Small and Decentralized Water System

Lecture 6: Economic and geo-political dimensions

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Presentation outline

- Recent challenges
- Can you explain the basic principles?
- Paradigm shift
- What will people pay? Willing to pay?
- Triple bottom-line
- Innovation for what?

Question 1

- At what level (percentage of incomes) rich economy are willing to pay for environmental sustainability?
- Water bills?

Question 2

- Priorities the following issues in developing nations:
  - Education
  - Road
  - Food supply
  - Piped water
  - Proper sanitation
  - Job opportunities
  - Security
  - Public order

Lesson from my life!

CHALLENGES?

Millennium Development Goals for Water & Sanitation

Adopted at the World Summit on Sustainable Development (2002)

- By 2015 to reduce by half the proportion of people who are unable to reach, or to afford, safe drinking water.
- By 2015 to reduce by half the proportion of people who do not have access to safe sanitation facilities.

Target water pollutants, chronologically…

Era	Pollutants	Solutions
1800s	Pathogenic bacteria	Sewer system
1900s	BOD, COD	Biological wastewater plants
1950s	Heavy metals, biodegradable substances	Treatment at source
1970s	Eutrophication	N and P control
1980s	Trace substances, carcinogens, flavor, taste	Activated carbon, membrane technology
1990s	CO_2, NH_4, N_2O, CFCs, NO_x, SO_x	Energy saving, photosyntetic bacteria, biotechnology, MBR
2000s	Endocrine disrupting chemicals (EDCs), eco-hazard	Membrane technology

Ujang Z. & Henze M. (2006) Municipal Wastewater Management in Developing Countries, IWA Publishing, London

Potential water resources

Water Survival Strategy

- If you need more water, import or make it yourself
- Use less water – conservation, tariff, efficient, technology
- Less consumption and demand
- Steal water from others!

Water technology

Marq de Villers (2000) *Water: The Fate of Our Most Precious Resource*, Mariner Book, NY

Back to basics

- **We need water**
  - Domestic / household
  - Industrial
  - Agricultural
- **We produce wastewater**
  - Public health?
  - Environmental protection?
  - Wealth creation? Domestic economy?
- **We need money to pay for the services**
  - Full subsidy
  - Partial subsidy
  - Full recovery

Paradigm shift in water management & technologies

- Monitoring: From on-site to on-line; From in-situ to remote sensing
- Purification: From sieving to bio-transformation; From big to small plants
- Treatment: From pollution reduction to pollution prevention
- Pollution control: From end-of-pipe to cleaner production
- Raw water intake: From clean upstream to polluted downstream
- Resource management: From free to precious commodity
- Public perception: From quantity to quality

Paradigm shift in water management & technologies

- Management approach: From sectoral to integrated
- River: From natural to concrete; From concrete back to natural channels
- Water delivery: From long pipes to bottled water
- Sewer network: From long, centralized to decentralized and small system
- Sludge management: From disposal to high value reuse; Co-disposal with gabbage
- Automation and control: On-line metering and billing
- Service: From public utilities to private companies & consumer products

Baltimore Charter 2007

Sustainable small & decentralized system

- Organized by Water Environment Research Foundation
- Supported by US EPA
- 50 participants (35 USA, 15 others)
  - Subject matters
  - Representative of sectors
  - Representative of continents, grouping etc
- To outline research agenda to meet the needs in 2025
- To review the existing philosophy, framework, concepts, approaches and engineering practice
- Propose a framework for WATER SUSTAINABILITY

Baltimore Charter 2007

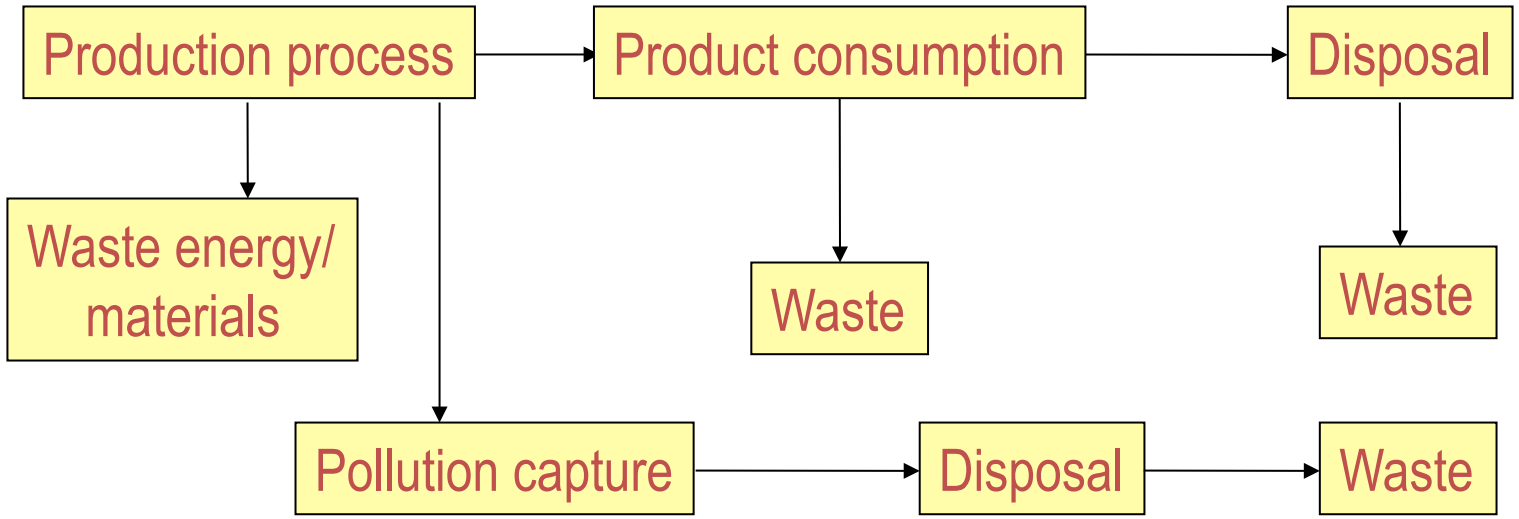
Sustainable small and decentralized system

