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NEXUS

# Integrated Resource Management in Asian Cities:

# the Urban NEXUS

*Joint Brown Bag Seminar – Urban and Water CoPs*
*Manila, October 2014*

## Participating countries:

- **China**
- **Indonesia**
- **Mongolia**
- **Philippines**
- **Thailand**
- **Vietnam**

## Participating cities:

- Ba‘nan, 920.000
- Rizaho, 2.880.000
- Weifang, 9.000.000
- Pekanbaru 1.000.000
- Tanjungpinang 230.000
- Ulaanbaatar, 1.200.000
- Naga City, 180.000
- Santa Rosa, 330.000
- Chiang Mai, 150.000
- Korat, 180.000
- Da Nang, 900.000

# Integrated Resource Management in Asian Cities: the urban Nexus (water, energy, food/land use)

- Time frame: 2013 - 2015
- Political Partner: UN ESCAP (Bangkok, Thailand)
- Implementation Partner: ICLEI Southeast Asia Secretariat (SEAS)
- Financed by BMZ (German Federal Ministry for Economic Cooperation & Development)

## Approach:

- Introduction of innovative engineering technologies in the area of waste water and solid waste management, generation of energy, link to (urban) agriculture, EE in/of buildings
- Holistic/integrated urban planning/breaking open of „silo“ thinking (creation of Nexus Task Forces in cities)
- Multi level approach (micro, meso, macro, supraregional)
- Private sector, civil sector, state/communal
- Grounded/concrete demonstration projects/PFS/FS/scaling up

# NEXUS Organisational Structure

**Supra-regional Level**
ASEAN, CDIA, CITYNET, Donors

**National Level**
Mongolia:
Ministry of Environment & Green Development
Ministry of Energy
Ministry of Construction & Urban Development
Philippines:
Department of Environment & National Resources
Department of Energy
Department of Public Works & Highways
Thailand:
Ministry of Natural Resources & Environment
China:
Ministry of Housing, Urban - Rural Development
Indonesia:
Ministry of National Development & Planning
Vietnam:
Ministry of Natural Resources & Environment
Ministry of Construction

**National meso Level**
Associations of Municipalities, Utilities, Training Inst.

**BMZ**
Finance/political directives

**UN ESCAP**
Political Partner

**GIZ NEXUS**

**ICLEI-SEAS**
Implementation Partner

| Rizhao NEXUS Taskforce | Weifang NEXUS Taskforce | Ba'nan NEXUS Taskforce | Ulaanbaatar NEXUS Taskforce | Pekanbaru Tanjungpinan | Santa Rosa NEXUS Taskforce | Naga City NEXUS Taskforce | Da Nang NEXUS Taskforce | Korat NEXUS Taskforce | Chiang Mai NEXUS Taskforce |
|---|---|---|---|---|---|---|---|---|---|
| Industrial waste water treatment ("Asia Symbol") | Eco City Binhaie | Erosion Landslides | Thermo-technical rehabilitation | Waste water management | Vacuum waste water collection | Waste water management | Vacuum waste water collection | Waste water management | Waste water management |
| | | Waste water management | Vacuum waste water collection | Solid waste management | Urban agriculture | Energy efficient LCH | Waste water management | Solid waste management | |
| | | | Waste water to energy | Re-development of water front cities | Energy efficient LCH | | Urban agriculture | Energy efficient pumps | |

# Sustainable waste water solutions

*Vacuum sewer collection system*

Source: RoeVac® Vacuum Sewer Systems

## Why Vacuum Sewerage Systems?

- Vacuum sewerage systems are reducing the impact on the environment and have the lowest carbon footprint of any municipal sewerage system;

- Vacuum sewerage systems are collecting waste-water by vacuum means, thereby minimizing:

    - Risks to the Environment
    - Odour
    - Diseases
    - Contamination
    - Energy Use
    - Water Use

# Sustainable waste water solutions

*Vacuum sewer collection system*

Source: RoeVac® Vacuum Sewer Systems

Vacuum sewer system

Gravity sewer system

**Advantages of vacuum systems for investors and operators:**

- Lightweight small diam. sewer pipes, ease of installation;
- Shallow and small trenches;
- No manholes, no lift stations;
- Only one central vacuum station instead of many lift stations;
- Speed of construction is greatly increased;
- Greatly reduced construction costs;
- Flexible pipeline construction;
- Easy to lay pipelines around obstacles

