Objectives of this assessment

• As the Omni Processor (OP) technology portfolio matures, technology partners and others continue to gain increased clarity about the technical capabilities of different OP options. This study represents a critical opportunity to complement that technical understanding with additional market insight in target geographies such as India to help guide further product development as well as inform and derisk market entry for commercial partners.

• In particular, there is value in understanding more deeply the needs of target cities in India and the ability of OP-based fecal sludge management (FSM) systems to competitively serve those needs relative to “incumbent” solutions, including sewer-based (SB) systems. This study was designed to achieve that deeper understanding, namely by pursuing the following objectives:
  – Develop a comprehensive overview of the urban sanitation needs including mapping the decision makers and influencers within the ecosystem and segmenting the market utilizing relevant market characteristics (as defined, bottom-up, by market needs);
  – Identify and characterize urban areas in India with potential demand for septage / fecal sludge treatment;
  – Develop a deep understanding of the defined segments, particularly their unmet sanitation needs, to allow for a compare-and-contrast across segments. For each segment, the analysis estimates market size, presents a purchase pathway and identifies points of leverage within the system, and defines the technical requirements (including optimal size in terms of number of people served) an OP would need to meet to achieve a meaningful value proposition;
  – Propose value proposition hypotheses that may best resonate for the specific segments selected for deep-dive, including developing technical design and business model considerations that are benefits or barriers to product adoption;
  – Conduct OP portfolio analysis and provide recommendations for new products and/or features.

Please contact STeP at info@stepsforsanitation.org for more detail beyond this report on the Market Insights for the Omni-Processor in India
Executive summary

EXECUTIVE SUMMARY

CONTEXT

TESTING VALUE PROPOSITION

GO-TO-MARKET RECOMMENDATIONS
Executive summary (1 of 4)

Context and background

• The urban Indian Fecal Sludge and Septage Management (FSSM) market can be divided into nine segments with four key variables – population, topography, aridity and enabling ecosystem. Population is the most dominant variable, driving other important variables like access to finance. The segments are listed below.

<table>
<thead>
<tr>
<th>Segment</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprawling Megacity</td>
<td>Population above 8 million</td>
</tr>
<tr>
<td>Rising Metro</td>
<td>Population between 1 million and 8 million, and in states with a positive ecosystem</td>
</tr>
<tr>
<td>Unruly Survivor</td>
<td>Population between 1 million and 8 million, in states with poor ecosystem</td>
</tr>
<tr>
<td>Dry and Arid</td>
<td>Population between 0.1 million and 1 million, in dry areas</td>
</tr>
<tr>
<td>Steady Roller</td>
<td>Population between 0.1 million and 1 million, in non-dry areas</td>
</tr>
<tr>
<td>Hilly City</td>
<td>Population of more than 0.1 million, or AMRUT cities below 0.1 million and a hilly topography</td>
</tr>
<tr>
<td>Small and Meek</td>
<td>Population less than 0.1 million, with no special focus</td>
</tr>
<tr>
<td>Little Prodigy</td>
<td>Population less than 0.1 million, with a history of activities in FSM and/or located near a megacity</td>
</tr>
<tr>
<td>Institution</td>
<td>Residential and public institutional entities</td>
</tr>
</tbody>
</table>

• Along with STeP and BMGF, we have prioritized four segments based on size, diversity and lighthouse effect (i.e., capacity to influence other cities). The selected segments are Rising Metro, Steady Roller, Hilly City, and Small and Meek.

Value propositions: Ways of positioning the OP for various segments

• We have identified six key value propositions – based on segment-needs and characteristics of the OP. The value propositions are Integrated Waste Management, Low Land Requirement, High Quality Treatment, Energy Neutrality, Ease of Operations, and Saleable End Products.

• Four value propositions resonate most with the segments. Integrated Waste Management, Low Land Requirement, Ease of Operations and Energy Neutrality are valued most by segments. Compared to these, High Quality Treatment and Saleable End Products were not as important to the segments at present, although the market is constantly evolving.

Note: (1) Public Affairs Index (2017) below 0.45, except for Odisha and Meghalaya due to their focus on FSSM (2) Cities with lower than 700 mm average rainfall in a year (3) Elevation higher than 1000 m (4) Please refer to the annex slide with the assumptions for sizing segments
Executive summary (2 of 4)

Technical recommendations: Suggestions on product characteristics

- **Develop a 100 KLD OP to address the ‘missing middle’ problem.** The OP portfolio lacks a product in the range of 50-100 KLD, a capacity ideal for two key segments: Steady Roller and Hilly City. For instance, Shillong Municipal Corporation issued a tender for a 100 KLD FSTP. Most functioning and under-construction FSTPs lie in this size range. Re-sizing one of the merging OP systems to a 100 KLD capacity will help satisfy the present and future needs of these two segments.

- **Reconfigure the product to treat more MSW so as to position OP as a ‘single solution for a city’.** In many cities, especially medium sized ones, the same decision makers are responsible for FSM as well as MSW service provision and would value single solutions that take care of these both these waste streams. The OP will have to treat more MSW (in proportion to FS) to be a truly integrated offering. However, this is a medium term win as currently tenders are still separate for FS & MSW.

- **Enable adaptability to fluctuating solid content.** The ability to treat FS with varying solids will avoid rejections and simplify operations.

- **Consider process automation to make the OP portfolio a plug and play system or an “FSTP in a box”.** Although all segments value ease of operations, operational challenges are one of the main causes behind limited sustainability of sanitation treatment plants. The OP must explore ways of simplifying operations, to make it attractive for all segments.

Commercial recommendations: Suggestions on price, messaging, and business models

- **Evaluate capex and opex for the Omni-Processors as they begin to be available on the market.** Comparison of the economics of the different Omni-Processor systems coming to market will be possible in 2019-2020.

- **Tailor communications to emphasize attractive features as well as benefits over competition.** For instance, segments care more about liquids than solids – both of which the OP is capable of treating. The OP its must elevate messaging by emphasizing adequate treatment of separated black water. Similarly, the OP portfolio should seek to address misconceptions around pyrolysis vis-à-vis incineration. The OP should educate to dispel biases, especially around environmental impacts of pyrolysis.

- **Emphasize efficiency in land utilization to make capex attractive relative to competition.** The OP systems have one of the smallest land footprints per KLD of sludge treated. Including land costs within the capex, can help the OP become competitive relative to other solutions. Land-efficiency is most useful in segments with soaring prices – Rising Metro and Hilly City. Therefore, the OP should target cities where land availability is low and land prices are high, eliminating competition from land intensive solutions.

- **Target setting up of integrated business models across value chain.** Profits from the collection and transport part of the value chain can be used to fund FS treatment. For example, Shillong Municipal Corporation earns almost INR 600,000 (USD 9230) a month, with its desludging and transportation operation, which can help cross-subsidize operations of any Fecal Sludge Treatment Plant (FSTP). In addition, integrated models offer convenience via simplified contracting and increase accountability of the operator. Such value chain integration coupled with scheduled de-sludging is a key trend that the OP should leverage.
Executive summary (3 of 4)

Commercial recommendations (continued)

- Focus on financing mechanisms that rely on households for opex recovery (either through integrated fee across the value chain, or separate user levy/tax) to build sustainability. Currently, the most common financing archetype is capex by philanthropy or government, private operator and recovery using non-commercial sources. For a sustainable operating model, capex investment from private operators and opex recovery from households using commercial means should be considered.
- Focus on local sourcing, partner with manufacturers that have the ability to customize products, and facilitate collaboration with big manufacturers.
- Pursue bulk contracting for OPs, with different tender formats (integrated FS+MSW, separate tenders for O&M, and longer duration O&M) to facilitate selection of OP.

Ecosystem recommendations: Suggestions on interacting with different stakeholders

- Unlock available financing through improving allocation and its efficiency, using demonstration effect, and institutionalizing capability. Although financing required for FSM in India is ~5% of total sanitation funds, it needs to be unlocked by reallocations, establishing sustainability and using new financing mechanisms.
- Strengthen private sector engagement through incentivizing integrated models. Targeted efforts across the value chain, beyond treatment are crucial to strengthen private sector capacity and facilitate operations for OP. For example, measures should be taken for increasing private sector knowledge about septic tank quality standards (containment), promoting licensing of C&T operators (collection & transport), and incentivizing integrated business models.
- Draft an FSSM playbook and engage in other awareness and capacity building efforts for local governments (e.g. demonstrating successful use cases). Despite some enthusiasm for FSSM, city implementation will require extensive capacity building efforts to tackle low awareness and sub-optimal consumer behavior. Some efforts include drafting of an FSSM playbook, and targeted awareness campaigns for citizens.
- Advocate for binding regulations for disposal/treatment of FS and bio-solids, inclusive definition of FSTPs in the national policy, scheduled desludging, and binding regulations for septic tank construction. FSM is still nascent in India and regulations are not up to par with the current requirement. There is a need for standards and practices to be defined for FS solids and biosolids treatment, scheduled desludging, and construction of septic tanks.
  i. Regulations exist only for the liquid component of sewage and septage. Hence there is a need to advocate for stringent regulation for treatment of biosolids from STPs as well as FS solids.
  ii. Given that there are no regulations for scheduled desludging, advocacy for policy action and awareness at the household level is needed.
  iii. Although norms for construction of septic tanks have been codified by the Bureau of Indian Standards, building by-laws don’t have these standards. Advocacy is needed to tie the septic tank standards to NOC for new buildings, as well as to include norms in building by-laws.
Executive summary (4 of 4)

Market entry pathways: Way forward once technology is proven

- Six dimensions are relevant while evaluating the relative effectiveness of market entry modes. These are transaction cost efficiency, resource needs, control possible, context advantage, risk management, and competitive advantage.

- Considering a licensing and distribution alliance market entry model, there are four entry pathways for OP:
  1. Enter into distribution partnerships with FSTP players
  2. Partner with proximate waste treatment players
  3. Partner with large infrastructure companies, and
  4. License the technology to government bodies and institutions to improve affordability.
<table>
<thead>
<tr>
<th></th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Segmentation of the urban FSSM market</td>
</tr>
<tr>
<td>B</td>
<td>Priority segments for deep-dive</td>
</tr>
<tr>
<td>C</td>
<td>FSSM pathways and potential use-cases</td>
</tr>
<tr>
<td>D</td>
<td>Details of the OP portfolio</td>
</tr>
</tbody>
</table>
Overall segments

The urban FSSM market can be divided into nine segments

<table>
<thead>
<tr>
<th>Segment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprawling Megacity</td>
<td>Cities with a population above 8 million</td>
</tr>
<tr>
<td>Rising Metro</td>
<td>Cities with a population between 1 million and 8 million, and in states with a positive ecosystem</td>
</tr>
<tr>
<td>Unruly Survivor</td>
<td>Cities with a population between 1 million and 8 million, in states with poor ecosystem</td>
</tr>
<tr>
<td>Dry and Arid</td>
<td>Cities with a population between 0.1 million and 1 million, in dry areas</td>
</tr>
<tr>
<td>Steady Roller</td>
<td>Cities with a population between 0.1 million and 1 million, in non-dry areas</td>
</tr>
<tr>
<td>Hilly City</td>
<td>Cities with a population of more than 0.1 million, or AMRUT cities below 0.1 million and a hilly topography</td>
</tr>
<tr>
<td>Small and Meek</td>
<td>Cities with a population less than 0.1 million, with no special focus</td>
</tr>
<tr>
<td>Little Prodigy</td>
<td>Cities with a population less than 0.1 million, with a history of activities in FSM and/or located near a sprawling megacity</td>
</tr>
<tr>
<td>Institutions</td>
<td>Residential and public institutional entities</td>
</tr>
</tbody>
</table>

*Note: Segment profiles and details on decision-making, financing and procurement processes, are featured in the annex

(1) Public Affairs Index (2017) below 0.45, except for Odisha and Meghalaya due to their focus on FSSM
(2) Cities with lower than 700 mm average rainfall in a year
(3) Elevation higher than 1000 m
### Variables

*Four variables are key to defining these segments, with population being the most significant*

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>DEFINITION</th>
<th>WHY DOES IT MATTER?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Population</strong></td>
<td>Total population of entity</td>
<td>Population of a city is the most significant variable, and drives decision-making, access to finance, and supply of FS and infrastructure. Example: All cities above the size of 100,000 have access to Amrut funding(^1)</td>
</tr>
<tr>
<td><strong>Topography</strong></td>
<td>Elevation</td>
<td>Higher elevation makes sewerage infeasible and expensive (INR 40000 – 60000 or USD ~600-900(^2) per capita) due to pumping requirements. Example: Hilly cities like Shimla and Shillong are opting for FSTPs</td>
</tr>
<tr>
<td><strong>Aridity</strong></td>
<td>Average rainfall per annum</td>
<td>Aridity affects water supply, and hence, directly impacts the feasibility of sewerage; sewerage system is not recommended below 135 lpcd. Example: In Maharashtra, cities with less than 100 lpcd water are not allowed to undertake sewerage projects</td>
</tr>
<tr>
<td><strong>Enabling Ecosystem</strong></td>
<td>Rankings of states based on Public Affairs Index and special focus on city</td>
<td>The state level ecosystem, within which a city is situated, can be a key driver for proclivity to adopt FSSM solutions. Example: Despite having similar size, Patna and Indore have very different approaches to sanitation, a reflection of the political ecosystem in their respective states</td>
</tr>
</tbody>
</table>

---

\(^1\) Source: AMRUT website

\(^2\) Source: Expert Interviews
Segments
These variables help determine which segment a city would belong to

City

What is the population of the city?

> 0.1 Mn

Is the city hilly?

Yes

Sprawling Megacity

Favorable

Rising Metro

No

1 Mn – 8 Mn

What is the ecosystem that the city is situated in?

Favorable

Rising Metro

Challenging

Unruly Survivor

0.1 Mn – 1 Mn

Is the city arid?

Yes

Dry and Arid

No

Little Prodigy

Is there special focus on the city?

Yes

Little Prodigy

No

Small and Meek

< 0.1 Mn

Is there special focus on the city?

Yes

Little Prodigy

No

Small and Meek

Institution

What is the type of entity?

Institutions

Location¹ / pioneer in FSSM

Yes

Little Prodigy

No

Small and Meek

City

What is the type of entity?

Institution

¹ This refers to proximity to a Sprawling Megacity and is important because the access to finance of these cities tends to increase compared to a city of similar size (as they usually fall within the Megacity’s Development Authority that is financially strong)
Segment prioritisation

Size, diversity, and capacity to influence other cities were used to prioritize four of these segments

Need for FSM and MSW v. Feasibility of OP (Bubbles represent segment size i.e., total FS load)

(1) Need for FSM captures the amount of FS generation and perceived likelihood of adoption of FSM as a solution, as well as need for MSW and Bio-solids treatment. MSW and Bio-solids treatment is determined by the size of the cities within the segment i.e., bigger cities have a greater number of STPs. (2) Feasibility of OP is determined by the availability of finance (higher availability means higher feasibility) and the comparative advantage of the OP due to its lower land footprint (lack of land availability means higher feasibility)
### Prioritized segments

*Four segments were studied in detail to understand the opportunity for the OP*

#### Rising Metro
- Cities with a population between 1 million and 8 million, and in states with a positive ecosystem

#### Steady Roller
- Cities with a population between 0.1 million and 1 million, in non-dry areas

#### Hilly City
- Cities with a population of more than 0.1 million, or AMRUT cities below 0.1 million and a hilly topography

#### Small and Meek
- Cities with a population less than 0.1 million, with no special focus

### SELECTION CRITERIA

<table>
<thead>
<tr>
<th>Rising Metro</th>
<th>Steady Roller</th>
<th>Hilly City</th>
<th>Small and Meek</th>
</tr>
</thead>
<tbody>
<tr>
<td>- High population growth and increasing periphery, which is likely to remain un-sewered; with significant population reliant on septic tanks</td>
<td>- Biggest segment, most cities have low sewerage and inadequate finance for sewerage, making FSM the most feasible alternative</td>
<td>- Very high need for FSSM because of negligible chance of sewerage due to challenging topography</td>
<td>- High reliance of septic tanks and no chance of sewerage in the near term, heightening the need for FSSM</td>
</tr>
<tr>
<td>- Potential to influence cities in another segment (Unruly Survivor)</td>
<td>- Potential to influence cities in another segment (Dry and Arid)</td>
<td>- Unique segment, which cannot be influenced by any other segment</td>
<td>- Large number of cities with low access to finance, enable cluster based and state level decision-making</td>
</tr>
</tbody>
</table>

---

1. Public Affairs Index (2017) below 0.45, except for Odisha and Meghalaya due to their focus on FSSM
2. Cities with more than 700 mm average rainfall in a year
3. Elevation higher than 1000 m
## Other Segments

**Other segments have varying levels of attractiveness for the OP market**

<table>
<thead>
<tr>
<th>Definition</th>
<th>Potential attractiveness of segment¹</th>
</tr>
</thead>
</table>
| **Sprawling Megacity** Cities with a population above 8 million           | - Ever-growing periphery population and hence, there is a significant population reliant on on-site sanitation until sewerage expansion occurs. However, cities express a desire to sewer the city completely  
- Significant amount of fecal waste from sewered population does not reach STPs due to poor conveyance and leakage. Additionally, biosolids from STPs are often not treated and dumped illegally, hence will benefit from co-location of an OP with the STP  
- Considered model cities by others and hence, can unlock large potential |
| **Unruly Survivor** Cities with a population between 1 million and 8 million, in states with poor¹ ecosystem | - Need for FSSM is high due to minimal sewer coverage, and high reliance on on-site sanitation  
- Feasibility, however is limited due to poor ecosystem, limited ULB capacity and access to finance |
| **Dry and Arid** Cities with a population between 0.1 million and 1 million, in dry areas² | - Low rainfall and resulting water shortage limit the viability of sewerage, especially for cities with a smaller population to command resources for expensive water supply projects. Cities with large populations are promised sewerage, but it is often not delivered due to practical constraints  
- Access to finance is moderate due to the large population |
| **Little Prodigy** Cities with a population less than 0.1 million, with a history of activities in FSM and/or located near a sprawling megacity | - Cities with existing FSTPs: Since these cities already have an FSTP solution, they are not looking for another solution  
- Cities located near sprawling megacity: Sewerage is considered infeasible due to high costs, but proximity to a megacity increases access to finance |
| **Institutions** Residential and public institutional entities              | - Mandated to have on-site STPs in many states, and hence are not looking for an FSSM solution; these segments prefer a single solution that combines their sanitation treatment needs (grey water+ black water) |

Note: Please note this is current potential attractiveness, and may change with change in conditions like access to finance, ecosystem etc. in the future (1) Public Affairs Index (2017) below 0.45, except for Odisha and Meghalaya due to their focus on FSSM (2) Cities with lower than 700 mm average rainfall in a year
Prioritized segment overview

The four prioritized segments offer a large and unique potential opportunity for the OP to target.