G. Tchobanoglous, UC Davis

Water technologies

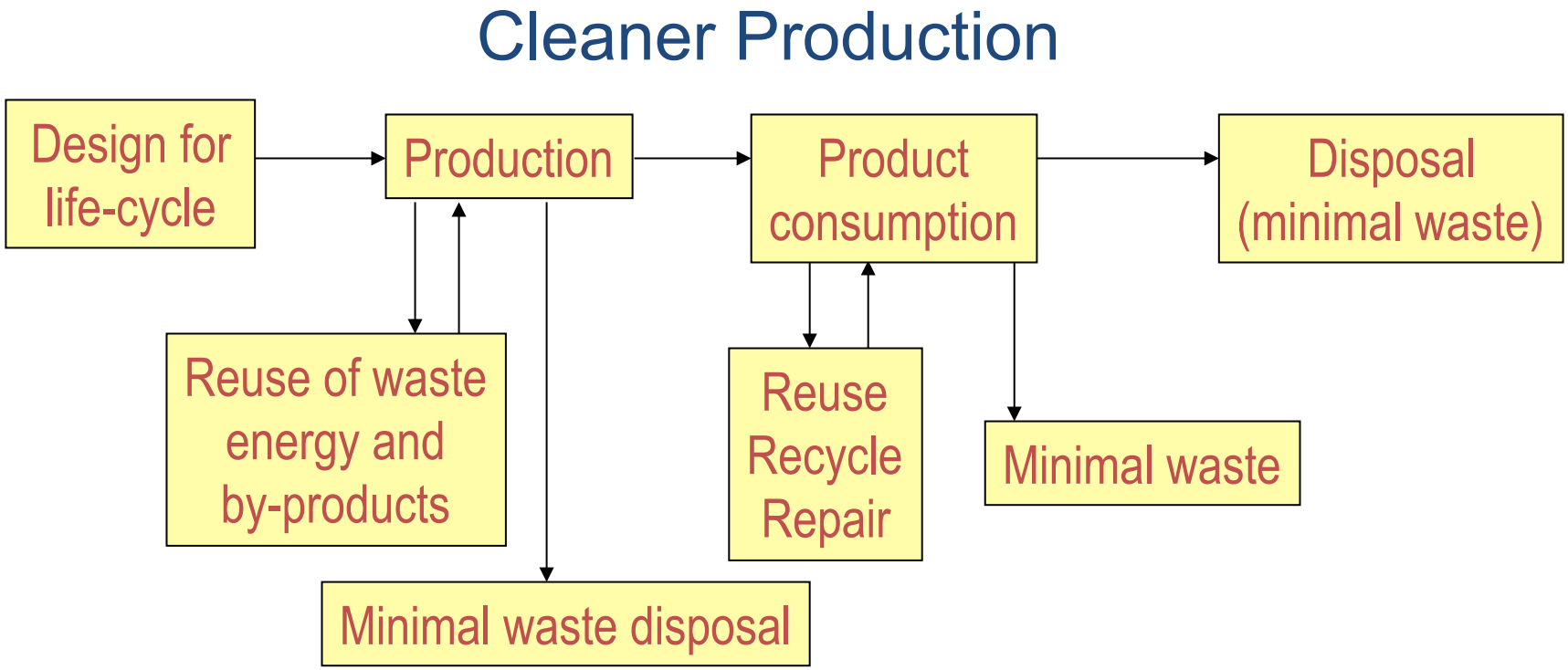
Eg: ■ Pollution control: From end-of-pipe to cleaner production

