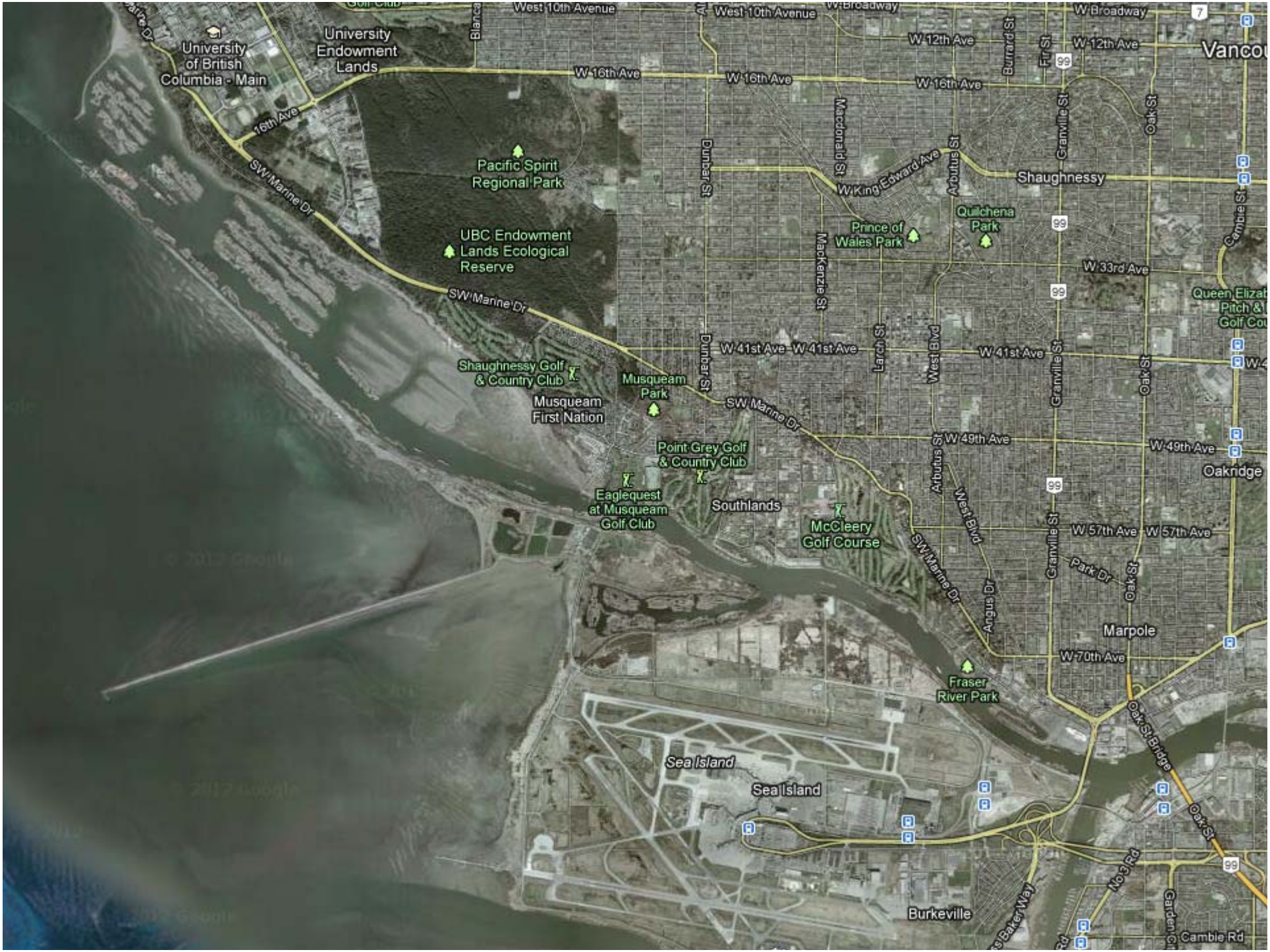