# Vacuum Sewer System

*for 110 households in the eastern costal area of Da Nang City*

Equipment

## Collection chambers 30
## ROEVAC® G50 (average 4 households per collection chamber)

- Flexible installation depths
- Every collection chamber is individually adjusted to the depth of the gravity sewer pipe
- Separation between sewage water and valve chamber
- No flooding of controller and valve monitoring unit possible
- Vacuum valve unit remains always clean and hygienic
- Max. 5 gravity pipe connections possible
- Only one vent pipe necessary in case of multiple connections

Bottle neck

- Constructional element which limits the size of solid pieces entering the system
- Smallest diameter of the entire system

# Vacuum Sewer System

*for 110 households in the eastern costal area of Da Nang City*

European Standard (EN 1091) to prevent clogging

According to EN 1091 the following resistance to blockage test is performed 5 times to show what foreign matter‘s size and material range can be disposed in the vacuum system without causing blockages.

The following foreign matter shall be placed in the collection sump, piece by piece over 10 cycles, in random order:

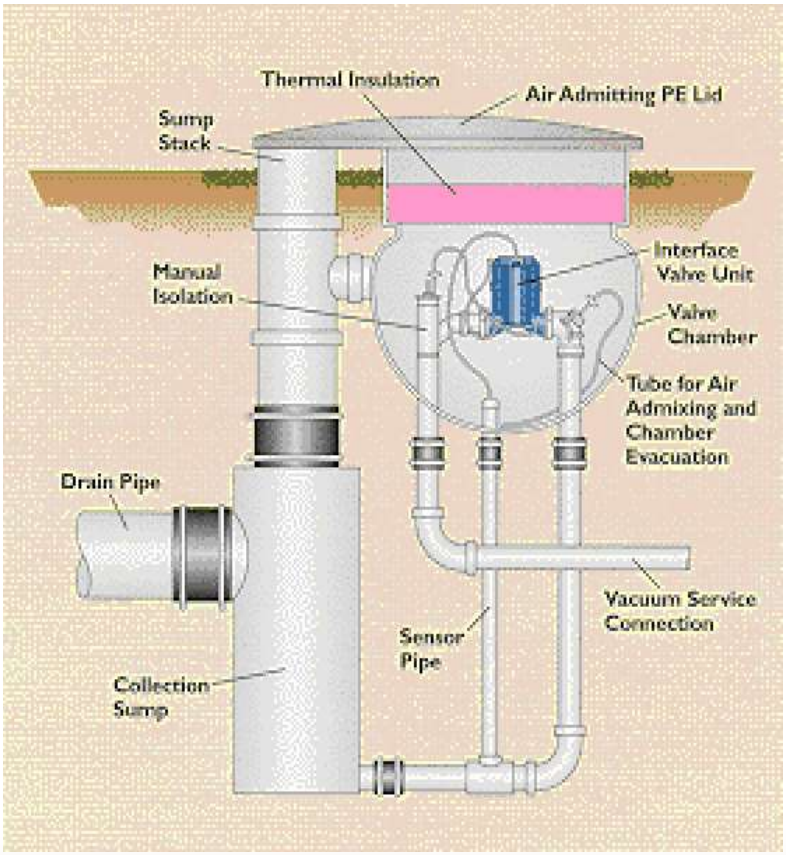
- Cotton handkerchiefs: (400 ± 35) mm x (400 ± 35) mm; (15 ± 5) g 2 pieces
- Plastic bag: (300 ± 30) mm x (270 ± 20) mm 1 piece
- Plastic bag: (200 ± 20) mm x (150 ± 15) mm 1 piece
- Metallic crown corks: nominal diameter 25 mm 2 pieces
- Male condom: 2 pieces
- Sanitary towels: by dry weight (40 ± 10) g (number to suit)
- Disposable baby‘s nappy: complete with water- proof backing, 1 piece by dry weight 45 g

All absorbent material shall be submerged in water for not less than 1 min or more than 3 min before being placed in the sump.

