Interactions of urban form and source-separating sanitation technologies

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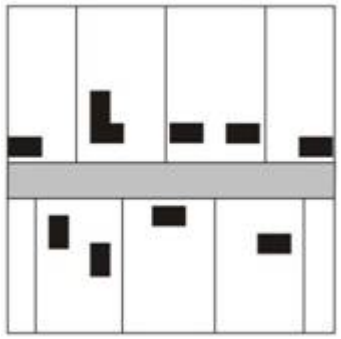
Background

- Source-separation of wastewater as basis of new sanitation concepts
- Pilot projects mainly in new developments
- Little experience with regard to retrofitting of existing buildings and neighbourhoods
- But: refurbishments of existing housing stocks become more and more important
- More knowledge about characteristics of existing urban areas required

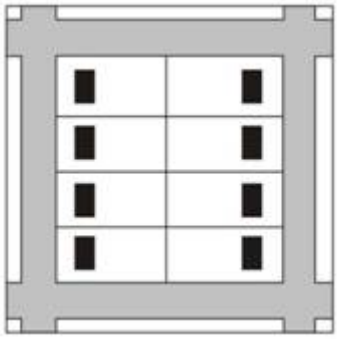
Aim of the study

- Development of a typology and assessment of different types of urban form
- Focus on four different source-separating systems
- Suitability check considering nine selected neighbourhoods representing the typology
- Detailed check of urine diversion system
  - » Cost assessment (investment costs)
  - » Two options considered