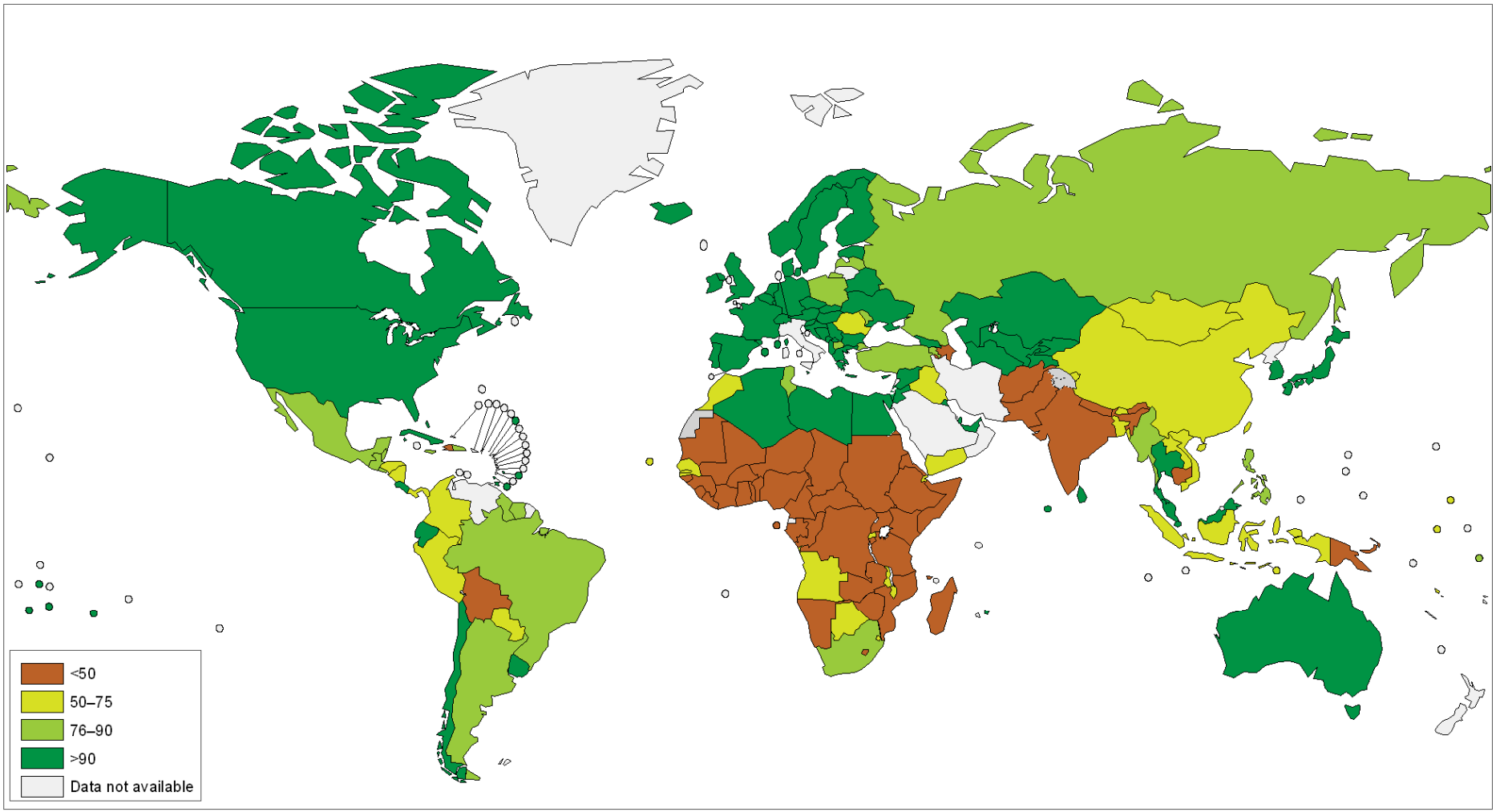
RETHINKING WASTE WATER MANAGEMENT