End-of-pipe approach

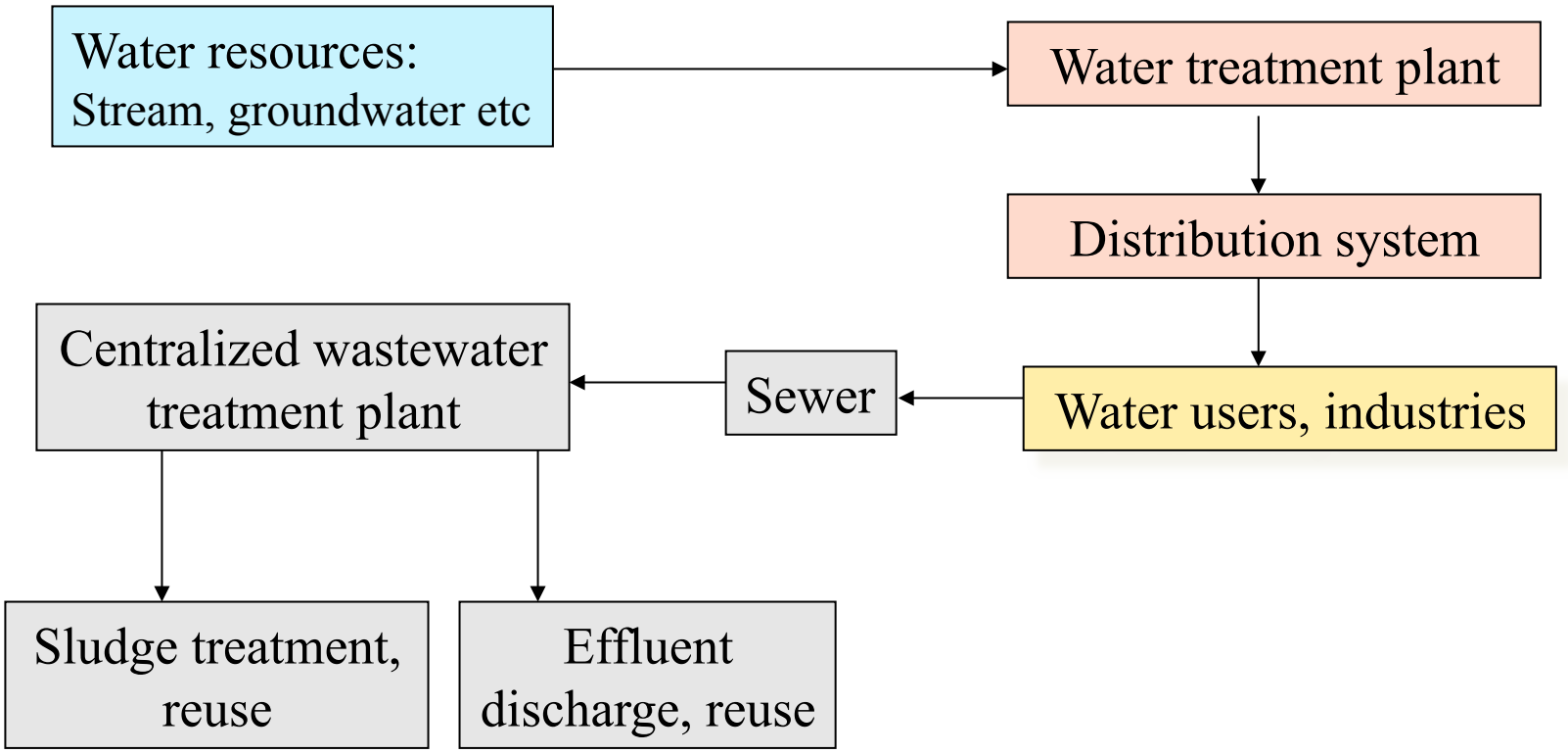


Water technologies

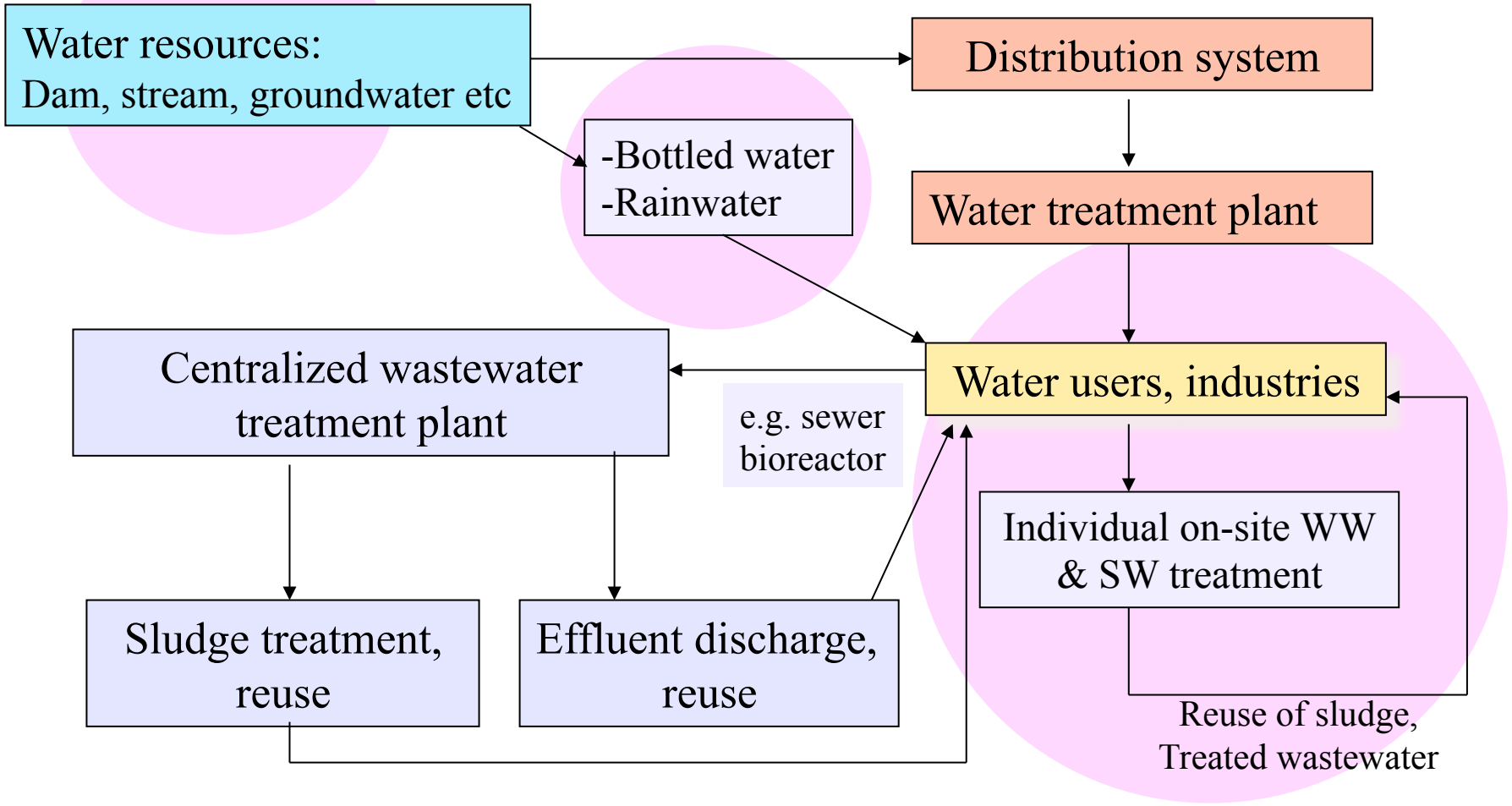
Eg: ■ Pollution control: From end-of-pipe to cleaner production



