UNESCO-IHE
Institute for Water Education

Course 4 Unit 1

Financial aspects and market considerations

Part A: Financial aspects and cost estimates
Part B: Market considerations

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Course 4 Unit 1

Part A: Financial aspects and cost estimates

Preamble

- I've come to realise that the question is not so much about "how much does it cost?", but rather "how can it be financed best?"
- At the sustainable Sanitation Alliance meeting on 11-12 Aug 07 in Stockholm, several new financing initiatives were announced, e.g.
  - Global Sanitation Fund Forum (Jack Sim, World Toilet Organisation, Singapore)
  - World Sanitation Fund (Amanda Fox from Ashoka, USA)
- Stay tuned for further developments in that regard, I think we will see some interesting developments!

Financial aspects for ecosan in urban areas - overview

- Ecosan systems are typically less expensive than conventional water-borne sanitation systems (capital and O&M* cost)
- But are they more or less costly than simple on-site systems (pit latrines / septic tanks)?
  → That depends, as you will see later in this presentation
- Make sure you "compare apples for apples":
  - e.g. options should have similar, comparable environmental impact
  - Define boundary of the system for comparison
- A cost-benefit analysis is only needed if options have different benefits (in general, all sanitation systems have the same benefits, at least in terms of public health)

* O&M = Operation and maintenance

Financial sustainability of ecosan systems is very important

- Otherwise the system will be abandoned once external funding stops
- Consider financing options such as:
  - User-pays principle (or at least: user contributes)
  - Cross-subsidies and capacity to pay (see following slides)
  - Pro-poor approach
  - Micro-credit schemes
  - Involvement of private sector and micro-enterprises (e.g. private operator of public toilets or of vault emptying service)
- Municipalities may need to adapt existing payment systems for water and sanitation

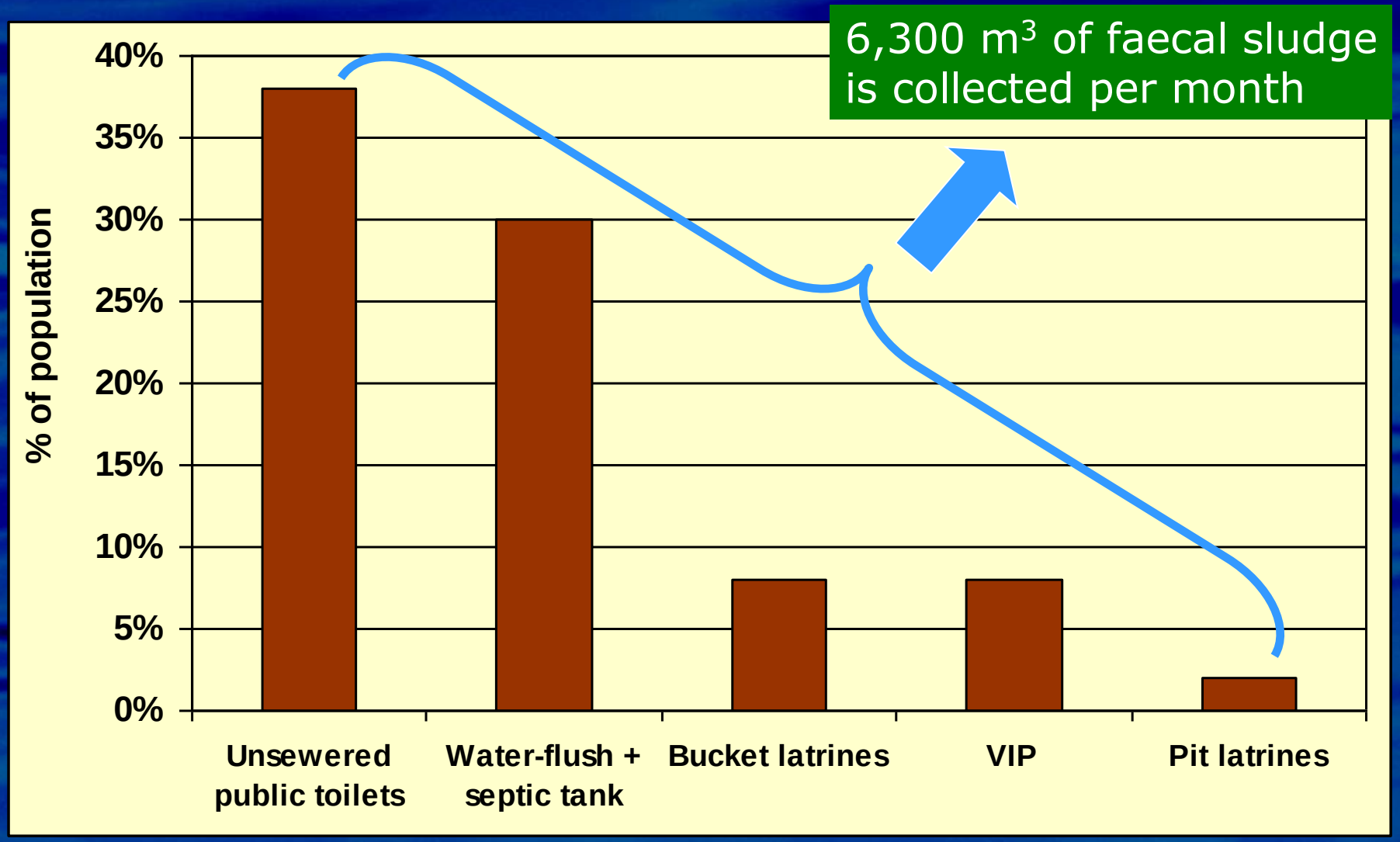
* O&M = Operation and maintenance

Example of possible cross-subsidy scheme in sanitation: Kumasi in Ghana, West Africa (slide 1 of 5)

- Population: 1.48 million
- 300 km Northwest of capital Accra
- 86% of population use on-site sanitation systems from which faecal sludge can be collected

Source: Vodounhessi and v. Münch (2006)

Existing on-site sanitation systems in Kumasi (slide 2 of 5)