Exploring applications of artificial intelligence to support decision-making


University of British Columbia - Main
University Endowment Lands
West 10th Avenue
W 16th Ave
16th Ave
SW Marine Dr
Pacific Spirit Regional Park
UBC Endowment Lands Ecological Reserve
Shaughnessy Golf & Country Club
Musqueam First Nation
Musqueam Park
Point Grey Golf & Country Club
Eaglequest at Musqueam Golf Club
Southlands
McCleery Golf Course
Dunbar St
Macdonald St
Arbutus St
Granville St
Oak St
W 12th Ave
W Broadway
Burrard St
W King Edward Ave
Shaughnessy
Quilchena Park
Prince of Wales Park
MacKenzie St
W 33rd Ave
W 41st Ave
Larch St
West Blvd
W 49th Ave
Oakridge
W 57th Ave
Park Dr
Angus Dr
Marpole
W 70th Ave
Fraser River Park
Oak St Bridge
Sea Island
Sea Island
Burkeville
No 3 Rd
Cambie Rd
Garden City Rd
Baker Way

Proportion of population using improved sanitation facilities (%), 2008



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Data Source: World Health Organization
Map Production: Public Health Information and Geographic Information Systems (GIS)
World Health Organization

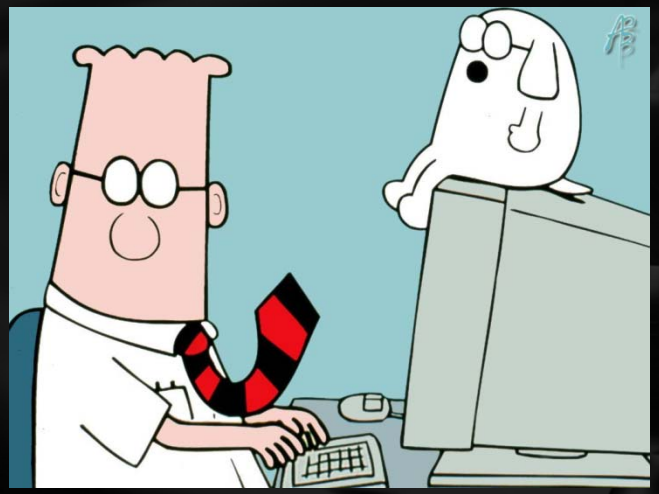
World Health Organization

Assumptions

- Healthy water supply and pollution management requires WW management
- Many WW treatment systems coming to end-of-life
- Developing areas dealing with social and environmental problems
- Conventional methods provide partial solutions

Big-Picture Questions

- What is an ideal WW system?
  - How do we find it?
  - How do we choose it?



Enter Sustainability

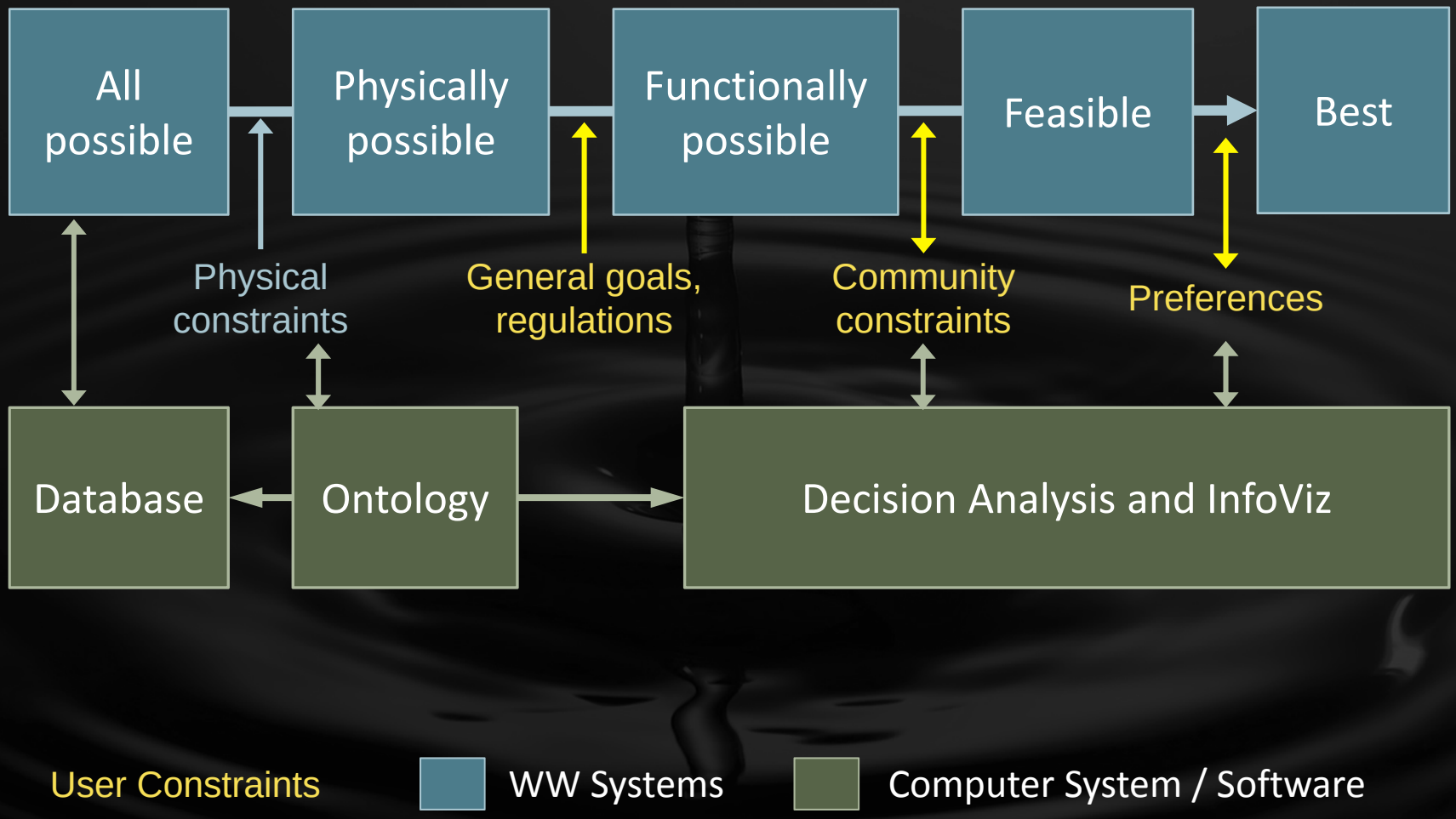
- Conventional systems may not consider full range of economic, environmental and social impacts
- New approaches/designs are sustainability-oriented and balance the three