# Sustainable waste water solutions

*Vacuum sewerage system – outdoor solution*

## Functional Description



# Sustainable waste water solutions

*Vacuum sewerage system - outdoor solution*

## What does it cost ?

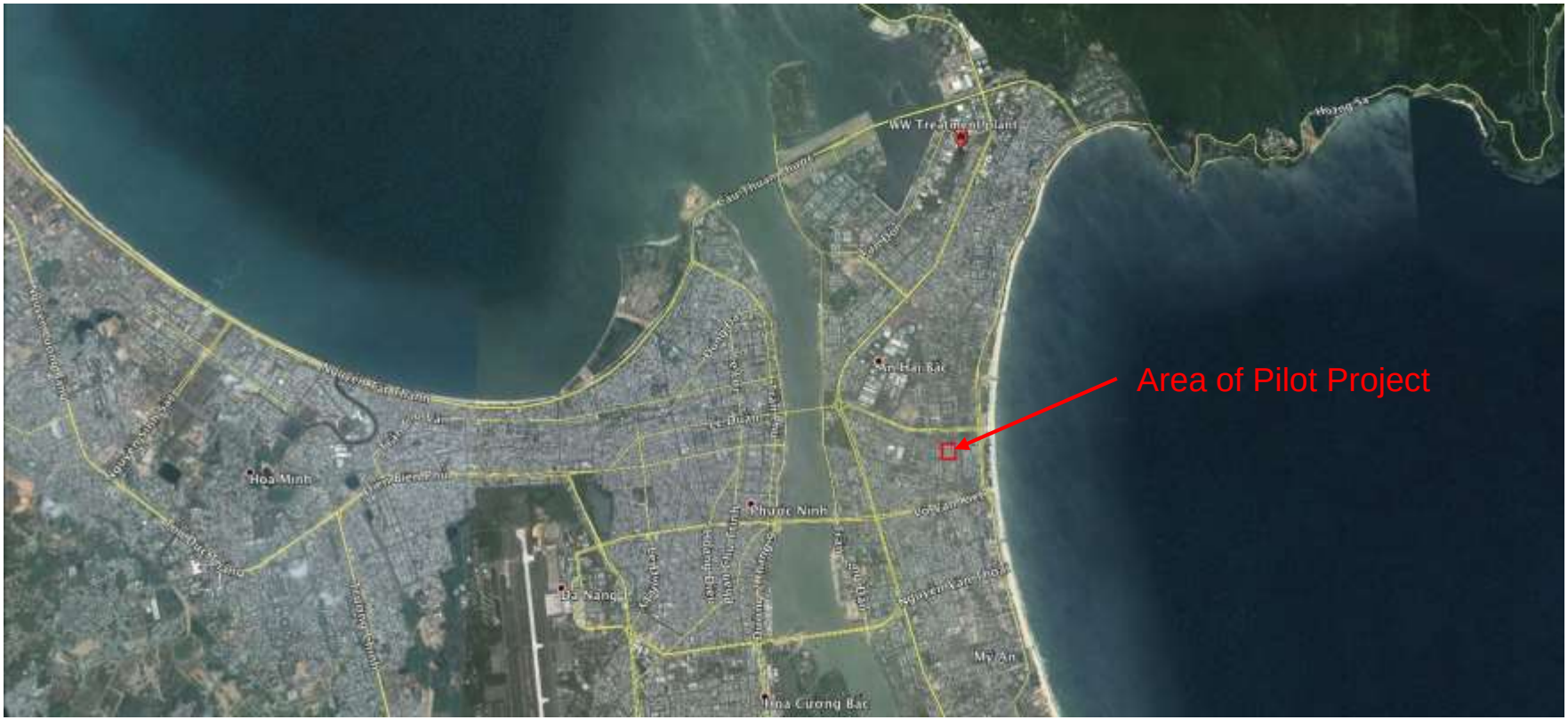
- Costs vary depending of network size and project specifications;
- The cost saving factor is the network itself, so a minimum project size is required to be competitive;
- Vacuum sewer systems can achieve up to 25 - 40% cost savings compared to gravity sewer systems, considering all aspects of construction;