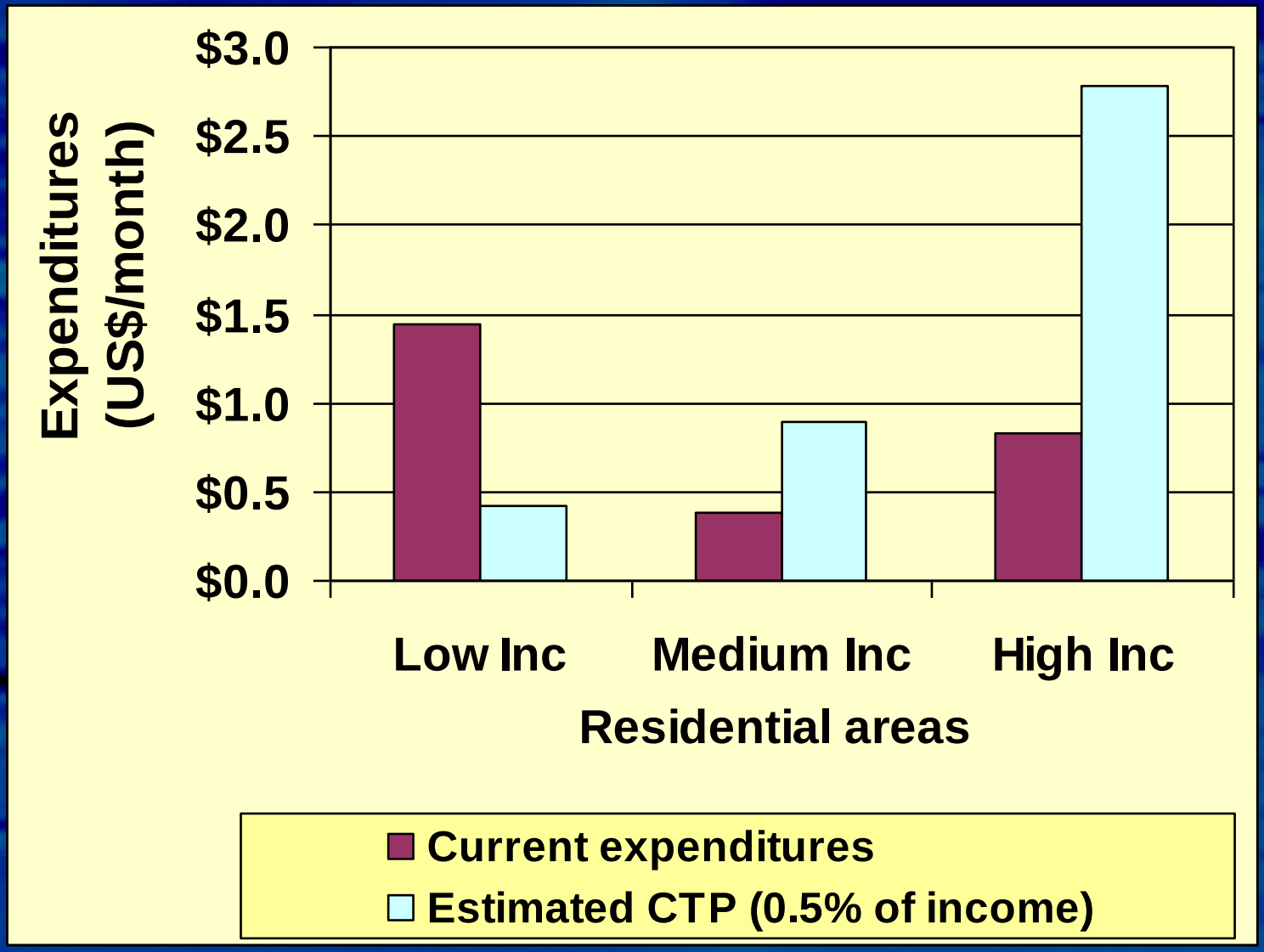
86% of population use on-site sanitation systems which produce FS (other: 10% connected to sewerage system, 4% open defecation)

Faecal sludge (FS) collection and treatment (slide 3 of 5)

- **Collection:**
  - **92% of FS is collected by private companies (so you see: there is money to be made in the "shit business"!)**
  - **The other 8% is collected by city council or publicly owned companies**

- **FS treatment:**
  - **1 FS treatment plant, commissioned in 2004 (9 waste stabilisation ponds)**
  - **But poor effluent quality discharged to local river**

Household's current monthly expenditure* on sanitation services (slide 4 of 5)



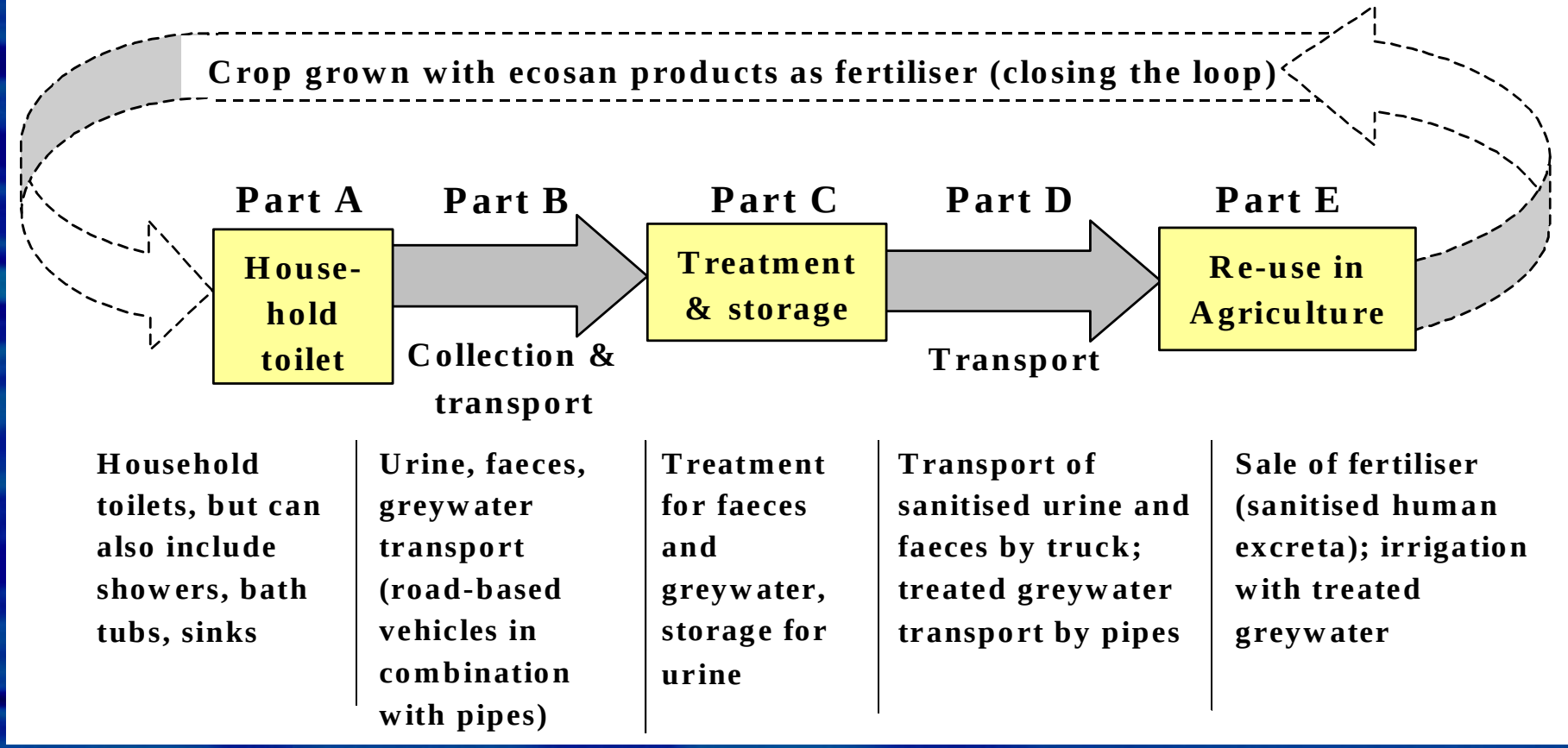
* Expenditure: FS emptying service (from household septic tank or pit latrine) or public toilet user fee. CTP = Capacity to pay

Conclusions from this research (slide 5 of 5)

- Poor people pay considerably more for sanitation than wealthy people (in absolute and relative terms)!
  - Payments should somehow be based on a capacity-to-pay approach (e.g. 0.5% of household income)
  - This would effectively then be a cross-subsidy scheme (like a tax)
- [This research was based on interviews with 20 households only, but it is nevertheless thought to be quite representative of common trends in cities in developing countries]

How much do you pay for your sanitation services at home?
Do you have a septic tank that needs emptying?