Proposed Approach

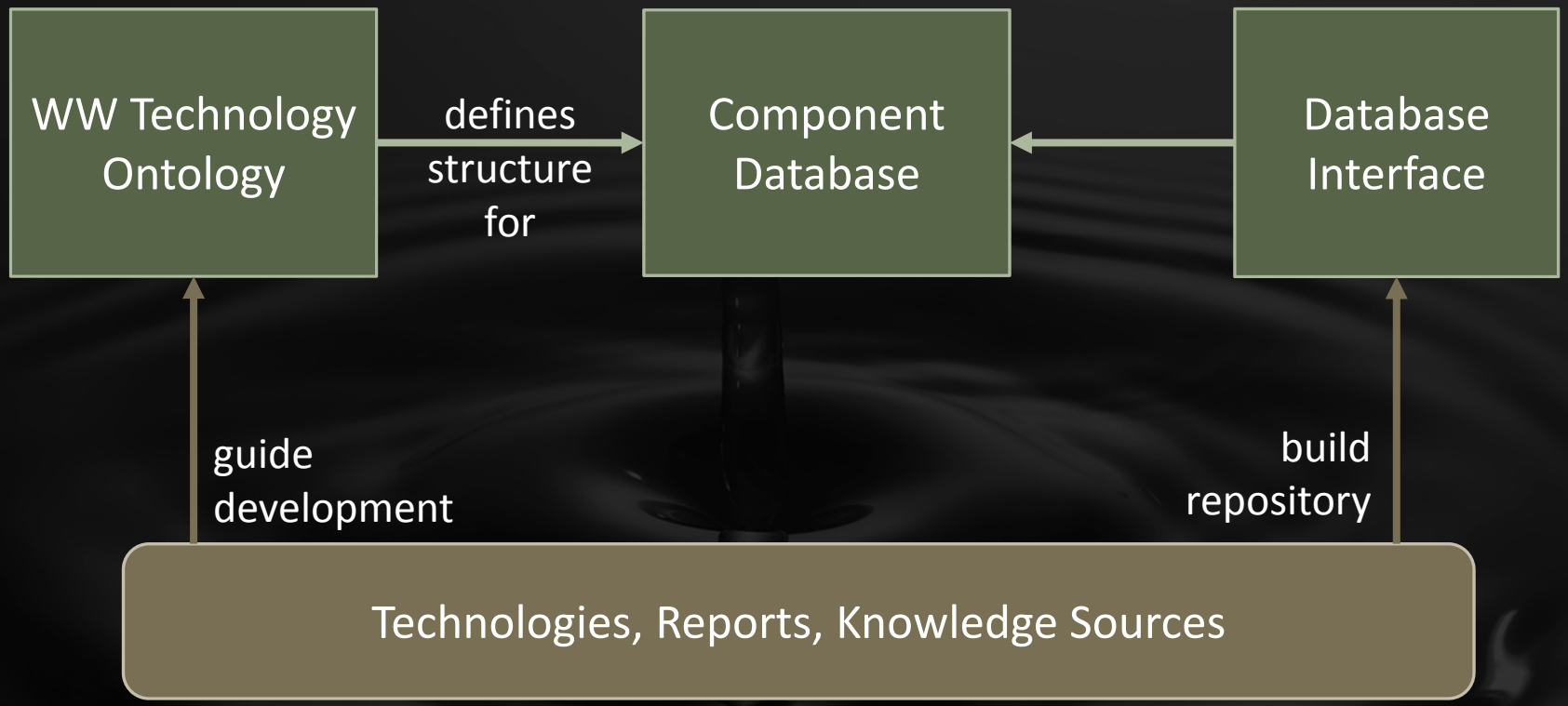
- Develop decision-support and analysis system to aid planners and decision-makers in selecting sustainable a WW system