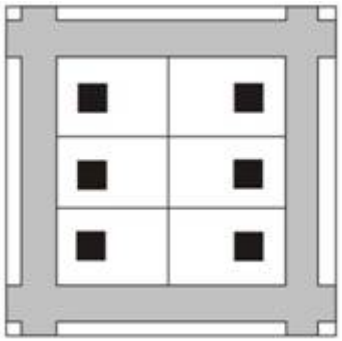
Types of urban form



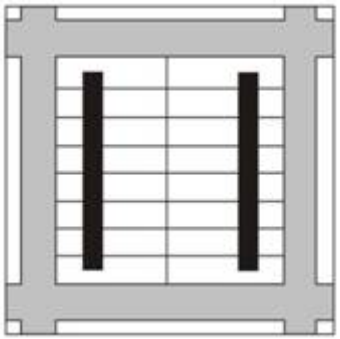
1) Rural settlement



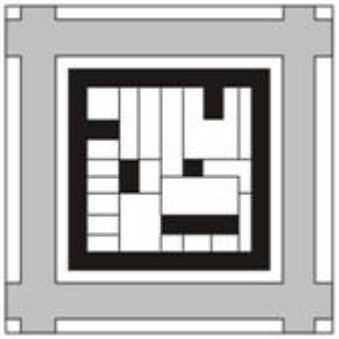
2) Detached & semi-detached houses



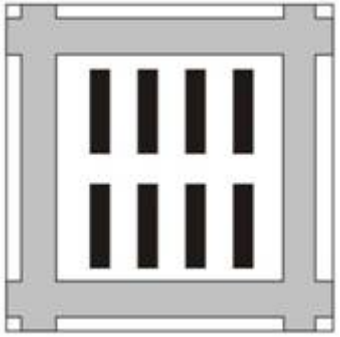
3) Urban mansions



4) Terraced houses

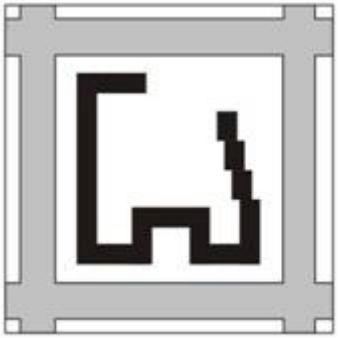


5) Perimeter block

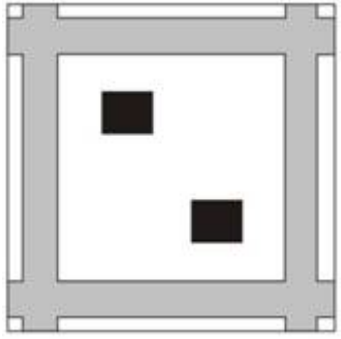


6) Linear block

7) Slab block



8) Large scale development

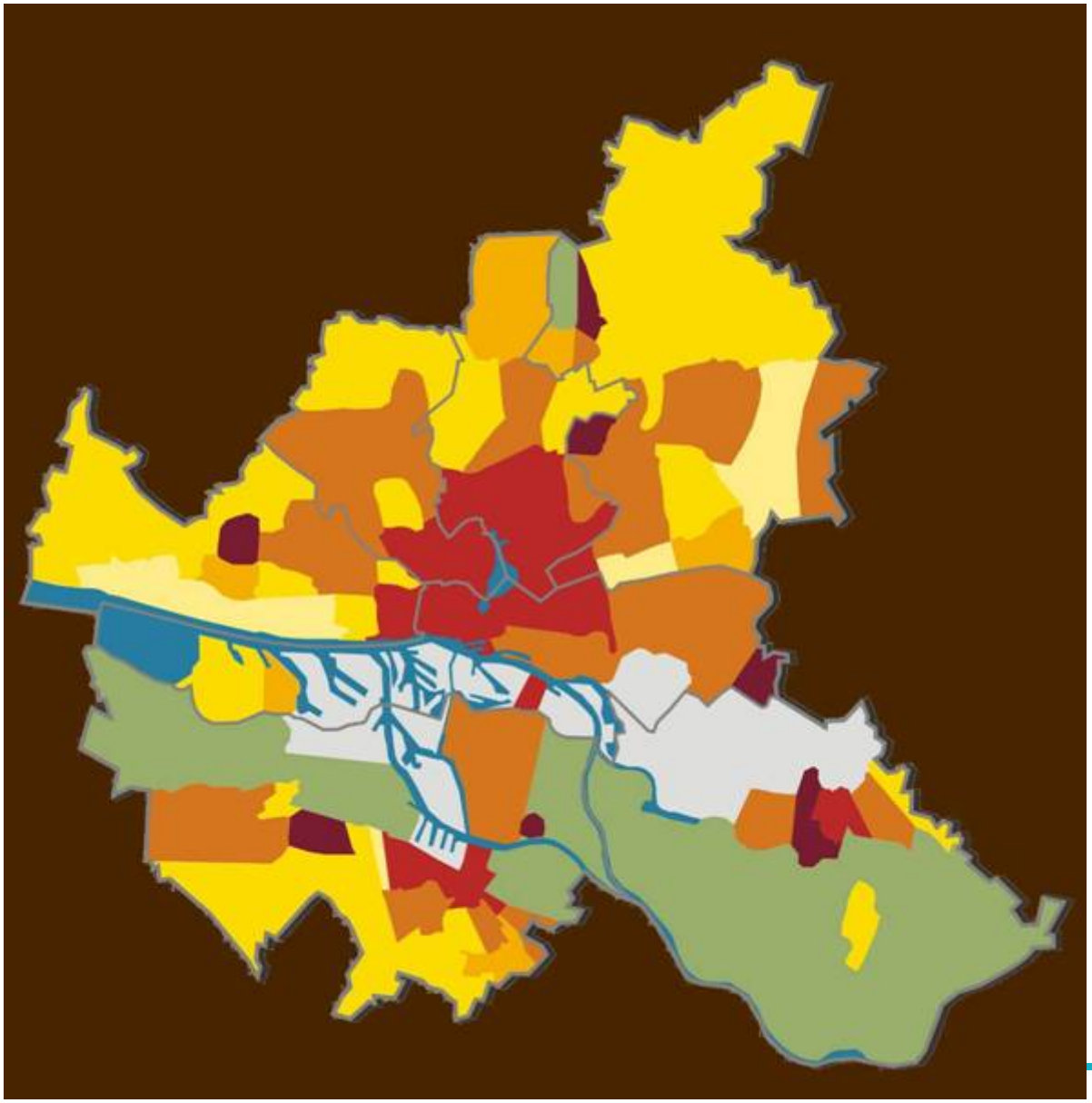


9) Multi-storey buildings

Typology of urban form

Type	Floor-space index	Number of storeys	Persons per building	Buil-dings per ha	Population density (inh per ha)
1 – Rural settlement	0.25	1.5-2	4	6-7	15
2 – Detached and semi-detached houses	0.2-0.4	1.5-2	2	8-16	40
3 – Urban mansions	0.6	2.5	6	10	60
4 – Terrraced houses	0.3-0.8	2	12	10-20	130
5 – Perimeter block	1.2-3.5	3-4	14	8-16	260
6 – Linear block	0.8-1.3	3-4	60	5-10	400
7 – Slab block	1.6	10-15	250	1	184
8 – Large scale development	1.0-1.8	4-10	864	0.5	125
9 – Multistorey buildings	3.5-7	8-15	105	4-6	500

Types of urban form in Hamburg



- Slab block
- Linear block
- Terraced houses
- Detached and semi-detached houses
- Urban Mansions
- Large scale development
- Rural settlement
- Industry