"So how much does it (ecosan) cost exactly?"



Need to design Parts A to E; then determine costs for Parts A to E

Accuracy of cost estimate decreasing in this direction
Number of people covered increasing (economy of scale)

Important points regarding cost estimates for ecosan systems

- You can only obtain a reasonably accurate cost estimate if you have a good concept design (better: detailed design) of the sanitation system
  - Failing that, you could try to use other people's figures but costs can be quite different for different countries or different regions (rural/urban)

- It is important to consider capital cost and annual operating costs together, over a certain project life span (e.g. 10, 15 years)
  - This is best quanitifed and made comparable by using:
    (a) NPV (see next slide) or
    (b) annualised capital costs plus O&M costs (see slide after NPV slides)

(a) Equation for Net Present Value (NVP)

$$NPV = \sum_{i=1}^{n} \frac{values_i}{(1+rate)^i}$$

NPV is a way of summarising capital costs and all annual O&M costs (over a certain project life span) to derive a total amount

NPV	**Net present value, in € (the lower its absolute value the better)**
i	**Year counter: from year 1 to year n (sum up the values over the years)**
n	**Number of years (project life time); my advice: 10, 12 or 15 years is sufficiently long**
values	**These are the annual values for expenditure and income; note some people give expenditures a negative value, others give it a positive value – be careful (this term is also called cash flows). Normally the big capital expenditure occurs in Year 1 and perhaps again in Year 10 or so.**
rate	**Discount rate (my advice: use 12% unless otherwise determined)**

Examples for NPV calculation

- Excel has a built-in function for the NPV calculation and good explanations in the help file
  - The function is like this: =NPV(rate; value 1, value 2, value 3, ...)
- Examples:
  - Have a look at the Excel spreadsheets from the MSc theses of Kennedy Mayumbelo and Kalyani de Silva (under Extra Materials) to see a worked example of NPV calculations
  - Also the composting handbook of Sandec includes NPV calculations and explanations (see Course 2 Unit 6 Extra Materials)

(b) Equation for annualised capital cost

$$C_{cap,annual} = C_{cap,total} \cdot \frac{(1+rate)^n \cdot rate}{(1+rate)^n - 1}$$

This is a way of dividing the total capital cost into a per year figure.

To this value you add the annual O&M cost, and then you have the "total annual cost" of the installation (you can compare this figure with the annual household income).

$C_{cap,\ annual}$	**Annualised capital cost (€/year)**
n	**Number of years (project life time); my advice: 10, 12 or 15 years is sufficiently long; this is also called the depreciation period**
$C_{cap,\ total}$	**Total capital cost of the project (€)**
rate	**Discount rate (my advice: use 12% unless otherwise determined)**

An example for using the annualised capital cost in the financial analysis can be found in Vodounhessi and v. Münch (2006)

Discount rate to be used for NPV or annulised capital cost calcuations

- The discount rate is related to the rate at which governments can borrow money
- There is controversy about which value to use for projects in developing countries (e.g. see the entries on www.wikipedia.org)
- I recommend using 12% unless anyone else can give you a better value for your particular country and situation (check with your local financial expert)

Notes on NPV and annualised capital cost calculations

- Using the NPV and annualised capital cost as described here is a very crude, simple financial analysis
  - It's the sort of analysis that engineers (like me) can cope with! ("quick and dirty")

- But if you show this to an accountant or financial expert, they would want to analyse the situation in more detail, taking into account e.g.:
  - inflation
  - government interventions
  - rising fuel prices
  - currency devaluation
  - effect of subsidies or tax breaks

Example 1: Low-cost sanitation options for peri-urban population in Lusaka, Zambia (1.2 million people)

System component	Option 1 (conventional): VIP and downstream processes	Option 2 (ecosan): UDD and downstream processes
Part A: Toilet (1 toilet for 12 people)	VIP toilets	Single vault UDD toilets
Part B: Transport	Vacuum tankers for faecal sludge	Open trucks for urine barrels and dried faeces
Part C: Treatment	One faecal sludge treatment plant (ponds and co-composting)	Urine storage (2 weeks, plastic tanks); Faeces storage on concrete slabs with tarpaulin covers
Part C: Transport of sanitised material	Open trucks	Open trucks
Part E: Fertiliser sale	Compost	Urine; dried faeces

Example 1 cont'd: Cost analysis

based on entire peri-urban population of Lusaka (1.2 million)

Parameter	Unit	Option 1: VIP and downstream processes	Option 2: UDD and downstream processes
Total capital costs (Parts A to E)	Mio €	39	48
Capital cost per capita	€/cap	31	39
Annual operating costs - Total (Parts A to E)	Mio €/yr	2.9	2.6
Annual operating costs per capita	€/cap	2.3	2.1
Total NPV (10 years project life; 12% interest rate)	Mio €	55	63

Option 1 has lower NPV but has potential for groundwater pollution (→ what would be the cost associated with that? Are we really comparing apples for apples?) - Source: v. Münch and Mayumbelo (2007)

Example 2: Cost break-down for one outdoor UDD* toilet (with superstructure) in Durban

Component	Cost
Plastic toilet pedestal	€ 33
Back covers (vault) for two	€ 16
Vent pipes (for two)	€ 16
Door	€ 31
Roof	€ 33
Other materials (bricks etc. – for superstructure)	€ 302
Local contractor	€ 91
Labour	€ 88
Total	**€ 608**

* UDD = urine-diverting dehydrating

A very expensive toilet (probably an upmarket version) – see next 2 slides (from Course 2 Unit 1 Part C)

Source:
E-mail from Teddy Gounden (Manager Community Education and Councillor Liason), 31 March 2006
Using exchange rate of March 2006

Reminder: Durban (South Africa) rural areas:

Council is planning to install 47,000 double-vault UDD toilets by 2007 (17,500 already installed in 2003-2006)

Two openings at the back for removal of dried faeces from faeces vaults (each vault has its own vent pipe)

Plastic UD pedestal and bucket with sand

Left: Closed vault
Middle: Waterless urinal
Right: Plastic UD pedestal and bucket with sand

The walls, roof and door around this outdoor toilet constitute the "superstructure"

Pictures: E. v. Münch (May 2005)

Example costs for toilets (notice the wide range!)