## Again !

- Vacuum sewerage systems do not require manholes;
- Trenching is limited to average depth of 0.9 - 1.2 m;
- No interim pumping station for large networks in flat terrain;
- Central Vacuum Station and Odour Control;

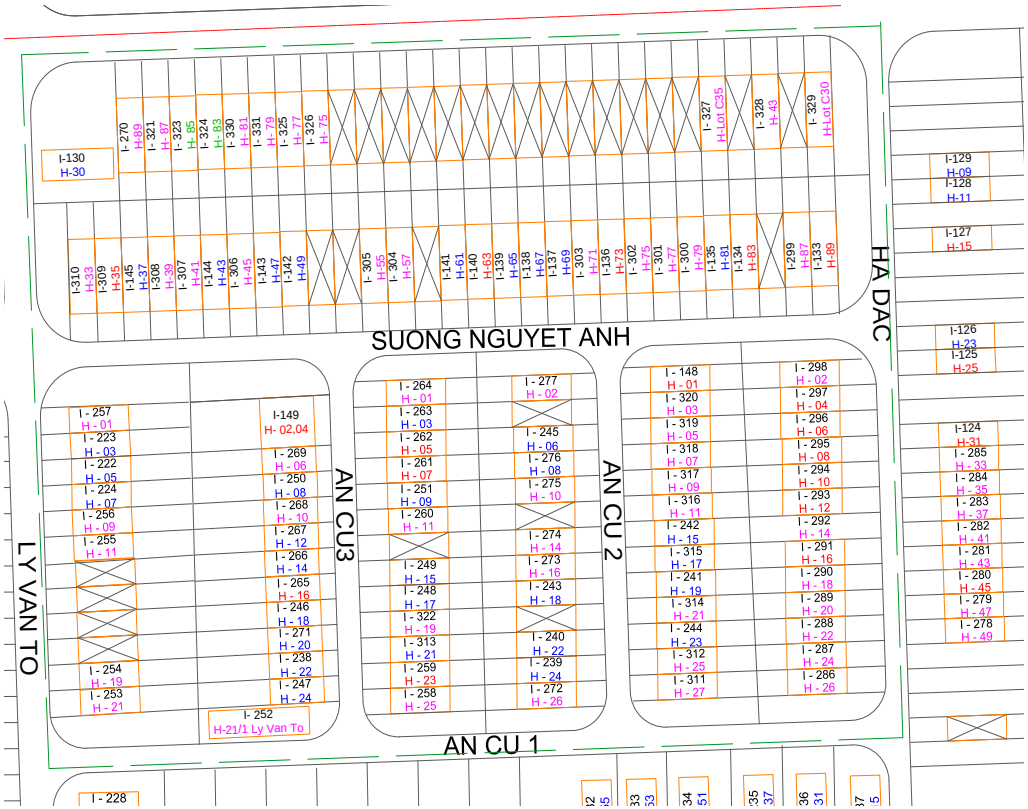
# Vacuum Sewer System

*for 110 households in the eastern costal area of Da Nang City*



# Vacuum Sewer System

*for 110 households in the eastern costal area of Da Nang City*




The data for designing the vacuum sewer system:

- Daily waste water: 160l/PE/day
- Peak factor: 3
- Number of plots: 110
- Persons per plot: 4
- Persons (PE) total: 440
- Design peak flow: 2,44l/s

# Vacuum Sewer System

*for 110 households in the eastern costal area of Da Nang City*

The drainage channel is under the walkway between the houses.

The vacuum sewer system will be installed here after.