<table>
<thead>
<tr>
<th>Segment</th>
<th>Number of cities</th>
<th>Total population</th>
<th>Average sewerage¹</th>
<th>Total FS load of segment³</th>
<th>Average FS load per city</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RISING METRO</strong></td>
<td>43</td>
<td>92 Mn</td>
<td>40%</td>
<td><strong>22,800 KLD</strong></td>
<td><strong>530 KLD</strong></td>
</tr>
<tr>
<td><strong>STEADY ROLLER</strong></td>
<td>344</td>
<td>97 Mn</td>
<td>16%</td>
<td><strong>34,400 KLD</strong></td>
<td><strong>100 KLD</strong></td>
</tr>
<tr>
<td><strong>HILLY CITY</strong></td>
<td>12</td>
<td>4 Mn</td>
<td>22%²</td>
<td><strong>1440 KLD</strong></td>
<td><strong>120 KLD</strong></td>
</tr>
<tr>
<td><strong>SMALL AND MEEK</strong></td>
<td>3500</td>
<td>112 Mn</td>
<td>10%</td>
<td><strong>14,000 KLD</strong></td>
<td><strong>4 KLD</strong></td>
</tr>
</tbody>
</table>

Note: (1) Based on Census 2011, other figures are based on projections for 2018 (2) Removing the outliers i.e., 4 cities with a high sewerage percentage (primarily due to heritage sewers and/or being capital cities) reduces the average sewerage percentage to 11%. (3) Assuming a per capita generation of 0.63 LPD; formula used to calculate total FS load: Per capita generation*Total population of segment*Population connected to septic tanks (including septic tanks connected to individual households and public toilets). Other key assumptions used to size the segments have been listed in the annex.
FSSM pathways
*Prioritized segments consider three scenarios for FSSM*

In cities where sewerage is infeasible due to cost or water supply constraints, FSSM will be the only solution.

---

In cities with partial sewerage and a low probability of expanding sewerage, FSSM can permanently serve the unsewered population.

---

In cities with partial sewerage and a higher perceived probability of expanding sewerage, FSSM can be considered an intermediate solution. However, given the high cost of sewerage, it is likely that many cities will never be 100% sewered. Hence, FSSM can become a permanent solution in these cases too.

---

In cities where sewerage is infeasible due to cost or water supply constraints, FSSM will be the only solution.
Other waste treatment needs
Additionally, these segments identify a strong need for treating MSW and bio-solids from STPs

Municipal Solid Waste treatment

• Owing to the visibility of the problem and land availability issues, cities widely consider MSW to be their biggest problem, coupled with the policy push.¹

• According to the Planning Commission, 377 million people in urban areas generate 62 million tons of MSW annually. This will increase to 436 million tons by 2050, requiring about 1,240 hectare of landfill space per year.²

Bio-solid treatment

• For cities that rely on Sewage Treatment Plants (STPs) for waste water treatment, residual bio-solids can be a health hazard and also have an additional challenge of land availability, due to large volumes and time taken for solar drying.

• Studies suggest that application of bio-solids without adequate treatment can lead to polluting crops and soil, which further affects human health through consumption of these agricultural products.

Note: (1) ~50% of the budget under Swacch Bharat Mission (Urban) is for Solid Waste Management; Solid Waste Management Rules were updated in 2016 which promote segregation at source, user fees for collection, solid waste processing to generate compost and energy and provides new standards for landfill sites (2) Assuming current annual MSW generation of 62 million tonnes is dumped without treatment. Source: Vinod Kumar, “A Review on Sewage Sludge (Biosolids) a Resource for Sustainable Agriculture”; Rajkumar Joshi and Sirajuddin Ahmed, “Status and challenges of municipal solid waste management in India: A review”, Cogent Environmental Science (2016)
Use cases

The OP portfolio can address these market needs through four use-cases

1. **Stand-alone OP:**
   *Only FS*
   
The OP is used to process only fecal sludge from an area, without the addition of any other waste stream

2. **Integrated waste management:**
   *FS + Biosolids*
   
The OP is used to process both fecal sludge as well as biosolids produced at an STP

3. **Integrated waste management:**
   *FS + MSW*
   
The OP is used to process fecal sludge and supplement energy balance with Municipal Solid Waste (MSW)

4. **Integrated waste management:**
   *FS + Biosolids + MSW*
   
The OP is used to processes fecal sludge, biosolids produced at an STP and supplement its energy balance with Municipal Solid Waste (MSW)

In all these cases, the OP can be located at a new site or co-located with an existing waste treatment facility. In use cases 2, 3, and 4, co-location with an STP or a MSW processing plant offers added benefits.

Note: (1) Biosolids refers to the residual, semi-solid material that is produced as a by-product during sewage treatment (2) Co-location with an STP for this use case can help ease acquisition of land, and facilitate sale of additional electricity produced by the OP directly to the STP leading to significant energy savings for the STP since energy costs comprise of about 40-50% of an average STP’s O&M costs; (2) Adding MSW due to its higher calorific value compared to FS, can help bring up the solid % to the amount required for OP to function (3) This includes ease in acquiring land if there is extra space available on the existing waste treatment site, ease in sourcing input (e.g. biosolids from an STP can be fed directly to the OP if located on the same site, with minimal transportation costs), and sharing of costs like electricity, labour etc.
The OP portfolio

Three products have been considered within the portfolio

ANKUR SCIENTIFIC

TIDE TECHNOCRATS

DUKE
The technology includes a MSW gasifier, Volute press dewatering unit, a MBBR for filtrate treatment and the OP. All the analysis in this report is for this entire system (2) Ankur Scientific’s system in Vadodara was designed based on available biosolids from the 86 MLD STP, equal to 200 KLD at 4% total solids content. Energy input to the boiler is expected to be supplied by 8 TPD (4% of 200 KLD) biosolids, and 20 TPD of MSW. Where FS has lower solids content, additional dewatering and effluent treatment capacity will be required. Ankur has the ability to design a system for 30-1000 KLD at incoming TS content of 2-100%; (3) Opex does not include financing costs, engine replacement, and turbine refurbishment cost; (4) Capex quoted by Ankur for the 20th unit - includes JOP, effluent treatment and MSW gasifier (5) Litres per hour.
Note: [1] Tide has two plants of 15 KLD in Warangal and Narsapur, and one plant of 30 KLD in Wai. Out of the 30 KLD plant in Wai, 15 KLD is dedicated to FS collected from community toilets and public toilets. [2] Sourced from FSTP Database as of 8 June 2018, compiled by KPMG India and NFSSM Alliance. These costs are for the system as is, and do not include any change in cost due to economies of scale in the future. [3] The current plants have a sanitation resource park, and hence the total land occupied is 4046 sq m. However, the sanitation resource park is offered as an option to the city decision-makers. [4] This is assuming the plant runs for 8-10 hours a day. [5] Biochar produced depends on the carbon % and calorific value of the incoming sludge. The FS collected from community toilets and public toilets does not produce biochar since it contains very low solid % and hence, has a lower calorific value.
Note: (1) System is designed for 15% total solids content, and a calorific value of 15 MJ/kg. However, the solid content and calorific value of FS in India can be lower and hence, a co-fuel like waste oil, diesel, gasoline, alcohol may need to be added to reach the required energy balance of the system. Dewatering the incoming FS before adding the co-fuel is also possible but would require additional dewatering and filtrate treatment equipment. (2) Assuming 0.85 LPD (including urine) with about 100 g dry weight per day (3) Assuming USD 1 = INR 65 (3) Costs for the 100th unit quoted, assuming USD 1 = INR 65. Eliminating the gas expander can reduce capex but significantly increase opex due to the need to purchase electricity for operations. Please note the 5 KLD system does not produce enough electricity with the gas expander to offset 100% onsite electricity needs and hence requires a small amount of grid electricity.

<table>
<thead>
<tr>
<th>Commercial partner</th>
<th>Duke University²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key technology</td>
<td>Super critical water oxidation</td>
</tr>
<tr>
<td>Number of people covered</td>
<td>6,000²</td>
</tr>
<tr>
<td>Product size (KLD)</td>
<td>5 KLD</td>
</tr>
<tr>
<td>Opex p.a. (INR/USD)</td>
<td>Removed – Preliminary</td>
</tr>
<tr>
<td>Capex (INR/USD)</td>
<td>Removed – Preliminary</td>
</tr>
<tr>
<td>Land requirement</td>
<td>30 sq. metre</td>
</tr>
<tr>
<td>Quantity of end products</td>
<td>Distilled water</td>
</tr>
<tr>
<td></td>
<td>Hot water</td>
</tr>
<tr>
<td></td>
<td>Electricity</td>
</tr>
<tr>
<td></td>
<td>Minerals</td>
</tr>
<tr>
<td></td>
<td>Thermal</td>
</tr>
</tbody>
</table>
Strategy development for the OP portfolio responds to four key questions

A. What is the unmet waste treatment need for priority segments?
B. What is the OP portfolio’s value proposition and how does it align with the prioritized segments?
C. What technical, commercial, and ecosystem considerations will help serve the need better?
D. What are the recommended paths to market entry for the OP?
What this section covers

A. Detailed overview of the segments (Overview, Preferred Treatment Solutions, and Key Drivers)

B. Relevant value proposition and corresponding OP solution

C. Testing value proposition
OP Value Proposition
The OP has six value propositions that were tested against the needs of prioritized segments

1. Integrated waste management (FS, MSW, biosolids) – truly ‘omni’
2. Low land requirement for ease of scale up and overall lower capex
3. High quality treatment of solids with practically zero residual pathogens
4. Energy neutral machine, that can tackle energy shortages easily, thereby lowering opex
5. Easy to operate and low opex
6. Treats waste and produces saleable end products reducing opex

These value propositions have emerged from (i) conversations with city decision-makers regarding desired qualities for sanitation management, and (ii) benefits of the OP, in comparison with existing competition. The subsequent slides focus on the needs of these four segments and how the value propositions resonate.
1 RISING METRO
## Rising Metro | Overview

### Segment need and size

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Feasibility of the OP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of entities</strong></td>
<td><strong>Low</strong></td>
</tr>
<tr>
<td><strong>Cities</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Population covered</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Million</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Sewerage

| Average sewerage | **Low** | **Medium** | **High** |
| **%** | | | |

| Total STP capacity | **MLD** | **Low** | **Medium** | **High** |
| **6610** | | | |

### Per city generation

| Average FS generated | **KLD** | **Low** | **Medium** | **High** |
| **530** | | | |

| Average MSW generated | **TPD** | **Low** | **Medium** | **High** |
| **1000** | | | |

### Total generation

| Total FS generated | **KLD** | **Low** | **Medium** | **High** |
| **22,800** | | | |

| Total MSW generated | **TPD** | **Low** | **Medium** | **High** |
| **43,000** | | | |

### Access to finance

- Opex is primarily the responsibility of the ULB. ULB’s own resources in this segment are moderately high due to high user recovery rates (Aurangabad collected INR 13 crores (USD 2 mn), from sewerage tax in FY 2016-17)
- Preferential focus in National and State level schemes, because these cities are usually capitals of states and/or highly populated cities

### Existing O&M ability

- Presence of many private operators to collect and transport waste, including desludgers and solid waste collectors
- Some players exist in the space of building and running STPs

### Demand for end products

- Demand for treated water from local and peripheral industries, driven by high industrial activity in the segment
- Some demand for biochar may exist from nearby farmers, if the quality and price of acquisition is comparable or better than existing manure

---

Note: For all the segments, we have assumed FS generation of 0.6 litre per capita per day (1) Public Affairs Index (2017) above 0.45, in addition to Odisha and Meghalaya due to their focus on FSSM (2) Capex on the other hand, can either be funded through own ULB resources, transfers from the state / centre, or through private investments.
Cities would consider FSM as a bridge solution, MSW and bio-solids are a huge concern

Perceived possibility of expanding sewerage

- Cities have partial UGD coverage with the expectation of achieving full coverage, however, high costs of laying sewerage inhibit many cities from achieving 100% sewerage
- Despite future plans, even if 10% of a rising metro is unsewered, a population of ~0.1 million will still need an FSM solution
- Old pockets as well as city peripheries have FS generation, however desludging is unsupervised, with many private players dumping in open grounds or water bodies

Interest in MSW

- Cities in this segment produce c. 1000 TPD of MSW, increasing visibility of the MSW problem; land challenges due to high population and density
- Civic pressure coupled with policy focus on Solid Waste Management (e.g. incorporation in national rankings like Swachh Survekshan Survey) enhances interest in solving the problem

Interest in bio-solids

- 21 out of the 43 cities in this segment have existing STPs, accounting for 45% of India’s sewage treatment capacity
- These STPs produce huge amounts of sludge every day (e.g. a 86 MLD STP in Vadodara produces 8000 kg sludge every day at 4% TS). Currently, disposing these biosolids is expensive (due to high land requirement), takes time, does not work in monsoons, does not completely treat the solids and does not recover water from the biosolids

(1) Biosolids treatment in the Ankur OP can occupy lesser space, reduce time by 3-4 weeks, work in monsoons, treat the solids completely and also recover water from the sludge
### Rising Metro | Key Drivers

**Three key drivers affect the choice of solution for this segment**

1. **Positioning FSM as a bridge solution and advocacy efforts can generate interest**
   - Cities within this segment consider sewerage to be the gold standard; however, sewerage is more expensive for the scattered far-flung peripheral areas and FSM may be a viable interim solution, or permanent if limited interest in expanding sewerage (e.g. Rajasthan is currently proposing decentralized mini STPs served by microbore sewerage for scattered and peripheral zones for a low cost alternative to UGD).
   - There are policy gaps as well as a lack of enforcement which incentivizes use of sub-optimal solutions (e.g. dumping); improved enforcement can help tackle this.

2. **An integrated waste management product will be attractive**
   - Cities within this segment prioritize Municipal Solid Waste management over FSM solutions, given higher visibility, and land required for disposal; products that enable both MSW and FS treatment will be attractive.
   - Given relatively manageable volumes of FS, cities prioritize cost and convenience, over performance, selecting sub-optimal treatment options as a result. (In Rajasthan and Karnataka, FS is dumped into manholes or taken directly to STPs for co-treatment). A product that can co-treat FS and bio-solids will be attractive.

3. **Municipal corporation is the decision maker, with consultants being key influencers**
   - Unlike megacities, these cities usually don’t have a separate sewerage board; although the ULB is the main decision maker, it is influenced by consultants and the State Department of Urban Affairs. (Consultants play a key role in influencing the Urban Local Body (“ULB“) and creating the DPR, including the choice of technology.)
### Rising Metro | Value propositions and relevant OP product

*Two OP value propositions resonate most with this segment, with Ankur being the relevant OP*

<table>
<thead>
<tr>
<th>Value proposition</th>
<th>Relevant OP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <strong>Integrated waste management (FS + MSW, FS+ biosolids) – truly ‘omni’</strong></td>
<td>![Ankur Logo]</td>
</tr>
<tr>
<td>2. <strong>Low land requirement for ease of scale up and lower overall capex</strong></td>
<td>![Ankur Logo]</td>
</tr>
<tr>
<td>- <strong>FS +MSW:</strong> Cities produce 1000 TPD(^1) MSW on average, select cities have waste treatment plants, however, capacity remains low; there is civic pressure to manage MSW</td>
<td><strong>Average FS treatment capacity required:</strong> 200-500 KLD</td>
</tr>
<tr>
<td>- <strong>FS+ Bio-solids:</strong> Of the 23,800 MLD STP capacity in India, 16,200 MLD is in cities with population above 1 million; On average, 150 MLD of sewage is treated in each city in this segment, producing 600 – 800 kg(^2) of dry sludge per day, facing challenges of land shortage and treatment quality</td>
<td><strong>200 KLD(^4)</strong></td>
</tr>
</tbody>
</table>

**Note:** (1) Based on average population estimates for the segment (2) Assuming 4 to 6 kg of dry sludge production per MLD of sewage treated in the STP (this is based on the following calculation: \(1\text{m}^3=1000\) kg and hence, at 4% solids, the mass of biosolids produced equals 40 kg); (3) Based on the average prices for representative cities; (4) Ankur Scientific’s system in Vadodara was designed based on available biosolids from the 86 MLD STP, equal to 200 KLD at 4% total solids content. Energy input to the boiler is expected to be supplied by 8 TPD (4% of 200 KLD) biosolids, and 20 TPD of MSW. Where FS has lower solids content, additional dewatering and effluent treatment capacity will be required. Ankur has the ability to design a system for 30-1000 KLD at incoming TS content of 2-100%. Source: Dalberg analysis
Assumptions:

(i) Total FS and MSW generated in a city is collected and can be transported to the OP
(ii) 51% of MSW is organic and hence, can be processed in the OP
(iii) 20% of total MSW generated in a Rising Metro city is treated and hence does not come to the OP. Treatment capacity of other segments is zero (iv) TS % of FS=3%, TS of MSW=53%

Note: (1) Average MSW and FS values for each segment are based on the calculations used for sizing segments, as displayed in the segment profiles in the annex (2) Ankur Scientific’s system in Vadodara was designed based on available biosolids from the 86 MLD STP, equal to 200 KLD at 4% total solids content. Energy input to the boiler is expected to be supplied by 8 TPD (4% of 200 KLD) biosolids, and 20 TPD of MSW. Where FS has lower solids content, additional dewatering and effluent treatment capacity will be required. Ankur has the ability to design a system for 30-1000 KLD at incoming TS content of 2-100%. Source: Dalberg analysis

Rising Metro | Testing Integrated Waste Management as the value proposition
The Ankur OP should consider reconfiguring its system to reflect the city’s MSW needs

<table>
<thead>
<tr>
<th>Average MSW and FS by mass^2 (TPD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rising Metro</td>
</tr>
<tr>
<td>Dry MSW</td>
</tr>
<tr>
<td>Dry FS</td>
</tr>
</tbody>
</table>

The OP is currently designed to treat 20 TPD of feedstock. However, there is opportunity to reconfigure OP to treat more MSW available for treatment in the Rising Metro segment.

Recommendations

Conduct study to determine:

i) Amount of MSW treatment that will be considered valuable by the city. The Ankur OP^2 currently maintains minimum 15% MSW of overall dry sludge quantity, but the upper limit is not known and can be configured based on city’s needs

i) Cost benefits of treating MSW in the OP vs other solutions currently adopted by the city
Bio-solids are an attractive value proposition for Ankur OP to consider

Assumptions: (1) Equal parts of biosolids and FS is treated in the OP i.e., 50% of biosolids and 50% FS (2) STP produces 93 kg of dried sludge at 4% TS per MLD sewage treated

Calculation for mass of biosolids: 1 KLD = 1 m\(^3\) = 1000 kg. Hence, at 4% solids, the mass of biosolids equals 40 kg.

Source: Stakeholder interviews and Dalberg analysis

92% of STPs in India have a capacity of less than 75 MLD

Assumptions: (1) Equal parts of biosolids and FS is treated in the OP i.e., 50% of biosolids and 50% FS (2) STP produces 93 kg of dried sludge at 4% TS per MLD sewage treated (3) Calculation for mass of biosolids: 1 KLD = 1 m\(^3\) = 1000 kg. Hence, at 4% solids, the mass of biosolids equals 40 kg.