Sewer network: From long, centralized to decentralized system



Decentralized sanitation and reuse (DESAR)



Why an ideal system does not work in most developing countries?

- The regulatory requirement is too good and perfect (e.g. BOD 10 mg/l for discharge standards)
- The system has no local inputs (e.g. trained engineers and research facilities)
- The system has no capable implementers (e.g. able politicians, trained engineers and skilful operators)
- The system has no legal back up (e.g. acts, legislation)
- The system has a poor financial framework (CAPEX, OPEX)
- The system is efficiently corrupted (political influence, etc.)

Expenditure in the Eighth Malaysian Plan (RMK8, 2000-2005))
Allocation in the Ninth Malaysia Plan (RMK9 2006-2010)

Utilities	Expenditure RMK8	Allocation RMK9
Water supply	RM3,882.9	RM8,203.6
Sewerage	RM1,347.9	RM3,132.8
Rural water supply	RM733.9	RM1,206.5
Flood mitigation	RM1,788	RM3,997.6
TOTAL	**RM7,752.7 b**	**RM16,504.5 b**


MALAYSIA KITA
Oleh MIKI
HADIAH
DARI JABATAN
BEKALAN AIR
MIKI

What will people pay?
My monthly water charges and other bills

Services	Monthly, RM	Percentage
Water supply	50	<5
Sewerage services	8	<1
Cell phones (4)	300 + 100 + 50 + 50	50
Fixed-line phone	150	15
Internet	88	9
ASTRO bill	49	<5
Solid waste	10 (?)	<1
Electricity	150	<15

Why I am willing to pay, generously, for the cell phones?

- Service I need
- Improve my communication, in real time
- My children call me, 4 to 5 times a day!

- BASIC NEED, NOT LUXURY ITEMS!

- Note: I change my cell phone every year with the latest model, slimmer but more applications

Consumers' perspective

LEVEL 1

- Basic services
- Reasonable cost
- Public health protection

LEVEL 2

- Quality services
- Competitive cost
- Environmental protection

Consumers in 1970

- Do we really need tab water?
- Do we require a wastewater treatment plant?
- Do we need landfill for solid and hazardous waste disposal?
- Do you prefer water from well, or river?

Consumers in 2007

- Do we really need bottled water?
- How best we can achieve nutrient removal in wastewater treatment plant?
- How best we can operate sanitary landfill for solid and hazardous waste disposal?
- Do you prefer mineral or reverse osmosis water?