# Sustainable waste water solutions

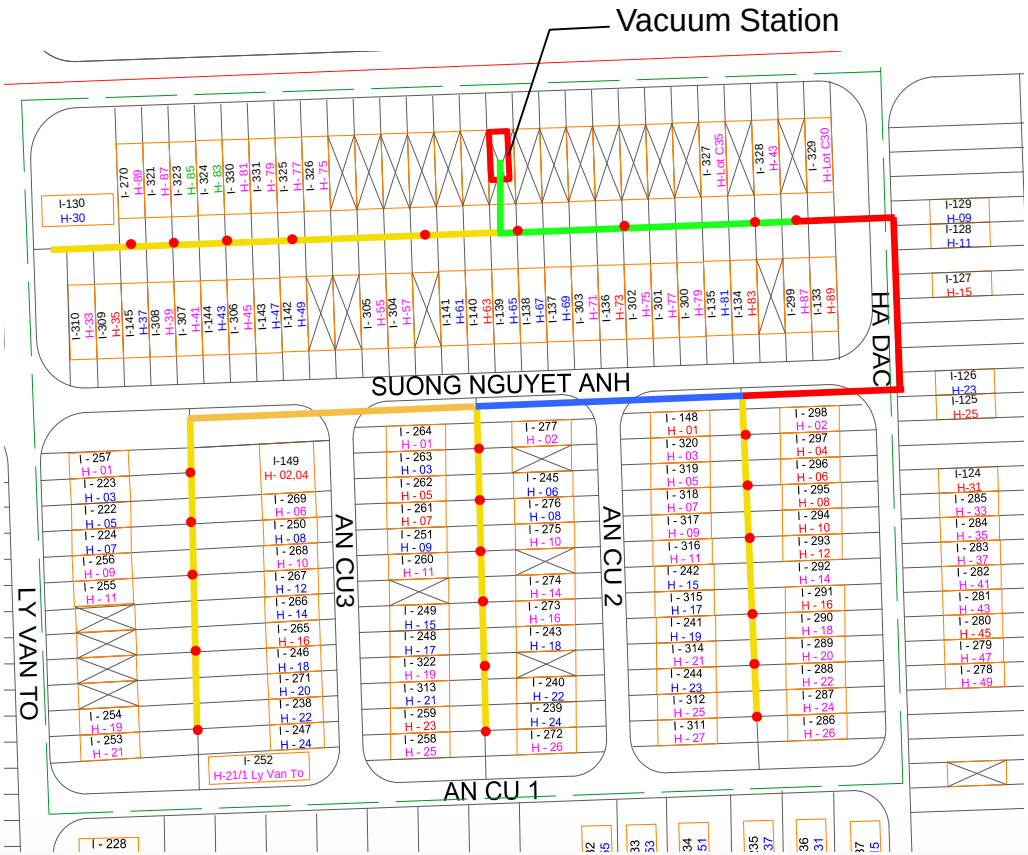
*Da Nang, Vietnam, vacuum waste water collection*

Sewer pipes

# Vacuum Sewer System

*for 110 households in the eastern costal area of Da Nang City*

## Vacuum pipe network




High-density polyethylene pipes

HDPE (PN 10, SDR 11)

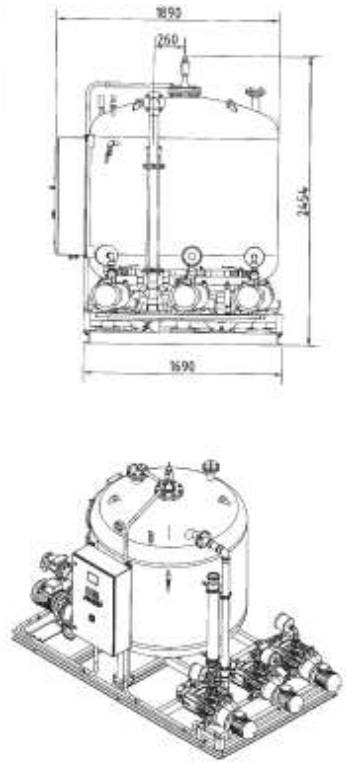
| | | |
|---|---|---|
| ∅ 90mm | 250m |
| ∅ 90mm | 50m |
| ∅ 110mm | 30m |
| ∅ 125mm | 50m |
| ∅ 140mm | 100m |

- Collection chambers 30 ROEVAC® G50 (average 4 households per collection chamber)

# Vacuum Sewer System

*for 110 households in the eastern costal area of Da Nang City*

Vacuum Station




## Compact Station 360

- 3 vacuum pumps 3,5 kW
- 2 discharge pumps 4 kW
- 1 vacuum vessel 3m$^3$, ∅ 2m
- Electrical control panel,

  (VDE German Standard)