Source: Stakeholder interviews and Dalberg analysis
Rising Metro | Testing Low Land requirement as the value proposition

The OP systems are more efficient than most in terms of land utilization, especially Duke and Ankur

**Comparison of efficiency in land utilization of FSTPs and the OP variants in India**

Land required in square feet per KLD of fecal sludge treated

- **OP variants**
- **Operational FSTPs**
- **FSTPs under construction**

**Note:** (1) Ankur Scientific’s system in Vadodara was designed based on available biosolids from the 86 MLD STP, equal to 200 KLD at 4% total solids content. Energy input to the boiler is expected to be supplied by 8 TPD (4% of 200 KLD) biosolids, and 20 TPD of MSW. Where FS has lower solids content, additional dewatering and effluent treatment capacity will be required. Ankur has the ability to design a system for 30-1000 KLD at incoming TS content of 2-100%; Source: FSTP Database as of 8 June 2018, compiled by KPMG India and NFSSM Alliance Note: Land for the FSTP in Bhadrak in Orissa has not been found yet as of June 8; Our understanding is that this is land actually being used, with the hypothesis that there is direct co-relation to the land required

<table>
<thead>
<tr>
<th>City</th>
<th>Operational FSTP</th>
<th>FSTPs under construction</th>
<th>Land area in square meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bhubaneswar</td>
<td>1,634</td>
<td></td>
<td>2,178</td>
</tr>
<tr>
<td>Brahmapur</td>
<td>1,815</td>
<td></td>
<td>2,287</td>
</tr>
<tr>
<td>Cuttack</td>
<td>2,178</td>
<td></td>
<td>3,267</td>
</tr>
<tr>
<td>Rourkela</td>
<td>3,145</td>
<td></td>
<td>8093</td>
</tr>
<tr>
<td>Trichy</td>
<td>2,287</td>
<td></td>
<td>3,788</td>
</tr>
<tr>
<td>Sambalpur</td>
<td>680</td>
<td></td>
<td>6,800</td>
</tr>
<tr>
<td>Kanchipuram</td>
<td>8094</td>
<td></td>
<td>8,094</td>
</tr>
<tr>
<td>Devanahalli</td>
<td>6070</td>
<td></td>
<td>6,107</td>
</tr>
<tr>
<td>Baripada</td>
<td>6070</td>
<td></td>
<td>6,107</td>
</tr>
<tr>
<td>Leh</td>
<td>897</td>
<td></td>
<td>1,008</td>
</tr>
<tr>
<td>Baleswar</td>
<td>1,162</td>
<td></td>
<td>2,023</td>
</tr>
<tr>
<td>Devanahalli</td>
<td>1,166</td>
<td></td>
<td>1,980</td>
</tr>
<tr>
<td>Tide: 15 KLD</td>
<td>726</td>
<td></td>
<td>3,897</td>
</tr>
<tr>
<td>Tune: 30 KLD</td>
<td>797</td>
<td></td>
<td>4,127</td>
</tr>
<tr>
<td>P-palayam</td>
<td>861</td>
<td></td>
<td>4,647</td>
</tr>
<tr>
<td>Ankur</td>
<td>135</td>
<td></td>
<td>2,287</td>
</tr>
<tr>
<td>Puri</td>
<td>215</td>
<td></td>
<td>2,287</td>
</tr>
<tr>
<td>Simnar</td>
<td>238</td>
<td></td>
<td>2,287</td>
</tr>
<tr>
<td>Cochin</td>
<td>129</td>
<td></td>
<td>2,287</td>
</tr>
<tr>
<td>Duke: 5 KLD</td>
<td>65</td>
<td></td>
<td>2,287</td>
</tr>
<tr>
<td>Duke: 25 KLD</td>
<td>39</td>
<td></td>
<td>2,287</td>
</tr>
</tbody>
</table>

**The Tide and Duke OPs’ land efficiency increases with increasing capacity. E.g. Tide: 30 KLD has a smaller land footprint per KLD compared to Tide: 15 KLD**
Rising Metro | Co-location with an STP

Co-location with an STP has added benefits of cost reduction and possibility of water recovery

<table>
<thead>
<tr>
<th>Existing scenario: STP only</th>
<th>Potential scenario: Co-location of OP with STP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No treatment:</strong> Biosolids generated during treatment process are often dumped in open land spaces and/or water bodies</td>
<td><strong>Complete treatment:</strong> The OP will help completely treat the biosolids from an STP, by making it pathogen-free</td>
</tr>
<tr>
<td><strong>High land and time requirement:</strong> Biosolids occupy large land spaces for dumping and solar drying (commonly adopted method for making biosolids less harmful). Solar drying also takes longer</td>
<td><strong>Reduce cost through land and time savings:</strong> Treatment in the OP will reduce land requirement since it is an enclosed technology, with one of the lowest land footprints and also helps reduce time required for treatment</td>
</tr>
<tr>
<td><strong>Low climatic adaptability:</strong> Solar drying of bio-solids is not feasible in areas with heavy monsoon</td>
<td><strong>High climatic adaptability:</strong> The OP does not rely on biological processes like solar drying and hence, is more reliable due to the use of physical processes</td>
</tr>
<tr>
<td><strong>No water recovery:</strong> Solar drying of biosolids does not allow for recovery of water from the sludge</td>
<td><strong>Allows for water recovery:</strong> The OP can recover water from sludge, which otherwise evaporates through solar drying</td>
</tr>
</tbody>
</table>

Additionally, co-location with an STP can lead to modest energy savings\(^1\) by feeding the additional electricity generated by the OP to the STP.

Note: (1) Energy costs form 40-50% of the monthly O&M costs of an STP.
# Rising Metro | Recommendations

*Land footprint is already a strong VP, design changes can strengthen integrated management VP*

---

<table>
<thead>
<tr>
<th>Value proposition</th>
<th>Recommendations: Existing Product</th>
<th>Recommendations: New Product</th>
</tr>
</thead>
</table>
| Integrated Waste management: FS + MSW | • **Conduct study** to determine: i) amount of MSW treatment that will be considered valuable by the city; ii) cost benefits of treating MSW in the OP vs other solutions  
  • **Reconfigure OP’s upper limit of MSW** based on the findings of the study (the lower limit is currently maintained at 15% of overall dry sludge quantity) | • Develop a product offering that treats 100% FS without MSW, to be able to respond to pure FSTP tenders  
  • Develop a scaled up version of Ankur, that can treat a significant portion of FS and MSW (500 KLD and 1000 TPD MSW) |
| Integrated waste management: FS + biosolids | • **Emphasize its value proposition** since more than 90% of STPs are less than 75 MLD, and Ankur can treat a significant portion of bio-solids for these STPs (assuming 50% of the input to the Ankur OP is biosolids, and the other 50% is FS)  
  • **Demonstrate capex reduction through land saved, time saved, ability to work in monsoons and recover water from sludge** | • Explore advanced dewatering technologies that allow for a FS + Biosolids only processing facility. This would effectively increase the amount of input that the OP can process, and is important as STPs increase in size and/or capacity utilization in cities  
  • Consider a scaled-up Duke or Duke positioned as a decentralized system serving part of the city. While the current size of Duke cannot serve an entire city in this segment, its ability to treat biosolids and hazardous waste can be a valuable proposition to this segment, with high STP capacity and industrial activity  
  • Explore the Tide OP’s ability to process other inputs including MSW, biosolids and hazardous waste |
| Strongest alignment with value proposition | Some changes required | Low land requirement |
| **Low land requirement** | • **Emphasize low land requirement** since OP has one of the smallest footprints per KLD sludge treated. When land prices are combined with equipment capex, the Ankur OP becomes competitive compared to other solutions | • Consider making a product that is vertically stackable since it will make the product more competitive while scaling up too, which is not possible with the current product |

---

Note: (1) The Ankur OP currently uses the MSW gasifier to increase the solid content of the input. However, the JOP (Janicki Omni Processor) has the ability to process FS and dry biosolids without the MSW gasifier, if the inputs can be dewatered to 33% TS
2 STAPY ROLLER
Steady Roller | Overview

Cities with population between 0.1 million and 1 million with annual rainfall more than 700 mm

<table>
<thead>
<tr>
<th>Segment need and size</th>
<th>Feasibility of OP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
</tr>
<tr>
<td>Number of entities</td>
<td>344</td>
</tr>
<tr>
<td>Population covered</td>
<td>97 Million</td>
</tr>
<tr>
<td><strong>Sewerage</strong></td>
<td></td>
</tr>
<tr>
<td>Average sewerage</td>
<td>16 %</td>
</tr>
<tr>
<td>Total STP capacity</td>
<td>7550 MLD</td>
</tr>
<tr>
<td><strong>Per city generation</strong></td>
<td></td>
</tr>
<tr>
<td>Average FS generated</td>
<td>100 KLD</td>
</tr>
<tr>
<td>Average MSW generated</td>
<td>85 TPD</td>
</tr>
<tr>
<td><strong>Total generation</strong></td>
<td></td>
</tr>
<tr>
<td>Total FS generated</td>
<td>33,500 KLD</td>
</tr>
<tr>
<td>Total MSW generated</td>
<td>29,600 TPD</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Access to finance</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Access to central government schemes (e.g. AMRUT, Smart Cities) but funds might have to be spent on competing needs (e.g. water supply)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Existing O&amp;M ability</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Limited operational capacity with the ULBs to operate plants</td>
</tr>
<tr>
<td>• Desludging ecosystem is poor with very few ULB-owned trucks and an unorganized market. Desludging is mostly done by private operators and the dumping is unsupervised i.e., there are hardly any designated dumping sites.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Demand for end products</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Limited demand for end-products, market linkages are limited. This could relate to lack of viable distribution channels, e.g. water transportation costs are high, limiting interest from surrounding industry clusters, even if a need is identified</td>
</tr>
</tbody>
</table>

Note: (1) This is an indicative figure and has been calculated by subtracting total installed STP capacity of cities with population above 1 million from total installed STP capacity in India (2016). It is assumed that the Dry and Arid segment (cities with the same population range as Steady Roller, but average rainfall below 700 mm) is zero.
Steady Roller | Preferred Treatment Solution

Cities have little sewerage and moderate financing, making FSM the permanent choice

Source: Dalberg analysis

Perceived possibility of expanding sewerage

- Cities have little sewerage, with most of the population dependent on on-site systems, making fecal sludge collection and treatment a concern. Additionally, containment systems are poor i.e., a majority of them have pits instead of septic tanks
- Dumping of FS in storm water drains is common, with limited regulation and lack of private sector engagement
- An enabling ecosystem does exist, but needs to be strengthened specifically for sanitation
- Some cities within the segment have seen proclivity to prioritize sanitation (e.g. Warangal), this is driven by a positive ecosystem at the state level

Interest in MSW

- Cities have very high interest in managing their municipal solid waste, both due to the increased visibility and land allocation required to dump
- However, compared to the Rising Metro segment, cities within this segment face challenges with segregation of waste
- “Segregation is a big problem. A city like Bhubaneshwar at least has some segregation, but smaller towns have almost no segregation. Our first priority should be to change people’s habits within households”- Bhubaneshwar ULB Official
Steady Roller | Key Drivers

Three key drivers affect the choice of solution for this segment

1. Ecosystem and other parts of the value chain are key
   - Despite low to negligible existing sewerage and paucity of funds to extend sewerage, the interest remains high; significant policy and advocacy efforts need to be directed to generate interest in alternative solutions
   - Low awareness amongst households, little regulation, and lack of private sector engagement in collection and transport makes the value chain unorganized and FSM difficult (e.g. households use open drains and pits instead of septic tanks)

2. There are sub-segments with different methods for sewerage, level of attention, and ecosystem
   - Towns with less than 100 lpcd of water supply have lower chances of sewerage (e.g. Dhanbad)
   - Towns on the coast or near major rivers have a higher water table, thus increasing costs of sewerage. In addition, these towns have also garnered attention because of their role in polluting rivers and seas
   - Since the ecosystem in this segment is still developing, cities in states with positive ecosystem can be targeted

3. State level authorities are biggest influencers
   - Most cities in this segment respond to push mechanisms, therefore, state level authorities have a key role to play in encouraging improved FSM
   - In some cases, using the power of elected representatives, MLAs can influence the proactivity of a city
### Steady Roller | Value propositions and relevant OP

*Three OP value propositions will resonate the most, but no single OP can serve at current capacity*

<table>
<thead>
<tr>
<th>Value proposition</th>
<th>Relevant OP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Easy to operate and low opex</td>
<td>- 200 KLD</td>
</tr>
<tr>
<td>2. Low land requirement for ease of scale up and lower overall capex</td>
<td>- 15-30 KLD</td>
</tr>
<tr>
<td>3. Integrated FS+ MSW management</td>
<td>- 5-25 KLD</td>
</tr>
</tbody>
</table>

**Average FS treatment capacity required:** 100 KLD

At their current size, no single OP product can meet the needs for this segment, therefore, we have considered a scaled down version of Ankur (it can operate at 30 KLD capacity), or a multiple of Tide and Duke products (3-4).

Note: (1) Assuming that cities with population below 1 lakh don’t have an STP (2) Based on average population estimates for the segment (3) Based on the average prices for representative cities; (4) Ankur Scientific’s system in Vadodara was designed based on available biosolids from the 86 MLD STP, equal to 200 KLD at 4% total solids content. Energy input to the boiler is expected to be supplied by 8 TPD (4% of 200 KLD) biosolids, and 20 TPD of MSW. Where FS has lower solids content, additional dewatering and effluent treatment capacity will be required. Ankur has the ability to design a system for 30-1000 KLD at incoming TS content of 2-100%. Source: Dalberg analysis.
Steady Roller | Testing Value Propositions: Bio-solids and MSW treatment can potentially have a strong value proposition; ease of operations and opex value propositions will need modification

An integrated Ankur OP will have to consider the MSW/FS ratio, it can treat bio-solids effectively

FS + MSW

The 20 TPD OP can already treat a significant portion (~75%) of the MSW available for treatment in an average city in this segment. Reconfigure system to position OP as a ‘single solution for a city’ that can process 100% FS and MSW available for treatment

FS + Biosolids

There are 10 cities within the Steady Roller segment with STPs of greater than 50 MLD capacity. Ankur can treat these effectively. While Duke OP can also treat the biosolids from an STP, the maximum amount of biosolids it can take as input is not known

Ank has low opex but is not easy to operate, Tide is ‘highly containerized’, but has high opex

Ankur OP

Low opex: Out of 20 FSTPs, Ankur OP is the 3rd cheapest in terms of opex per KLD; however,
Ease of operations: The 200 KLD Ankur plant has multiple components, and needs 8-12 people to operate the 200 KLD plant per shift, including the MSW feedline. Out of these, minimum 4 supervisors with superior technical know-how are required (2 mechanical engineers, and 2 electrical engineers) and 4-5 unskilled laborers are required to transport the input, segregate the MSW etc.

Tide OP

Low opex: Out of 20 FSTPs in India, the smaller Tide system (15 KLD) ranks 13th on opex per KLD, and the scaled up Tide (30 KLD) plant ranks 16th;
Ease of operations: The Tide system needs only 1 operator and 1 assistant to run the plant at any point, which is similar to the operational requirements of other competitive FSTPs like Leh and Devanahalli. Additionally, these operators need limited technical experience (e.g. general diploma holder or basic industrial training)

The OP’s low land footprint makes its capex competitive, if land cost is included in the total capex

Ranking of 20 FSTPs on total capex

<table>
<thead>
<tr>
<th>OP variant</th>
<th>Capex ranking w/o land cost</th>
<th>Capex ranking incl. land cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ankur OP</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td>Tide OP: 30 KLD</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>Tide OP: 15 KLD</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Duke OP: 25 KLD</td>
<td>19</td>
<td>10</td>
</tr>
<tr>
<td>Duke OP: 5 KLD</td>
<td>20</td>
<td>18</td>
</tr>
</tbody>
</table>

Emphasizing on the opportunity cost of land savings while showcasing OP’s capex to decision-makers can thus be valuable

Note: (1) This includes all operational and under construction FSTPs from the FSTP Database, compiled by KPMG India and NFSSM Alliance as of 8 June, 2018, along with the 3 OP variants; (2) Sourced from “Inventorization of Sewage Treatment Plants”, Central Pollution Control Board (2015); (3) Assuming that 200 KLD Ankur OP can treat 30 MT of MSW per day; average MSW production per day for steady roller is 90 TPD; (4) Land price of INR 5000 per sq. feet has been considered (5) 1 mechanical engineer and 1 electrical engineer is required for the MSW feedline. The system plans to operate in 3 shifts of 8 hours each per day
Steady Roller | Recommendations

Set out here are our recommendations for the OP to align with this segment (1 of 2)

<table>
<thead>
<tr>
<th>Value proposition</th>
<th>Recommendations: Tide Technocrats</th>
<th>Recommendations: Ankur</th>
<th>Recommendations: Duke</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low land requirement</td>
<td>• <strong>Emphasize low land footprint</strong> to show competitiveness of system in terms of total capex (incl. land cost) than most systems. The overall capex is sensitive to land prices, which in Steady Roller cities can go as high as INR 3000 per ft², or even higher. There is opportunity to <strong>reduce the land footprint closer to 200 ft² per KLD</strong> to outdo nearest competition</td>
<td></td>
<td>• <strong>Emphasize reduction in capex through land savings</strong> since Ankur and Duke have one of the lowest land footprint per KLD of treatment</td>
</tr>
<tr>
<td>Integrated waste management: FS + biosolids</td>
<td>• <strong>Emphasize Tide’s vertical stackability as the system scales up.</strong> Due to Tide’s ability to be vertically stacked, its land efficiency improves with increasing capacity. This will be valuable for the Steady Roller cities that are characterized by high growth, and hence will value a system that can be easily scaled up, without placing a burden on high land requirement</td>
<td></td>
<td>• <strong>Highlight Ankur and Duke’s ability to process biosolids</strong> in Steady Roller cities that have STPs. More than 90% of STPs in India are less than 75 MLD. While Ankur can treat a significant portion (50-100%) of biosolids from these STPs (assuming Ankur OP processes equal amount of biosolids and FS i.e., 50% each), conduct studies to understand the amount of biosolids Duke can treat, in relation to the requirement of current STPs in these cities.</td>
</tr>
<tr>
<td>Strongest alignment with value proposition</td>
<td></td>
<td></td>
<td>• <strong>Demonstrate capex reduction through land saved, time saved, ability to work in monsoons and recover water from sludge</strong></td>
</tr>
<tr>
<td>Some changes required</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Steady Roller | Recommendations**

*Set out here are our recommendations for the OP to align with this segment (2 of 2)*

<table>
<thead>
<tr>
<th>How can the relevant OP product be most readily adopted to offer the value proposition for this segment?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Value proposition</strong></td>
</tr>
<tr>
<td>Integrated waste management: FS + MSW</td>
</tr>
<tr>
<td>Easy to operate and low opex</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What are other technical recommendations for OP to consider to serve this segment?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adapt technology to treat fluctuating solid content</td>
</tr>
</tbody>
</table>
3 HILLY CITY
### Cities with a population of more than 0.1 million, or AMRUT\(^1\) cities below 0.1 million and a hilly topography\(^2\)

<table>
<thead>
<tr>
<th>Segment need and size</th>
<th>Feasibility of the OP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
</tr>
<tr>
<td>Number of entities</td>
<td>12 Cities</td>
</tr>
<tr>
<td>Population covered</td>
<td>4 Million</td>
</tr>
<tr>
<td><strong>Sewerage</strong></td>
<td></td>
</tr>
<tr>
<td>Average sewerage</td>
<td>22 %</td>
</tr>
<tr>
<td>Total STP capacity(^3)</td>
<td>100 MLD</td>
</tr>
<tr>
<td><strong>Per city generation</strong></td>
<td></td>
</tr>
<tr>
<td>Average FS generated</td>
<td>120 KLD</td>
</tr>
<tr>
<td>Average MSW generated</td>
<td>110 TPD</td>
</tr>
<tr>
<td><strong>Total generation</strong></td>
<td></td>
</tr>
<tr>
<td>Total FS generated</td>
<td>1,420 KLD</td>
</tr>
<tr>
<td>Total MSW generated</td>
<td>1,300 TPD</td>
</tr>
</tbody>
</table>