Toilet type (all with superstructure)	Location	Cost
UDD toilet (Adobe - see next next slide)	Sabtenga, Burkina Faso	€ 55 (as built)
UDD toilet (with bricks)	Poa, Burkina Faso	€ 134 (as built)
UDD toilet	Pucheng, China	€ 72 (as built)
Unlined pit latrine	Lusaka, Zambia	€ 254 (estimate only)
Single vault UDD toilet	Lusaka, Zambia	€ 371 (estimate only)
VIP latrine	Accra, Ghana	€ 354 (estimate only)
Double vault UDD toilet	Accra, Ghana	€ 447 (estimate only)

Sources: for Burkina Faso from Linus Dagerskog (CREPA), March 2007; for China from Prakash Kumar (Plan China), March 2007; for Zambia from Mayumbelo MSc thesis (2006); for Ghana from Kalyani de Silva MSc thesis (2007).
A cost breakdown for all is provided in Excel spreadsheets under Extra Materials

As an aside: What is this cheap building material called "Adobe"?

- Adobe is a natural building material mixed from sand, clay and straw, dung or other fibrous materials, which is shaped into bricks using frames and dried in the sun. It is similar to cob and mudbrick.
- Adobe structures are extremely durable and account for the oldest existing buildings on the planet.
- Adobe buildings also offer significant advantages in hot, dry climates; they remain cooler as adobe stores and releases heat very slowly.

Source: www.wikipedia.org

Costs of other parts of the sanitation system

- It is relatively straight forward now to obtain costs for Part A (toilets) of the system (see previous few slides)

- But for the costs for Part B to E (transport, treatment, reuse), I have rarely seen any publications
  - You have to work them out for yourself for a given situation
  - For transport costs see also Course 2 Unit 3 Part D

How to compare costs

- When you look at published costs of toilets or sanitation systems, always check:
  - Which country? Material and labour cost in that country?
  - Which year?
    - Which currency? Does the currency still have the same value now?
  - What is included (materials and labour)?
  - For rural or for urban context?
  - Base version or upmarket version?
  - Size of project (pilot scale or full scale) – remember economies of scale for larger projects

→ It is not easy to compare cost estimates from different projects!

Sanitation cost "ladder" from Rockström *et al.* (2005), p. 49

Increasing cost

	Conventional	Ecological sanitation	Example country
Mainly urban	Tertiary WWT	UDD toilet (indoor), piped urine system, composting, greywater (GW) treatment	China (see also next slide)
	Sewer connection and secondary WWT	Indoor toilet, black water collection, biogas digester	China, India
	Conventional sewer, no treatment	Indoor single-vault UDD toilet, GW treatment constructed wetlands	China
Mainly peri-urban	Sewer connection, no treatment	UDD single-vault toilet outdoors; GW infiltration	South Africa, El Salvador
	Septic tank	UDD single-vault toilet outdoors; GW treatment	China, West Africa, Zimbabwe
Mainly rural	Pour-flush latrine		
	VIP, simple pit latrine	Soil composting pit with cement slab and simple super-structure	Zimbabwe (Arborloo or Fossa Alterna)
	Improved traditional practice	Soil composting shallow open pit	Zimbabwe

The need for large scale ecosan projects

- Using pilot projects to make cost predictions has a number of drawbacks:
  - No economy of scale → costs will be higher
  - No prior experiences, no market forces → costs will be higher
  - Sometimes subsidies are available → costs may be lower than what is realistic

- Now is the time to go to scale with ecosan to obtain real experiences and real costs
  - See project Erdos Eco-Town in Dongsheng, China described on the next slides

The largest urban ecosan project in the world: China-Sweden Erdos Eco-town Project, Dongsheng, Inner Mongolia, China

- A town with one-, two and four-story buildings including service and shopping facilities for 7000 people is currently being built. The project will be completed by 2008.
- First major attempt in China (and the world) to build from the ground up an entire functioning modern town using sustainable water and sanitation practices.

Project Details:

- 1600 households in 1-, 2- and 4-story buildings
- UDD toilets ("long drop" design for faeces)
- urine collection and recycling
- dry faecal collection, sanitisation and recycling
- greywater collection, treatment and reuse
- kitchen organics collection, composting and recycling
- source-separation of solid waste and recycling

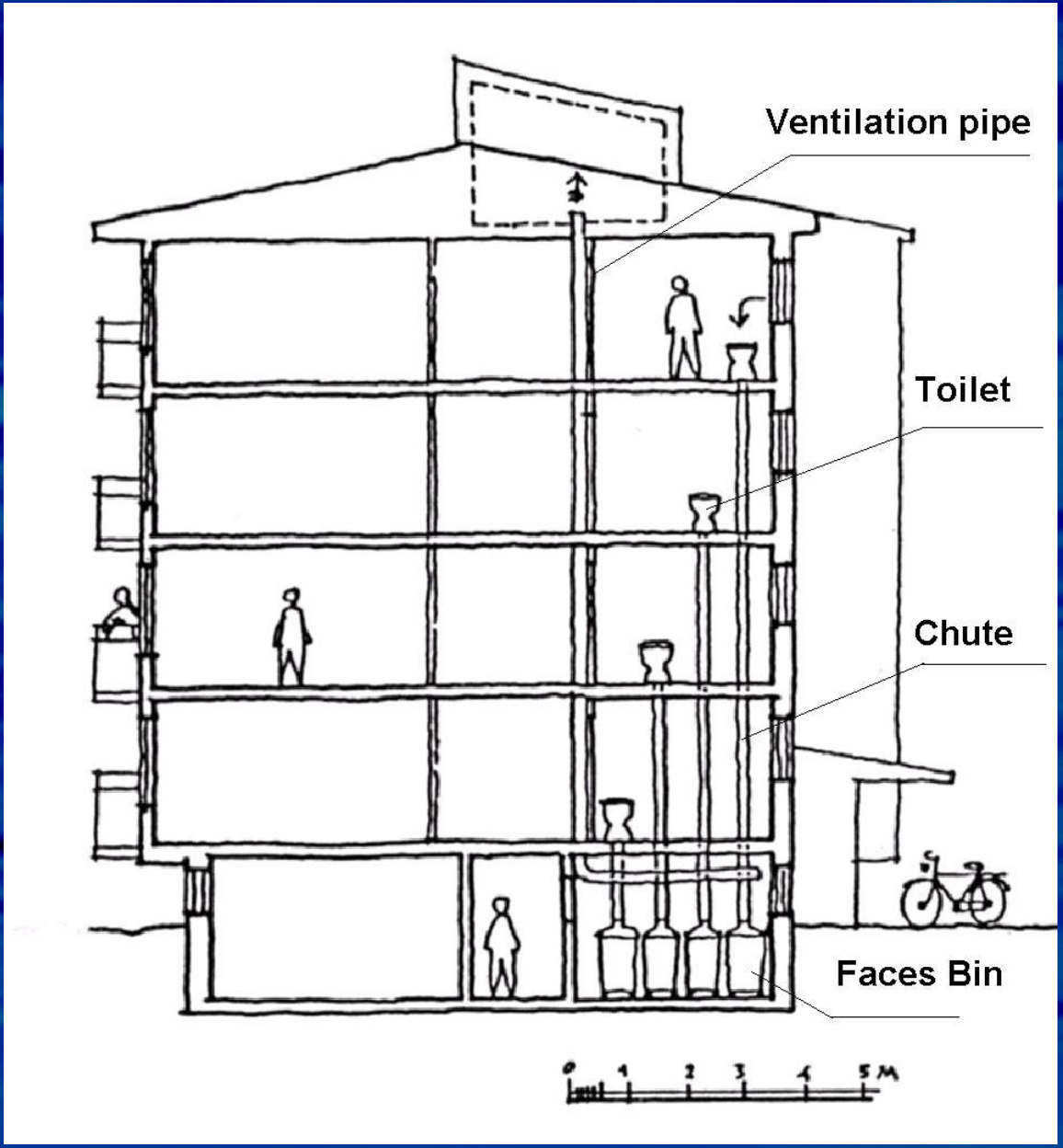
Source for this slide and next four: see powerpoint presentation under Assigned Reading
See also: http://www.ecosanres.org/pdf_files/Fact_sheets/Fact_Sheet_11ls.pdf

