This presentation premiered at WaterSmart Innovations

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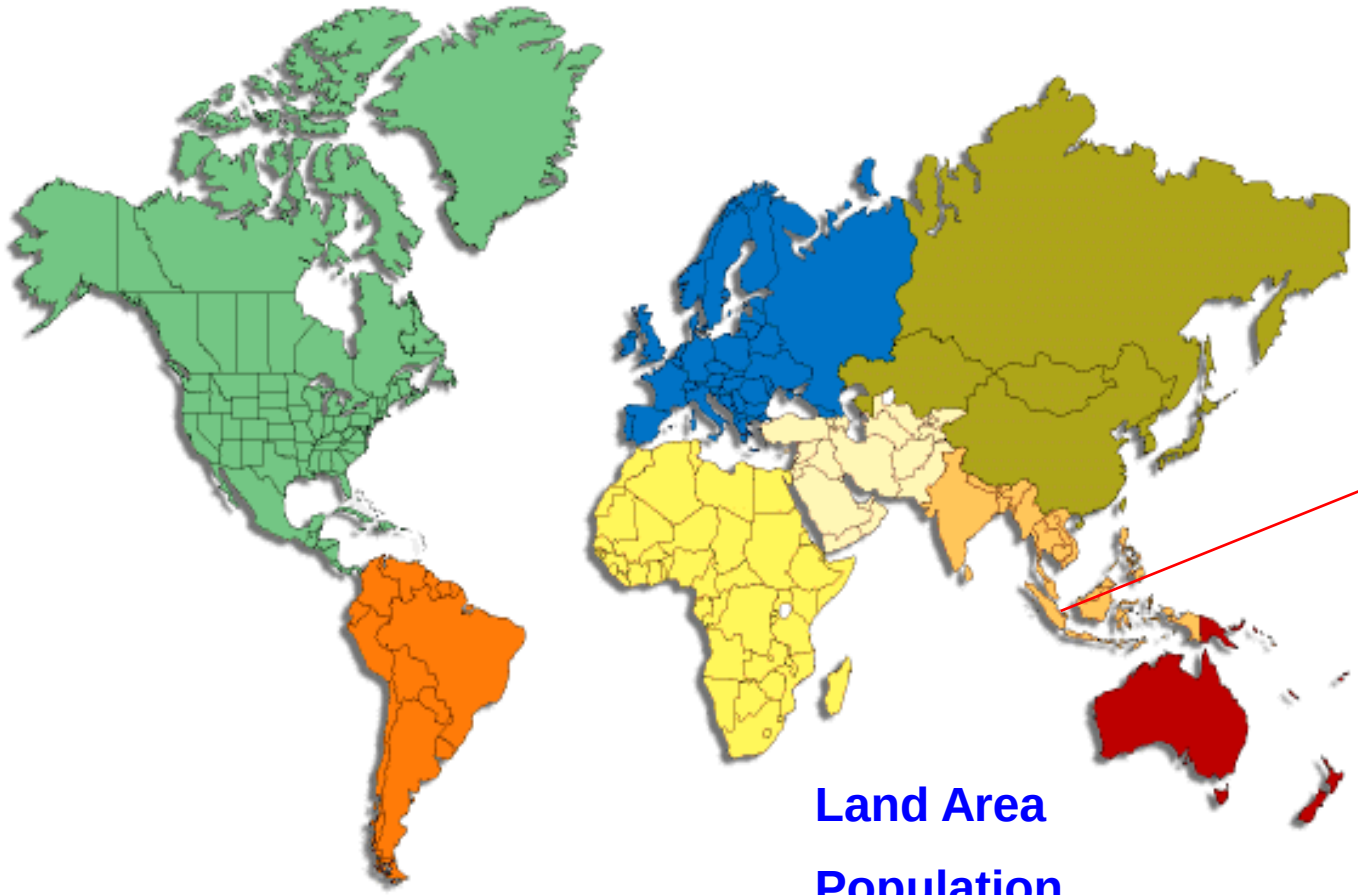
INNOVATIONS

Water for All
Conserve, Value, Enjoy
PUB

Singapore's Experience in Water Demand Management

Wong Wai Cheng
PUB, National Water Agency

Singapore



Singapore

Land Area	**710 km^2**
Population	**5.03 mil**
Average Annual Rainfall	**2,400 mm**
Average Water Demand	**1.7 mil m^3/day**

PUB : Part of Singapore's MEWR Family

Ministry of the Environment and Water Resources

To deliver and sustain a clean and healthy environment and water resources for all in Singapore.

National Environment Agency

To ensure a sustainable quality environment in Singapore

- ***Clean Land***
- ***Clean Air***
- ***Public Health***

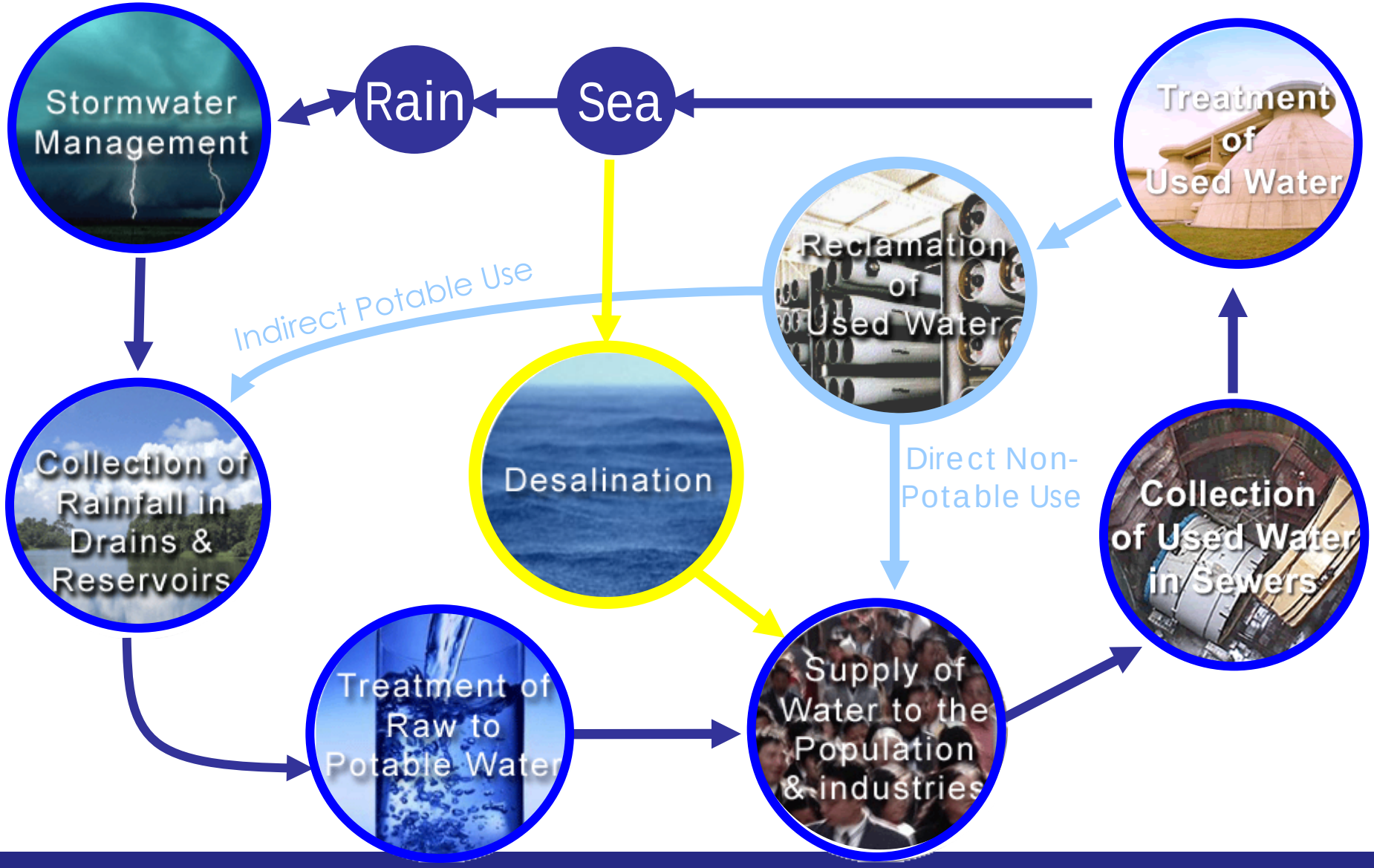
PUB

Water for All : Conserve, Value, Enjoy

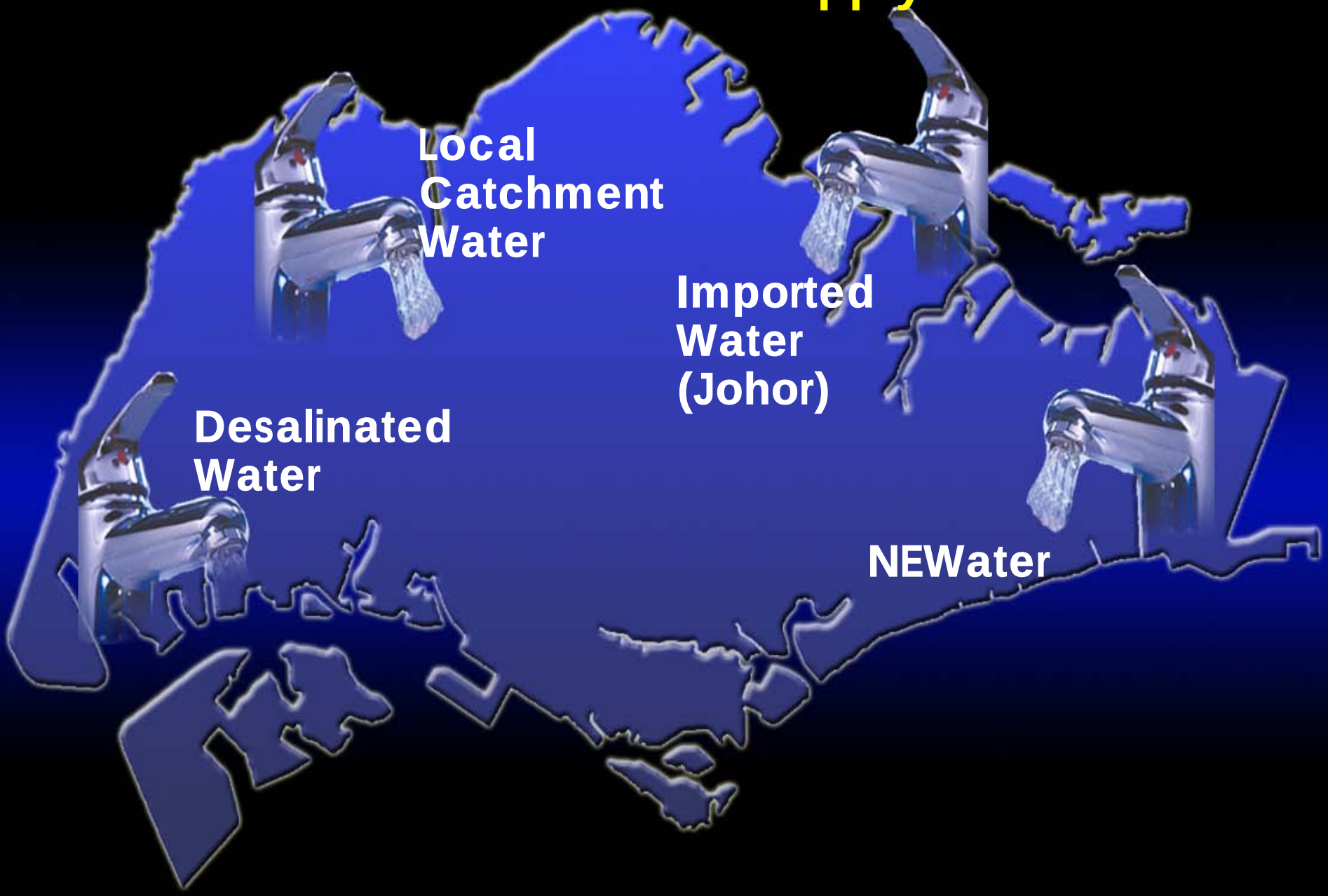
To ensure an efficient, adequate and sustainable supply of water