Producers' / service providers' perspective

LEVEL 1

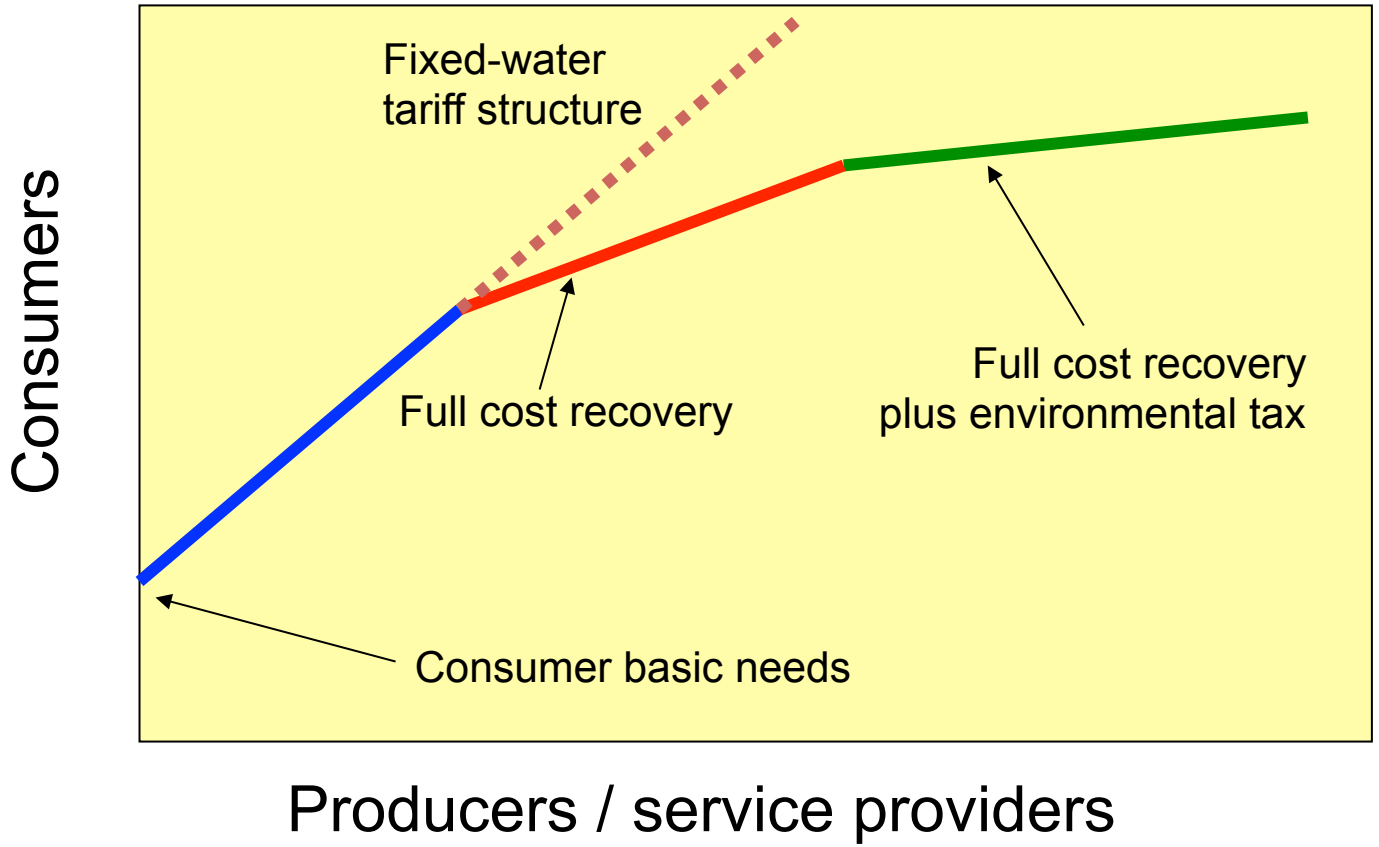
- Quality services
- Competitive or reasonable cost
- Reliable services
- Customer-driven

LEVEL 2

- Expending market segment
- Share holders' expectation
- Innovation
- Reputation

Triple bottom line

Producers' or service providers' perspective



Triple bottom line principle

- Financial costing
- Social costing
- Environmental costing

MODEL FOR SUSTAINABLE TARIFF STRUCTURE	
Basic needs	Cross subsidy
Over consumption	Full cost recovery
Wastage consumption	Full cost recovery + Environmental tax
>> Wastage	Full cost recovery + Environmental tax + Wastage tax