Erdos Eco-Town project: Physical features

(current: August 2007)

- Forty-two 4 and 5 storey buildings equipped with UDD seating toilet;
- 832 flats with about 2900 inhabitants;
- GRW and urine piping system and 22 urine tanks

EcoSanRes
生态卫生系统研究



Faces & urine system

- Urine diversion seat toilet
- Faces drop chute
- Faces bin and bin cover
- Ventilation system
- Urine piping
- Urine tank

EcoSanRes
生态卫生系统研究

Erdos Eco-Town: Project Facts

(current: August 2007)

- Three-phase project covering 55.6 ha and ca 2500 flats
- Phase one completed in 2006, has produced 833 flats in 43 buildings; all were quickly sold and occupancy is about 400 flats
- Ecosan installations
  - Dry urine-diverting toilets (Swedish-China design; manufactured in Guangdong – Meilong Co.)
  - 22 underground urine tanks
  - Fecal collection - one bin for each toilet
  - Greywater kept separate and piped to the eco-station
  - Eco-station
    - Greywater treatment and storage pond
    - Composting of the faeces and kitchen organics (offsite farm up to now)
    - Sorting and temporary storage of solid waste

Erdos Eco-Town: The Challenges
(current: August 2007)

- Building quality has varied due to the high pace of urbanisation in Dongsheng and the restriction of not being able to build during the winter
- The building company has responded by making necessary repairs
- Improper installations of ecosan equipment causing odor
  - Urine tanks – piping not built according to blueprints caused back flow of air to the toilets
  - Toilets – some poorly installed causing problems in operation and leaky urine connections
- Greywater system – delay in testing due to low flow of water - because not enough flats were occupied in 2005 and 2006; some pipes crushed by tractors; some wells blocked by soil and debris; flow is now adequate for activated sludge operation (20 m^3/hr; capacity is 50 m^3)

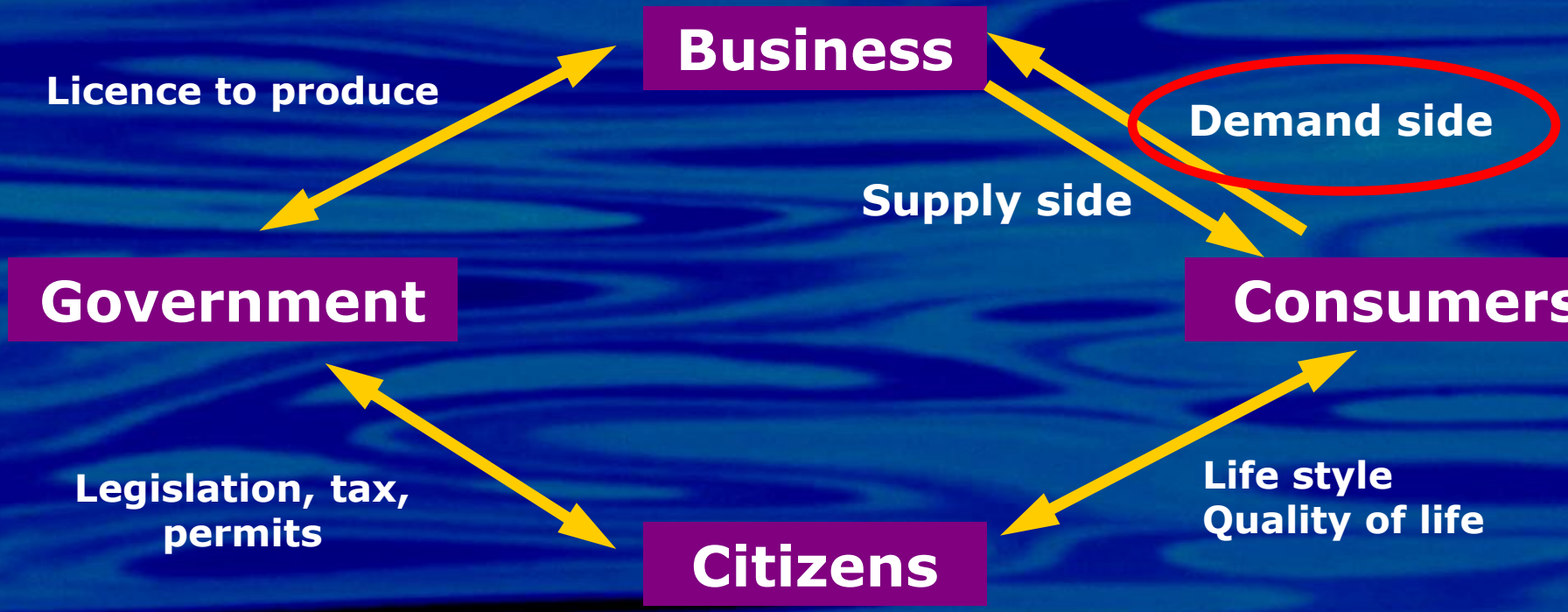
For further details on problems and solutions: see separate powerpoint presentations by the Swedish-Chinese team under Assigned Reading

Course 4 Unit 1

Part B: Market considerations

* Watch this video clips to hear from Peter Kolski (World Bank) about private sector involvement in ecosan, discussing some of the points made in this Part B: mms://mediaserver.ihe.nl/course/video_general/ecosan/human_excreta14_256kbps.wmv

A general model on how markets work



The problem we have in sanitation / ecosan: <u>Demand is low</u>; supply is therefore also low → prices are (relatively) high. But we can and should influence this demand.

Source: Peter van Luttervelt, Ecosan Seminar, Sofia, Bulgaria, April 2007

We should be selling a concept, not a toilet

People go to the shop / supplier and buy this item	But what they really buy is this concept
Car	Personal mobility
Mobile phone	Communication
TV, radio	Entertainment, information
Toilet (or better: entire bathroom)	Convenience for personal hygiene, privacy, status

Ask yourself: Why do even poor people have good mobile phones nowadays but still no toilet?
It has to do with priorities, marketing, perceived benefits, access, availability of technology (I would argue that cost is not the main consideration)

What do people want from a toilet?

Possible reasons for wanting a toilet (in typical order of priority):

1. **Privacy and safety (especially important for women and children who could be exposed to sexual harassment) – toilet in your own house would be best**
2. **Convenience, easy to clean**
3. **No odour, no flies, cleaner surroundings**
4. **Status, dignity respect, less embarrassment with visitors**
5. **Cheap and easy to construct and maintain**
6. **Health (reduced gastrointestinal diseases) and environmental protection often come last (if at all)**

The order of priority may well differ depending on the current sanitation situation of the household, their level of awareness and education, the gender of the decision maker, household income, etc.