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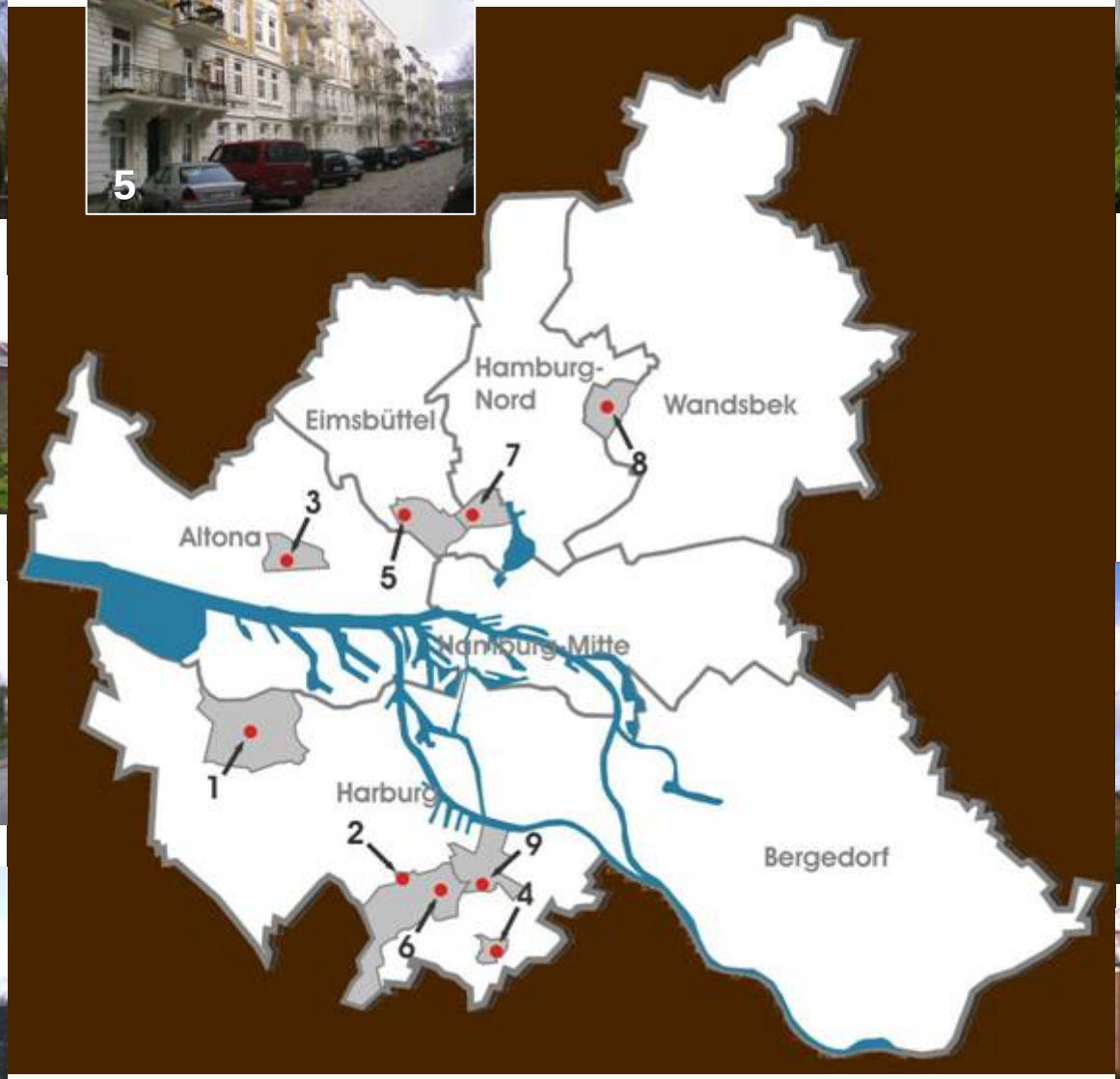
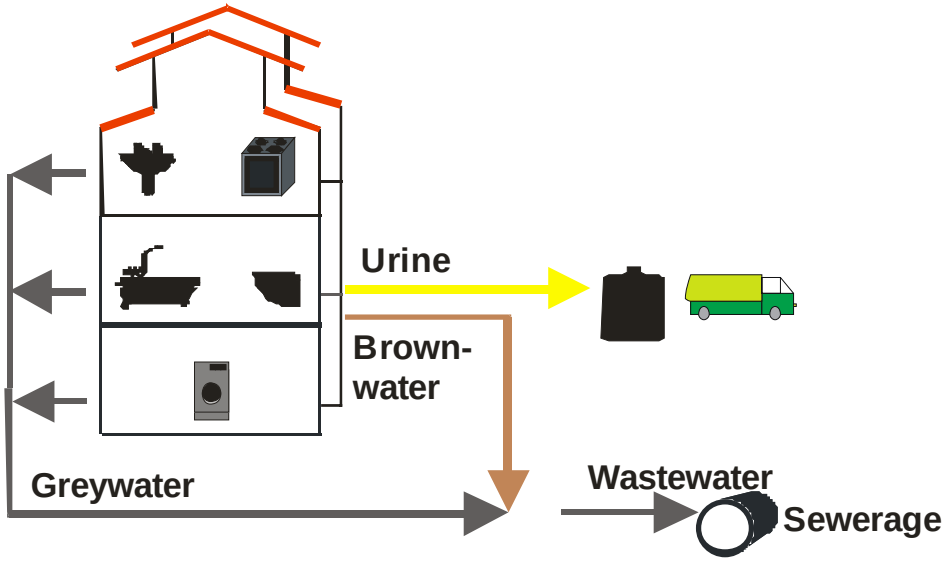
Selected neighbourhoods in Hamburg