**Access to finance**
- Only the AMRUT cities have some outlay for sewerage/FSM; AMRUT is the main reason why these towns are thinking of FSSM

**Existing O&M ability**
- Due to the remoteness of the region, local skills are poor and O&M is challenging. For e.g., MSW processing center in Shillong closed down because of poor O&M

**Demand for end products**
- Demand for treated water can exist in hilly states where there are industries (e.g. Himachal Pradesh), but there are some hilly states with very low industrial activity (e.g. North-eastern states) and hence demand for treated water is low. Additionally, cities like Shimla are facing an acute water crisis and hence, supply of treated water to households can be explored.
- Systems requiring low electricity are desirable since power outages are common

---

Note: (1) AMRUT – Atal Mission for Rejuvenation and Urban Transformation which is a national scheme to establish water supply and sewerage infrastructure for urban transformation in 500 cities (2) Elevation higher than 1000 m (3) This includes the STPs in Srinagar and Shimla only
Hilly City | Preferred Treatment Solution
Cities within this segment identify FSM to be a permanent solution, and also identify a MSW need

Perceived possibility of expanding sewerage

- Most hill cities have very low sewer coverage (an average of 22%); this is driven by terrain related difficulties, coupled with the high cost of pumping and laying pipelines and high private ownership of land; there are some exceptions (e.g. Shimla has some heritage sewers that currently face many issues like leakages, defunct pipes etc.)
- Significant number of households (75%) are connected to on-site sanitation systems
- These cities also have moderate access to finance (mostly AMRUT funds), while the per capita sewerage costs can be as high as INR 40,000-60,000

Interest in MSW

- Hill cities find MSW disposal to be relevant because of high density, low land availability, low land ownership and high tourism
- The capacity of treatment is often much lower than the MSW production. For example, of 130 tons of MSW produced per day in Shillong, only 1 ton is composted. The remaining MSW is dumped in a landfill
- The difficulty of getting land for treating MSW can be gauged by the age of the landfills. For instance, the dumping ground in Shillong was set up before independence in 1938

Source: Dalberg analysis; (1) Expert Interviews

Open drain in Shillong with no sewerage

Garbage collection truck in Shillong
Hilly City | Key Drivers

Five key drivers will affect the choice of FSM solution for this segment

1. **Upstream location makes FS a high health risk**
   - Increased visible pollution in the nallahs and rivulets, thus increasing urgency for a solution that reduces FS-based pollution risk, including treatment of greywater.

2. **Fluctuating load makes modular technology important**
   - The load in these cities fluctuates due to two factors. i) **Climate**: Heavy rains or cold climates affects the amount desludged (e.g. in Shillong, desludging frequency increases during the rainy season and in Leh, it drastically reduces in cold weather due to which the Leh FSTP was shut for 4-5 months) ii) **Population**: Most hilly cities are popular tourist destinations with peak and off-peak seasons and usually have to account for a fluctuating load before deploying any technology (e.g. Leh’s peak season is during summer, and hence, the load is much higher then).

3. **Climatic conditions pose a hindrance to operations**
   - Both access and reliability of electricity is lower due to topographic and climatic challenges (e.g. heavy rains) leading to constant power outages. Hence, climatic adaptability of technologies is a key consideration.

4. **Land availability is a challenge, making low tech footprint a need**
   - Land availability is a major issue in most hill cities driven by difficult terrain posing construction difficulties and high private land ownership in the case of north-eastern states (more than 90% land is privately occupied). This also makes the handling of MSW a major concern.

5. **Private sector engagement is low, needing local partnerships**
   - There are very few private players operating in hilly cities, mostly driven by their remote location. Hence, local presence of vendors is a highly desirable characteristic for any technology that has to be regularly maintained.

Note: (1) Due to the upstream location of hilly cities, greywater that comes out from homes is directly discharged in open drains that flow into the river streams. The oil / grease component along with organic waste and detergents in the greywater is a major concern for water pollution of surface water in these cities due to its high BOD/COD content. Source: Stakeholder interviews, Dalberg analysis
Hilly City | Value propositions and relevant OP

Three OP value propositions will resonate the most, but no OP can serve at its current capacity

<table>
<thead>
<tr>
<th>Value proposition</th>
<th>Relevant OP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Energy neutral, tackling energy shortages with ease and reducing opex</td>
<td>Average FS treatment capacity required: 100 KLD</td>
</tr>
<tr>
<td>2. Low land requirement for ease of scale up and lower overall capex</td>
<td></td>
</tr>
<tr>
<td>3. Integrated FS+ MSW management</td>
<td>At their current size, no single OP product can meet the needs for this segment, therefore, we have considered a scaled down version of Ankur (it can operate at 30 KLD capacity), or a multiple of Tide and Duke products (3-4).</td>
</tr>
</tbody>
</table>

Note: (1) Data based on numbers reported on Ministry of Power’s URJA Dashboard for representative cities (2) Estimated land capacity is based on FS load models and the actual numbers for representative cities (3) These value propositions have been tested elsewhere with cities of similar capacity and financing available, hence, has not been replicated here; (3) Ankur Scientific’s system in Vadodara was designed based on available biosolids from the 86 MLD STP, equal to 200 KLD at 4% total solids content. Energy input to the boiler is expected to be supplied by 8 TPD (4% of 200 KLD) biosolids, and 20 TPD of MSW. Where FS has lower solids content, additional dewatering and effluent treatment capacity will be required. Ankur has the ability to design a system for 30-1000 KLD at incoming TS content of 2-100%. Source: Dalberg analysis
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Neutral</td>
<td>• Bring down the current energy requirement of 5-7 KWh to compete with solutions that have no power requirement (e.g. gravity based FSTPs) • Explore alternative and renewable sources of power</td>
<td>• Reduce start-up energy requirements by tailoring the design capacity to meet available feedstock. Alternatively, look for alternative sources of energy, and consider storing sufficient additional energy to meet the starting up requirements. While Ankur is energy-neutral once operational, it requires start-up power through an external source (e.g. diesel generator) if it has to lower its daily throughput to meet this segment’s capacity requirement</td>
<td>• Emphasize energy neutrality of the 25 KLD system and increase the energy efficiency of the 5 KLD system, which does not produce enough electricity even with the gas expander to offset 100% onsite electricity needs and hence needs some grid electricity to operate. Acquiring this electricity for continuous operations can be a challenge in this segment.</td>
</tr>
<tr>
<td>Low land requirement</td>
<td>• Emphasize low land footprint to show competitiveness of system in terms of total capex (incl. land cost) than most systems. The overall capex is very sensitive to land prices in hilly cities, where land is expensive. Frame inclusion of land price in terms of opportunity cost, which decision-makers increasingly realize as a valuable commodity. There is opportunity to reduce the land footprint closer to 200 ft² per KLD to outdo nearest competition • Communicate vertical stackability and improving land efficiency with increasing size propositions, as they are important considerations for this segment</td>
<td>• Emphasize that Ankur OP has one of the least land-footprints per KLD sludge treated. When land prices are combined with equipment capex, the Ankur OP becomes competitive. • Explore making product vertically stackable to remain competitive while scaling up, which is not possible with the existing product</td>
<td>• Emphasize that Duke OP has the smallest footprints per KLD sludge treated.</td>
</tr>
</tbody>
</table>

Strongest alignment with value proposition

Some changes required
Set out here are our recommendations for the OP to align with this segment (2 of 2)

**Value proposition**
- Integrated waste management: FS + MSW

**Recommendations: Tide Technocrats**
- **Conduct evaluative pilots** to understand the ability to treat MSW. Currently, Tide system takes in agricultural biomass to compensate for lack of solids

**Recommendations: Ankur Scientific**
- **Reconfigure system to position OP as a ‘single solution for a city’** that can process 100% FS and MSW available for treatment. Currently, the Ankur OP can process c. 55% of MSW available for treatment in this segment
- **Conduct study to assess cost benefits of treating MSW in the OP** vs other solutions and emphasize in communications
- **Develop ability to treat 100% FS** without MSW, to be able to respond to pure FSTP tenders

- Develop a scaled down version of Ankur or scaled up version of Tide, that can treat a significant portion of FS and MS (100 KLD and 100 TPD MSW), based on these

**What are other technical recommendations for OP to consider to serve this segment?**

- Adapt technology to treat fluctuating solid content
- **Ensure technology is adapted to treat fluctuating solid content of FS** since it can vary significantly in India (from 2% to 9%). E.g. the current Tide system in Warangal is rejecting 50% of FS because the solid content is around 8%, while it is designed to treat only 4-5% of solids. Similarly, the Ankur OP identifies the unpredictability in % solids at its plant as one of the major challenges, as it can go down to as low as 0.1%

- Test the climatic adaptability to hilly regions
- **Test for operations in hilly climate, or build features to insure against such elements.** Hilly cities often face heavy rainfall and occasional snow, causing operational issues for waste management. For example, the MSW plant in Shillong is dysfunctional because of rains.

“**The STP here will be unable to operate in colder climates, like in Jammu and Kashmir.**”
- STP operator in Indore
4 SMALL AND MEEK
<table>
<thead>
<tr>
<th>Segment need and size</th>
<th>Feasibility of the OP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
</tr>
<tr>
<td>Number of entities</td>
<td></td>
</tr>
<tr>
<td>Population covered</td>
<td>3524</td>
</tr>
<tr>
<td></td>
<td>Cities</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sewerage</strong></td>
<td></td>
</tr>
<tr>
<td>Average sewerage</td>
<td>11</td>
</tr>
<tr>
<td>Total STP capacity</td>
<td>N.A.¹</td>
</tr>
<tr>
<td></td>
<td>MLD</td>
</tr>
<tr>
<td><strong>Per city generation</strong></td>
<td></td>
</tr>
<tr>
<td>Average FS generated</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>KLD</td>
</tr>
<tr>
<td>Average MSW generated</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>TPD</td>
</tr>
<tr>
<td><strong>Total generation</strong></td>
<td></td>
</tr>
<tr>
<td>Total FS generated</td>
<td>15,325</td>
</tr>
<tr>
<td></td>
<td>KLD</td>
</tr>
<tr>
<td>Total MSW generated</td>
<td>19,050</td>
</tr>
<tr>
<td></td>
<td>TPD</td>
</tr>
</tbody>
</table>

**Access to finance**
- Complete reliance on state/national funds
- Own tax receipts are used up in running the ULB, and FSSM usually gets low priority on the ULB’s agenda
- FSSM can become a reality only if UDHD allocates funds for it

**Existing O&M ability**
- No capacity within ULB, and the presence of private players is very low. Some instances of MSW treatment, however, success has been limited

**Demand for end products**
- Some demand for manure, however, using untreated sludge is common practice and there is expectation that it will be provided for free
- Need for energy is high, and hence, additional energy produced by the OP can be a valuable proposition.²

---

Note: (1) Most cities below a population of 1 lakh do not have a sewerage system in place, however there could be some exceptions (2) This has been discussed separately as part of the end-product value proposition
Small and Meek | Preferred treatment solution

*FSM is the only choice for this segment, however, operational capacity makes this a challenge*

---

**Perceived possibility of expanding sewerage**

- Many towns are not 100% open defecation free. There is very little possibility of extending sewerage due to both capex requirement and operational complexities
- Almost 100% reliance on central/state funds - very low ULB capacity to operate sanitation systems; space is a constraint for both building septic tanks (many households are still connected to a pit latrine either with or without a slab) and desludging, making FSM a challenge
- Prioritizing FSM in these cities will be a factor of the state level ecosystem

---

**Interest in MSW**

- After Swacch Bharat Mission, the MSW collection is regularized in many small towns, with vehicles designated for specific areas
- However, there is no segregation and effective treatment. In fact, often there is no treatment due to lack of interest as well as lack of expertise
- Compared to bigger cities, land is easily available for open and unregulated dumping which is a common practice in this segment. However, after SBM, some improvement in the collection and transport of MSW is seen in these cities.

---

*Deep pit for fecal waste inside small homes in Fatuah*

*Garbage collection truck in Fatuah*
Small and Meek | Key drivers

Three key drivers will affect the choice of solution for this segment

1. **ULB capacity is very low, with significant reliance on state for financing and technical support**
   - Own resources of the ULB are very low and hence, there is complete reliance on non-ULB funds (e.g. central/state/private funding) for tech/infra capex, ULBs rely on state for capacity and decision making
   - Since O&M is the responsibility of the ULB, opex financing will be a challenge, due to low recovery rates and inadequate market linkages (e.g. towns like Dhenkanal have property tax collection efficiency rates of less than 40%)

2. **Ease and sustainability of operations are significant drivers in determining technology**
   - Technical expertise within the ULB itself may be low, most ULBs have 2-3 officials; in addition, due to low income and literacy rates, skilling potential operators might be a challenge
   - Additionally, not many private players are operating in these ULBs, not just in treatment, but also in collection and transport, making partnerships a challenge; sustainability of operations beyond initial support will be important, and an integrated service provider model may be suitable

3. **Energy availability is a challenge, making low running energy a key proposition**
   - Both access and reliability of energy is low (power outages are frequent, and last for a longer duration) in this segment, making low energy consumption for starting up and running a technology a valuable proposition. Due to lack of reliable grid electricity, the OP should continue relying on non-grid sources for start-up power (e.g. fuel) and explore having back-up generators
   - Additional energy produced by the OP can also potentially be a valuable proposition (if the quantity produced is deemed meaningful) due to the energy scarcity in this segment. However, there is a belief that such waste to energy systems only work on paper, and not in reality. Hence, it will be important to ensure proper working of these systems and managing the reputational risk
Energy neutral, tackling energy shortages with ease and reducing opex

- Both access to electricity and reliability are low due to frequent and longer power cuts. Average number of power cuts in a month are 10X times that of a Steady Roller, and the average duration is 7X times that of a Steady Roller. Minimum electricity consumption to ensure sustainability of systems is thus an important criteria for evaluating technologies.

Ease of operations and low Opex

- While the segment almost completely relies on state/national funds for funding capex, opex is the responsibility of the ULB, but the ULB's reserve of financial resources is limited since user recovery rates are very low. Moreover, own tax receipts are usually used up for other items that are seen as ‘higher priority’. Low opex to ensure sustainability of systems is hence a criteria for evaluation.
- Finding skilled operators is an added challenge in small cities, requiring innovative business models that mitigate against capacity constraints.

Average FS treatment capacity required: Less than 5 KLD

A clustered approach i.e., one system serving multiple cities can be considered for this segment since their average capacity requirement is less than 5 KLD. In case a clustered approach is adopted, the Tide OP can be considered too.

Note: (1) Ankur Scientific’s system in Vadodara was designed based on available biosolids from the 86 MLD STP, equal to 200 KLD at 4% total solids content. Energy input to the boiler is expected to be supplied by 8 TPD (4% of 200 KLD) biosolids, and 20 TPD of MSW. Where FS has lower solids content, additional dewatering and effluent treatment capacity will be required. Ankur has the ability to design a system for 30-1000 KLD at incoming TS content of 2-100%. Source: Dalberg analysis.
Small and Meek | Testing energy neutrality as the value proposition

Power cuts are most frequent and long, making these cities value low energy consumption

Power cuts in the Small & Meek and Hilly City segments are more frequent...

Average number of power cuts per month
Times per month, May 2018

<table>
<thead>
<tr>
<th>City</th>
<th>(Rising Metro)</th>
<th>(Steady Roller)</th>
<th>(Hilly City)</th>
<th>(Small &amp; Meek)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indore</td>
<td>1</td>
<td>12</td>
<td>69</td>
<td>126</td>
</tr>
<tr>
<td>Warangal</td>
<td>2</td>
<td>28</td>
<td>53</td>
<td>192</td>
</tr>
<tr>
<td>Srinagar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arambag</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

...and are also longer in duration. Hence, the OP cannot rely on energy intensive start-up everyday

Average duration of power cuts per month
Hours per month, May 2018

- Minimum electricity consumption is an important criteria for evaluation since sustainability of systems is key in smaller cities.
  - Expert, Odisha TSU

Source: Dalberg analysis
Small and Meek | Testing ease of operations and low opex as the value proposition
Finding skilled operators is difficult, after-sales service is a challenge and ULBs are cost-constrained

Skilled operators are few and difficult to find in smaller cities, and after-sales service is a challenge

“Finding skilled operators to operate the technology is really difficult in small cities.

- Technical Expert, Odisha TSU

“There is a lack of experienced technical players in small cities. Additionally, low accessibility to these cities reduces the possibility of good after-sales service.