Social Marketing

- **Social marketing: "The use of commercial marketing techniques to promote the adoption of behaviour that will improve the health or well-being of the target audience or of society as a whole"**

- **Social marketing could increase the <u>demand</u> for sanitation**

This slide and the next 6 were modified from Heeb *et al*. (2007) Module M4-6 Awareness Raising and Monitoring

Target audiences of social marketing

- **Primary target audience:**
  - those who are likely to change their practices or make the decision to buy particular goods which are being marketed
  - this includes mothers and school children for example
- **Secondary target audience:**
  - those in the immediate society who influence the primary target; fathers and mothers in law, for example
- **Tertiary target audience:**
  - opinion leaders and persons who have status
  - e.g. traditional leaders, elders, school teachers. politicians

→ **Target audience must both *want* and *be able* to change their behaviour**

Basic characteristics of social marketing are the four P's:

1 Product: decide what is the product and how it can be presented in terms of 'packaging' and characteristics.

2 Price: what is the consumer willing to pay both in terms of direct and indirect costs.

3 Place: where will the product be available; are there display or demonstration facilities.

4 Promotion: how will the consumers know that the product exists, what it costs, what its benefits are and where they can get it from.

(a fifth P is sometimes used for "Policy")

At the heart of successful marketing is an understanding of what the consumer (target audience) wants

Social Marketing: 1 - Product

- **Product**
  - physical object (e.g. UDD toilet, vacuum toilet, pour-flush toilet)
  - a service (e.g. faeces vault emptying service)
  - practice/behaviour (e.g. wash hands)

- **Note: To have a viable product, consumers must first believe that they have a problem and that this can be addressed by the product**
  - Range of product choices can prove instrumental, e.g. different colours, materials, sizes

Social Marketing: 2 - Price

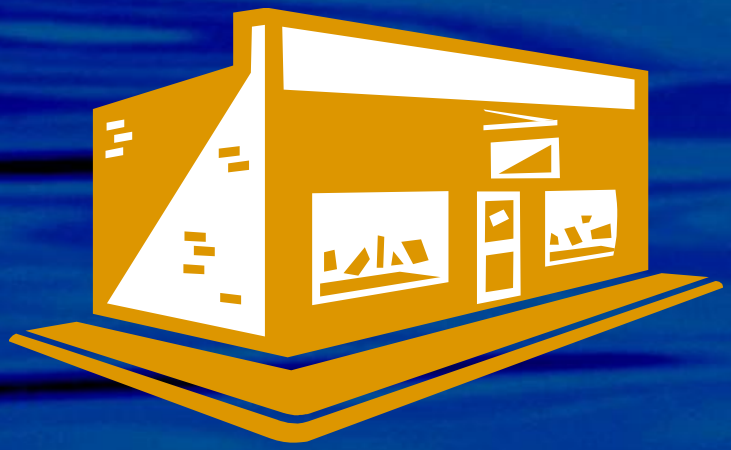
- Behaviour change itself may have no price tag; however associated products can come at a price.
  → affordable price to the target audience

- Note: price is rarely the most important factor ruling product uptake

Social Marketing: 3 - Place

- Products needs to be available at outlets accessible to the target audience, i.e. also for the urban poor or rural population

- A display or demo facility can be very effective



Social Marketing: 4 - Promotion

- Enabling environment for behaviour change: product available in the right place, for the right price
- Need for awareness raising (see Course 4 Unit 2 Part B "Institutional and policy aspects")
- Promotion based upon an understanding of the motivations