- ***Water Supply***
- ***Used Water***
- ***Drainage***

PUB Manages the Complete Water Cycle



Diversification of Sources of Supply



Demand & Supply

DEMAND AND SUPPLY 2010 & 2060

Singapore's daily water demand from the domestic sector and the non-domestic sector are met by a blend of the Four National Taps. NEWater is mainly supplied to the non-domestic sector.

Sustainable Water Management

"Water for All"

4 National Taps

Supply

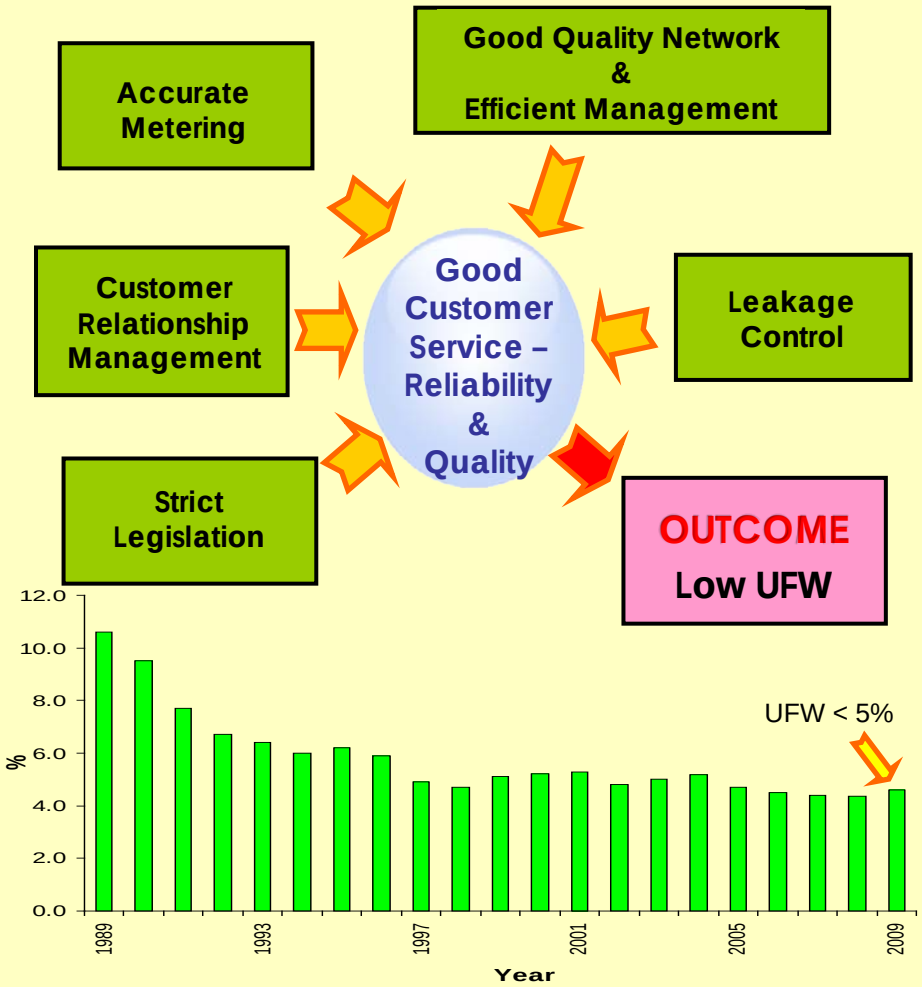
"Conserve, Value, Enjoy"