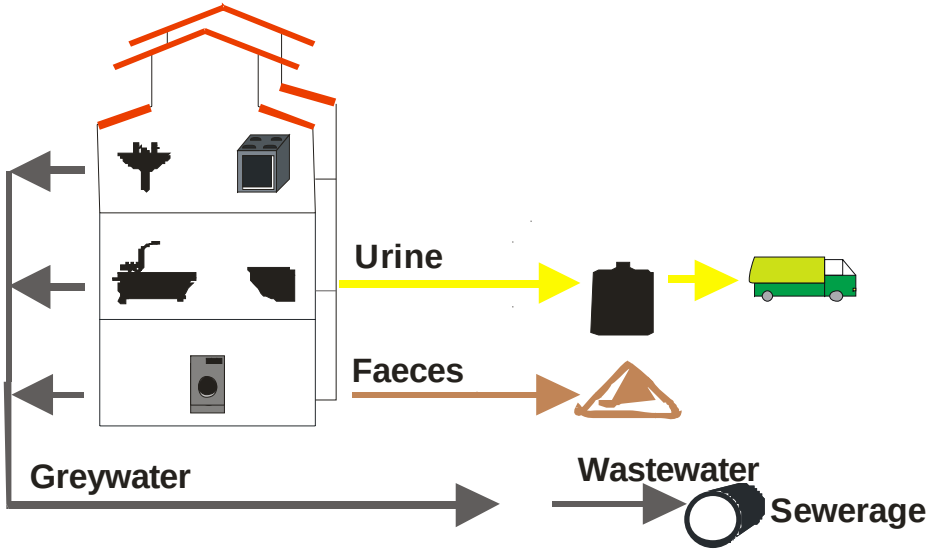
Source-separation: System 1

	Excreta / Blackwater		Greywater
	Urine	Faeces	
System 1	Separation, use as plant fertiliser	Conventional treatment in central facilities	



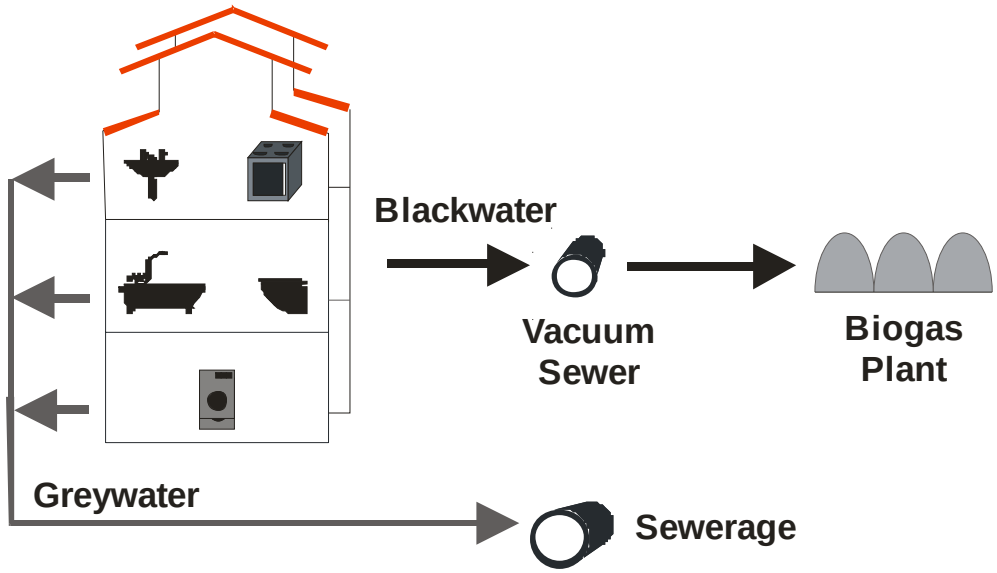
Source-separation: System 2

	Excreta / Blackwater		Greywater
	Urine	Faeces	
System 2	Separation, use as plant fertiliser	Composting, use as soil conditioner	Conventional treatment (central)



Source-separation: System 3

	Excreta / Blackwater		Greywater
	Urine	Faeces	
System 3	Vacuum toilets, vacuum sewers, anaerobic digestion in district facilities		Conventional treatment (central)