References used in the last 7 slides on social marketing

- Scott, B. (2005): Social Marketing: A Consumer-based approach to promoting safe hygiene behaviours. WELL Fact Sheet. Available at: http://www.lboro.ac.uk/well/resources/fact-sheets/fact-sheets-htm/Social%20marketing.htm#Anchor-HOM-43259 (Accessed 20 May 2007)
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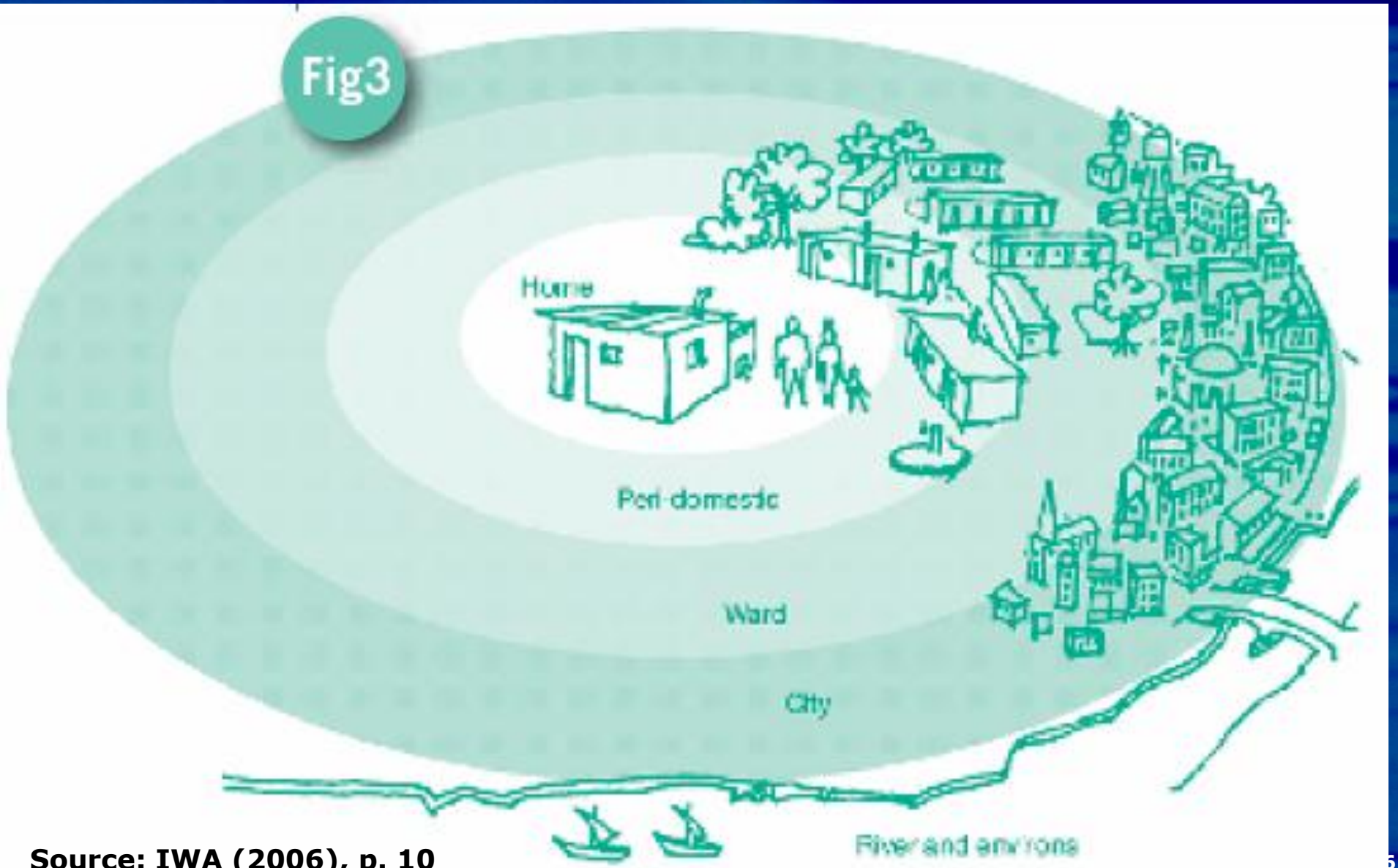
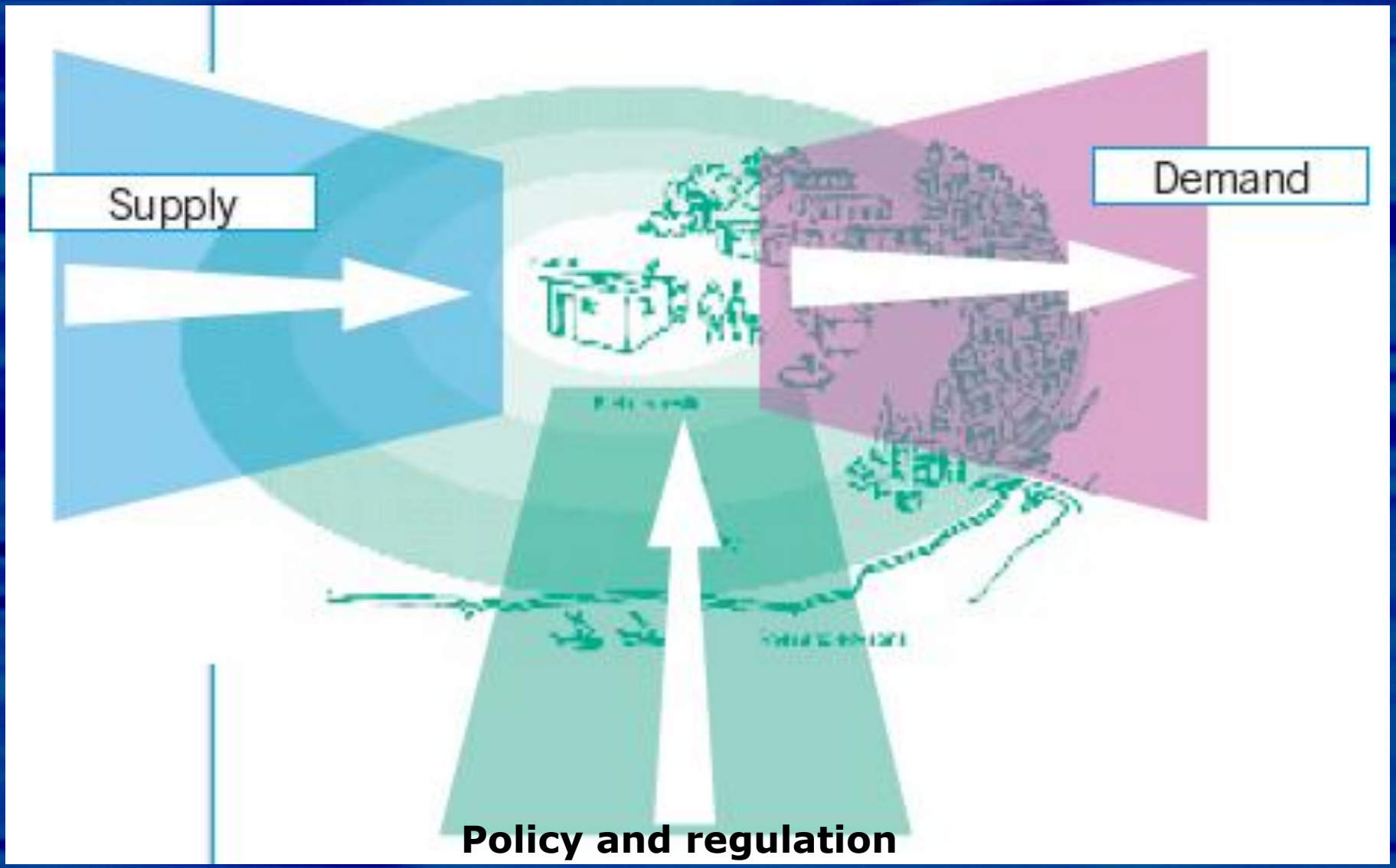
The household perspective on sanitation: defining domains (slide 1 of 3)