3P Approach

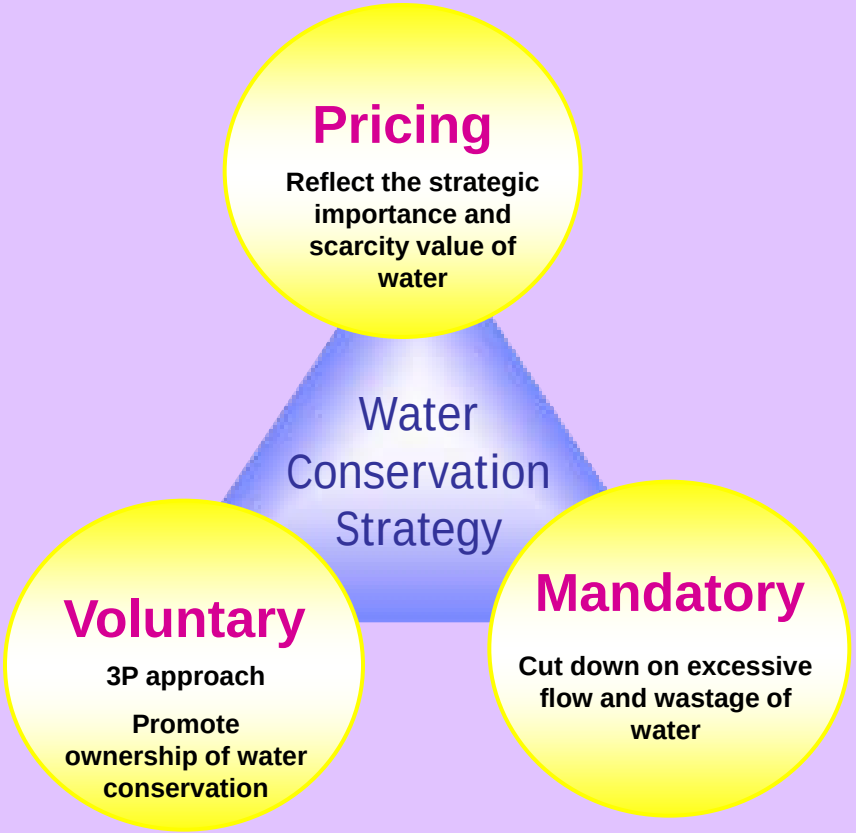
Demand

Water Demand Management

UFW Control



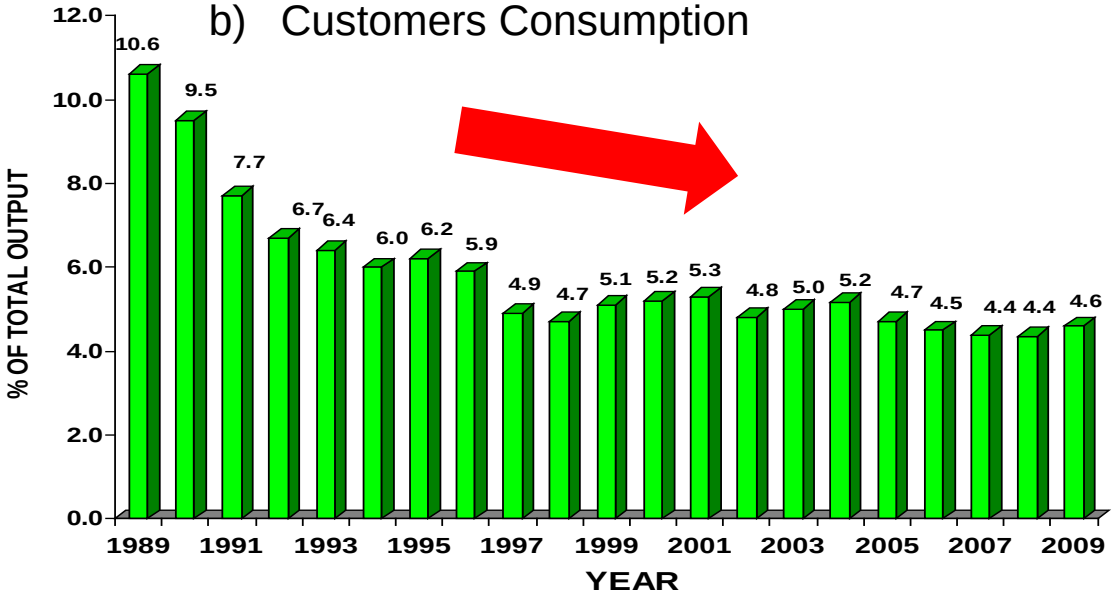
Water Conservation

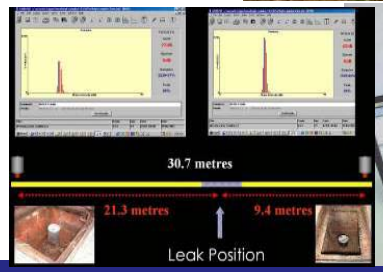


Unaccounted – For - Water

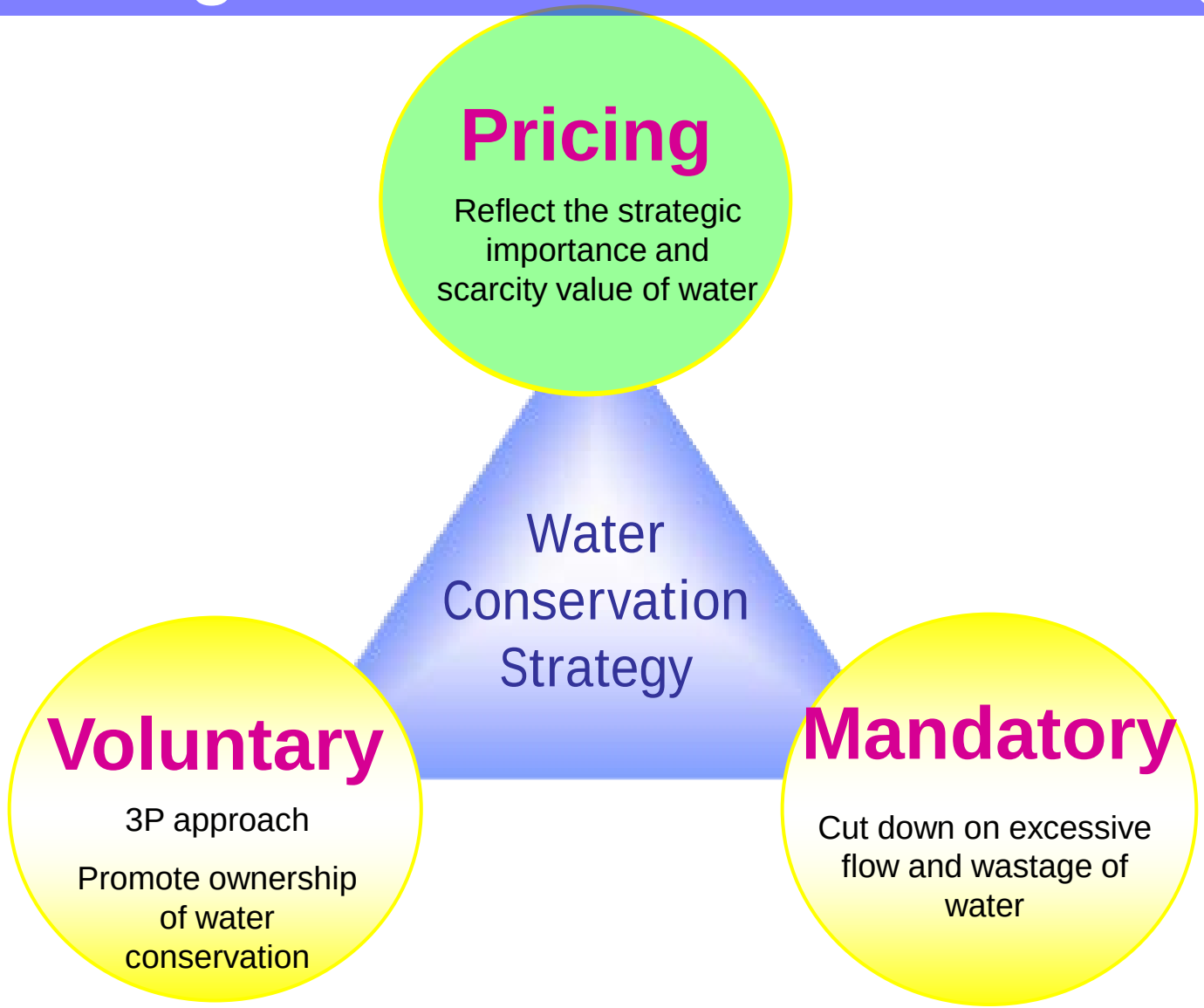
Reduces Readily as a result of:

1) Good Quality Network
   a) Replacement of old/problematic mains
   b) Strict supervision & control of workmanship
2) Efficient Management,
3) Active Leak Detection Programme
4) Accurate Metering
   a) Output of Waterworks
   b) Customers Consumption





3- Prong Water Conservation Strategy



Pricing

- All customers metered and charged
- Volume-based billing
- Regulated by Ministry (Environment & Water Resources)
- 1980s – early 1990s – social good , need to be provided for public health
- 1991 – water conservation tax (WCT) to discourage excessive water use
  - 5% - domestic consumption more than 20 cu m/mth
  - 10% - all water used for non domestic
- 1997 – 2000 – price review
  - Increase tariff – recover full cost of production and supply
  - Restructure WCT – reflect higher cost of next drop of water

Pricing

- Volume-based billing
- Regulated by Ministry (Environment & Water Resources)

		Potable Water			Used Water	
Tariff category	**Consumption block (m3 per mth)**	**Tariff (¢/m3)**	**WCT[1] (%)**	**Total (¢/m3)**	**WBF[2] (¢/m3)**	**SAF[3] (¢/appliance)**
Domestic	1 to 40	117	30	152	30	300
	Above 40	140	45	203	30	300
Non-domestic	All units	117	30	152	60	300

1: Water Conservation Tax – Tax on consumption to reinforce the water conservation message

2: Waterborne Fee – Volume-based used water fee

3: Sanitary Appliance Fee – Fixed used water fee based on the number of sanitary appliances

Mandatory Requirements

Code of Practice for Water Services –SS CP 48 : 2005 Water Conservation Measures (Cl 7.2)

- Install Self-Closing Delayed-Action Taps
  - All wash basins, shower pts
- In all non domestic premises (including common amenities of condominiums)

Manually-operated

Sensor-operated

Self-Closing-Delayed-Action Tap

Code of Practice for Water Services –SS CP 48 : 2005
Water Conservation Measures (Cl 7.2)

9 litre flushing cistern

1994

Single Flush Low capacity flushing cistern (4.5 litres)

From July 2009

Dual flush Low Capacity Flushing Cistern

- Install dual flush low capacity flushing cisterns in new developments and existing premises under renovation which involve the
  - replacement of water closets
  - applicable for non-domestic premises if flushing cisterns are to be used
  - applicable to all domestic premises

Water Efficiency Labelling Scheme

- Voluntary Water Efficiency Labelling Scheme (WELS)
  - launched on 31 Oct 06
- Objective of WELS
  - Aims to help consumers make well-informed purchasing decisions and reduce their water consumption by providing information on the water efficiency of products
- WELS rate products in terms of water efficiency
- (1 tick for Good rating, 2 ticks for Very Good rating and 3 ticks for Excellent rating)
- To enhance the Scheme, PUB has mandated it through the Mandatory WELS (MWELS) in July 2009

Types of products

Shower taps & mixers

Basin taps & mixers

Sink / Bib taps & mixers

Urinals & urinal flush valves

Dual flush low capacity flushing cisterns

Washing machines

Showerheads

Code of Practice for Water Services –SS CP 48 : 2005 Max allowable flowrates (Cl 4.1) & Public Utilities Water Supply Regulations (Cl 40)

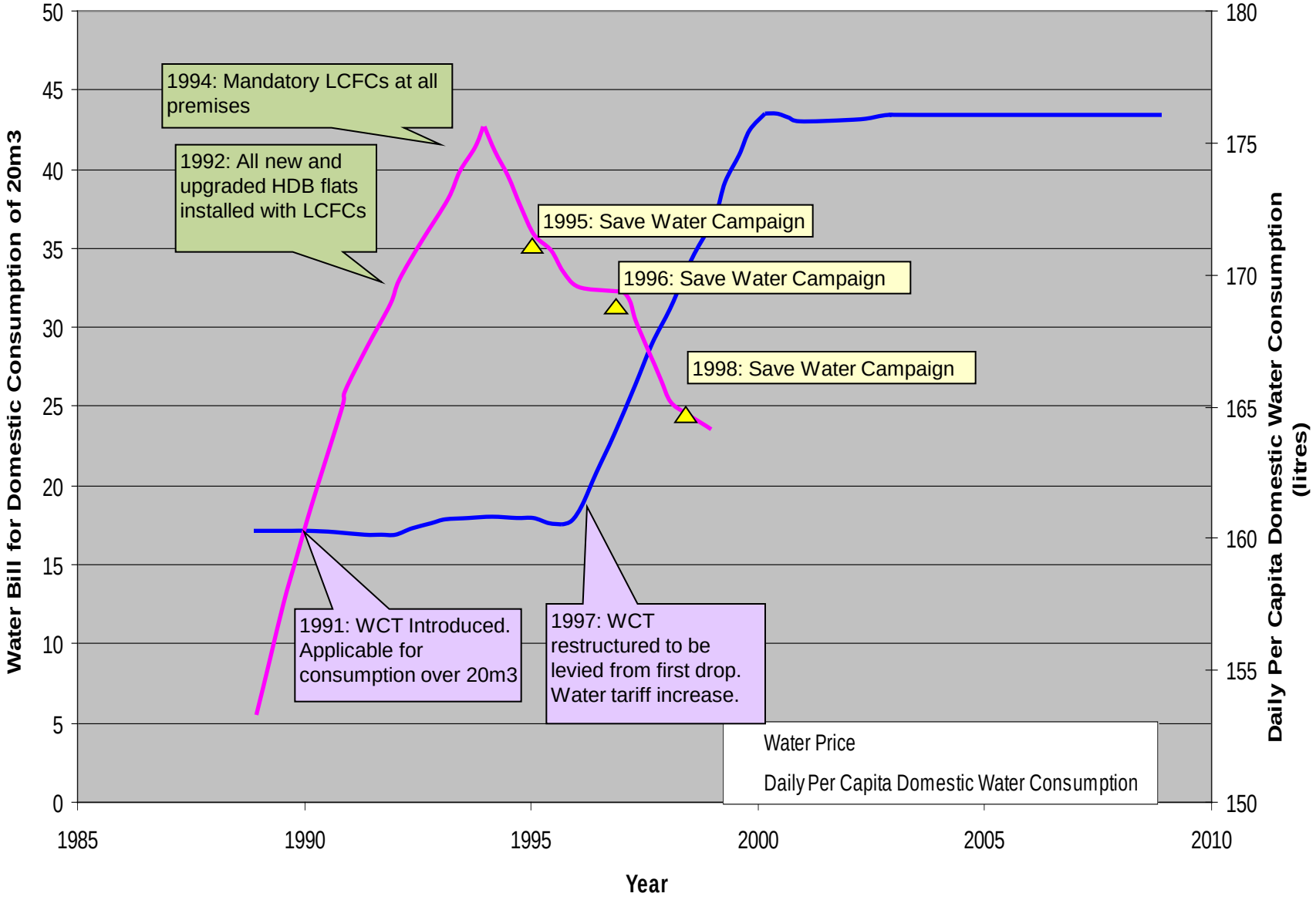
From 1 July 2009

- All taps, urinals and flushing cisterns to display MWELS labels prominently at point of sale and packaging
- For all new developments and existing developments undergoing renovations, only water fittings/products that are labelled with at least 1-tick water efficiency rating and above under MWELS shall be installed and used.