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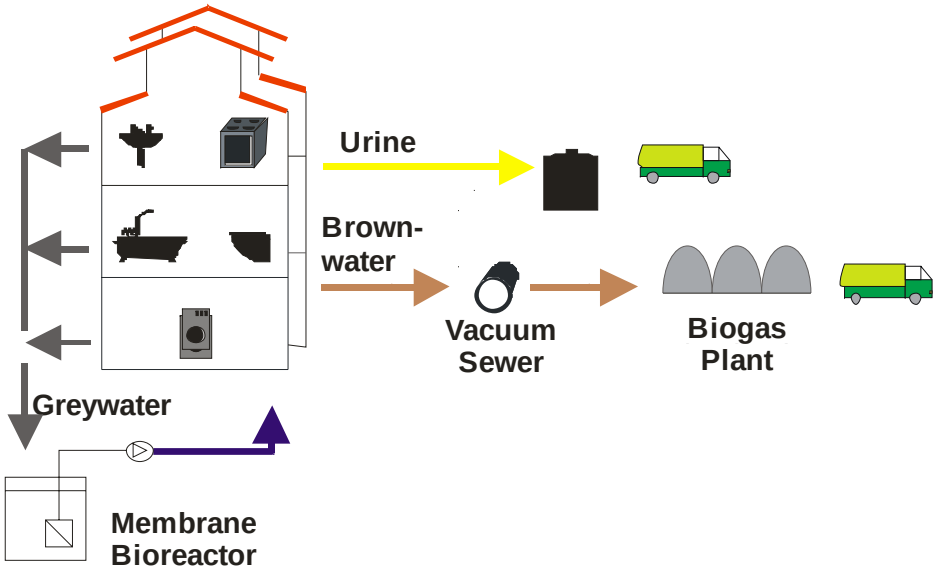
Source-separation: System 4

	Excreta / Blackwater		Greywater
	Urine	**Faeces**	
System 4	Separation, use as plant fertiliser	Vacuum toilets, anaerobic digestion (decentralised)	Decentralised treatment, use as process and drinking water