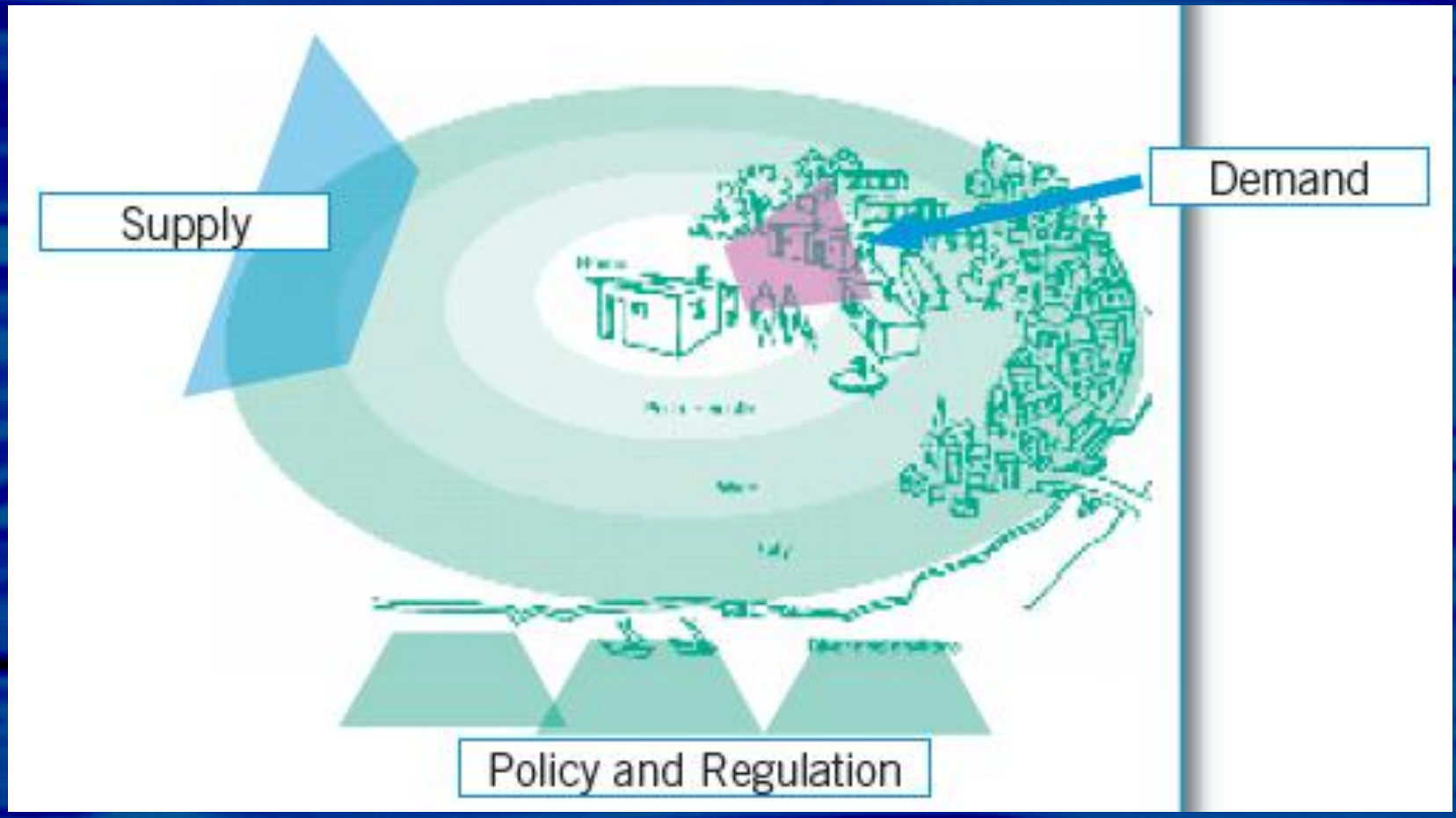


Source: IWA (2006), p. 10

The ideal situation: the supply of services is reaching the households (slide 2 of 3)



The actual situation: Failure to match the supply of an appropriate services to the demands and capacities of the actors in that domain (slide 3 of 3)



It is encouraging to see that IWA (International Water Association) is working on this publication, which includes ample references to ecosan. IWA used to be mainly focussed on the conventional, sewer-based sanitation only

Demand for Sanitation

- **Demand creation is a two-stage process:**
  - **Establish demand:**
    - **do households want improved sanitation**
    - **<u>stimulate demand</u> through promotion campaigns**
  - **Inform demand:**
    - **Realistic information: likely costs and benefits**
    - **Address unrealistic expectations**

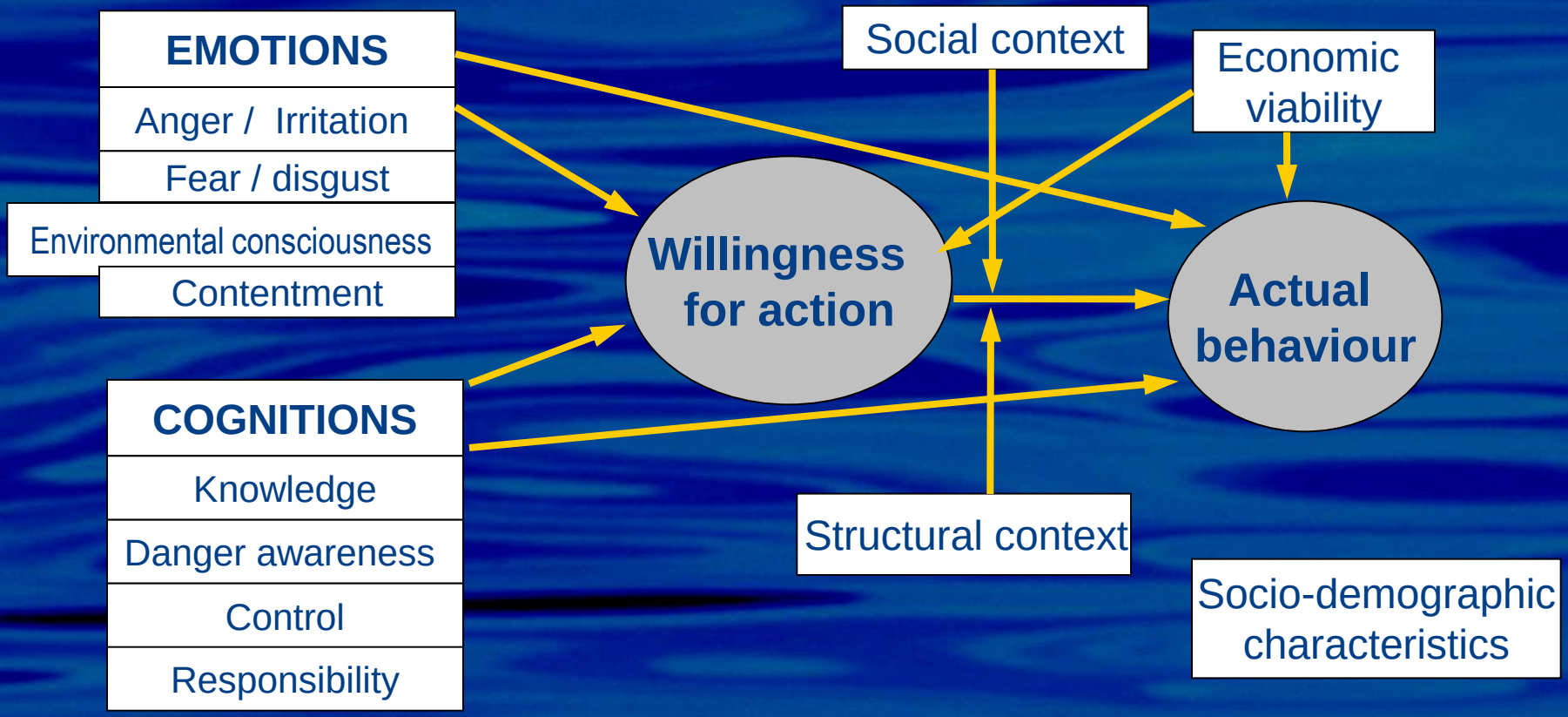
We want sanitation!! - We want sanitation!!

Imagine a demonstration like that !!

Source of the top part of this slide: Heeb *et al*. (2007)

Demand for sanitation…

Actor model for environmental behaviour of people (European context): how to influence the actual behaviour?



Source: Paul Schosseler presentation at Aachen Advanced Sanitation conference (March 2007) "Implementing sustainable sanitation concepts in Luxembourg – methodological approach and outcomes"– see presentation in Extra Materials

References

- IWA (2006) Sanitation 21 – Simple approaches to complex sanitation (a draft framework for analysis), International Water Association, London, UK. Available: www.iwahq.org/templates/ld_templates/layout_633184.aspx?ObjectId=639578 *
- Mayumbelo, K. (2006) Cost analysis for applying ecosan in peri-urban areas to achieve the MDGs – Case study of Lusaka, Zambia. MSc Thesis MWI 2006-10, UNESCO-IHE, Delft, The Netherlands. Available: http://www2.gtz.de/Dokumente/oe44/ecosan/en-cost-analysis-lusaka-2006.pdf
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- Vodounhessi, A., and von Münch, E. (2006) Financial and institutional challenges to make faecal sludge management integrated part of ecosan approach: Case study of Kumasi, Ghana. Water Practice and Technology (selected proceedings of the Beijing Biennial IWA Congress), 1 (2). Available: http://www-32.cis.portlandcs.net/wpt/001/0045/0010045.pdf *

* Also under Assigned Reading or Extra Materials for this course unit