Code of Practice for Water Services –SS CP 48 : 2005
Max allowable flowrates (Cl 4.1 Table 1)

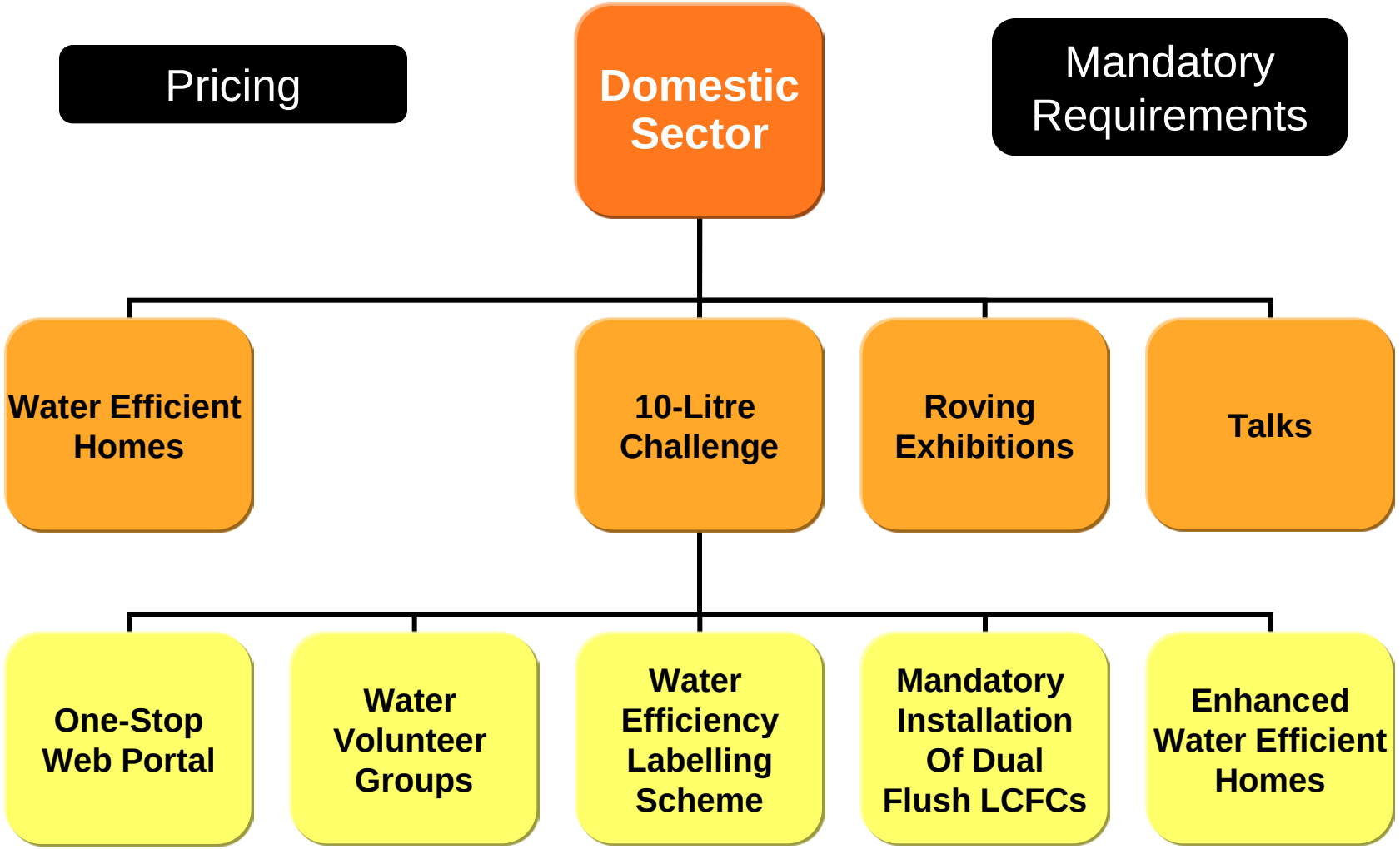
Area of Usage	Maximum Allowable Flowrate (litres/min) (2004)	WELS Flow Rating for 1 Tick Label (July 2009)	Remarks
Basin Tap & Self Closing Delayed Action Basin Tap	6	> 4 to 6	For *self closing delayed action basin taps, timing shall remain at between 2 and 3 sec
Sink / Kitchen Tap and Wash Area	8	> 6 to 8	
Shower Tap & Self-Closing Delayed Action Shower Tap	9 12 (hotels)	> 7 to 9	For self closing delayed action shower tap, timing shall remain at between 13 and 15 sec
Other Areas	8	> 6 to 8	

* Sensor self-closing delayed action basin taps with a flow rate of 2 litres/minute are allowed a maximum preset timing of not more than 60 seconds provided water supply from the tap is automatically cut off when the hand is moved away from beneath the tap.



Water Pricing and Initiatives vs Consumption

Water Conservation Framework for Domestic Sector



Voluntary - 3P Approach

Water Efficient Homes Programme (WEH)

- Launched in Feb 2003
- 3Ps – community driven programme
  - Grassroots leaders distribute FOC Water Saving Kits
  - DIY and adopt good water saving habits (e.g. washing machines, shorter shower)
- Mobile exhibitions at grassroots events
- Door to door visit to assist in installation of WSDs
- Can save up to 5% of monthly water consumption
- By 2006 - all 84 constituencies launched
- More than 910,000 water saving kits distributed & about 40% households installed

Enhanced Water Efficient Homes Programme

- Started in 2007
- Installation of water saving devices at high consumers

Voluntary - 3P Approach

Water Volunteer Group Programme (WVG)

- To educate households on behavioral aspects of water conservation and assist to install water saving devices
- Officially launched on 26 Mar 06 at Hong Kah North
- Target at all residential households (priority to high users)
- door to door visits by grassroots volunteers with support from PUB officers
- Residents will be challenged on saving 10 litres/person/day
- So far 92 WVGs have been formed.

Water Conservation Assistance Programme

(a) *1 year programme to assist more than 13,000 needy families from April 09 – Mar 10*

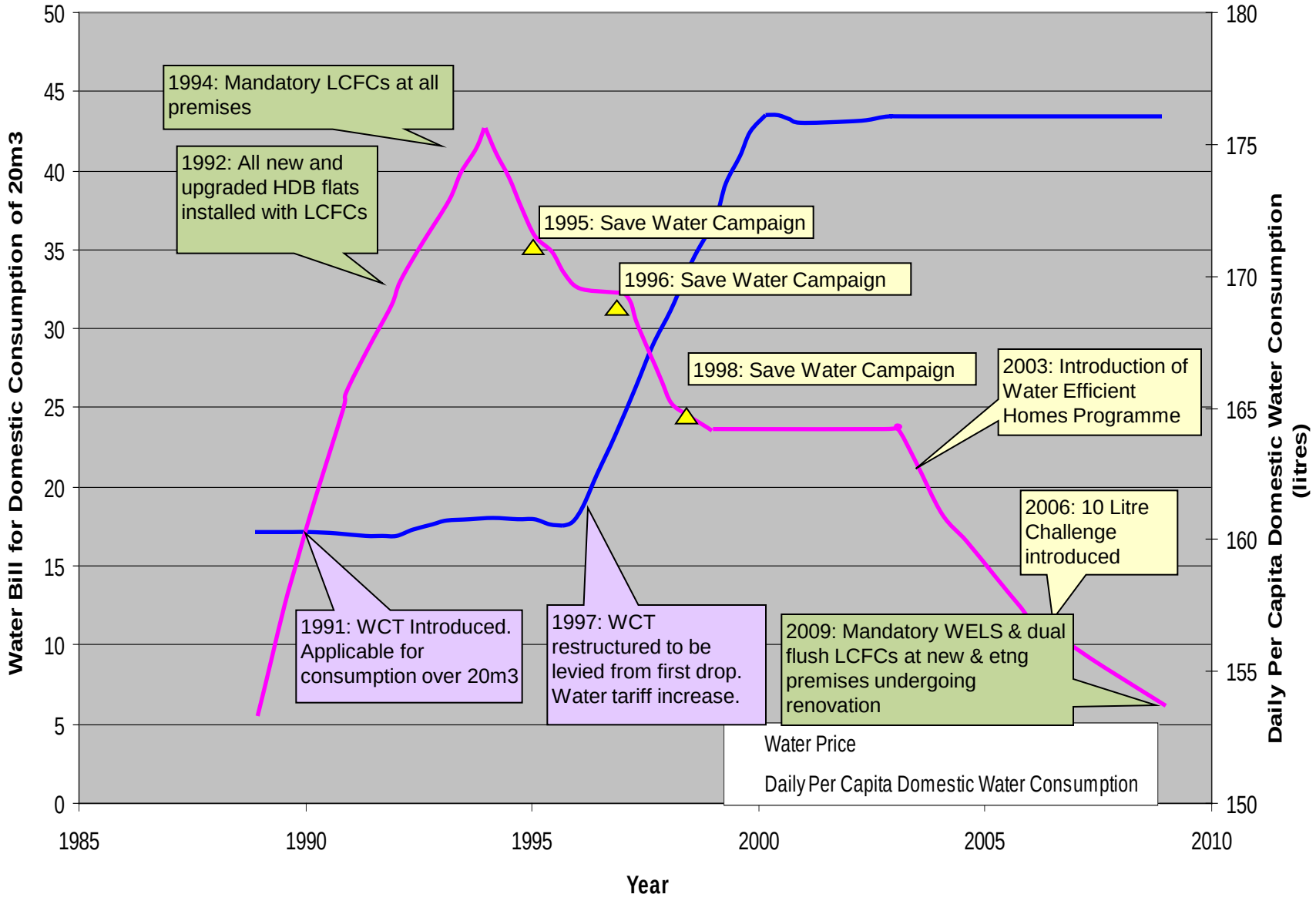
(b) *Work include installing water saving devices and advising customer to adopt good water saving habits.*