- Three components:
  - Ontology and database
  - Automated creation of functional alternatives
  - Learn preferences/constraints and compare alternatives

Decision Support System

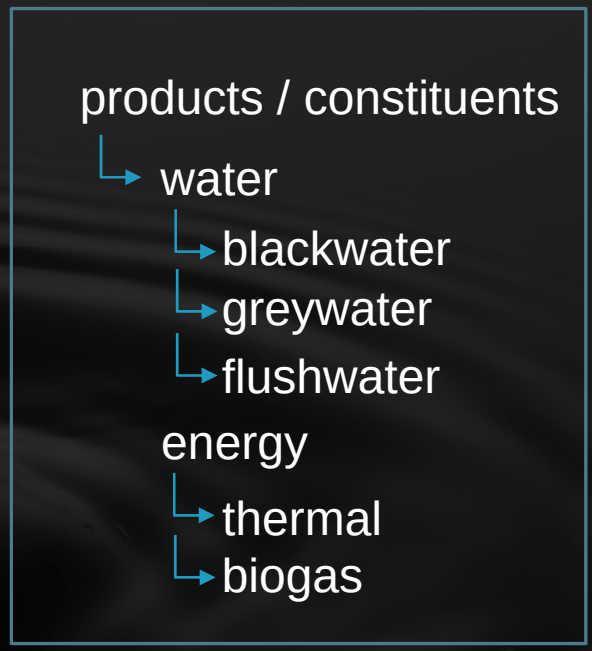


Ontology and Database

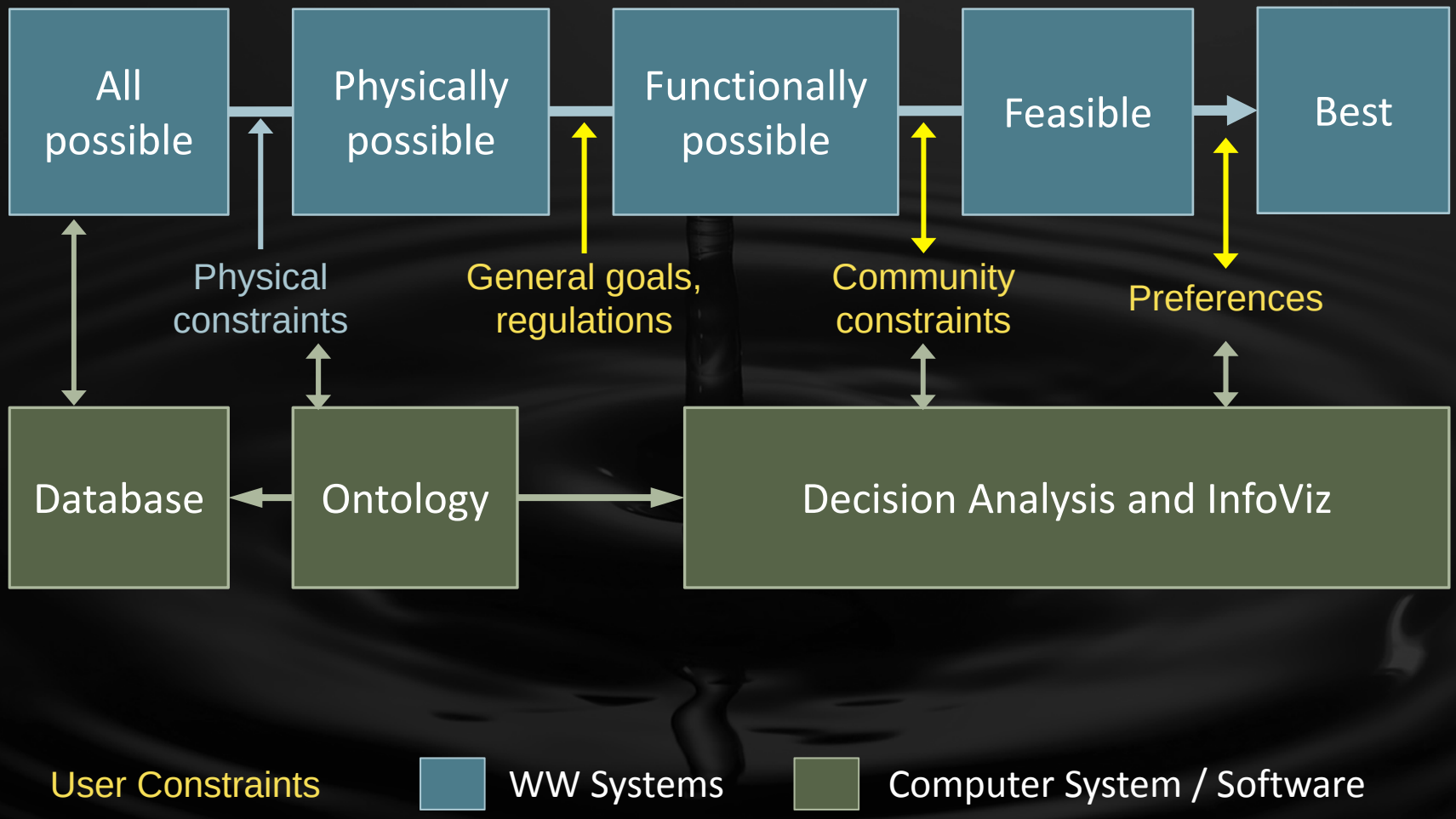


WW Technology Ontology

- Defines knowledge relevant to field of waste water
- Knowledge represented by
  - Concept: biogas
  - Relationship: anaerobic digestion *produces* biogas
  - Instance: Company XYZ's anaerobic digester