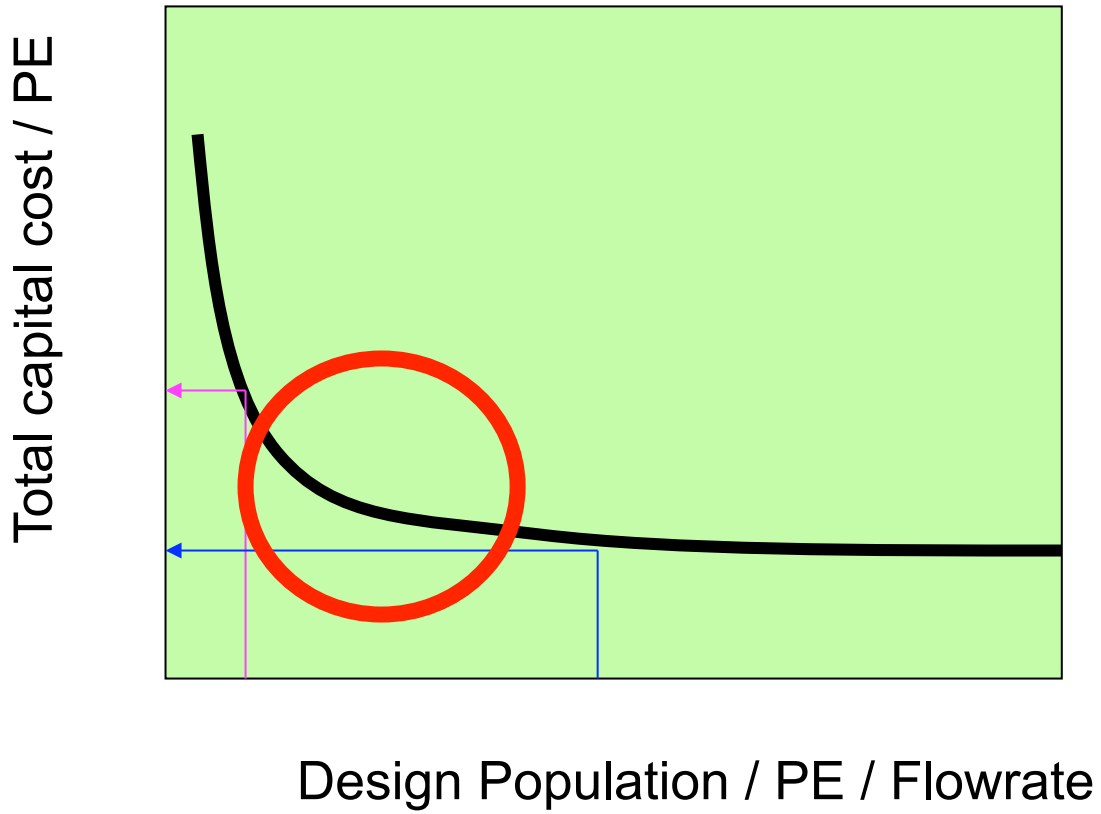
Issues lead to innovations

- Operating and maintenance cost
- Upgrading old modular plants
- Upgrading without subsidy?
- Options for upgrading schemes
- Higher compliance, higher quality