- Expert

Smaller cities have lower user recovery rates, when compared to bigger cities in the same state

Property tax collection efficiency of cities in Karnataka (%)

<table>
<thead>
<tr>
<th>City</th>
<th>Property Tax Collection Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bhubaneshwar</td>
<td>74%</td>
</tr>
<tr>
<td>Dhenkanal</td>
<td>34%</td>
</tr>
</tbody>
</table>

**Source:** Dalberg Interviews; CEPT PAS, “Financing FSSM Services” (2018); Odisha Urban Infrastructure Development Ltd, “Benchmarking of Financials of ULBs”; Vidhi Centre for Legal Policy, “Financing ULBs in Karnataka” (2018)

‘People in smaller cities just don’t pay. The small amount of tax receipts collected also goes into items that are viewed as higher priority. FSSM is not of a high priority in that list. Hence, for selecting cities to install FSTPs in Karnataka, we have considered financial strength of the ULBs as an important selection criteria. This is to gauge if the ULB can sustain operations’

- Official, Directorate of Municipal Administration, Karnataka

(1) Rates vary widely across states too, as represented in the graph
(2) Property tax accounts for c. 30% of ‘own’ municipal revenues in India
(3) Population figures based on census 2011
## Small and Meek | Recommendations

*Set out here are our recommendations for the OP to align with this segment*

**How can the relevant OP product be most readily adopted to offer the value proposition for this segment?**

<table>
<thead>
<tr>
<th>Value proposition</th>
<th>Recommendations: Duke</th>
<th>Recommendations: Tide Technocrats</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy Neutral</strong></td>
<td>• Increase the energy efficiency of the 5 KLD system (which is the closest to the capacity requirement of this segment). The 5 KLD Duke OP does not produce enough electricity even with the gas expander to offset 100% onsite electricity needs and hence needs some grid electricity to operate(^1). Acquiring this electricity for continuous operations will be a challenge in this segment.</td>
<td>• Increase the energy efficiency or alter the source of energy for the Tide OP so that it can function in small towns with unreliable power supply. Tide system needs around 5-7 kWh for the system to run, which can cost INR ~25000 or USD ~370 a month. This is higher compared to other products in the OP portfolio, as well as other bio-digester based FSTPs</td>
</tr>
</tbody>
</table>

| Ease of operations and low opex | • Emphasize ease of operations as it is already containerized and requires one operator and one assistant to run the plant at any point of time. These operators can be diploma or ITI holders. Tide can help better the proposition and dial up the communication about ease of usage. | • Invest in process improvements to reduce opex as Tide’s opex is high compared to existing FSTPs |

---

Note: (1) The energy draw for the 5 KLD system is 40 Wh/pp per day (2) Co-fuel addition is necessary because the system is designed for 15% total solids content, and a calorific value of 15 MJ / kg. However, the solid content and calorific value of FS in India can be lower and hence, a co-fuel may need to be added to reach the required energy balance of the system
Other OP value propositions: High quality treatment and end-products do not seem to resonate strongly with the prioritized segments

1. Integrated waste management (FS, MSW, biosolids) – truly ‘omni’
2. Low land requirement for ease of scale up and lower overall capex
3. High quality treatment of solids with practically zero residual pathogens
4. Energy neutral machine, tackling energy shortages with ease and reducing opex
5. Simple and easy to operate and sustainable in the long run
6. Treats waste and produces saleable end products that can be sold, thus reducing opex
High Quality: While an OP’s quality of treatment is superior to other FSTPs, cities do not prioritize quality as an important criteria when selecting technologies

The OP is presumably the first FSTP in India to ensure 100% pathogen-free treatment for the solid component of FS

The OP has the following advantages compared to other FSTPs:

✓ Higher reliability due to use of physical processes, as opposed to biological treatment in the other systems

✓ Completely treats the solid component of the FS as well as biosolids from STPs, as opposed to stabilization on sludge drying beds, which is most widely used in a majority of other FSTPs. The OP has an added advantage of requiring less space

✓ 100% pathogen-free treatment due to treatment occurring in a controlled, mechanized environment

However, treatment quality is not a selection criteria for cities across segments, and tech-neutral tenders are increasingly common

Current bid evaluation criteria:

✗ Does not account for superior quality of treatment and places, undue emphasis on lowest cost

✗ Does not specify technology preference\(^1\) in most cases and at most uses meeting of certain prescribed guidelines for treatment and emissions as ‘checkboxes’ at the screening stage. E.g. plant must meet State PCB guidelines

✗ Does not include stringent regulations for the solid component (biosolids of STP or solid component of FS). The focus is entirely on the liquid component

---

\(^1\) In the few instances technology is specified, biological-based treatment is preferred

Source: Dalberg interviews; Dalberg analysis
End products: While the waste-to-value proposition is getting increased policy focus, weak market linkages, cheaper alternatives, and poor perceptions hinder its attractiveness (1 of 3)

Policy incentives

- **Energy generation from MSW incentivized**: MNRE is extending financial assistance to WtE projects (e.g. excise duty exemption, preferential tariff for grid-connected WtE projects), and WtE (waste to energy) projects can receive up to 35% of total project cost from the Centre under SBM.

- **Energy from sewage sludge gaining traction**: STPs in India are beginning to utilize biogas generated during anaerobic treatment for electricity generation. However, only 9% of this generation is currently being captured.

- **Renewable energy targets include WtE and biomass**: Financial incentives are provided for electricity generation from renewable sources, in addition to talks of preferential tariffs. Off-grid renewable energy targets for 2016-17 include 15 MW eq. from waste to energy, 60 MW eq. from biomass cogeneration, and 10 MW eq. from biomass gasifiers.

Challenges

- **Low quantity**: Quantity produced by the OP is so low that additional energy generation (beyond self-sufficiency of plant) is not seen as valuable.

- **Cheaper alternative**: Cost of renewable energy is more, and hence may disincentivize purchase of renewable energy. OP operators can consider offering a price either comparable or lower to the prices of available alternatives.

- **Weak RE regulations**: While every state is mandated to meet RPO norms, implementation has been weak and there is no certainty that renewables produced from the OP will be bought by the state DISCOMs.

Note: (1) Current generation is 275 MW from 33 WtE plants and potential is 1532 MW. This is based on the fact that there are ~253 STPs in India based on ASP and UASB technologies that do not currently produce energy during the treatment process. (2) Current generation is 41 MUs from 18 STPs, but the potential estimated is 335-448 MUs from 253 STPs. (3) Renewable Purchase Obligation - Regulatory commission in each state mandates a certain percentage of electricity generation from renewable sources. Source: “Sewage Treatment Market in India” and “Municipal Solid Waste in India”, India Infrastructure Research (2017); Ministry of New and Renewable Energy Annual Report (2016-17); World Resources Institute (2015).
End products: While the waste-to-value proposition is getting increased policy focus, weak market linkages, cheaper alternatives, and poor perceptions hinder its attractiveness (2 of 3)

Policy incentives


• **Wastewater re-use under Smart Cities Mission**: Wastewater re-use has been identified as a focus area under the SCM and hence is gaining more traction than before in bigger cities. E.g. Delhi supplies treated water to wash metro coaches and Bengaluru supplies treated sewage to the Airport.

• **National momentum to address extreme water stress**: NITI Aayog’s report\(^1\) stated that by 2030, India’s water demand is projected to be twice the available supply. Additionally, cities like Shimla and Bengaluru\(^2\) are under immense pressure to look for alternate sources of water supply due to the ongoing water crisis.

Challenges

• **Additional transport cost**: Transportation costs from source of generation to point of demand increases the price. E.g. A water park in Bengaluru has a huge demand for treated water, but is not willing to invest in pipelines to source the treated water.

• **Cheaper alternative**: Municipal or borewell water is much cheaper compared to treated water and hence, preferred. Moreover, some entities have an in-house water treatment plant. E.g. The Bengaluru Golf Course buys secondary treated water from BWSSB and treats it further at their own treatment plant. Therefore, even if one finds a buyer, one is likely not to get a higher price than current price of alternatives.

• **No quality assurance**: There is no body governing the quality of treated water sold to industries, and hence some buyers hesitate.

(1) Report on Composite Water Management Index, 2018 (2) 54% of India faces high to extremely high water stress

Source: "Sewage Treatment Market in India" and "Municipal Solid Waste in India", India Infrastructure Research (2017); Ministry of New and Renewable Energy Annual Report (2016-17); World Resources Institute (2015)

'We have installed STPs of 206 MLD capacity, but our main problem is how to use this treated water. We have given paper ads for private companies to come and take it, but the demand is limited'.

- Senior Official, Aurangabad Municipal Corporation
End products: While the waste-to-value proposition is getting increased policy focus, weak market linkages, cheaper alternatives, and poor perception hinder its attractiveness (3 of 3)

<table>
<thead>
<tr>
<th>Policy incentives</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biochar</strong></td>
<td><strong>Poor perception of biochar</strong>: Perception of by-products from thermal treatment technologies is low. Environmentalists advise against burning of waste since it removes the nitrogen, which is a crucial component of soil conditioners. Other alternatives like manure as a result of co-composting is considered to be superior in quality</td>
</tr>
</tbody>
</table>

• **Push for compost from waste under SBM**: Under the SBM (U), the Ministry of Chemicals and Fertilizers in collaboration with MoUD is promoting ‘city compost’, which will allow ULBs to market compost from waste directly to farmers and claim market development assistance of INR 1500 or USD ~ 22 per tonne. MoUD will help ULBs to market the compost.

• **Cheaper alternative**: Farmers are used to applying untreated sludge on their farms free of cost

• **Lack of knowledge**: There is a lack of knowledge among farmers about the benefits of using FS-based manure and on specific types of crops (like non-edible flowers). Farmers need to be educated on how and why this works

Source: "Sewage Treatment Market in India" and "Municipal Solid Waste in India", India Infrastructure Research (2017); Ministry of New and Renewable Energy Annual Report (2016-17); World Resources Institute (2015)
**End-products:** As a result, the waste to value proposition is not a priority for segments, and efforts to sell end-products in the past have borne mixed results

ULBs view revenue generation from end-products only as an added benefit, and not as a deciding factor while evaluating technologies. This is driven by three reasons:

1. **Waste treatment is viewed as purely a public good**
   
   “Commercial viability argument is not valid for governments. Sanitation and water supply is a need for everyone, it is the government’s responsibility to provide for it.”
   
   - Karnataka Pollution Control Board

2. **Efforts to sell end-products have borne mixed results in the past**

   “Under SBM, we were mandated to sell co-composted manure to a company nearby. But they refused to buy it since it was considered inferior in quality”
   
   - Architect, Meghalaya Urban Affairs Department

3. **Uncertainty in sale causes hesitation to guarantee revenue while forming the DPR**

   “In the DPR for FSTPs, revenue from by-products will have to be mentioned and what if this is not met? Anyone can question us.”
   
   - Senior Official, Karnataka Urban Water Supply and Drainage Board

Note: (1) OP also has to also compete with existing technologies that produce similar end-products. E.g. (i) **Electricity:** waste to energy plants that process MSW and energy recovery from STPs through biogas generated during the treatment process; (ii) **Manure:** bio-digester systems that produce high quality manure, especially when co-composted (OP’s biochar is perceived to be of lower quality since it is only a soil conditioner produced using pyrolysis, which is said to remove the Nitrogen from FS, an important soil nutrient; (iii) **Water:** water recovered from STPs and tertiary water treatment plants that can be used for industrial purposes
What this section covers

A. Technical considerations

B. Commercial considerations

C. Ecosystem considerations
1 TECHNICAL CONSIDERATIONS
Technical recommendations: Develop a product to address the missing middle problem

NOTE – CURRENT SIZES SHOWN MAY HAVE CHANGED SINCE INITIAL ANALYSIS

Size: Develop a product to address the missing middle problem (~ 100 KLD)

Rough estimation of segment need

- Rising Metro
- Hilly City
- Steady Roller
- Small and Meek
- Tide technocrats
- Ankur Scientific

Darker shades represent stronger needs

Capacities in KLD

- Competition (operational and under construction)
- OP

Note: (1) Ankur Scientific’s system in Vadodara was designed based on available biosolids from the 86 MLD STP, equal to 200 KLD at 4% total solids content. Energy input to the boiler is expected to be supplied by 8 TPD (4% of 200 KLD) biosolids, and 20 TPD of MSW. Where FS has lower solids content, additional dewatering and effluent treatment capacity will be required. Ankur has the ability to design a system for 30-1000 KLD at incoming TS content of 2-100%

Source: FSTP Database as of 8 June 2018, compiled by KPMG India and NFSSM Alliance, and Dalberg interviews with stakeholders
### Technical recommendations: Reconfigure systems to position the OP as a single ‘omni’ solution for a city, reflecting the city’s MSW needs

#### Size: For segments, where FS+ MSW is a value proposition, develop a product / reconfigure existing products to treat the appropriate MSW, reflecting the city’s needs

#### Average MSW and FS by mass (TPD)

<table>
<thead>
<tr>
<th>Segment</th>
<th>Average MSW (TPD)</th>
<th>Average FS (TPD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rising Metro</td>
<td>16</td>
<td>23</td>
</tr>
<tr>
<td>Steady Roller</td>
<td>29</td>
<td>4</td>
</tr>
<tr>
<td>Hilly City</td>
<td>217</td>
<td></td>
</tr>
</tbody>
</table>

The OP is currently designed to treat 20 TPD of feedstock, which already covers 100% FS and a significant amount of MSW available for treatment for the Steady Roller and Hilly City segments.

#### Recommendations

- **For Steady Roller and Hilly City:** Reconfigure system to position OP as a ‘single solution for a city’ that can process 100% FS and MSW available for treatment.

- **For Rising Metro:** Conduct study to determine amount of MSW treatment that will be considered valuable. The Ankur OP currently maintains minimum 15% MSW of overall dry sludge quantity, but the upper limit is not known and can be configured based on a city’s needs.

- **For all segments:** Determine cost benefits of treating MSW in the OP vs other solutions currently adopted by the city (if any), and emphasize in communications.

Assumptions:
1. Total FS and MSW generated in a city is collected and can be transported to the OP.
2. 51% of MSW is organic and hence, can be processed in the OP.
3. 20% of total MSW generated in a Rising Metro city is treated and hence does not come to the OP. Treatment capacity of other segments is zero.
4. TS % of FS=3%, TS of MSW=53%
5. Average MSW and FS values for each segment are based on the calculations used for sizing segments, as displayed in the segment profiles in the annex.
Technical recommendations: Consider process automations to make the OP an “FSTP in a box”

Process and form factor: Reconfigure the OP to become a plug and play system or an “FSTP in a box”

Operational challenges are one of the most important reasons behind limited sustainability of sanitation treatment plants

In its current design, while Tide is easy to operate, Ankur OP is not

“Technology is not a problem. Our main problem is self-service. Many innovative technologies in the past have been brought to Shillong but have now had to shut since they were not able to sustain operations here due to lack of technical players within the area, constant power outages and poor after-sales service.”
- State AMRUT Head, Meghalaya

“Technology is really difficult in small cities”
- Technical Expert, Odisha TSU

“Finding skilled operators to operate the technology is really difficult in small cities”
- Technical Expert, Odisha TSU

“You only need 1 operator and 1 assistant to run the plant at any point. The operators only have to be diploma or ITI holders”
- Tide Technocrats

“The 200 KLD Ankur OP needs ~8 operators (1 mechanical supervisor, 1 electrical supervisor, 1 technical supervisor and 4-5 semi skilled laborers). If there is a pre-processing facility, you need 1 additional mechanical supervisor, 1 additional electrical supervisor and 2 additional laborers.”
- Ankur Scientific

Reconfigure Ankur OP to become a ‘plug and play system’, and introduce additional process automations for Tide, this will make it attractive for segments which value ease of operations

Note: (1) The Ankur system in Vadodara includes a MSW gasifier along with the OP, which requires additional resources
Source: Stakeholder interviews and Dalberg analysis
**Technical recommendations: Adapt technology to meet the special needs of the Indian market**

<table>
<thead>
<tr>
<th>Step</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td><strong>Adapt technology to treat fluctuating solid content</strong></td>
</tr>
<tr>
<td></td>
<td>Solid content of FS in India can vary significantly i.e., from 2-9% and can go as low as 0.5% in some areas. Ensure that the OP is adapted to deal with these variations to ensure smooth operations.</td>
</tr>
<tr>
<td>5</td>
<td><strong>Test climatic adaptability in hilly regions</strong></td>
</tr>
<tr>
<td></td>
<td>Test for operations in hilly climate, or build features to insure against such elements. Hilly cities often face heavy rainfall and occasional snow, causing operational issues for waste management.</td>
</tr>
<tr>
<td>6</td>
<td><strong>Eliminate components which are only there for generating by-product revenue</strong></td>
</tr>
<tr>
<td></td>
<td>Although revenue from end-products has the potential to increase revenue, it will take time for markets to develop. The OP can explore eliminating parts which are there for generating by-products only, until a robust market for end-products is established. E.g. Parts to make the distilled water potable.</td>
</tr>
<tr>
<td>7</td>
<td><strong>Conduct evaluative pilots to understand range of inputs all the OPs can process</strong></td>
</tr>
<tr>
<td></td>
<td>Integrated waste management as a value proposition resonates with many segments. Thus, conduct pilots to determine the range of inputs the different OP variants can process. E.g. Tide OP’s ability to accept MSW, and biosolids.</td>
</tr>
</tbody>
</table>
**Technical recommendations: Invest in making continuous improvements to the unique value propositions that the OP offers**

<table>
<thead>
<tr>
<th>8</th>
<th>Explore advanced dewatering technologies that allow for a FS + Biosolids only processing facility</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Consider making the OP vertically stackable</td>
</tr>
<tr>
<td>10</td>
<td>Determine ways to reduce start-up and operational energy requirements</td>
</tr>
<tr>
<td>11</td>
<td>Invest in process improvements to reduce opex</td>
</tr>
</tbody>
</table>

**Biosolids treatment** can be a promising value proposition for cities that have STPs. Advanced dewatering technologies can help increase amount of biosolids that the OP can process, and is important as STPs increase in size and/or capacity utilization.

**Low land footprint** is a unique advantage to the OP, and is highly valued by cities that are land crunched. Many cities in India are experiencing high growth and are looking for systems that are easy to scale up. A vertically stackable system can help improve land efficiency as the system is scaled up.

**The Hilly City and Small and Meek segments** experience frequent power outages, and are looking for systems that consume the least power. Invest in reducing start-up energy requirements of the OP, explore alternative non-grid sources to power the OP, consider storing sufficient additional energy to power next day’s operations, and make all the OP’s energy-neutral.

**Opex financing** is primarily the responsibility of the ULBs in India. ULBs in all segments, except for Rising Metros are not as financially strong. Lower opex can thus create a unique competitive advantage for OP. Additional process improvements, beyond automations may help reduce opex.
COMMERCIAL CONSIDERATIONS
Sales and Marketing: Separate tenders for construction and O&M, success stories, and considering longer duration O&M will be crucial for favorable evaluation and selection

<table>
<thead>
<tr>
<th>Findings</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Bulk contracting is becoming the norm: Andhra Pradesh plans to install 78 FSTPs in its ULBs through a state level RFP, for other cities with limited capacity, cluster level decision making is becoming increasingly common</td>
<td>• Enhance technical and financial capacity of existing providers to be able to respond to bulk tender requirements, along with marketing efforts that help establish a credible India presence</td>
</tr>
<tr>
<td>• Prior experience is important: Technical sanctions from state level agencies in two-stage bids include completion certificates and prior experience of bidders. E.g. OP was not allowed to bid for the 3 KLD Madikeri FSTP tender since it did not have a completion certificate and the tender for 78 Andhra Pradesh FSTPs has highlighted a preference for companies that have built at least 2 FSTPs of 20 KLD in the past</td>
<td>• Pilots are needed not only to become visible, but to also get technical sanctions from state nodal agencies and other requisite certificates; demonstration effect will be important</td>
</tr>
<tr>
<td>• Tech neutral tenders are increasingly common. However, current tenders do not emphasize the quality of the treatment, which is where the OP can out-perform incumbent technologies</td>
<td>• Advocate for more stringent quality standards for solids discharged from FSTPs. This is an area where the OP can outperform other technologies</td>
</tr>
<tr>
<td>• Privatization in urban infrastructure provision is increasing, and the duration of O&amp;M contracts is increasing from ~3 to ~10 years</td>
<td>• Consider implications on cost and ease of contracting for a longer duration</td>
</tr>
</tbody>
</table>

Note: (1) In general, bids are evaluated on technical basis, and only the ones that pass the technical round, are evaluated on financial basis (2) Please refer to the RTI Segmentation Excel Database shared by Dalberg that has a list of a few recent FSTP tenders to get more details on the kind of specifications in tenders

Source: Field visits; Dalberg analysis
Commercial recommendations: These span the business value chain from manufacturing to partnerships

- **Manufacturing:** What manufacturing considerations should commercial partners consider?
- **Pricing:** What do comparative solutions cost and what is an optimal price range for an OP?
- **Financing:** What are the most effective financing mechanisms for an OP?
- **Business models:** What are some emerging innovative models that an OP can consider?
- **Sales and marketing:** What are the marketing opportunities that an OP should consider?
- **Partnerships:** What kind of partnerships can enhance the business proposition for an OP?
### Challenges

- **Custom manufacturing required for segments:** Different locations have different requirements for various components, depending on the input and environmental conditions, requiring custom manufacturing.

- **Need for local manufacturing:** For the system costs to be viable, local manufacturing is preferable compared to receiving components from regional manufacturers and assembling them locally, given the high shipping costs. At the same time, local manufacturers might not be easy to find.