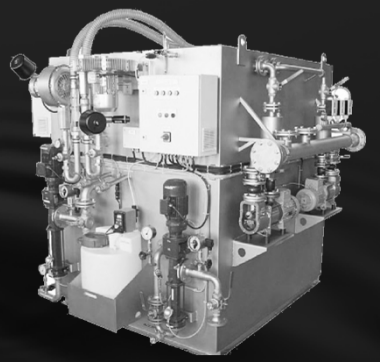


Decision Support System



Database of WW Components

$A = \{a_1, \ldots, a_n\}$ $B = \{b_1, \ldots, b_n\}$ $C = \{c_1, \ldots, c_n\}$



Possible Combinations

Theoretically Possible

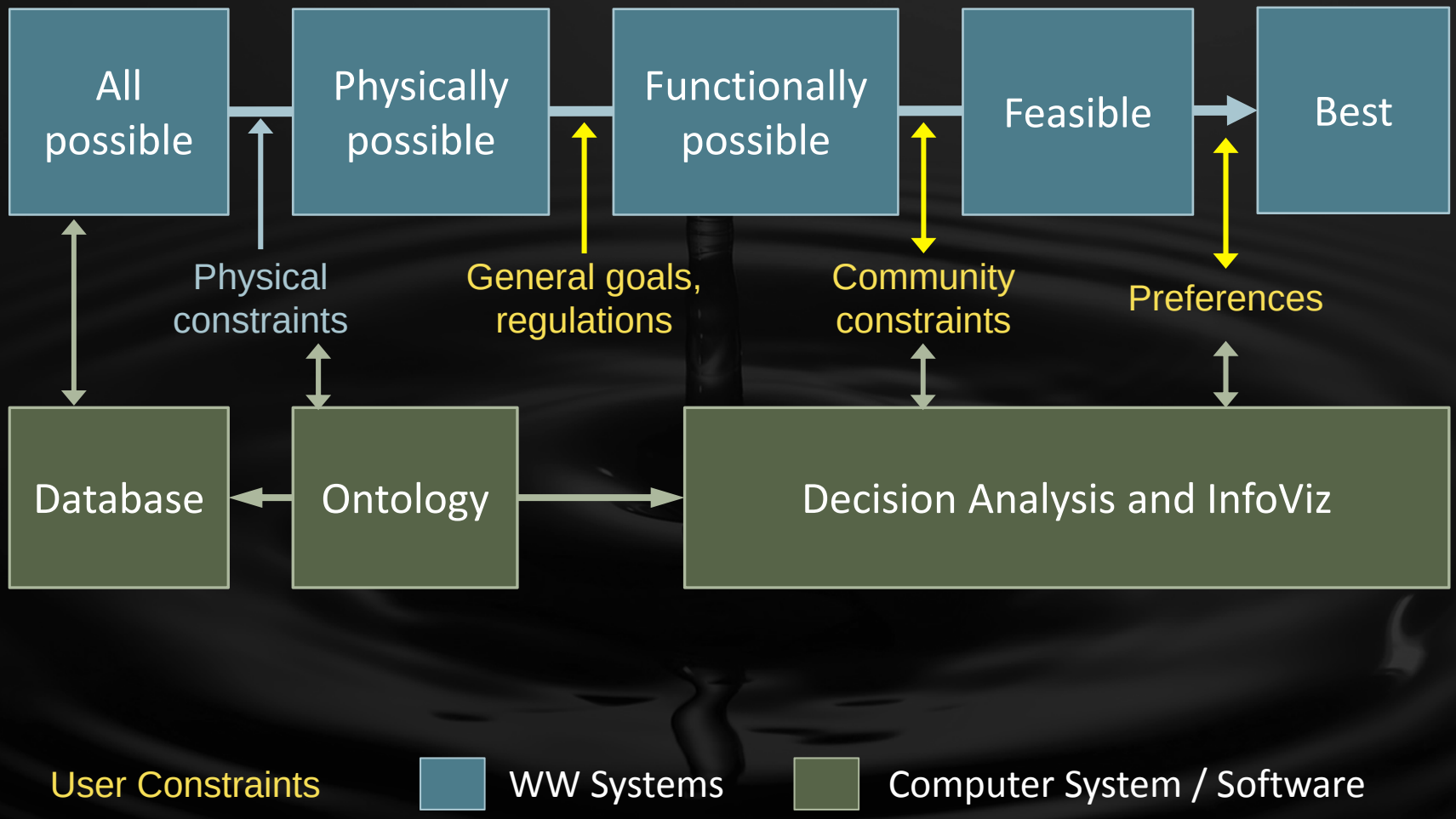
= {A, B, C}; where A, B or C could be null

Physically Possible

= {A, B, C}; where A, B or C could be null, and
{A, B, C} is actually possible

a_1 b_1 c_1 c_2

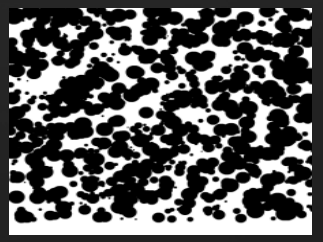
Decision Support System



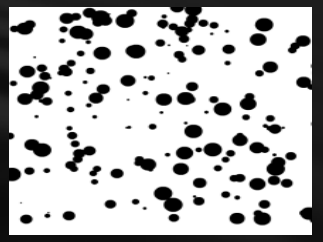
User Constraints

- General goals & regulations
  - Environmental standard
  - Cultural norms
- Community Constraints
  - Financial capacity
  - Space available
  - Capacity needs
- Preferences
  - Centralized / Decentralized
  - Resource recovery (nutrients, energy)