- IT IS MOSTLY INNOVATION IN **MANAGEMENT** SYSTEM, AND **PARTLY TECHNOLOGY**

Management issues

Cost for small and decentralized systems

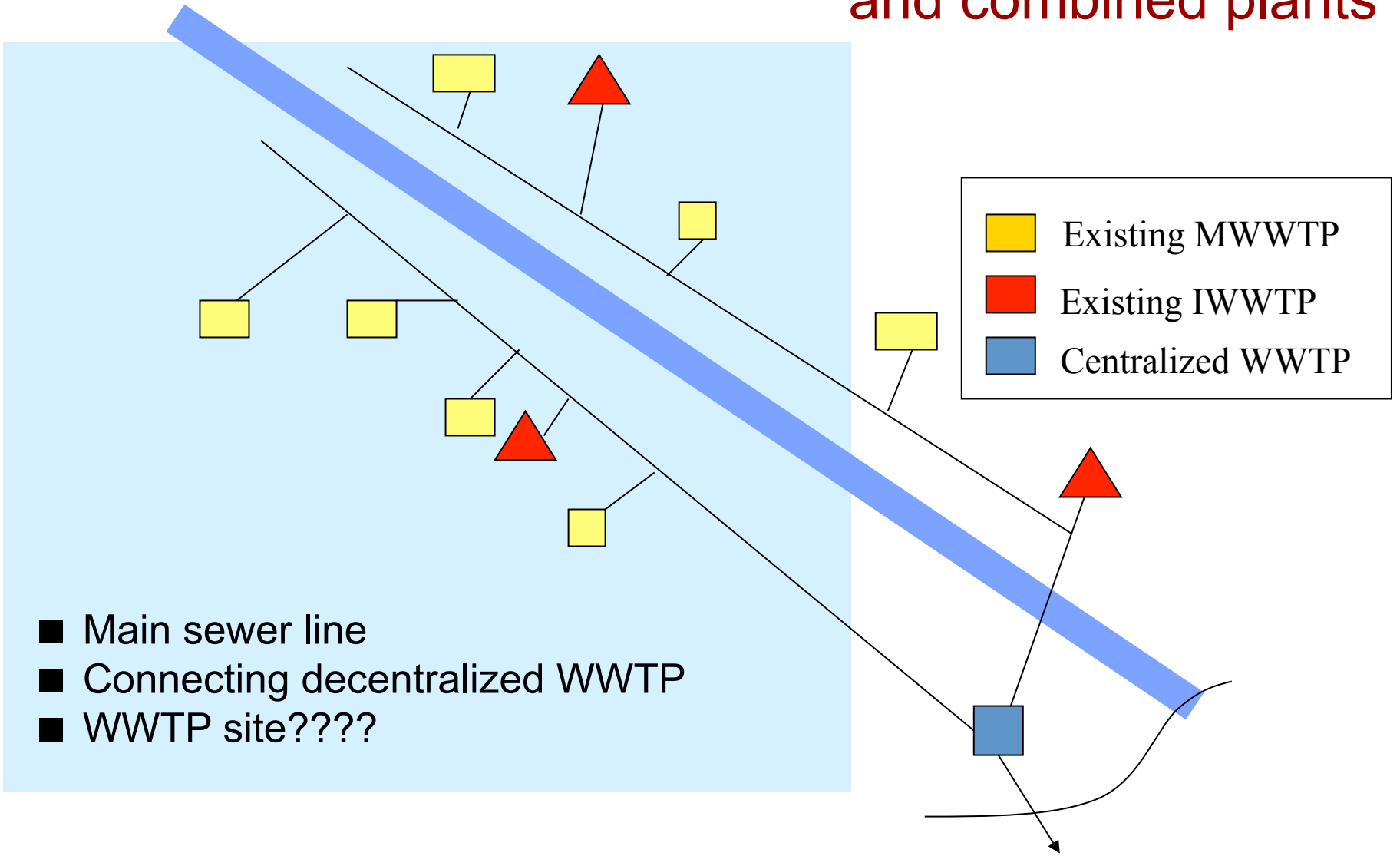


Cost of high tech

NEWater project in Singapore

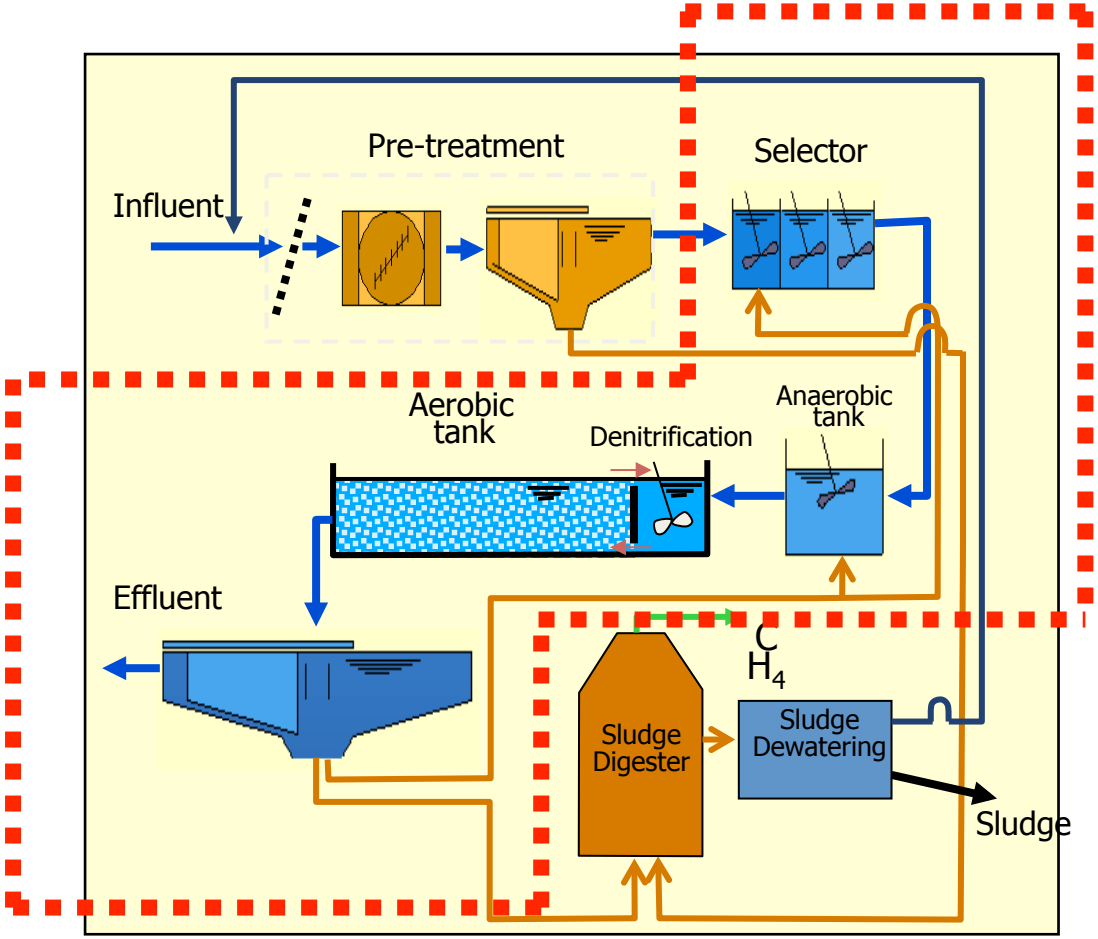
Projects	Production capacity	CAPEX	Status
Bedok NEWater	32,000 m^3/d	S$15.53 m	Completed
Kranji NEWater	40,000 m^3/d	S$21.05 m	Completed
Seletar NEWater	24,000 m^3/d	S$25.90 m	Completed

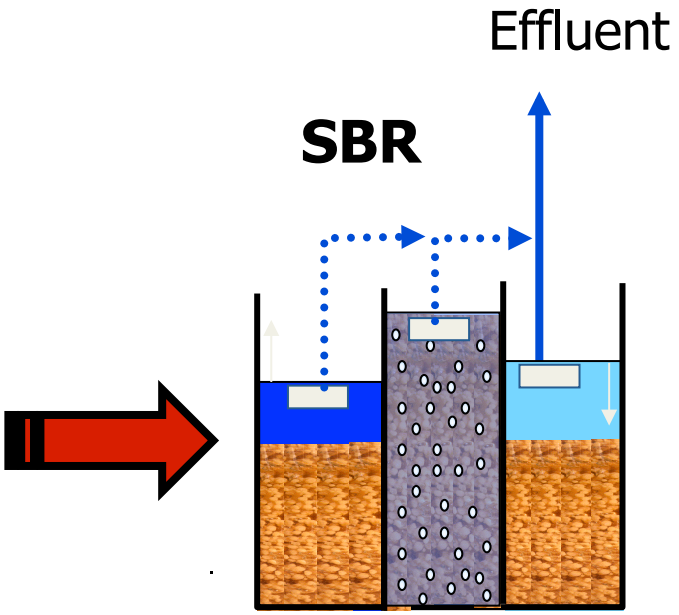
Upgrading modular plants to centralized and combined plants



- Main sewer line
- Connecting decentralized WWTP
- WWTP site????