# Vacuum versus Gravity Sewer System

*for 110 households in the eastern costal area of Da Nang City*

| INVESTMENT COST OF VACUUM SEWER SYSTEM versus GRAVITY SEWER SYSTEM | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Vacuum sewer system** | | | | | **Gravity sewer system** | | | |
| **No.** | **Items** | **Description** | **Unit** | **Amount U$** | **Items** | **Description** | **Unit** | **Amount U$** |
| 1.1 | Connection pipe from house to collection chambers | Using pipe uPVC Þ49, 60, 114 with total length is about 10m (based on GIZ calculation on exactly 78 households) | 110 houses | 35.631,67 | Connection pipe from house to manhole | Pipe connection to front of the house;<br>Using pipe uPVC Þ60, 90, 114 with average length using for one house is 51m | 110 houses | 113.419,90 |
| 1.2 | Construction cost of vacuum sewer system | Using 30 collection chambers type RoVac ® G50 along the network;<br>Using one vacuum station to pump wastewater to SPS2<br>Total length of vacuum network is 735 m; (using HDPE D90, 110, 125, 140)<br>Using 580m pressure pipe HDPE D90 to pump wastewater from VS to SPS2 | system | 42.488,84 | Construction cost of gravity sewer system | Using 48 manhole along the network;<br>Using 9 lift stations<br>Total length of gravity network is 890 m; (using HDPE D200, HDPED300, HDPED400) with 2.5%gravity slope<br>Total pressure pipe to transfer wastewater from lift station 9 to SPS2 is 600m; (using HDPE D90) | system | 193.304,54 |
| 1.3 | Equipment cost of vacuum sewer system | Using one vacuum station (incl. 3 vacuum pumps 3,5kW, 2 discharge pumps 4,0kW, 1 vessel 3m3) | system | 153.187,12 | Equipment cost of gravity sewer system | Using 9 trash screening 0,5x0,5x1,5m<br>Using 18 submerge pump 4kw | system | 127.224,06 |
| **TOTAL** (***before Tax, without overhead / indirect costs and profit***) | | | | **292.949,00** | | | | **549,591** |

# Vacuum Sewer System

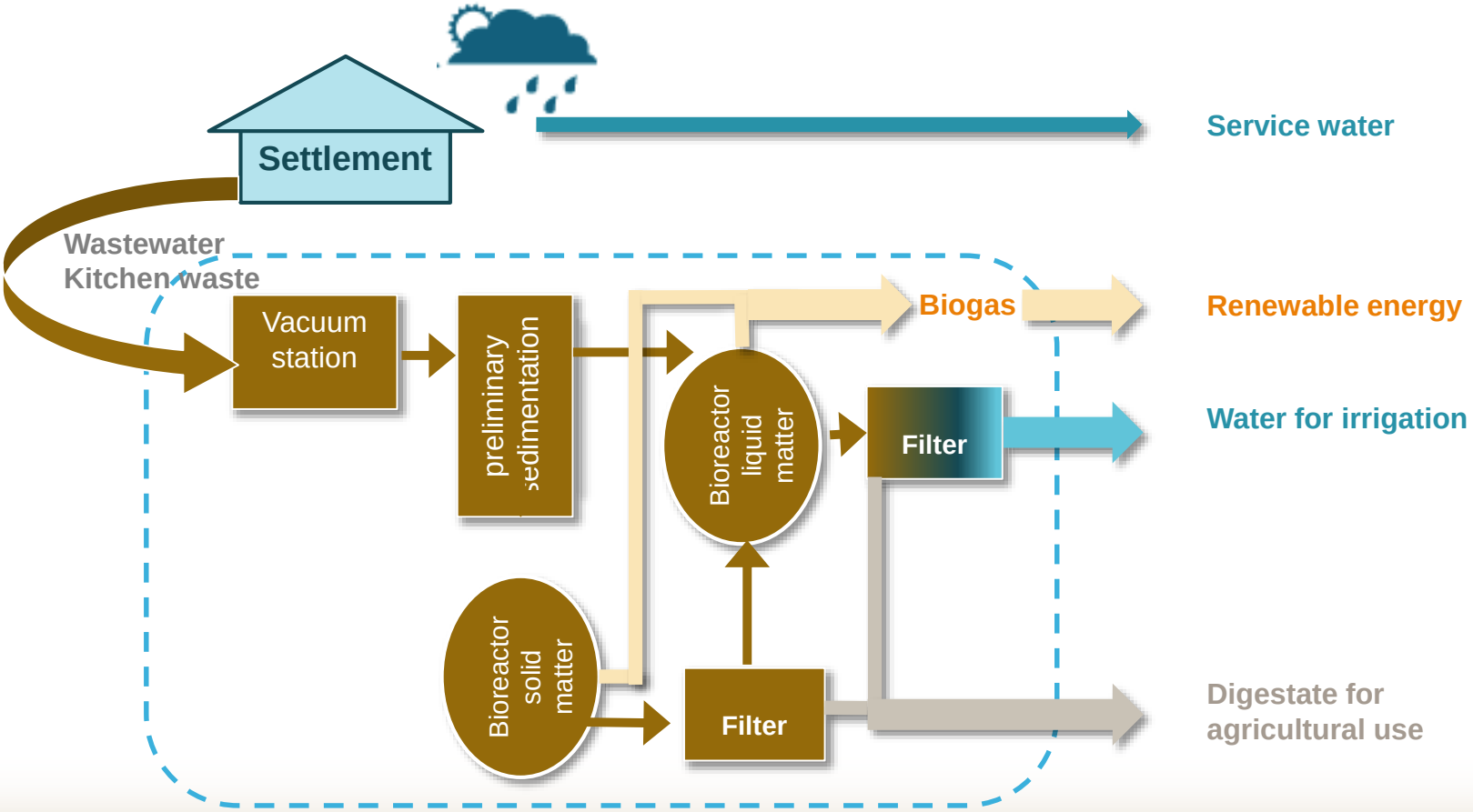
*for 110 households in the eastern costal area of Da Nang City*