Showerhose

Water Efficient Showerhead

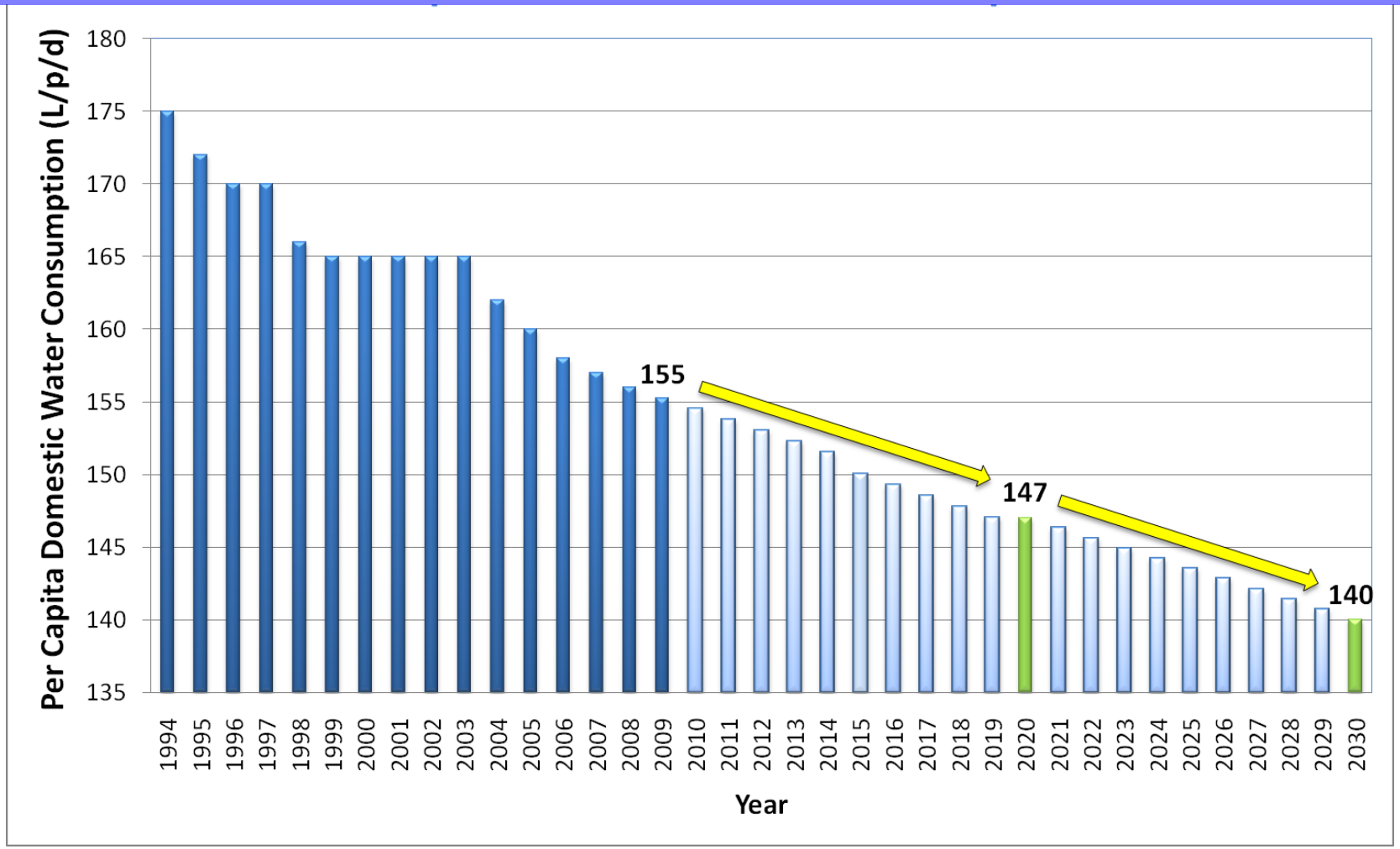
2 way taps

Install CFRs or thimbles



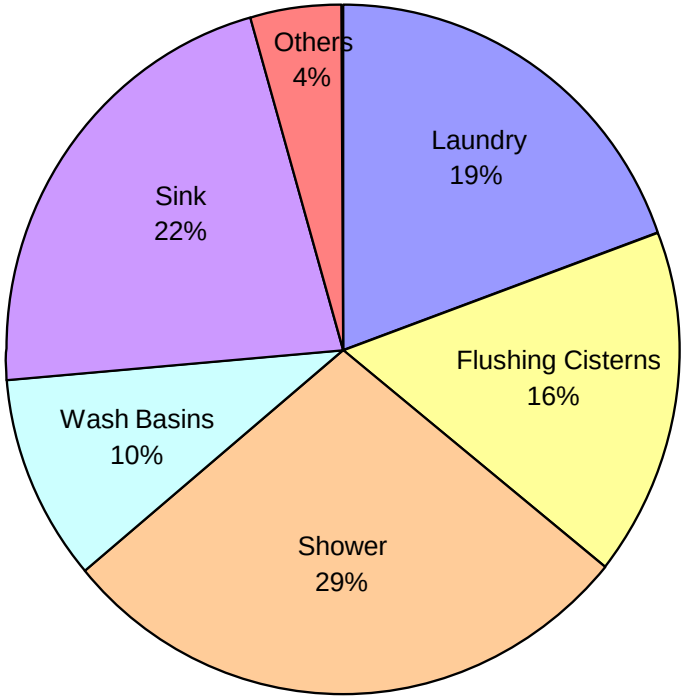
Water Pricing and Initiatives vs Consumption

Per Capita Domestic Water Consumption



To meet the target……

- Hardware = Technological Solutions
- Software = change of behaviour & attitude



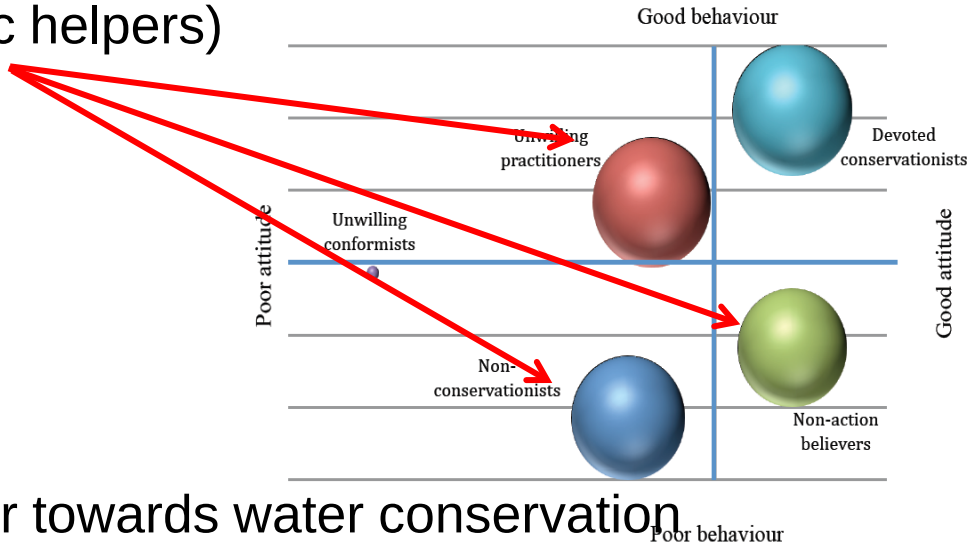
Domestic Sector Breakdown

Water Consumption Lifestyle Study

- Phase 1 (completed) :
  - Current water conservation attitudes and behaviour of individuals/households
  - Social, attitudinal and behavioural characteristics towards water consumption and conservation
  - How water usage (quantitative) and people's attitudes to water use (qualitative) are linked

Phase 1 findings

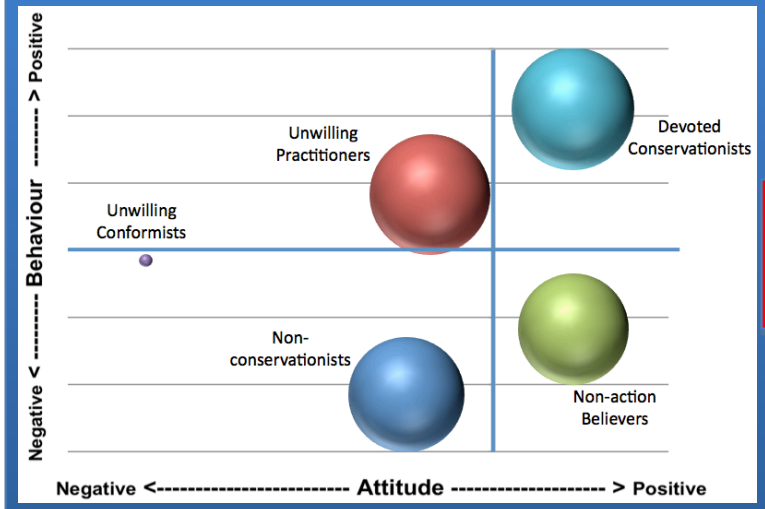
- Most perceived water conservation to be very important.
- Most believe that water consumption at home could be further reduced.
- Profile of people who appeared to have negative attitude and behaviour, high water consumers
  - Younger generation (age below 29)
  - Homemakers (including domestic helpers)
  - Lower educated / Elderly



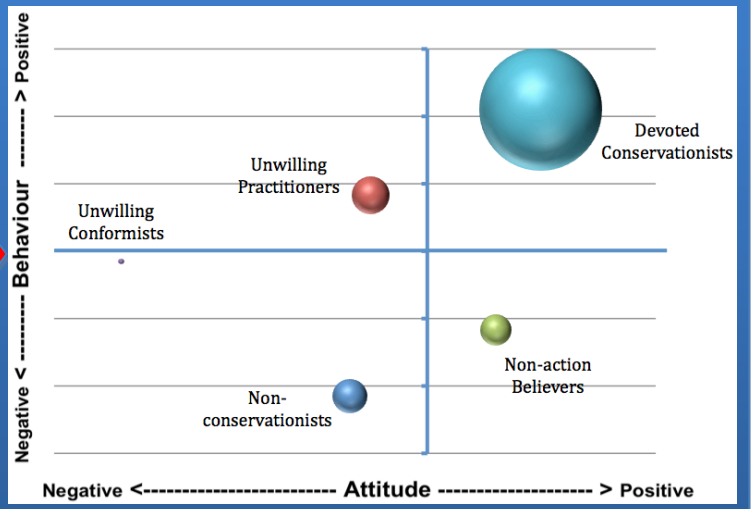
Phase 2 scope

- On-going
- Focus on ways
  - to improve attitude and behaviour towards water conservation
  - to promote water conservation as part of lifestyle thru Education, Facilitation and Intervention

Change of attitude and behaviour



Present



Future

Education

- formal or informal
- national education
- awareness campaigns
- community actions