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Linz AG

General suitability of the sanitation systems

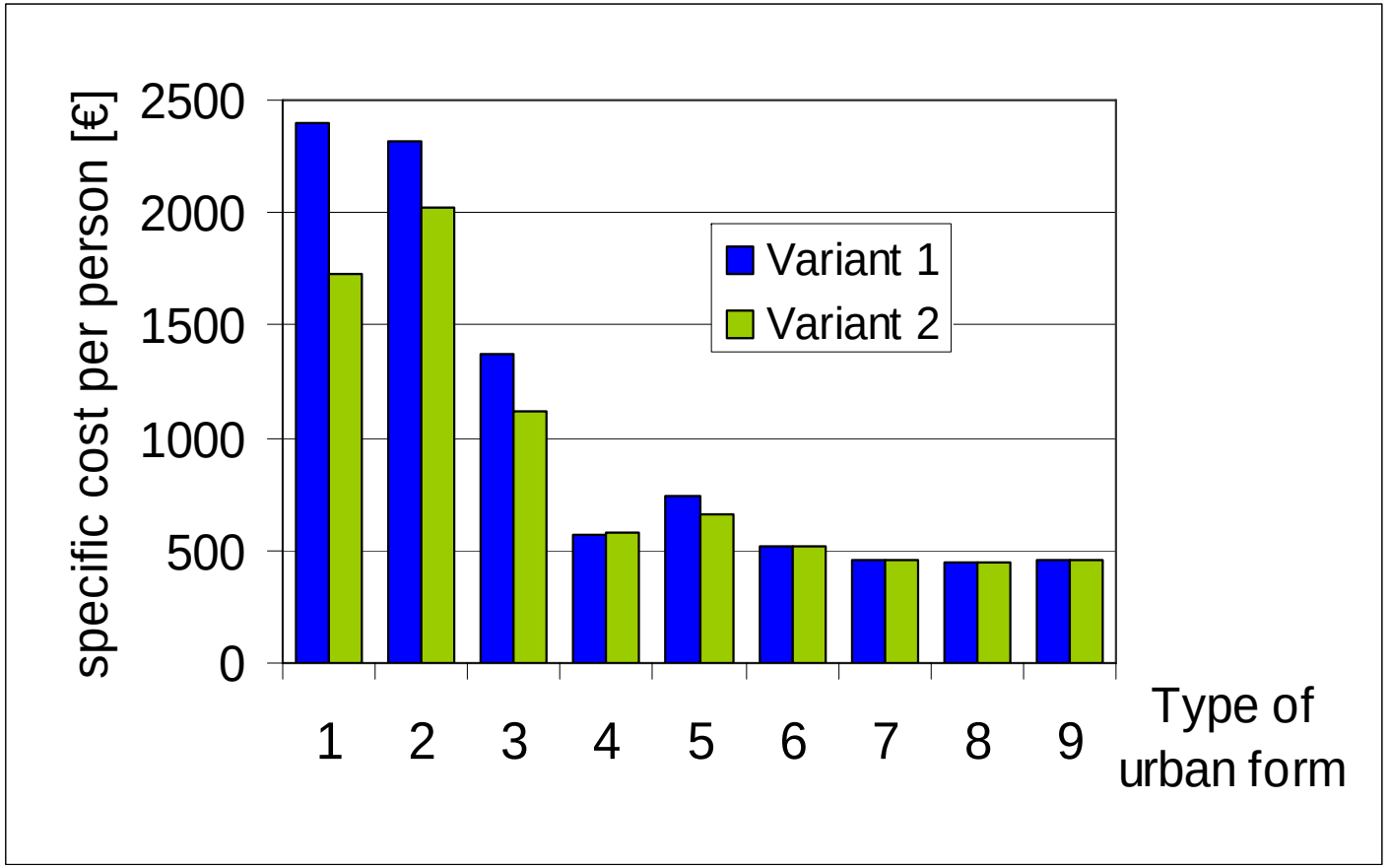
Type of urban form	System 1	System 2	System 3	System 4
1	+	+	+	+
2	+	+	+	o
3	+	+	+	o
4	+	+	+	-
5	+	o	+	o
6	+	o	+	o
7	+	-	+	o
8	+	-	+	o
9	+	-	+	+

Rating: + suitable
- not suitable
o limited suitability due to available space or height of buildings

Analysis of urine-diversion system

- Cost assessment of installation of urine-diverting toilets, pipes and collection tanks for nine reference neighbourhoods
- Characteristics of the neighbourhoods have impact on:
  - » Pipe length
  - » Number of toilets
  - » Number of storage containers
- Two options:
  1) Shared urine storage containers
  2) One container per house

Cost comparison – investment for urine diversion



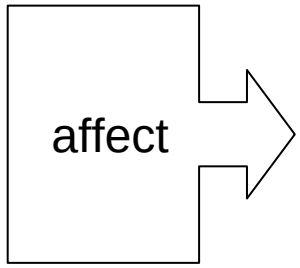
Higher density and appartment buildings decrease investment costs

Individual containers (variant 2) more cost-efficient, but logistics not considered

Parameters affecting planning and implementation

- Physical aspects
  - » Population density
  - » Housing layout
  - » Ratio of built area and open space
  - » Number of storeys

- Socio-economic aspects
  - » household size
    age distribution
    employment rates
    cultural practices



time spent at home
use of water
pollution loads
etc.

  - » Acceptance and awareness raising

Conclusions

- The development of a typology and the identification of important factors highlights restricting factors as well as potentials for greater benefit-cost ratios
- Integrated planning involving urban planners and sanitation experts is required
- More experience with regard to retrofitting existing buildings with source-separating systems should be gained
- In practice: urban (re)development projects as entry point for new sanitation concepts
- Future studies: logistical aspects and integration into existing (urban wastewater) systems

Thank you for your attention!

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