- **Limited availability of equipment manufacturers:** Tenders currently specify biological technologies, which require a lot of civil construction. As a result, it is easy to find civil construction vendors, but not as easy to find machine manufacturers.

- **Insufficient capacity:** Manufacturers may not have adequate throughput capacity to meet market demand, especially if it picks up too fast.

- **Lack of prioritization:** Since only one or two pieces need to be made and these are not off the shelf items, the orders are not prioritized.

*You cannot homogenize local and input conditions nationally, so you cannot homogenize the OP components* — Indian Vendor

### Recommendations

- **Focus on sourcing locally, state level** suppliers when possible, to reduce shipping costs. However, this will need to consider the costs and logistical challenges involved in setting up state level supply chains and how that might affect ease/cost of manufacturing.

- **Homogenizing components does not seem possible** right now, as more and more local conditions need to be understood. **Work with a supplier that can potentially scale** as the OP scales.

- **Explore collaborations with big brands (such as L&T, Veolia)** that can take the financial burden of manufacturing individual components until the OP scales.

- **Identify supply chain partners who can increase their efficiency/throughput capacity easily** to meet increased demand, and/or look for additional partners to meet the additional demand.

- **Conduct a separate study to assess the manufacturing cost at scale,** and explore whether local manufacturing or procurement can help reduce costs.

Source: Stakeholder interviews and Dalberg analysis
Financing: There are five key archetypes that can be considered for financing treatment solutions

1. **Private, recovery sourced from HHs (Integrated):** Private operator funds plant capex and recovers from the govt. through a PPP contract or from desludging charges. Same player operates the plant and collects desludging charges from the HHs to finance opex, either indirectly or directly through the govt.

Models are shifting from predominantly government financed, to greater participation of private operators, for both capex and opex (e.g. Hybrid Annuity Model is being applied for 78 FSTPs in the state. The private player shares upfront cost with the government and undertakes construction, O&M on a DBOT basis)

2. **Private, recovery from commercial sources/market:** Private operator funds capex fully or partially, operates the plant and collects revenue from reuse products and potentially tipping fees paid by C&T operators to finance opex.

3. **Phil. capex, private operator, recovery from commercial sources/market:** Philanthropic funders support capex, private player operates and collects revenue from sale of reuse products and potentially tipping fees to finance opex.

4. **Govt. or Phil. capex, private operator, recovery from non-commercial sources:** Philanthropic funders support capex, private player operates the plant and opex is financed through non-commercial sources such as government or philanthropic funders.

5. **Govt. capex, private operator, recovery from HHs:** Govt. funds capex, private operator operates the plant and opex is financed by collecting taxes/user charges from HHs, either directly or through the government.

**Financing:** Currently, OP commercial partners rely on philanthropic capex funding and recovery from non-commercial sources

<table>
<thead>
<tr>
<th>Wai</th>
<th>Narsapur</th>
<th>Warangal</th>
<th>Vadodara</th>
</tr>
</thead>
</table>
| **CAPEX**  
• Plant capex funded by BMGF, with a private player to design, build and operate the plant (DBOT). | **CAPEX**  
• BMGF has provided a grant to Tide Technocrats for the FSTP | **CAPEX**  
• FSTP using pyrolysis technology is being funded by BMGF, under a DBOT model | **CAPEX**  
• The Ankur OP, an OP solution coupled with a MSW gasifier is currently being set up inside the STP premises, funded by BMGF |
| **OPEX**  
• Tide Technocrats has a 1 year O&M contract, funded by BMGF  
• Plant O&M is planned to be funded through sanitation/property tax in the future | **OPEX**  
• One year O&M (funded by BMGF) is built into the contract with Tide Technocrats. The FSTP will be manned by five staff members, hired by Tide.  
• Only licensed operators are allowed to deposit faecal sludge at the FSTP | **OPEX**  
• The plant is being operated by Tide, with BMGF providing opex for the FSTP for the initial year | **OPEX**  
• The plant will be operated by Ankur, the land has been provided by the municipal corporation, while BMGF is funding the operational expenditure for a stipulated time period |

Financing: However, to address concerns of financial sustainability, the OP portfolio should prioritize two financing mechanisms (1/2)

<table>
<thead>
<tr>
<th>Private, recovery sourced from HHs (Integrated)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Why we recommend this for the OP</strong></td>
</tr>
<tr>
<td>• <strong>Recommended segments</strong>: Steady Roller, Hilly City, and Small and Meek</td>
</tr>
<tr>
<td>• <strong>Rationale</strong>: (i) <em>Can reduce the capex burden</em> for governments, making it an attractive value proposition for OP to sell; (ii) <em>Allows cross subsidization</em> of the loss making treatment stage with the profitable C&amp;T stage; (iii) <strong>Sustainable plant operations as the reliance</strong> on market linkages and opex recovery is low and (iv) <strong>Incentivizes safe disposal</strong> of collected FS since there is an integrated player</td>
</tr>
<tr>
<td>• <strong>Example</strong>: Blue Water Company (BWC) operates two trucks provided by the ULB, and has constructed and operates an FSTP in Leh, charges INR 1000 to households per year, treatment is partly funded by the desludging fees</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Barriers</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Currently, <strong>the OP tech and commercial partners have limited capacity</strong> to operate in the collection and transport part of the value chain, hence, will initially have to explore partnerships with existing players, and have a cost-revenue sharing arrangement, and eventually, build capacity</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Next steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Engage in <strong>advocacy efforts for scheduled desludging</strong>; it may be more conducive for integrated players given that it offers predictability of operations in C&amp;T</td>
</tr>
<tr>
<td>• Use <strong>market information and subtle nudges along with technical assistance</strong> to build capacity for OP providers who are willing and able to actively participate in both stages</td>
</tr>
<tr>
<td>• <strong>Improve ULB capacity to monitor private operations</strong>, collect and analyze septic tank data, design equitable tariffs, enforce and collect tariffs</td>
</tr>
</tbody>
</table>

Source: Field visits, Dalberg analysis
Financing: However, to address concerns of sustainability, the OP portfolio should prioritize two financing mechanisms (2/2)

<table>
<thead>
<tr>
<th>Govt. CapEx, private operator, recovery from HHs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Why we recommend this for the OP</strong></td>
</tr>
<tr>
<td>- <strong>Recommended segments</strong>: Rising Metro and Steady Roller</td>
</tr>
<tr>
<td>- <strong>Rationale</strong>: (i) Government funding for monthly O&amp;M costs is unlikely to be available beyond initial operations, due to limited interest in FSM; (ii) In the more advanced STP market, user fee/taxes have seen signs of success in bigger cities, or cities with a positive eco-system</td>
</tr>
<tr>
<td>- <strong>Example</strong>: The Bengaluru Water Supply and Sewerage Board introduced a sanitary cess to its water bills to finance the treatment part of the value chain, the collection rate is close to 100%, with INR 102 crores collected annually in levies/taxes; the city of Warangal has over 90% property tax collection, and is considering adoption of a slight hike in user fee to account for treatment costs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Barriers</th>
</tr>
</thead>
<tbody>
<tr>
<td>- A majority of ULBs struggle with tariff recovery from households, and the initiative is also seen as politically unpopular, with limited interest to implement/incorporate new forms of levy/tax</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Next steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Engage in significant policy and advocacy efforts to help ULBs incorporate the cost of treatment within tax recovery from households</td>
</tr>
<tr>
<td>- Improve awareness of households on the need for sanitation treatment</td>
</tr>
<tr>
<td>- Help ULB improve its capacity for enforcement and collection of tariffs</td>
</tr>
</tbody>
</table>

Source: Field visits, Dalberg analysis
Business models: An integrated business model for both different components of the FSM value chain, and MSW are recommended for OP commercial providers to consider

<table>
<thead>
<tr>
<th>Players &amp; profitability</th>
<th>Funding</th>
<th>Ecosystem levers that can help drive this model include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Currently dominated by non-profit and government funding since there is limited commercial return potential and technologies are in an early stage (and thus are seen as high risk)</td>
<td>• Capex is typically provided by government or philanthropy</td>
<td>(i) Licensing and monitoring of operators to ensure feedstock is transported to the treatment plant, instead of nearby open grounds</td>
</tr>
<tr>
<td>• Integrated models offer efficiencies, convenience, and easier contracting, with the same player responsible for operations across the value chain</td>
<td>• Opex is huge and recovery is limited. This is because ULB finances are weak and in cases where philanthropy funds the Opex, it is usually for a limited time (while demonstrating the viability of pilots), and the reuse revenue is limited due to market linkages being in early stage</td>
<td>(ii) Scheduled desludging and minimum volume agreements between ULB and integrated service providers to guarantee profitability through volumes, even if profitability per HH reduces (if fee charged per HH is the same as before, but treatment costs are added)</td>
</tr>
<tr>
<td>• High level of private participation reflects the high profitability in C&amp;T, and available capacity with the private players. The profitability from C&amp;T can be used to partly finance treatment, which the OP can benefit from</td>
<td>• Cities are contracting service providers to collect MSW and transport it to landfills, such service providers are likely to be interested in exploring partnerships with the OP. Currently, there are no known models which involve a ‘tipping fee’ structure for landfill operators, when MSW is deposited. Waste collectors are paid on a per kg basis to take the MSW from the source to the transfer station to the landfill.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standalone treatment</th>
<th>Integrated model (C&amp;T + Treatment, FS+ MSW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Integrated models offer efficiencies, convenience, and easier contracting, with the same player responsible for operations across the value chain</td>
<td>• Opex recovery for C&amp;T is typically from specific taxes, tariffs or user charges, with rare instances of government grants or philanthropic funds, a bundled price can be implemented efficiently</td>
</tr>
</tbody>
</table>

Note: (1) Dalberg Report on FSM business model landscape for CEPT estimates that the Opex for treatment seems to be larger than amortized Capex by 2-4 times; (2) Integrated models will offer easier contracting because it will reduce the number of contracts for a ULB and will ease management costs. Lucrative for (typically larger) treatment operators to bid either independently or in partnership with local collection operators. This could become the norm over time as more cities adopt. (3) A tipping fees model was planned for Bhubaneswar in Orissa, but didn't take off (4) This is because treatment costs are added, but fee charged per household may remain the same. Source: Dalberg interviews; Dalberg analysis

Similar integration and partnerships should be forged with players in the MSW value chain. Increasingly cities are contracting service providers to collect MSW and transport it to landfills. Many cities, such as Aurangabad, are struggling as the landfills are closed. These service providers are likely to welcome partnerships with the OP
**Sales and Marketing:** Big cities rely on trusted consultants for discovering technologies, while small cities depend on state-level nodal organizations for technical know-how and decision-making.

**Top-down approach:** Approach state UDHD of state to target the state/segment as a whole

**Bottom-up approach:** Approach city ULB to target a particular city

<table>
<thead>
<tr>
<th>Rising Metro</th>
<th>Hilly City</th>
<th>Steady Roller</th>
<th>Small and Meek</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Urban Development and Housing Department</td>
<td>AMRUT Officer and national institutes like CSE</td>
<td>State Urban Development and Housing Department, if ULB capacity is weak</td>
<td>State Urban Development and Housing Department</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Municipal Corporation and Water Supply and Sewerage Board</td>
<td>Consultants, institutes like CSE, and elected representatives¹</td>
<td>Consultants, elected representatives¹ and national institutes like CSE</td>
<td>Decision-makers to target</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Influencers to get buy-in from</td>
</tr>
</tbody>
</table>

**Successful pilots, especially in large metros, exemplary cities, or state programs are the easiest way to attract attention of decision makers and influencers. Advocacy via well renowned organizations trusted by the government are important as well (e.g. CSE, CEPT)**

---

(1) Officials such as Mayor, MLA
Source: Field visits; Dalberg analysis
Branding: Emphasize liquid treatment and differentiate between pyrolysis and uncontrolled incineration in communications

- Local government officials prioritize liquid treatment, when considering a sanitation management solution. For instance, they emphasize black water treatment, when talking about an FSTP.

- In fact, there is no legislation for treatment of FS solids. Tenders only specify treatment parameters for FS solids (e.g. technology should guarantee dryness of sludge between 20-25%).

- The OP variants emphasize the treatment of solids, but effective treatment of blackwater with the septic tank sludge needs to be communicated better. Most tenders specify the BOD and COD limits of liquids.

Source: Stakeholder interviews and Dalberg analysis
**Branding:** The current branding for OP systems needs to reflect the comparative advantage considering the competition and the needs of the market

---

**For Ankur OP**

- Highlight that it has one of the lowest land footprint per KLD of sludge treated. When land prices are combined with equipment capex, the OP becomes competitive.

- **Emphasize on low opex.** Out of the 19 FSTPs studied, Ankur’s opex is the third cheapest on a per KLD basis.

- **Focus on biosolids treatment.** More than 90% STPs in India are less than 75 MLD and Ankur can treat significant portion at 1:1 ratio of FS:biosolids. Additionally, demonstrate capex reduction through land and time saved, adaptability in monsoons and ability to recover water from sludge through bio-solid treatment in the OP.

- **Emphasize on energy neutrality of the systems.** A self-sufficient system is highly valued by decision-makers due to both the high energy costs and low reliability of constant energy supply in some segments (e.g. Small and Meek, Hilly City).

---

**For Duke OP**

- Highlight that it has the lowest land footprint in comparison of all the known FSTPs that are operational and under construction in India.

---

**For Tide OP**

- **Emphasize on ease of operations** as it is already containerized and requires one operator and one assistant to run the plant at any point of time. These operators can be diploma or ITI holders. Tide can help better the proposition and dial up the communication about ease of usage.

- **Stress on vertical stackability.** As the city’s treatment capacity need increases, Tide OP can be easily scaled up due to its vertical stackability.
Brand: As the market for end-products improve and become more viable, the OP could explore strengthening positioning as a wastewater reuse tech and other measures

1. Emphasize the OP as a wastewater re-use technology
   - As re-use is picking up, the market is looking for technologies that can convert wastewater into usable water
   - E.g. Delhi has adopted aspirational reuse targets to treat and reuse 50% of total sewage produced by 2022, and to 80% by 2027. Bengaluru’s water utility has built a 10 MLD tertiary treatment plant at Yallahanka that supplies reclaimed water to Bengaluru International Airport

2. Focus on sale to select industries and build sale into upfront contracts
   - Industrial demand is expected to increase, and supply to decrease
   - Industrial demand: 3.7X in Energy sector, 2.2X in Manufacturing sector

3. Make price of water competitive
   - Given that the range of price available for industries currently is USD 0.78 – 0.83 per KL, price industrial water for the end user at least that USD 0.76 per KL to be competitive.

4. Bundle delivery cost and subsidize upfront
   - The transportation of reclaimed water to end-users increases cost for end-buyers either in the form of trucks, pipelines or any other medium. E.g. it is estimated that, on a non-undulating surface, laying pipelines to transport the reclaimed water would cost approximately 0.46 million USD per km. In addition, further costs will be incurred for the O&M of the pipelines. These high costs erode the cost advantage of reclaimed water over standard piped water supply from the utility. Land gradation between the treatment plant and customers can increase these costs further.

   - Hence, bundle delivery cost with treatment, and explore subsidizing cost of delivery either upfront or through annuity payments to the private operator

Note: (1) Sourced from “Closing the water loop: Reuse of treated wastewater in urban India”, PWC (2016) (2) Assumes the annual utilizable freshwater remains the same over the next 34 years, and takes into account growing human demand (3) Refers to municipal water supplied by utilities. Source: “Closing the water loop: Reuse of treated wastewater in urban India”, PWC (2016); Dalberg Interviews; Dalberg analysis
Branding: This could also include investing in targeted communication to incentivize purchase of biochar and enter into bulk contracts for sale of electricity.

**Biochar**

1. **Refine communication**
   - Emphasize biochar being a soil enricher/amendment, and not a fertilizer to avoid inaccurate comparison with fertilizer as observed on the field.
   - Invest in communication to make end-users understand the benefits of applying biochar.

2. **Work closely with end-users**
   - Engage end-users i.e., farmers in the pilot stage to showcase change in yield by applying the biochar. E.g. Devanahalli FSTP worked with farmers who used raw FS earlier and asked them to use treated sludge to witness increase in yield. This not only helped them increase the quantity sold, but also increase the price gradually.

**Energy**

1. **Enter into bulk contracts with city/state DISCOMs**
   - Electricity distribution is controlled by the State in India and hence, can be a potential bulk buyer of the electricity produced by an OP. Emphasize the OP’s ability to help the city/state meet their RPO targets⁴.
   - In cases where the OP is co-located with an STP, forge a contract with the STP operator as an OP can lead to energy savings for the STP².

2. **Research capex implications of energy neutrality**
   - While the hilly city and small and meek segments value energy neutrality, technical configurations made to the OP to achieve this can add to upfront capex costs. Research to identify additional capex burden and willingness of the segments to pay.

---

“The general public is already purchasing fertilizer, and hence convincing them to use an additional enhancer can be a challenge...If it can be shown to farmers that the yield will increase, then there will be adoption. Just pamphlets and TV ads are not enough.”

- State AMRUT Head, Meghalaya

“More than 50% of O&M cost for an STP is due to electricity. Thus, if co-locating an OP with the STP can lead to significant savings, it will be highly appreciated.”

