toilet equipment	12 lts/flush (Single flush)	< 4 lts/ flush (Dual flush)	Saves 51 lts/ person/day Saves 30000-40000 lts/hh/day	$760 over ten years	$250 over ten years (67per cent reduction)	Accounts for 22 per cent water savings for WELS scheme; Average consumption not to exceed 5.5 lts/flush
		Urinal equipments	2.2 lts/flush	1.5 lts/flush	30 per cent reduction; Smart controls further reduce water use by 40-50per cent by reducing unnecessary flushing			Excludes waterless urinals
	White goods	Clothes Washing Machines (CWM)			WELS products uses 1/3rd water of older/ average model			Accounts for 50 per cent water savings for WELS scheme; By 2016 WELS CWM could save 25,600 megaliters of water/ year, which is a reduction of 8.8 per cent in water consumption of CWM sold between 2003-16.
	Dish-washers							By 2016 WELS dishwashers could save 1,200 megaliters of water/ year, which is a reduction of 6.5 per cent in water consumption of dishwashers sold between 2003-16
WaterSense	Toilets	Single and dual flush toilets		Not to exceed 4.8 liters/flush High Efficiency Toilets (HET)	Saves 4000 gallons/year or 15120 lts/year		$90/ year on water bills for a four member household	Dual flush → 1 full and 2 reduced flush

continued…

Annexure 1: **...continued**

Name of the labelling/rating system	Product Category	Details of the product in the category	Water use Ordinary product	Water use WE product	Water Savings	Cost Ordinary product	Cost WE product	Remarks
	Bathroom sinks faucets & accessories				WaterSense labeled faucets can reduce a sink's water flow by 30per cent or more without sacrificing performance; WaterSense labeled faucets saves 500 gallons/ year of water for an average HH			Account for more than 15 per cent of indoor HH water use
	Urinals		Average urinals uses 1gallon/flush (gpf) or 3.78 lts/flush; Old urinals use almost 5 times that amount	WaterSense labeled urinals cannot exceed 0.5 gpf	WaterSense labeled saves 1- 4.5 gpf and saves 4600 gallons/year for an average HH			
	New homes	Plumbing fixtures, an efficient hot water delivery system, water-efficient landscape design, and other water- and energy-efficient features		Use 20 per cent less water than the average new home; fixtures in bathrooms save nearly 5,000 gallons of water/ year	save an average of 10,000 gallons of water/year		save atleast $100 on utility cost per year	WaterSense labeled new homes include WaterSense labelled plumbing fixtures, an efficient hot water delivery system, water-efficient landscape design, and other water- and energy-efficient features

Compiled from WELS and WaterSense websites

Annexure 2: **Components of Green Buildings rating system in India**

The details of the criteria for each of the four rating systems are provided below, with special reference to water efficiency and reducing use of water through water efficient fixtures.

Rating Systems	Rating Systems Agency/ Association	Rating Systems Type	Rating Categories
IGBC Green Homes Rating System	The Indian Green Building Council (IGBC)	Residential	• Site Selection and Planning • Water Efficiency • Energy Efficiency • Materials • Indoor Environmental Quality • Innovation & Design Process
IGBC Green Factory Rating System	The Indian Green Building Council (IGBC)	Industrial Units	• Site Selection and Planning • Water Efficiency • Energy Efficiency • Materials • Indoor Environmental Quality • Innovation & Design Process
LEED India Rating System	The Indian Green Building Council (IGBC)	All building type	• Sustainable site development • Water savings • Energy efficiency • Materials selection and • Indoor environmental quality
GRIHA- National Green Building Rating System	Ministry of New and Renewable Energy, Government of India and the Energy and Resources Institute (TERI)	All building types	• Site Planning • Building planning and construction stage (water, energy and materials) • Building operation and management • Innovation

Annexure 3: **Water specific components of Green Buildings rating system in India**

Rating Systems	Rating Categories	Components	Weightage
IGBC Green Homes	Water Efficiency	Mandatory Requirements (Qualifying) • Rainwater Harvesting, 50per cent • Water Efficient Fixtures Other Requirements (Credits) • Turf Design (20per cent, 40per cent) • Drought Tolerant Species (25per cent) • Management of Irrigation Systems • Rainwater Harvesting (75per cent,95per cent) • Grey Water Treatment (50per cent, 75per cent, 95per cent) • Treated Grey Water for Landscaping (50per cent, 75per cent, 95per cent) • Treated Grey Water for Flushing (50per cent, 75per cent, 95per cent) • Water Efficient Fixtures (20per cent, 30per cent) • Water Metering	20 per cent
IGBC Green Factory	Water Efficiency	Mandatory Requirement (Qualifying) • Rainwater Harvesting, 50per cent Roof and non-roof Run-off • Low Flow Water Fixtures Other Requirements (Credits) • Limit Turf Area (20per cent, 30per cent, 40per cent) • Drought Tolerant Species (30per cent, 40per cent) • Management of Irrigation System • Rainwater Harvesting (75per cent, 95per cent) • Non-process Wastewater - Treatment (75per cent, 95per cent) • Water Use Reduction (20per cent, 30per cent)	21 per cent
LEED India	Water Savings	• Water Efficient Landscaping • Water Efficiency in Air-conditioning System • Innovative Wastewater Technologies • Water Use Reduction (water efficient and/or dry fixtures, occupant sensors)	8.69 per cent
GRIHA- National Green Building	Building planning and construction stage (water, energy and materials)	• Reduce landscape water requirement • Reduce building water use (using efficient fixtures like low-flow fixtures, etc.) • Efficient water use during construction • Wastewater treatment • Water recycle and reuse (including rainwater)	13 per cent