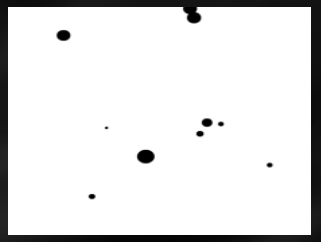
All Functional



Feasible



Best



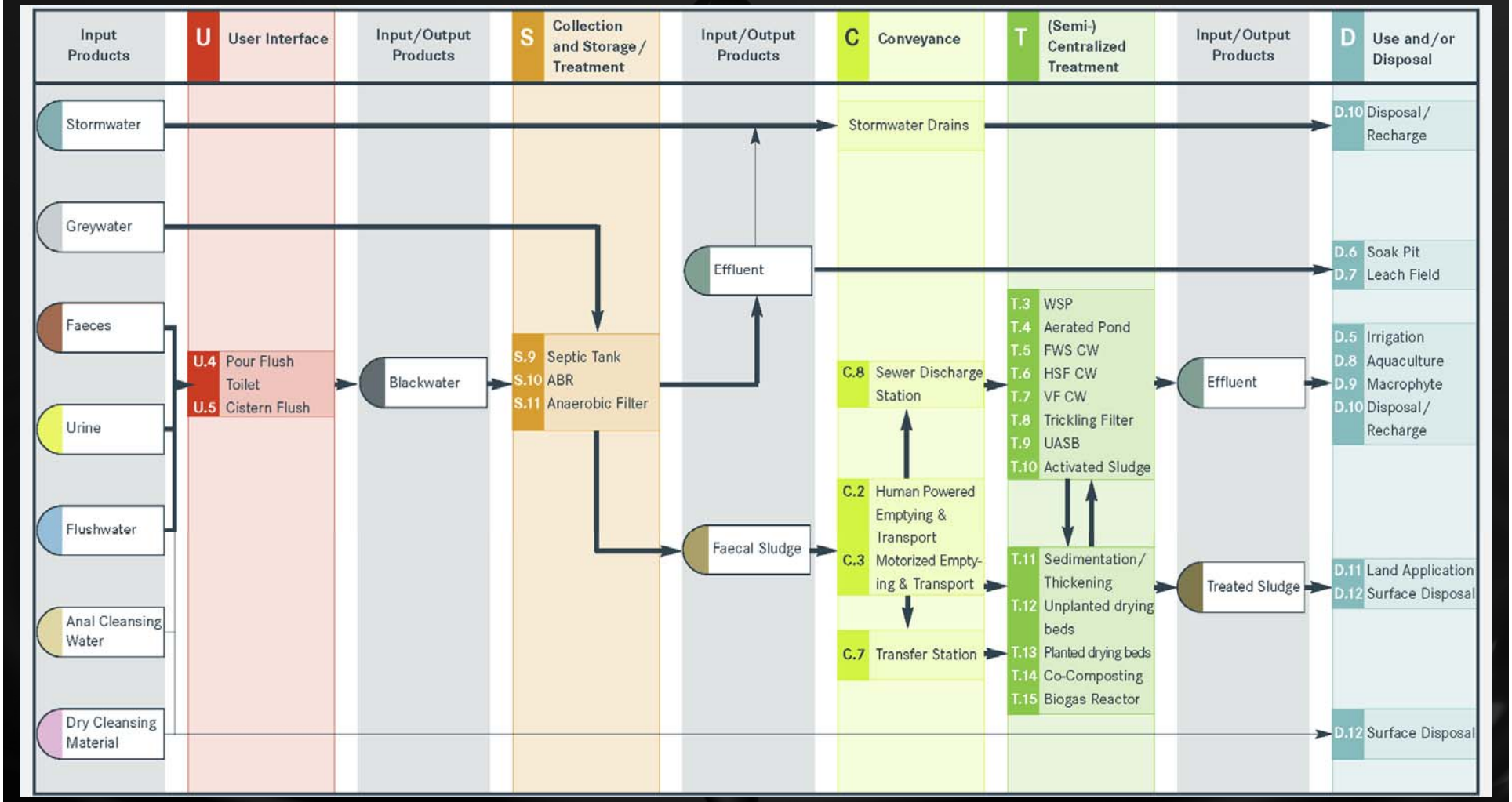
Domain-Specific Questions

- How can computational methods improve decision-making?
- What applications of Artificial Intelligence techniques could improve decision-making process?

Task

- Choose one of three components of DSS and develop method/idea for using AI to aid in decision-making process. Components:
  - Ontology and database
  - Automated creation of functional alternatives
  - Learn preferences/constraints and compare alternatives
- Use Compendium to aid in the process

Compendium: System 5



Compendium of Sanitation in Developing Countries, Eawag: Swiss Federal Institute of Aquatic Science and Technology

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Compendium of Sanitation in Developing Countries
http://www.eawag.ch/forschung/sandec/publikationen/compendium_e/index_EN