## Annual Operation and Maintenance Costs

| Operation and maintenance costs per year<br>VACUUM SEWER SYSTEM versus GRAVITY SEWER SYSTEM | | |
|---|---|---|
| **Labour** | · Annual check of collection chambers;<br>· Regular check of vacuum station<br>· Optional air treatment only at vacuum station (biofilter) | · Regular check of manholes<br>· Pipeline inspection, CCTV inspections<br>· Cleaning accumulated sludge, slime and debris (jetting with high-pressure) |
| **Repair/ Replacement** | · Oil and filters to vacuum pumps<br>· Valve parts (few pieces, membranes) | · Oil discharge pumps and lifting stations<br>· Manhole / sewer rehabilitation |
| **Energy consumption** | · Only energy consumption at vacuum station;<br>· Using one electrical station. | · Energy consumption at pumping station;<br>· At each pumping station there must be operation power and standby power. |
| **Maintenance** | · Vacuum sewer mains are self-cleaning due to high velocity | · H2S (hydrogen sulphide) deodorization<br>· Flushing the pipe network |
| **Wastewater treatment** | · Only wastewater<br>· Better aerated waste water<br>· Closed system – handles only wastewater of the community (no infiltration) | · Handle big amount of infiltrated ground water<br>· Handle aged and possibly septic wastewater<br>· Handle wastewater from suspicious sources<br>· Exfiltration risk |
| **Operation & Maintenance costs** | **6,611.45 U$/year** | **24,155.30 U$/year** |

# Sustainable waste water solutions

*Vacuum sewerage system – biogas production*



# Sustainable waste water solutions

*Vacuum sewerage system – urban agriculture*

Vegetables fertilized by the digested black water,
Chentang Village, in Chengdu City, Jiangsu Province of China

- Irrigation of agriculturally used areas
- No further energy intensive treatment necessary
- Nitrogen and phosphate remain in the irrigation water as fertiliser

Urban agriculture in Da Nang, Vietnam

# Sustainable waste water solutions

*Vacuum sewerage system – soil production*

- The remaining sludge after the anaerobic treatment is not contaminated with heavy metal
- The sludge can be used directly for agricultural purposes
- The sludge can be dewatered and grated up to top soil fertiliser

Conditioning of sludge after digestion

Implemented by

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