- Senior Practice Lead, Indian Institute of Human Settlements

---

Note: (1) Renewable Purchase Obligation - Regulatory commission in each state mandates a certain percentage of electricity generation from renewable sources (2) Electricity comprises of 40-50% of an STP’s monthly O&M costs
**Partnerships:** Apart from a rational needs assessment, four kinds of diffusion processes help adoption of waste treatment technologies like the OP at scale

| Emulation | • Cities tend to emulate other role model cities. For larger Indian cities, this means emulating global best practices often assuming that these “best practices” will work effectively in a very different context  
• Smaller cities tend to emulate practices and processes within big cities |
| Learning | • Cities often search for technology “selectively” with confirmation bias implicitly built in  
• Decision makers visit conferences, seek out research that validates what they want to hear (which for larger and medium sized cities, is most often STPs)  
• ULB decision makers also visit “model cities” for learning from each other. For example, many administrators are visiting Allepey and Indore, model cities in MSW management, to understand how to incorporate their practices |
| Competition | • Cities are under pressure to create plans that will entitle them to funding from the Center as well from State governments  
• Budgets are likely to get reduced in case big-project spending does not take place on time in programs such as AMRUT. For example, if a city does not exhaust its budget for this year, its budget will be curtailed next year |
| Coercion | • The last few years have seen a very centralized push to improve toilet coverage in India under the SBM  
• 2019 onwards, the focus is expected to shift to waste management and States might ask cities to implement universal waste management |
Partnerships: Apart from ULBs, four categories of partnerships will be the most important to consider for successful uptake, given the different kinds of diffusion

<table>
<thead>
<tr>
<th>Partnerships</th>
<th>Funders</th>
<th>Decision makers</th>
<th>Influencers</th>
<th>Commercial partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rising Metro</td>
<td>ULB, Ministry of Housing and Urban Affairs (MoHUA)</td>
<td>ULB (strong ULB capacity), State Urban Development and Housing Department (UDHD)</td>
<td>Consultants and institutes like CSE and NIUA, State Urban Development and Housing Department (UDHD), Elected representatives</td>
<td>Who: Large established companies like L&amp;T, Ramky, VA Tech, etc. which have experience in wastewater, sewage and effluent treatment and typically undertake large infrastructure projects. How to induce interest: large bulk contracts at state level, large scale projects in rising metros.</td>
</tr>
<tr>
<td>Hilly City</td>
<td>ULB, Ministry of Housing and Urban Affairs (MoHUA)</td>
<td>Urban Development and Housing Department (UDHD)</td>
<td>AMRUT officer, National institutes like CSE and NIUA</td>
<td>Who: Remote location makes private sector engagement difficult, can explore proximate players (e.g. ETP operators for hospitality industry). How to induce interest: Access to SME capital for would crowd-in several operators, backed by guarantee mechanisms.</td>
</tr>
<tr>
<td>Steady Roller</td>
<td>ULB, Ministry of Housing and Urban Affairs (MoHUA)</td>
<td>ULB, Urban Development and Housing Department (UDHD)</td>
<td>Consultants and institutes like CSE and NIUA, Elected representatives</td>
<td>Who: EPC companies like Ramky, VA Tech, Local private operators with de-sludging contracts (to source FS load). How to induce interest: Introduce large bulk contracts at state level.</td>
</tr>
<tr>
<td>Small and Meek</td>
<td>Ministry of Housing and Urban Affairs (MoHUA), Philanthropic organizations, State Urban Development and Housing Department (UDHD)</td>
<td>Urban Development and Housing Department (UDHD), ULB and the Town council, Influential individuals</td>
<td>Directorate of Municipal Administration (DMA), Elected representative</td>
<td>Who: Local contractors who usually get most of the infrastructure projects in the region. How to induce interest: Access to SME capital could crowd-in several operators.</td>
</tr>
</tbody>
</table>

Source: Dalberg analysis; We have included details of some direct and proximate players in the Annex.
ECOSYSTEM CONSIDERATIONS
Ecosystem recommendations: Four ecosystem recommendations can be considered

- Improving overall financing
- Influencing through policy and advocacy
- Strengthening private sector engagement
- Investing in awareness and capacity building
Improving Financing: Overall funding required for universal FSM in India is just ~5% of total available funds, however it needs “unlocking” through advocacy and policy

Rough estimate of funding pools and required funding for FSSM in India for the next 10 years

*Amounts in INR crore*

<table>
<thead>
<tr>
<th>Source</th>
<th>Central funds¹</th>
<th>State funds²</th>
<th>ULB finances³</th>
<th>Philanthropic funding⁴</th>
<th>Private investment⁵</th>
<th>Total funds available</th>
<th>Funding required⁶</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ULB finances</strong></td>
<td>281,000</td>
<td>421,001</td>
<td>163,680</td>
<td>10,000</td>
<td>3,250</td>
<td>878,931</td>
<td>45,024</td>
</tr>
</tbody>
</table>

Notes: (1) Includes SBM – Urban, AMRUT, SCM, Namami Gange and HRIDAY; funding numbers sourced from respective websites; (2) Includes a part of state budget for urban development and housing, state contribution to smart city, and the grant from the 14th Finance Commission (3) Calculated by aggregating income from property tax (4) Calculated for Multilateral and bilateral funding (5) Calculated by aggregating CSR funding (6) EPA estimates for average septage production per person, and KPMG estimates for FSTP costs

Assumptions: All funds: Based on the data for next 5 years, similar funding will be available for ensuing 5 years; State funds: 10% of state budget for urban development and housing will be used for sanitation; state will contribute equally as the center towards smart cities

Required funding: 2/3 of India is unsewered; capex per capita for FSM treatment services is Rs 360 and opex per capita per year of FSM treatment services is Rs 20; average septage production per person per day is 0.6 litres

Source: Dalberg analysis
Improving Financing: Funds for FSSM, specifically sanitation treatment can be unlocked by increasing funds earmarked for FSSM...

1. Increase the FSSM financing pie

Challenge:
- Overall funding required for FSM, both capex and opex, is typically adequate, considering the direct and proximate funds that can be potentially deployed for sanitation. However, most of these funds are directed towards other activities (e.g. water supply, other urban development needs).

Proposed solution:
- Increase pool: Increasing the overall pool of funds for sanitation, by advocating for reallocation of urban development funds, will make available additional funds for FSSM, without compromising on other sanitation needs. This is particularly relevant for states with capacity to deploy additional funds and/or where FSSM funding needs are significant.

2. Improve the allocation and its efficiency

Challenge:
- The amount of funds needed for FSSM can vary depending on the state or the ULB. A previous Dalberg study indicates that FSSM funding needs range from 7% to 31% of states’ sanitation funds.

Proposed solution:
- Establish funding need: A detailed evaluation should be carried out by states to arrive at a more appropriate allocation of sanitation funds, within which FSSM finds its due importance.
- Reallocate: Funds earmarked for expansion of sewer systems can be prioritized for re-allocation to less expensive FSSM systems, which may be more appropriate for cities in Small and Meek and Steady Roller segment. At the scheme level, a portion of funds for access to sanitation (e.g. toilet/septic tank construction) or treatment systems, can be earmarked for FSSM.
- Decide between state-led or ULB-led financing: A direct allocation from the state budget offers a single source of funds to implement a targeted objective. E.g. Andhra Pradesh’s allocation of funds for 78 FSTPs is an example. ULB-led initiatives should be used where relevant schemes to fund ULB projects already exist and can plug gaps for ULB-specific requirements.

Source: Dalberg study on FSSM Financing Landscape; Dalberg analysis
Improving Financing: ...and improving allocation using demonstration effect and/or institutionalizing capability

3. Use demonstration effect to unlock government financing

Challenge:
- National schemes can be viably explored for upfront financing, however, government is reluctant to invest in new technologies due to limited evidence of success.

Proposed solution:
- **Explore alternative sources of financing for pilots**: Government funding through schemes/transfers requires evidence to invest. Fear of failure in the government departments is high and hence, appetite for high-innovation technologies is low. This holds true for both the financially strong and weak ULBs. For example, the Commissioner in Aurangabad mentioned that this technology could be commissioned under the Smart Cities Mission project in the city, but immediately retracted when he learnt that the projects are still in the pilot stage.
- **Engage in evaluative pilots**: Invest in tracking success of initial pilots to prove viability. This will help unlock government financing in the future by showcasing evidence to the government.

4. Institutionalize capacity

Challenge:
- Some ULBs do not have the technical or financial know-how to estimate and implement FSSM financing schemes or mechanisms.

Proposed solution:
- **Help find support**: Designated government agencies can provide technical support to guide ULBs on scheme eligibility requirements, preparing requests for funding, and efficient project implementation. This is particularly important since FSSM is in its nascent stages in India. E.g. MoUD developed a rapid assessment tool (in an excel format) for ULBs to estimate the financial requirements for FSSM.

Source: Dalberg study on FSSM Financing Landscape; Dalberg analysis
**Policy and advocacy:** *Four main policy recommendations should be considered*

1. **Advocate for standards for FS solids and biosolids treatment**

   **Challenge:** Regulations exist only for the liquid component of sewage and septage. Many stakeholders on the field felt there was no need to focus on treating the biosolids or solid component of FS since it is not a regulation, or they see it as less harmful due to comparatively smaller quantities.

   **Proposed solution:** Advocate for stringent regulations for the treatment of biosolids from an STP and solid component of FS by highlighting the environmental harm that can be caused.

   **Implication for OP:** Input available for treatment will increase as OP can be positioned as a cost-effective way to treat the biosolids and solid component of sludge, meeting the requisite standards.

2. **Influence FSTP description in National FSSM policy**

   **Challenge:** The National Policy on FSSM (2017) describes FSTPs as a plant ‘runs on gravity (no electricity) with very little mechanical equipment that does not require skilled operators’. This description does not fit the OP or some other FSTPs.

   **Proposed solution:** Advocate for change in the description of FSTPs in the National FSSM policy by highlighting the other benefits of FSTPs that are mechanized and run on electricity.

   **Implication for OP:** Stakeholders who read the FSSM policy document will not have a pre-conceived notion that FSTPs are only the ones that run on zero electricity and do not require skilled operators. They can then evaluate OP against other FSTPs.

3. **Champion scheduled desludging as a norm**

   **Challenge:** While scheduled desludging is encouraged, there are no stringent regulations at the central level mandating it.

   **Proposed solution:** Advocate for scheduled desludging at the policy level, and raise awareness for its need at the household level. Benefits of the same can be highlighted using examples of cities where it scheduled desludging has been implemented. E.g. Wai, Sinnar.

   **Implication for OP:** Scheduled desludging at an interval of 3-5 years instead of current practice of 8-10 years can increase the percentage of septic tanks cleaned p.a. from ~2-4% to ~33%, thus increasing the input available for OP.

4. **Recommend binding regulations for septic tank construction**

   **Challenge:** Currently, the construction standards have been codified by the Bureau of Indian Standards, but actual construction is largely left to the households to manage and the standards are not present in the building bye-laws.

   **Proposed solution:** Advocate for binding regulations for septic tank construction. Compliance can be improved by tying the NOC of a building to design of septic tank, including norms for septic tank construction in the building bye-laws. For existing septic tanks, recommend inspection followed by mandatory upgrading.

   **Implication for OP:** The physical, chemical and biological qualities of FS are influenced by the build and performance of septic tanks or pits, besides duration of storage, temperature, soil condition, intrusion of groundwater/surface water in septic tanks or pits, and tank emptying technology and pattern. Thus, a well-built septic tank will ensure consistency of the input to OP.

---

Sources: "Citywide Integrated FSM", PAS Project; National FSSM Policy (2017); CPCB standards; Dalberg Interviews; Dalberg Analysis
End-products: *Create clear guidelines and frameworks to incentivize implementation of water reuse projects, in addition to endorsing it in policy*

<table>
<thead>
<tr>
<th>• National wastewater re-use policy with clear targets</th>
<th>• Define quality standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advocate for a jointly issued wastewater re-use policy by the Centre and states. Clear policy targets along with legislative, regulatory and financial measures needed to achieve those targets are crucial to incentivize implementation.</td>
<td>Persuade Ministry of Environment and Ministry of Water Resources to define quality norms for different grades of industrial water together. This will help address the issue of quality assurance of treated water expressed by stakeholders on the field, and ensure consistent quality.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>• Prevent industries from groundwater extraction at a level that leads to over-exploitation</th>
<th>• Help develop city-level frameworks and train</th>
</tr>
</thead>
<tbody>
<tr>
<td>The current low cost of exploiting groundwater makes reuse unviable and irreversibly depletes groundwater sources. In areas where reclaimed water is made available, groundwater extraction should be strictly regulated by either the utility or the State PCB.</td>
<td>Provide technical support to help cities prepare urban wastewater reuse plan along with detailed feasibility studies for individual projects based on industrial water demand assessment. This study will help define level of treatment required and other design aspects involved. State-level workshops could be organized to sensitize utility managers about water reuse covering technology options, new standards, policy incentives, implementation challenges, and best practices in procurement.</td>
</tr>
</tbody>
</table>

Source: “Closing the water loop: Reuse of treated wastewater in urban India”, PWC (2016); Dalberg Interviews; Dalberg analysis
Private sector engagement: Targeted efforts across the value chain will help strengthen private sector participation

**Challenge**
- Significant capacity gaps of players installing / constructing septic tanks and hence, they do not conform to quality standards
- Highly fragmented industry
- Limited regulation for private operators
- Limited players in the FSSM treatment space
- Absence of established re-use market

**Proposed solution**
- **Containment**
  - Improve quality of supply: Increase knowledge of private sector players about the quality standards for septic tanks
  - Increase nature of demand: Binding regulations for septic tank construction will ensure higher compliance by increasing demand for well-built septic tanks

- **Collection and transport**
  - Promote licensing: Each ULB should be encouraged to register all C&T players operating within the ULB
  - Form regulations: Rules like designated sites for dumping, regularizing of desludging charges should be in place for all licensed players
  - Manage enforcement: Set up robust monitoring mechanisms to ensure enforcement

- **Treatment and re-use**
  - Incentivize participation: Private players, particularly the proximate ones should be incentivized to enter the FS treatment and re-use space. This can be done by increasing knowledge of additional investment requirement in terms of costs and skills to be built and showcasing profitability
  - Improve willingness to pay: This can help increase collection efficiency in cities

- Promote integrated models: Integrated models can help use profitable collection proceeds to fund treatment and lend an opportunity to implement a bundled price to recover either from government for households. E.g. Devanahalli FSTP has implemented a 23 lakhs p.a. contract for C&T, along with FSTP and composting operations

(1) Includes players involved in sewage treatment, MSW treatment, and other parts of the FSSM value chain
**Awareness and Capacity Building:** Despite some enthusiasm for FSSM, city implementation will require extensive capacity building and awareness generation efforts

### Challenge

**Low awareness** about FSSM within government departments, including officials such as SBM State Heads

**Limited resources** that are comprehensive, easy to access and actionable to understand and practice FSSM

"Government knowledge is limited. For example, we are trying to make the government shift to per capita comparison for FSTPs instead of per KLD, because they are used to per MLD comparison for STPs and do not acknowledge that FSTPs are reaching a higher population at a lower per capita cost."

- Practice Lead, Tamil Nadu Sanitation TSU

### Proposed solution

**Reinforce need for FSSM:** Publicize the need for mainstreaming FSSM by promoting sewerage not being the gold standard and showcasing benefits and use cases of FSSM

**Draft an FSSM playbook:** Make an end-to-end knowledge repository for all steps that need to be taken to implement FSSM within a ULB once the need is identified

**Train FSSM practitioners:** Promote FSSM to be a key component of the syllabus for sanitation practitioners like civil engineers, which is currently focused mostly on sewerage management

### Awareness generation for households

**Sub-optimal consumer behavior** across the value chain:

- **Containment:** Incomplete information and lack of space within households lead to poorly constructed systems.
- **C&T:** Cleaning is on demand and infrequent, with gaps as long as 8-10 years, resulting in seepage and environment hazards
- **Treatment:** Households are typically against treatment systems located in close proximity

"Involving citizens to make any city-wide initiative successful is crucial. Toilet construction and solid waste segregation have primarily been possible due to household awareness."

- Architect, Meghalaya Urban Affairs Department

**Invest in awareness campaigns for households:** Potential themes to cover for the mass campaigning can include need for:

- Constructing proper septic tanks and quality standards governing them
- Frequent desludging and associated benefits
- Treatment systems in a city, and advantages of well-functioning treatment plants that cause no odor or any other nuisance in the locality

---

(1) This could include steps to be taken throughout the FSSM value chain, tools to estimate FS treatment capacity, financing requirement, innovative user financing mechanisms, tips on ensuring sustainability of operations
**Recommendations:** *These can be split across steps to be taken immediately, in the mid-term and long-term (1 of 2)*

<table>
<thead>
<tr>
<th>Category</th>
<th>Immediate (1-6 months)</th>
<th>Mid-term (6-18 months)</th>
<th>Long-term (&gt;18 months)</th>
</tr>
</thead>
</table>
| Value proposition | • Conduct study to determine amount of MSW treatment that will be considered valuable by a Rising Metro and cost benefits of treating MSW in the OP vs other solutions  
• Demonstrate capex reduction through land saved, time saved, ability to work in rainy climates and recover water from sludge due to bio-solid treatment in the OP  
• Emphasize that the OP systems have one of the smallest land-footprints per KLD sludge treated  
• Emphasize ease of operations as the Tide OP’s strong value proposition | • Consider making product vertically stackable  
• Develop ability to treat 100% FS without MSW to account for variations in MSW supply  
• Reduce land footprint for Tide OP to less than 200 ft² per KLD, to make capex competitive  
• Conduct evaluative pilots to understand Tide’s ability to treat MSW  
• Increase the energy efficiency of the 5 KLD system Duke OP, at least to meet onsite electricity needs  
• Consider a scaled up version of Duke for the Rising Metro segment, as it can accept biosolids and hazardous waste as inputs | • Test for operations in hilly climate, or build features to insure against such elements |
| Technical recommendations | • Enable adaptability to fluctuating solid content | • Consider process automations to make the OP portfolio a plug and play system or an “FSTP in a box”  
• Reconfigure system to position OP as a ‘single solution for a city’ that can process 100% FS and MSW available for treatment  
• Conduct evaluative pilots to understand range of inputs all the OPs can process  
• Eliminate components which are only there for generating by-product revenue  
• Determine ways to reduce start-up and operational energy requirements | • Develop a 100 KLD OP to address the ‘missing middle’ problem  
• Consider making the OP vertically stackable  
• Explore advanced dewatering technologies that allow for a FS + Biosolids only processing facility  
• Invest in process improvements to reduce opex |
### Recommendations: These can be split across steps to be taken immediately, in the mid-term and long-term (2 of 2)

<table>
<thead>
<tr>
<th>Category</th>
<th>Immediate (1-6 months)</th>
<th>Mid-term (6-18 months)</th>
<th>Long-term (&gt; 18 months)</th>
</tr>
</thead>
</table>
| **Commercial recommendations** | • Emphasize efficiency in land utilization to make capex attractive relative to competition  
  • Focus on local sourcing, manufacturer’s ability to customize products, and collaboration with big manufacturers  
  • Tailor communications to emphasize attractive features as well as benefits over competition  
  • Include land in the overall capex, this can help reduce the relative capex per KLD, also highlight the opportunity cost involved in gifting land to operators, given availability constraints and competing needs | • Reduce capex for Ankur OP, reduce capex and opex for Tide OP  
  • Reduce capex and opex of Duke systems; explore local manufacturing  
  • Separate tenders for construction and O&M, success stories, and longer duration O&M can help with favorable selection of OP  
  • Invest in targeted communication to incentivize purchase of biochar and enter into bulk contracts for sale of electricity | • Target setting up integrated business models across the value chain  
  • Focus on two financing mechanisms for operational sustainability (integrated financing across the value chain, and recovery sourced from households)  
  • As the markets for end-products develop, strengthen positioning as a wastewater reuse tech, sell treated water to industries with highest demand at a competitive price, explore subsidizing delivery cost of treated water and incentivizing purchase of biochar and electricity |
| **Ecosystem recommendations** | • Invest in awareness campaign for households and incentivize willingness to pay (regular desludging, advantages of treatment solutions) | • Draft an FSSM playbook and showcase FSM use cases for government to demonstrate advantages over sewerage | • Unlock available financing through improving allocation and its efficiency, using demonstration effect, and institutionalizing capability  
  • Four policy recommendations: Advocate for standards for FS solids and biosolids treatment, inclusion of mechanized FSTPs. Champion scheduled desludging, and binding regulations for septic tank construction  
  • Create clear guidelines and frameworks to incentivize implementation of water reuse projects, in addition to endorsing it in policy }
Based on the suggested technical, commercial, and ecosystem changes, different paths to market entry can be considered.

A. What is the unmet need waste treatment need for priority segments?

B. What is the OP portfolio’s value proposition and how does it align with the prioritized segments?

C. What technical, commercial, and ecosystem considerations will help serve the need better?

D. What are the recommended paths to market entry for OP?
Both equity and non-equity market entry models can be evaluated for scaling the OP in India.