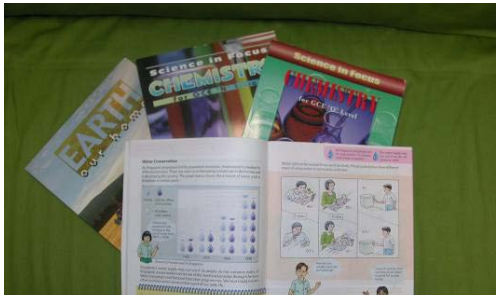
Facilitation

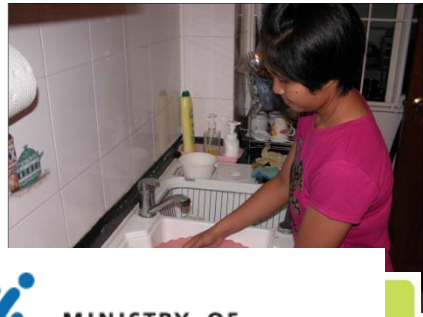
- water efficient facilities / housing designs
- smart water meters
- grey water recycling
- rainwater harvesting

Intervention

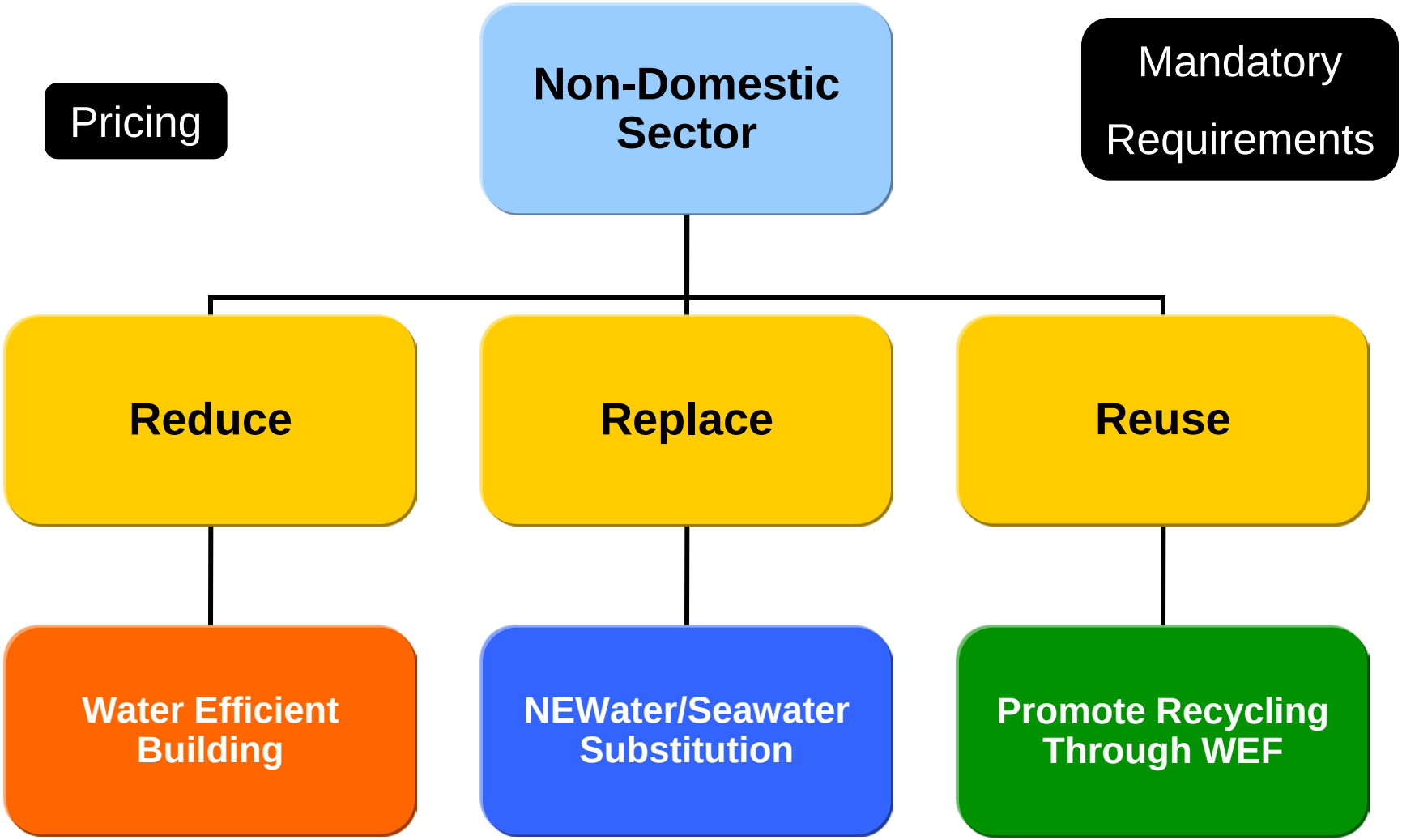
- mandatory standards
- water use regulations
- pro-environment policies

Collaborating with various agencies.....





Water Conservation Framework for Non-Domestic Sector



Reduce : Water Efficient Building Programme

Install meters and take meter readings regularly

Basin Tap

2 litres/min

Adopt water efficient flowrates & flush volume

Avoid water wastage. Repair leak fittings promptly.

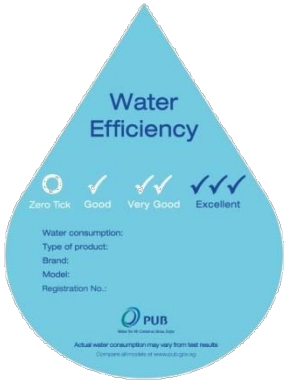
Urinal

0.5 litres/flush

Shower

7 litres/min

Check flowrate using a beaker and watch



Use high water efficient labelled products

To-date, more than 1800 buildings/premises are certified as Water Efficient Buildings

Green Mark Scheme – Water Efficiency

Part 2 – Water Efficiency	Green Mark Points			
2-1 Water Efficient Fittings Encourage the use of water efficient fittings covered under the Water Efficiency Labelling Scheme (WELS).	Rating based on Water Efficiency Labelling Scheme (WELS)			Points awarded based on the number and water efficiency rating of the fitting type used (Up to 9 points)
	Good	V Good	Excellent	
	Weightage			
	4	6	8	
2-2 Water Usage and Leak Detection Promote the use of sub-metering and leak detection system for better control and monitoring.				
(a) Provision of sub-meters for major water uses which includes irrigation, cooling tower and tenants' usage.	1 point			
(b) Linking all sub-meters to the Building Management System (BMS) for leak detection.	1 point			
2-3 Irrigation System Provision of suitable systems that utilise rainwater or recycled water for landscape irrigation to reduce potable water consumption.				
(a) Use of non potable water including rainwater for landscape irrigation.	1 point			
(b) Use of water efficient irrigation system.	Extent of Coverage : At least 50% of the landscape areas are served by the system 1 point			
2-4 Water Consumption of Cooling Tower Reduce potable water use for cooling purpose.				
(a) Use of cooling tower water treatment system which can achieve 6 or better cycles of concentration at acceptable water quality.	1 point			
(b) Use of NEWater or on-site and recycled water from approved sources.	1 point			
PART 2 – WATER EFFICIENCY CATEGORY SCORE :	Sum of Green Mark Points obtained from Item 2-1 to 2-4			

Building and Construction Authority

We shape a **safe**, **high quality**, **sustainable** and **friendly** built environment.

BCA GREEN MARK

home 1

September 26, 2010 thesundaytime

S'pore scores in green efforts

Canadian-based World Green Building Council gives nod to environment-friendly plans here

Jessica Cheam

The little red dot has been determinedly going green these past few years and its efforts are noteworthy, a first-of-its-kind report has said.

The report by the Canadian-based World Green Building Council (WGBC) on the global green building movement compiles examples of how such buildings can help provide affordable housing, job creation and even disaster recovery.

"It's the first time we have reported on the wider social-economic benefits a better built environment can play," said WGBC chief executive Jane Henley.

Singapore stood out for its concerted efforts to green its buildings, particularly in its green labelling programme for products, and its leadership in water efficiency standards, she added.

The report, released last week, is titled Tackling Global Climate Change, Meeting Local Priorities.

Speaking to The Sunday Times, Ms Henley said the report is "living evidence of examples across the globe" where buildings are addressing local needs while reducing carbon emissions as well.

Green buildings are doable. Built to reduce their negative impact on the environment, they not only improve occupants' comfort, but they typically cost only 3 per cent to 5 per cent more than standard buildings to construct, said Ms Henley.

Costs are coming down, and there is much potential for buildings to further reduce their carbon emissions – by more than 35 per cent, she said. Green buildings have also been shown to cut waste output by 70 per cent, water usage by 40 per cent, and energy usage by 30 to 50 per cent, and in some cases, producing surplus energy that can add to the national grid, she added.

In some cases, green buildings can even help in disaster recovery. In Australia, for example, through the Build It Back Green programme following wildfires that destroyed thousands of homes and killed over 100 people in Victoria in February last year, greener and more resilient homes were built for the community.

In the US, after Hurricane Katrina hit in 2005, the Green Building Council brought in experts in urban planning, waste and water management, and architecture to work with local communities in the post-disaster, green reconstruction.

In Singapore, the green building momentum has been kept up in the five years since the launch of its first green building rating system, the Green Mark, said Singapore Green Building Council (SGBC) president Lee Chuan Seng.

When it was launched in 2005, the Green Mark attracted only 17 buildings that could be certified as environmentally friendly. Today, the number has grown 30 times to tip past 500 such buildings.

Outstanding Singapore stood out for its concerted efforts to green its buildings, particularly in its green labelling programme for products, and its leadership in water efficiency standards.

The scheme has also "gone overseas". More than 80 overseas projects have applied for the Green Mark stamp and over 32 of these projects have achieved it, said the Building and Construction Authority, which oversees the Green Mark scheme.

The SGBC recently hosted an international congress on green buildings to celebrate World Green Building Week, which began on Sept 20, and to gather experts to share their knowledge and best practices.

"The event helped to boost Singapore's image as the leading hub for green buildings in the tropical climate zone," said Mr Lee. Also, the incentives provided by the Government have seen the building sector rising to the challenge.

"Many industry designers and professionals are now equipped with the skills and capabilities to develop and run buildings on a sustainable level not achieved before. This is something that Singapore can now export," Mr Lee added.