New innovation using granular sludge



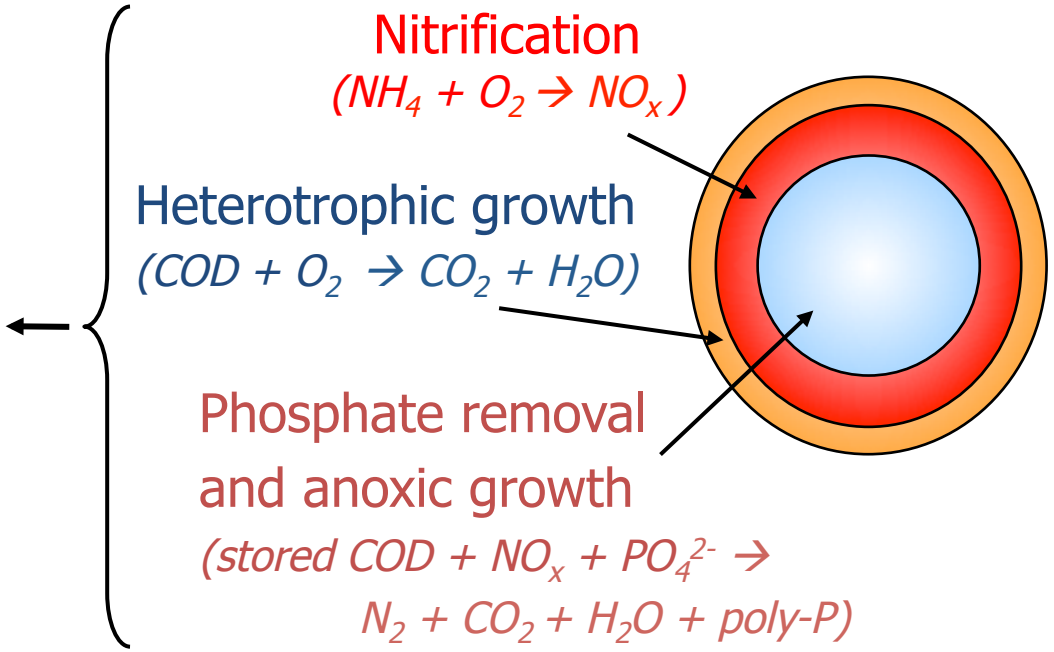


Aerobic Granular Sludge Reactor

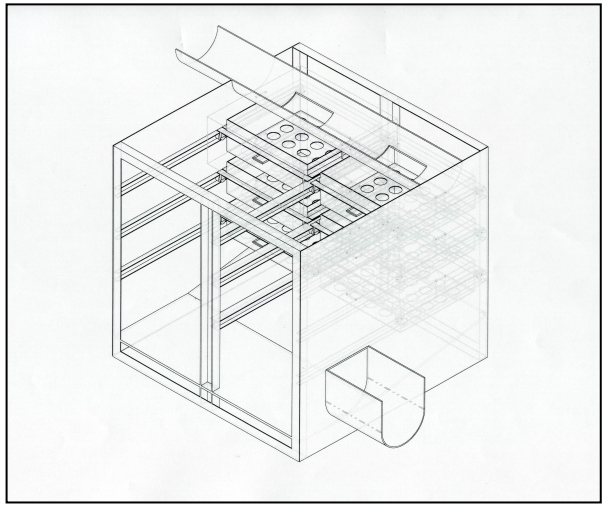
Why aerobic granular sludge reactor?

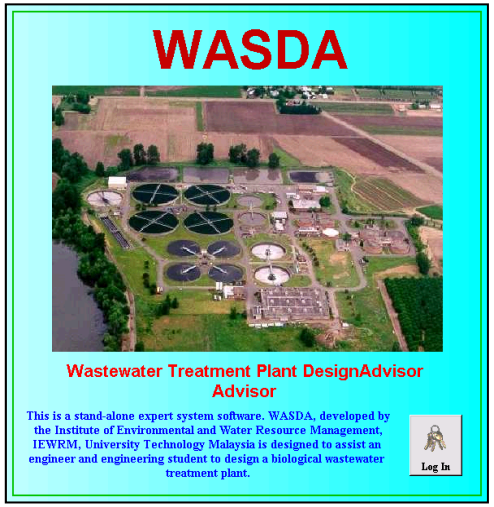
- Straightforward (no return sludge, less sludge handling)
- Small area requirement
- Simultaneous N,P and COD removal in one reactor
- High-speed unit process
- More efficient treatment system

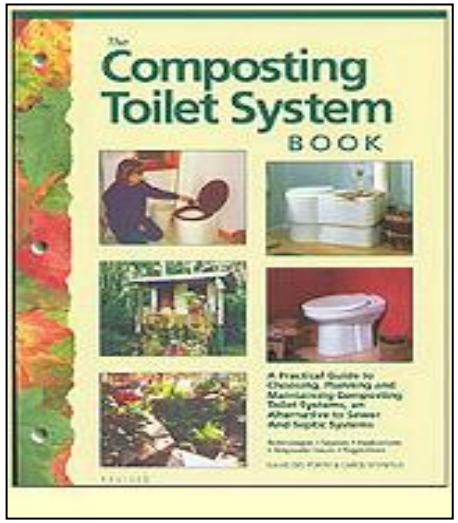
C, N and P removal
(as well as settling
and thus biomass effluent
separation) in one reactor



Latest innovation







Latest innovation

Case study in Jakarta

Thank You!

Terima kasih!

Tak!