Source: Compiled from various data sources

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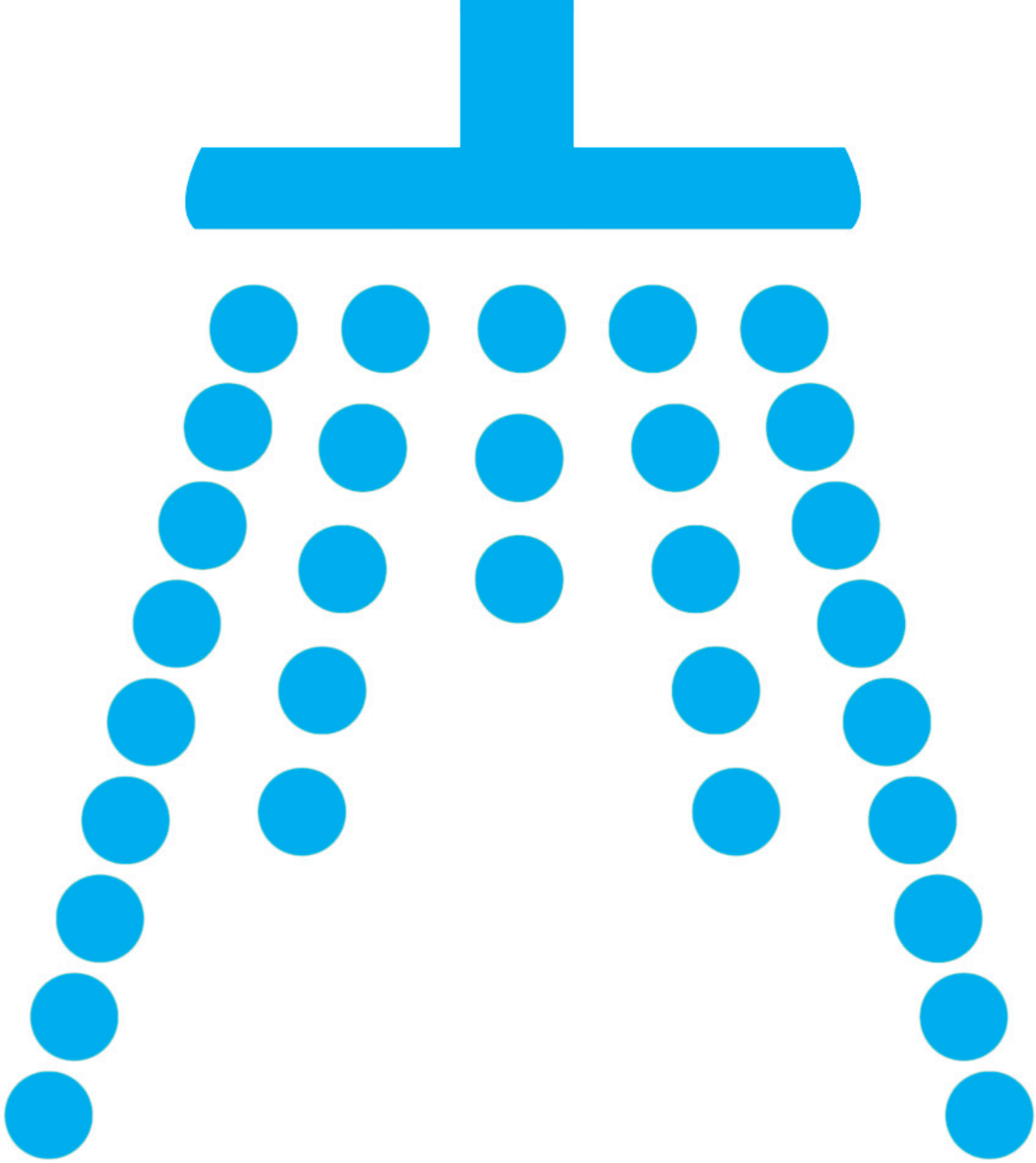

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