Mr Russell Cole, principal and building group leader at the Singapore office of British architecture firm Arup, said green building design "is becoming the new orthodoxy rather than a passing fashion".

"The industry is quickly developing skills and taking a harder look at all aspects of the building, and seeing how it can be made more comfortable, using less energy and resources," he said.

Energy consumption is also being reduced by good insulation, shading and other passive design features, he added.

Another push factor in the growing adoption of green buildings: regulation. On the whole, building regulation standards worldwide are getting increasingly higher and greener, said Mr Cole.

Singapore, meanwhile, is not resting on its laurels, said SGBC's Mr Lee.

Some industry critics have questioned if the Green Mark is a standard too easily obtained, to which Mr Lee pointed out: "The standards go up every year".

"Instead of setting the goals too high, which make people give up and say 'it's too expensive', we decided to start with something that had a decent standard but was not too difficult to achieve," he said.

BCA's Green Mark for new buildings is now into Version 4 – where the minimum energy efficiency standard is 28 per cent higher than that set out in the first building code released in 2005.

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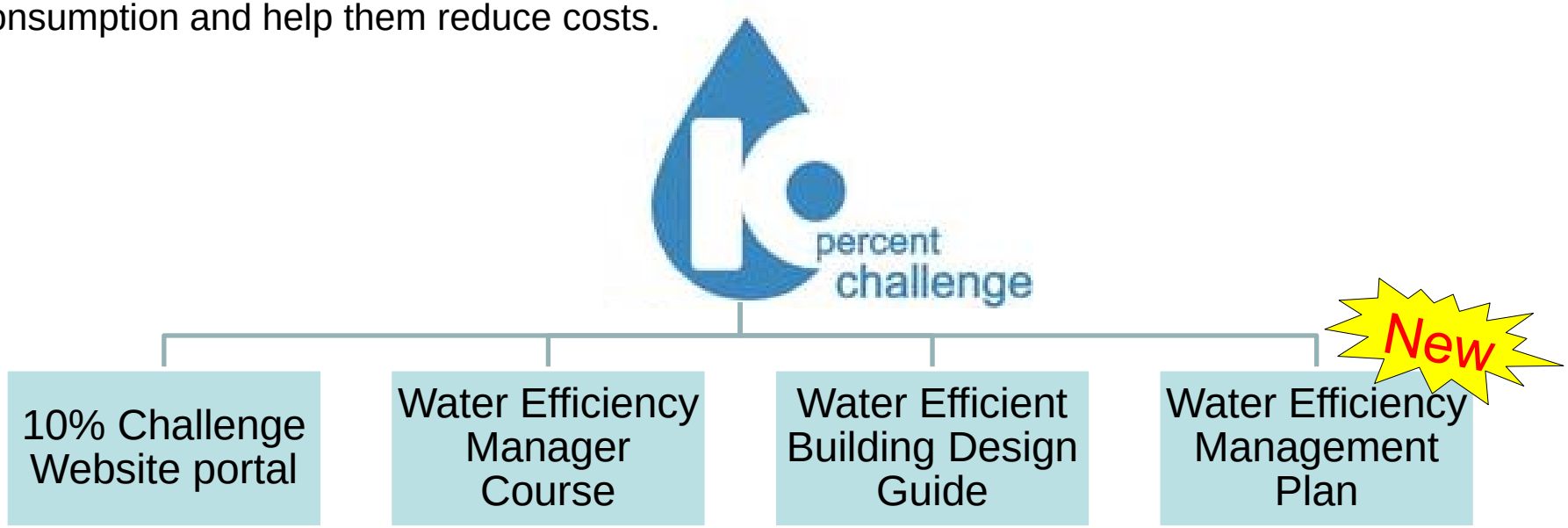
"Outstanding Singapore stood out for its concerted efforts to green its buildings, particularly in its green labelling programme for products and **its leadership in water efficiency standards."**

Canadian based World Green Building Council ,CE, Ms Jane Henley

10% Challenge

- To challenge the non-domestic sector, particularly the hotels, schools, commercial buildings, government office buildings, etc, to work towards becoming a WEB and save 10% of their monthly water consumption

- To help non-domestic customers better manage and improve their efficiency in water consumption and help them reduce costs.



10% Challenge Website

www.tenpercent.sec.org.sg

- Water Efficiency Index (WEI) Calculator
- Water Efficient Practices
- Water Audit Checklist
- Electronic Feedback Form
- Success stories
- Download WEB Design Guide Book & publicity materials

Water Efficiency Manager (WEM) Course

(Jointly developed by Singapore Polytechnic and PUB)

- **Objective**
  - To equip facilities managers with the knowledge and skills to conduct water audit.
  - Apply water efficiency measures to reduce water consumption in commercial/residential buildings.

- **Target Audience**
  - Facilities & Estates Managers
  - Building Owners
  - Engineers & Architects

Replace : NEWater, Sea water, rainwater, etc

- Encourage substitution with NEWater, Seawater, rainwater, etc

- NEWater :

  i) frees up potable water for other uses

  ii) quality suitable for process use (UPW), boilers, laundry, air-con cooling towers, toilet flushing, general washing

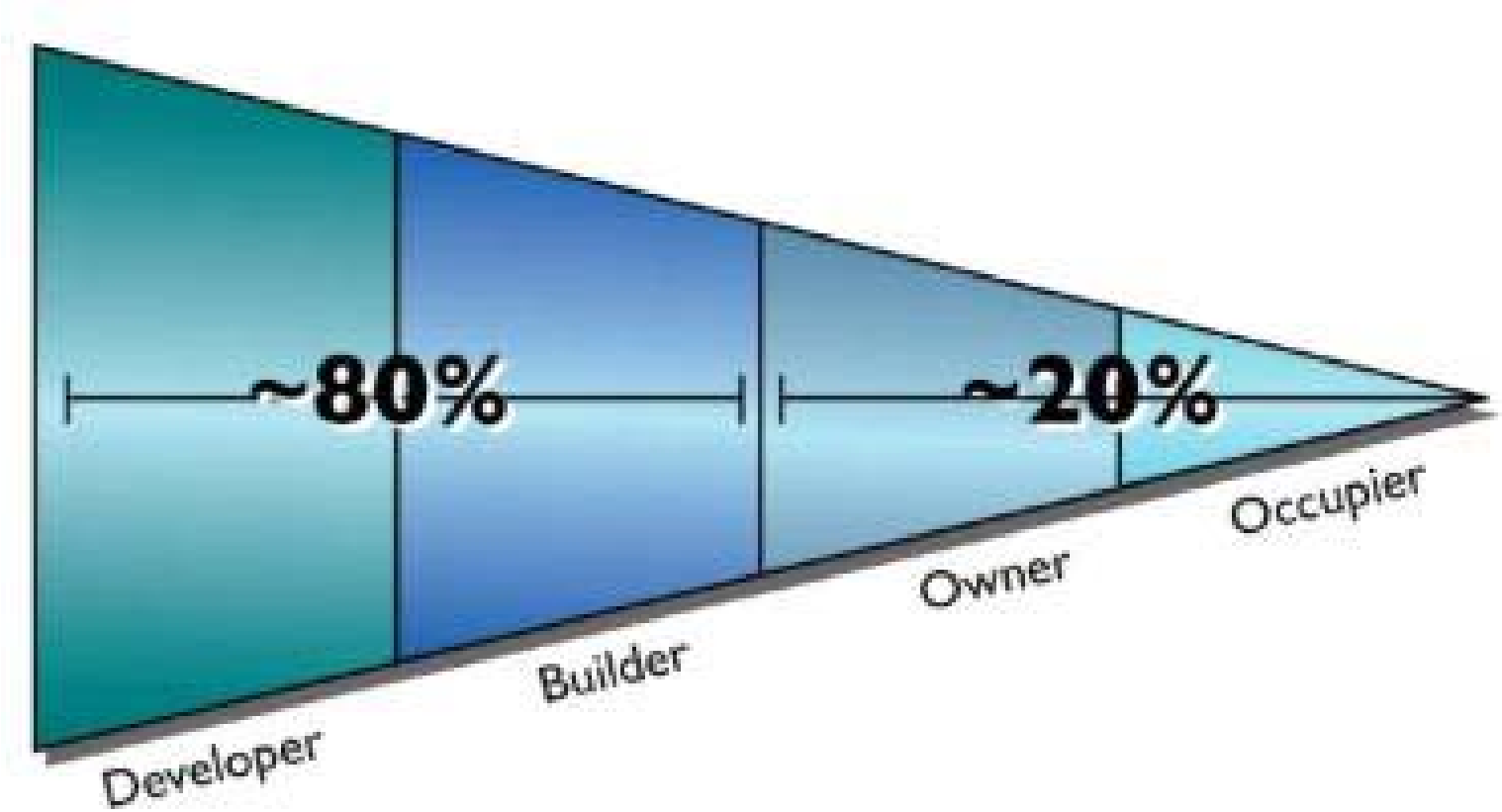
  iii) lower price - save 30% ($1.52 to $1)

  iv) Current : $1.00

  New price : $1.10 (Oct 2010)

  $ 1.22 (April 2012)

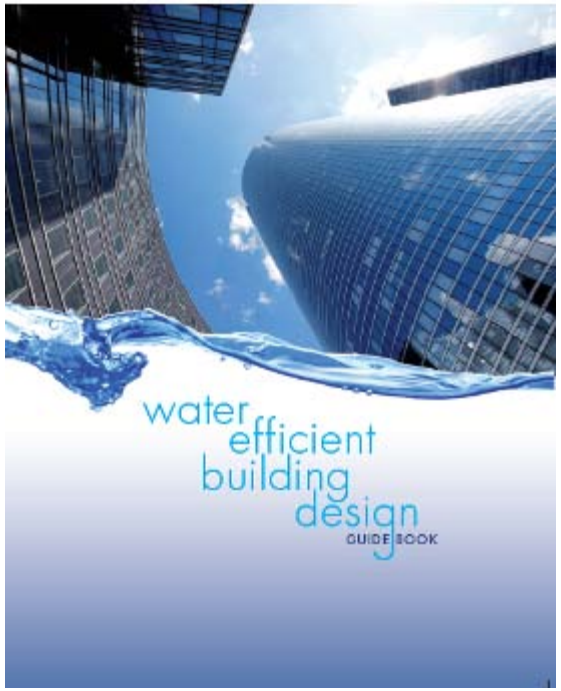
Who have more impact to water efficiency?



- The figure demonstrates the importance of integrating water demand management from the planning and design stage, as most of the achievable water savings are realised through infrastructure and technology.

Water Efficient Building Design Guide Book

Download from www.tenpercent.sec.org.sg



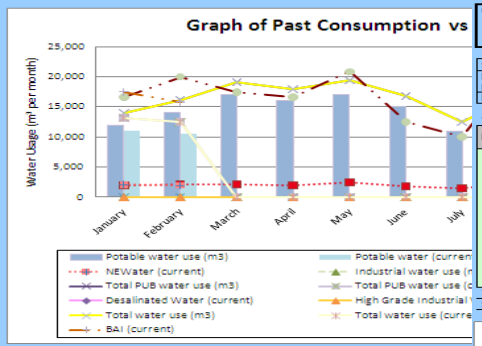
Water Efficiency Management Plan

http://www.pub.gov.sg/conserve/Business/Pages/WEMP.aspx

- Voluntary Submission
  - ✓ analysis of current water use
  - ✓ identification of potential water saving measures
  - ✓ action plan and implementation timelines
- Apply Water Efficiency Fund to implement measures

Water use and production data for the past 12 months For Period (MMYY - MMYY): 01/09 - 12/09

Month	BAI	Potable water use (m³)	NEWater use (m³)	Industrial water use (m³)	Total PUB water use (m³)	Desalinated Water (m3)	High Grade Industrial Water (m3)	Total water use (m³)
January	200	12,000	2,000	0	14,000	0	0	14,000
February	240	14,000	2,200	0	16,200	0	0	16,200
March	210	17,000	2,100	0	19,100	0	0	19,100
April	200	16,000	2,000	0	18,000	0	0	18,000
May	250	17,000	2,400	0	19,400	0	0	19,400
June	150	15,000	1,800	0	16,800	0	0	16,800
July	120	11,000	1,500	0	12,500	0	0	12,500
August	260	14,500	2,500	0	17,000	0	0	17,000
September	195	15,000	1,950	0	16,950	0	0	16,950
October	245	14,200	2,300	0	16,500	0	0	16,500
November	150	15,200	1,850	0				
December	90	13,500	1,400					
Total	2,310	174,400	24,000					
% of Total PUB Water Use		87.9%	12.1%					



Water for All Conserve, Value, Enjoy PUB

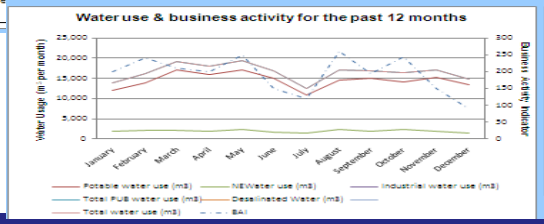
2. Business activity and water consumption

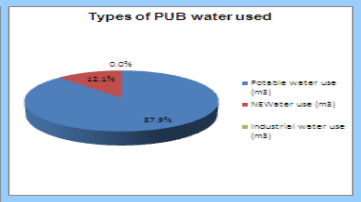
Objective : The information collected will help you to calculate your water efficiency index as well as highlight improvement opportunities. It will also help us to plan to better cater for your needs if your plant is expanding its capacity. The information will also help you to measure your progress as you implement water saving activities. Determining your BAI helps you to set measurable target for your water saving initiatives regardless of the variation in business.

SSIC	352 MANUFACTURE OF CHEMICAL PRODUCTS		
Business Activity Indicator (BAI)	MT	If other, please	Internal recycling rate
Days of operation per y	320		#VALUE! %

Water use and production data for the past 12 months

Month	BAI	Potable water use	NEWater use (m³)	Industrial water use	Total PUB water use	Desalinated Water		Total water use
January	200	12,000	2,000		14,000			14,000
February	240	14,000	2,200		16,200			16,200
March	210	17,000	2,100		19,100			19,100
April	200	16,000	2,000		18,000			18,000
May	250	17,000	2,400		19,400			19,400
June	150	15,000	1,800		16,800			16,800
July	120	11,000	1,500		12,500			12,500
August	260	14,500	2,500		17,000			17,000
September	195	15,000	1,950		16,950			16,950
October	245	14,200	2,300		16,500			16,500
November	150	15,200	1,850		17,050			17,050
December	90	13,500	1,400		14,900			14,900
Total	2,310	174,400	24,000	0	198,400	0	0	198,400
% of Total PUB Water Use		87.9%	12.1%	0.0%				





6. Action Plan for Water Saving Opportunities

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Objectiv Write your BAI and water usage target and the water saving initiatives to meet that target. Use this template to capture key information about water saving opportunities that have been identified in your organisation. You should refer to Reference Reading 1 for more guidance on how to prioritise your projects.

Priority 1 : High water savings - Low cost to implement

Action	Description of project	Responsible	Due date for	Capital cost S$	ROI	Water savings	Comments
1	Reduction of make up water to the cooling tower through the increase in COC and use of Variable Speed Drive	Bob Ho	End Oct'10	$5,000			

Priority 2 : Low cost - low water savings

oject	Responsible	Due date for	Capital cost	ROI	Water savings	Comments
at key water readings.	Bob Ho	End Jun'10				
he taps and	Bob Ho	End Jun'10				
n exhibition	Bob Ho	End Dec'10				
irrigation	Bob Ho	End Jun'10				

- high cost

oject	Responsible	Due date for	Capital cost	ROI	Water savings	Comments

- high cost

oject	Responsible	Due date for	Capital cost	ROI	Water savings	Comments

Usage Target

et	Water Usage m³	BAI	WEI m³/BAI	Time Frame	Next Review	Comments
	201,000	2,500	80.4	1 year	1-Apr-11	

	Approved by:	Jane Tan
	Position	President
	Date	8-Apr-10

Reuse : Water Efficiency Fund

Objective

- To encourage companies to look into efficient way of managing their water demand through various water conservation projects.

- Aims at getting companies to look into efficient way of managing their water demand, which includes PW, NW and IW, through recycling, use of alternate sources of water supply as well as initiative to promote water conservation in the community.

Focus on strong partnership & continuous improvement

Partnership
- working with assns/ suppliers, services providers/consultants

Water Efficiency Guidelines/ Standards

Legislation

Water Consumption
- Reduce, Replace, Reuse

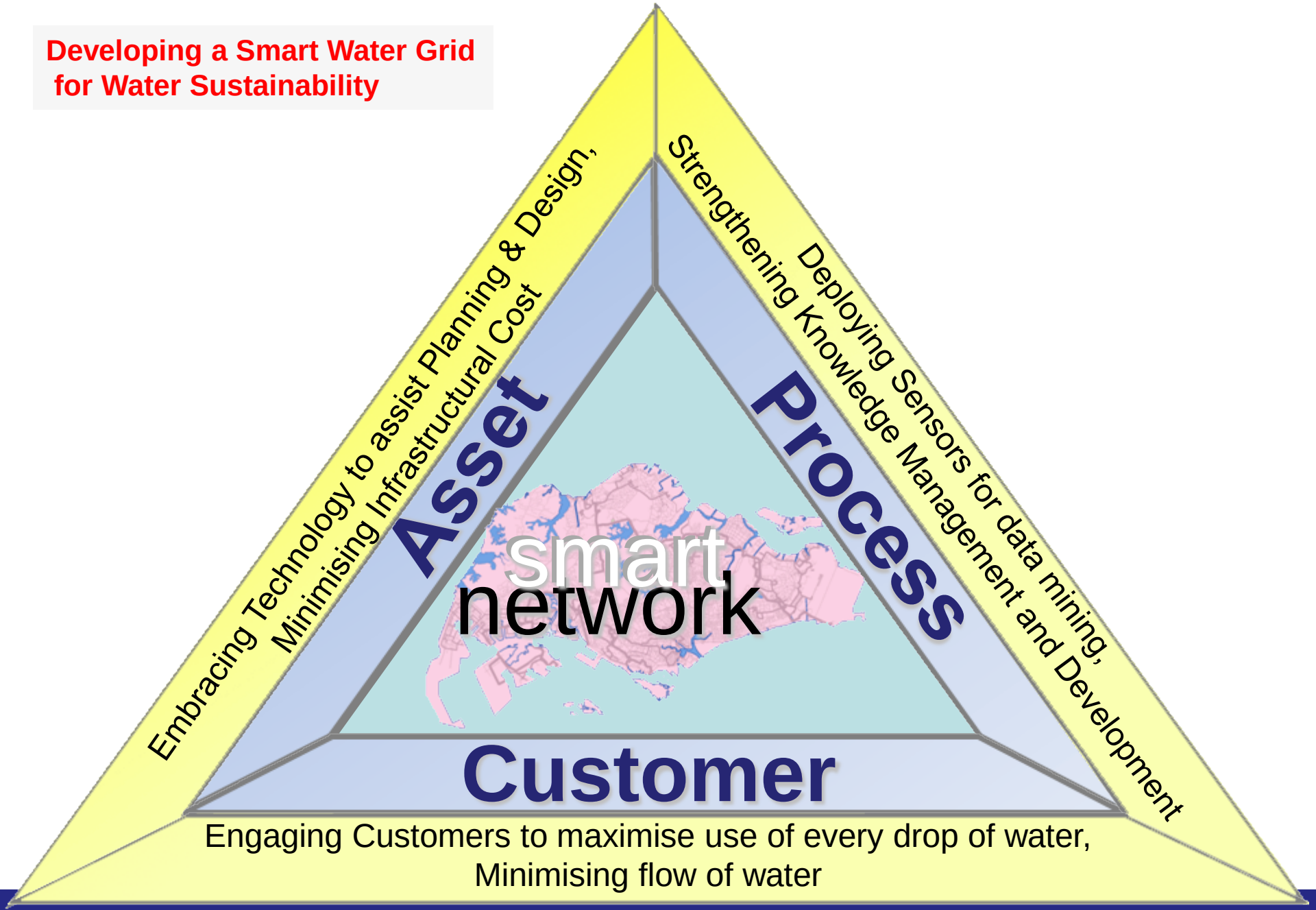
Training
- Water Efficiency Manager Course

Recognition
- Green Mark
- Water Efficient Bldg

Implementation
- WEF
- Demonstration Projects

Technology , R&D

Developing a Smart Water Grid for Water Sustainability



Singapore International Water Week

Sustainable Water Solutions for a Changing Urban Environment

Singapore International Water Week 2011, 4 - 8July 2011

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  - Bring together policymakers, industry leaders, experts and practitioners
  - Address challenges, showcase technologies, discover opportunities & celebrate achievements
  - Attracted 8,500,10,000 and 14,000 attendees in 2008, 2009 and 2010 respectively

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Thank You