**Market Entry Choices**

**Equity**
- Wholly Owned
- Greenfield
- Acquisitions
- JVs
- Majority
- Equal
- Minority

**Non-Equity**
- Exports
- Direct Exports
- Indirect Exports
- Contractual Agreements
- Licenses
- Alliances & distribution arrangements
- R&D contracts
### Six dimensions are relevant while evaluating the relative effectiveness of market entry modes

<table>
<thead>
<tr>
<th>Definition</th>
<th>Illustrations / Relevance for the OP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transaction cost efficiency</strong></td>
<td>Setting up a new company for the OP will have poor transaction cost efficiency until sales volumes increase beyond a threshold.</td>
</tr>
<tr>
<td>How efficient (or inefficient) is a particular mode with respect to costs such as entity registration, cost of business development, hiring staff</td>
<td></td>
</tr>
<tr>
<td><strong>Resource needs</strong></td>
<td>Setting up a new company to manufacture and sell the OP will be more resource intensive than striking distribution partnerships.</td>
</tr>
<tr>
<td>What resources are needed (financial, human, technical) to adopt a certain market entry mode</td>
<td></td>
</tr>
<tr>
<td><strong>Control possible</strong></td>
<td>Having a majority JV would enable the OP to control these parameters much more than a simple distribution partnership</td>
</tr>
<tr>
<td>How much control in terms of quality, design, pricing, service delivery will the entry mode allow the technology innovator to exercise</td>
<td></td>
</tr>
<tr>
<td><strong>Context advantage</strong></td>
<td>Tying up with a local sanitation company with existing government contracts would enable the OP to capitalize on cultural and contextual familiarity.</td>
</tr>
<tr>
<td>How much contextual familiarity and local knowledge is the entry mode able to harness</td>
<td></td>
</tr>
<tr>
<td><strong>Risk management</strong></td>
<td>Entering into distribution partnerships, at least initially, will help the OP contain risks of customer adoption and avoid irreversible investments.</td>
</tr>
<tr>
<td>How effective is the mode at mitigating risks associated with market entry (e.g. customer adoption)</td>
<td></td>
</tr>
<tr>
<td><strong>Competitive advantage</strong></td>
<td>A JV with an existing partner might lead to better competitive advantage than a greenfield investment for the OP.</td>
</tr>
<tr>
<td>How effective will the entry mode be in competing with other competitors in the market</td>
<td></td>
</tr>
</tbody>
</table>
A comparison of different entry modes reveals that licenses & distribution alliances might be the most effective in the short-medium term.

<table>
<thead>
<tr>
<th>Category</th>
<th>Mode</th>
<th>Economic efficiency</th>
<th>Resource availability</th>
<th>Control possible</th>
<th>Context advantage</th>
<th>Risk management</th>
<th>Competitive Advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity</td>
<td>Greenfield</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Acquisitions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Majority JV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equal JV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minority JV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Equity</td>
<td>Direct exports</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indirect exports</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Licenses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alliances for Distribution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>R&amp;D Contracts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Consider four different pathways the OP can consider in adopting a licensing & distribution alliance market entry model for India

<table>
<thead>
<tr>
<th>Pathway 1</th>
<th>Enter into distribution partnerships with existing partners and other existing FSTP players</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pathway 2</td>
<td>Partner with proximate waste treatment players</td>
</tr>
<tr>
<td>Pathway 3</td>
<td>Partner with large infrastructure companies</td>
</tr>
<tr>
<td>Pathway 4</td>
<td>License the technology to government bodies/institutions to improve affordability</td>
</tr>
</tbody>
</table>
Pathway 1: Distribution partnerships with existing FSTP Players

<table>
<thead>
<tr>
<th>Illustrative Players</th>
<th>Benefits</th>
<th>Potential to scale</th>
<th>Key to success</th>
</tr>
</thead>
</table>
| Blue Water Company   | - Existing expertise and cognition of the market opportunity  
|                      | - Tacit knowledge around market conditions and “what works”  
|                      | - Eagerness to scale  
|                      | - Openness to experimentation  | - Can be a key channel in the 5-6 showcase states that these firms are operational in with a special focus on Small & Meek and Steady Rollers  
|                      |                      | - Should be supported for “bulk tenders” and the OP should be positioned as a viable choice  | - Building comfort around the FS+MSW value proposition  
|                      |                      |                      | - Having a clear “playbook” to help these players understand where and in which contexts to position the OP  
|                      |                      |                      | - “De-risking” the OP for this segment by providing “technical support” to help manage challenging configuration issues / troubleshooting as needed.  

<table>
<thead>
<tr>
<th>Challenges</th>
</tr>
</thead>
</table>
| - Much smaller footprints as compared to traditional infrastructure companies  
| - Leadership teams and L2 management teams are a constraint  
| - Limited ability to absorb capital and grow  
| - “Access to government” might be limited outside of showcase states  |
### Pathway 2: Partnerships with proximate wastewater and solid waste treatment players

<table>
<thead>
<tr>
<th>Illustrative Players</th>
<th>Benefits</th>
<th>Potential to scale</th>
<th>Key to success</th>
</tr>
</thead>
</table>
| Shivam Water Treaters| - Tacit knowledge on waste water and solid waste treatment  
- Deep networks in ULBs and familiarity with the procurement process  
- Used to big-ticket treatment projects and have management capacity  
- Larger number of players with a national footprint  
- Contract structures will allow co-location of the OP within the STP being run by these operators | - The channel with the greatest depth and breadth  
- Potential to take the OP across the four segment types across large parts of India  
- Access to finance and management capacity is also better developed | - Building comfort around the FS+MSW value proposition and how the OP is complementary to them  
- Having a clear “playbook” to help these players understand where and in which contexts to position the OP  
- Helping nudge the public ecosystem towards “larger bids” that make it interesting for this segment |
| Saraplast | Sumeet Group | | |
### Pathway 3: Partnerships with large infrastructure companies including global utility majors

<table>
<thead>
<tr>
<th>Illustrative Players</th>
<th>Benefits</th>
<th>Potential to scale</th>
<th>Key to success</th>
</tr>
</thead>
</table>
| LT, HCC, GMR, Suez, Veolia | - Deep experience with city-level projects  
- Deep relationships  
- Ease of scaling  
- Access to finance and management capability | - Can “bundle” in the OP as part of larger city waste management projects  
- Can help shape tenders / RFPs for ULBs after highlighting the complementarity and the need for FSM + MSW | - Building comfort around the FS+MSW value proposition and positioning it as part of their “city” solution  
- Several players, including Veolia, are exploring the value and potential from decentralized solutions. Positioning the OP in this frame.  
- Positioning the OP as a product that will help these companies build both FS / MSW relationships with small and medium cities |
|                      | Challenges |                      |                |
|                      | - Diminished perception of the need for FSM and, within that, the value of the OP  
- Might perceive limited value in “adopting / licensing” technology as opposed to creating it in-house  
- OP is likely to be a small component of their “cities” business line |                      |                |
## Pathway 4: License the IP to the Government or Government Research Institutions

### Illustrative Players

![Icons of various government and research institutions]

### Benefits

- Build buy-in within Government
- Reduces costs as the product transforms from a risky innovation to a standardized component
- Can scale quickly with States using OP output specs in their tenders

### Challenges

- Very few precedents in India
- Organizations like DRDO have competing technologies
- Government institutions have very limited experience and incentives to structure forward-looking IP licensing arrangements with the industry

### Potential to scale

- Can scale across States and segment types
- Some organizations outside of WASH, such as ICRISAT, are experimenting with this model and can be used as de-risking examples

### Key to success

- De-risking a pilot for this within a certain geography (a progressive State)
- Co-opting the technical staff of institutions such as the IIT and high-lighting the business benefit for them (through royalty fees)
- Setting up a small capabilities center to push this
- Getting a political champion for this idea
Risks: The OP should also be mindful of certain potential technical, commercial and ecosystem risks that can impede market entry and growth

**Technical**

**Operational**
- Inability to process low solid % of FS in India
- Limited ULB capacity to maintain, despite providing capex to install

**Supply**
- The input regularly fluctuates in quality and quantity (e.g. due to absence of scheduled desludging)

**Commercial**

**Financial**
- Revenue from end-products does not match expectations
- Interested private players may not be able to raise upfront capex required

**Business**
- Limited interest from private players to manufacture, install and operate the OP

**Ecosystem**

**Compliance**
- FSTP tenders are screened based on completion certificates/experience of players in establishing similar plants earlier due to which OP is not able to bid

**Reputational**
- Limited success of pilots
- Perception of lack of financial or technical wherewithal
- Use of incineration is a concern among environmentalists

**Political**
- FSM might be on the agenda, but change in government might mean that it’s not a priority anymore
- Political disturbances caused due to elections, or unforeseen circumstances can impede market entry or operations

**Cultural**
- Public resistance to provide land for OP or allow its construction, in addition to hesitation to utilize end-products
List of acronyms used

- **AMRUT**: Atal Mission for Rejuvenation and Urban Transformation
- **BOD**: Biochemical Oxygen Demand
- **C&T**: Collection and Transportation
- **Capex**: Capital Expenditure
- **CEPT**: Centre for Environmental Planning and Technology
- **COD**: Chemical Oxygen Demand
- **CSE**: Centre for Science and Environment
- **CSR**: Corporate Social Responsibility
- **DISCOM**: Distribution Companies
- **DMA**: Directorate of Municipal Administration
- **EPC**: Engineering, Procurement and Construction
- **FS**: Fecal Sludge
- **FSSM**: Fecal Sludge and Septage Management
- **FSTP**: Fecal Sludge Treatment Plant
- **HRIDAY**: Heritage City Development and Augmentation Yojana
- **INR**: Indian Rupee
- **JV**: Joint Venture
- **KLD**: Kiloliters per day
- **LPCD**: Litres per capita per day
- **MLA**: Member of Legislative Assembly
- **MLD**: Million liters per day
- **MoHUA**: Ministry of Housing and Urban Affairs
- **MSW**: Municipal Solid Waste
- **O&M**: Operations and Maintenance
- **OP**: Omni Processor
- **Opex**: Operating Expenditure
- **PCB**: Pollution Control Board
- **R&D**: Research and Development
- **RFP**: Request for Proposal
- **SBM**: Swacch Bharat Mission
- **SCM**: Smart Cities Mission
- **SME**: Small and Medium Enterprise
- **STP**: Sewage Treatment Plant
- **SWM**: Solid Waste Management
- **TPD**: Tons per day
- **TS**: Total Solids
- **TSU**: Technical Support Unit
- **UDHD**: Urban Development and Housing Department
- **UGD**: Under Ground Drainage System
- **ULB**: Urban Local Body
- **USD**: United States Dollar
- **WtE**: Waste to Energy
Profiles of direct and proximate players
<table>
<thead>
<tr>
<th>Company</th>
<th>Description</th>
<th>Value chain component</th>
<th>Key Personnel</th>
</tr>
</thead>
</table>
| **Blue Water Company**  | • Involved across the FSSM value chain. They operate desludging vehicles and construct and operate simple FSTPs that require low manpower and use biological treatment mechanisms.  
                          • They are the implementing body for desludging and FSTP plant installation and operations in Leh  
                          • Funded by BORDA                                                                                                                                  | Desludging & Treatment | Mr Manas Rath           |
| **Tide Technocrats**    | • Tide Technocrats provides fecal sludge treatment technology with significant reuse potential  
                          • Offer FSTPs utilizing their pyrolysis technology - reportedly produces valuable biochar  
                          • Their projects include treatment plants in Wai, Narsapur, and Warangal                                                                    | Treatment              | Mr Sampath Kumar, MD    |
| **Shivam Water Treaters** | • Shivam Water Treaters has provided liquid waste and water treatment technology for over two decades  
                              • Solutions include sewage treatment, drinking water treatment.  
                              • Their projects include working on the FSTP near Coimbatore.                                                                          | Treatment              | Mr Vishal Dave, Business Head |

Sources: Company websites, Owler.com, Dalberg interviews with Tide Technocrats, Blue Water Company, Shivam Water Treaters
<table>
<thead>
<tr>
<th>Company</th>
<th>Description</th>
<th>Value chain component</th>
<th>Key Personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kam-Avida</td>
<td>• Manufactures vacuum trucks and equipment, and has a pan India presence&lt;br&gt;• Customers include civic bodies and private operators&lt;br&gt;• Also operates and maintains vehicles in some areas, where it is required to do the same due to contractual requirements&lt;br&gt;• Pan India presence. Partnered with CDD in Devenahalli</td>
<td>Desludging – equipment and operations</td>
<td>Mr M Krishna, Managing Director</td>
</tr>
<tr>
<td>Saraplast / 3S India</td>
<td>• 3S is a brand owned by Saraplast, and is focused on innovative models for sanitation and waste management&lt;br&gt;• Offers portable toilets, containerized toilets, handwash stations, urinals, bio-toilets, septic tanks, and desludging services for portable toilets&lt;br&gt;• Operating desludging services across a large number of ULBs</td>
<td>Desludging and treatment</td>
<td>Mr Rajeev Kher, CEO</td>
</tr>
<tr>
<td>Era Hydro-Biotech Energy Private Limited</td>
<td>• Pune based firm that manufactures and constructs, water, wastewater, and sewage treatment plants.&lt;br&gt;• Manufactures sludge dewatering machines and has expressed an interest in BOOT contracts for FSTPs</td>
<td>Treatment</td>
<td>Mr Milind Kulkarni, CEO</td>
</tr>
</tbody>
</table>

Sources: Company websites, Owler.com, Dalberg interviews with Kam Avida, 3S India
## Illustrative Profiles Of Direct & Proximate Players (3/3)

<table>
<thead>
<tr>
<th>Company</th>
<th>Description</th>
<th>Value chain component</th>
<th>Key Personnel</th>
</tr>
</thead>
</table>
| **AIGA engineers private limited** | • Active in water and wastewater treatment in Tamil Nadu but are considering expanding to Delhi and Uttar Pradesh  
• They have previously constructed 4 STPs and 3 industrial effluent plants, and are have constructed the 25 KLD FSTP in Karunguzhi.  
• They have expressed an interest in being involved in more FSTP projects. | Treatment plant construction | NA                                                      |
| **Sumeet Group**             | • Multi-industry conglomerate with a presence in septic tank desludging, facility management, security services, engineering services, electronic security services, manufacturing, trading etc  
• Operates desludging trucks in Pune, and will be participating in the desludging business in Wai | Desludging – operations | Dr Prahbakar Salunkhe, Founder Chairman                 |
| **Ankur Scientific**         | • Active in the Waste to Energy space, with extensive experience in design, development, manufacturing and project management of facilities  
• Treatment plants planned in Vadodara and Hasangaon | Treatment                  | Jignesh Shah                                           |

Sources: Company websites, Owler.com, Dalberg interviews with AIGA Engineers, Sumeet Group
Segmentation Approach
Original approach: *Five variables were used as inputs for ingoing segmentation of entities*

1. **Demographics**
2. **Supply of FS and infrastructure**
3. **Presence of an enabling ecosystem**
4. **Access to Finance**
5. **Type of decision making entity**

Note: (1) Supply of FS and infrastructure includes spatial distribution of FS generation w.r.t. STP and FSTP; (2) We considered a few other variables for our segmentation (topography, demand for end products, perceived criticality of the demand in the entity, capacity of the entity to execute/supervise operations, and cultural practices of using FSM based products), but have eliminated from our final list due to low measurability or actionability. We will consider these variables as their significance is clearer and as more information is available.
Original approach: **Metrics to help define these variables were identified**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics</strong></td>
<td><strong>Supply of FS and infrastructure</strong></td>
<td><strong>Type of decision making entity</strong></td>
<td><strong>Presence of an enabling ecosystem</strong></td>
<td><strong>Access to Finance</strong></td>
</tr>
<tr>
<td>Population (number of people)</td>
<td>Sewer coverage (percentage HH covered by sewers or conversely with OSS)</td>
<td>State (top-down pressure)</td>
<td>Completion of toilet construction as part of SBM (percentage)</td>
<td>Funding gap for FSM</td>
</tr>
<tr>
<td>Density (persons per sq. km)</td>
<td>Current STP capacity (MLD)</td>
<td>Cluster of cities</td>
<td>Presence of a city sanitation plan</td>
<td>Presence of related taxes (property, sanitation, etc.)</td>
</tr>
<tr>
<td></td>
<td>Quantity(^1) of fecal sludge (FS) generated</td>
<td>Urban local body (ULB)</td>
<td>Stand w.r.t. centralized vs decentralized systems</td>
<td>Ease of accessing credit</td>
</tr>
<tr>
<td></td>
<td>Quality(^2) of fecal sludge (FS) generated</td>
<td>Commercial entity (airport, restaurant, colleges, etc.)</td>
<td>Rankings of cities based on NUSP(^4)</td>
<td>Eligibility for special schemes (e.g., AMRUT)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Residential colonies or apartments</td>
<td>Ease of procuring land(^3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Institutional agglomerations (e.g. Army/ Railways)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: (1) Given the lack of data, we might have to use proxies like aridity, population, soil quality and water supply; (2) For instance, calorific value; we will use proxies like desludging price and interval; (3) Prices, percentage agricultural land, cultural factors, etc. (4) National Urban Sanitation Policy
### Original approach: A combination of these variables helped define ingoing segments

<table>
<thead>
<tr>
<th>Sr no</th>
<th>Segment name</th>
<th>Demographics</th>
<th>Supply of FS and infrastructure</th>
<th>Enabling ecosystem</th>
<th>Decision making</th>
<th>Access to Finance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sprawling Megacity</td>
<td>Big and dense</td>
<td>Higher sewer coverage with high FS generation</td>
<td>High</td>
<td>ULBs</td>
<td>High</td>
</tr>
<tr>
<td>2</td>
<td>Rising Metro</td>
<td>Big and dense</td>
<td>Higher sewer coverage with high FS generation</td>
<td>High</td>
<td>ULBs</td>
<td>Medium</td>
</tr>
<tr>
<td>3</td>
<td>Nurtured Star</td>
<td>Medium and dense</td>
<td>Higher sewer coverage with high FS generation</td>
<td>High</td>
<td>State</td>
<td>Medium</td>
</tr>
<tr>
<td>4</td>
<td>Unruly Survivor</td>
<td>Medium and dense</td>
<td>Low sewer coverage and high FS generation</td>
<td>Low</td>
<td>ULBs</td>
<td>Medium</td>
</tr>
<tr>
<td>5</td>
<td>Dry and arid</td>
<td>Medium and dense</td>
<td>Higher sewer coverage with low FS generation</td>
<td>High</td>
<td>ULBs</td>
<td>Medium</td>
</tr>
<tr>
<td>6</td>
<td>Small and Meek</td>
<td>Small and dense</td>
<td>Low sewer coverage and high FS generation</td>
<td>Low</td>
<td>State</td>
<td>Low</td>
</tr>
<tr>
<td>7</td>
<td>Steady Rollers</td>
<td>Small and dense</td>
<td>Low sewer coverage and high FS generation</td>
<td>High</td>
<td>ULBs</td>
<td>Medium</td>
</tr>
<tr>
<td>8</td>
<td>Hill City</td>
<td>Small and sparse</td>
<td>Low sewer coverage and low FS generation</td>
<td>Low</td>
<td>ULBs</td>
<td>Medium</td>
</tr>
<tr>
<td>9</td>
<td>Little Prodigy</td>
<td>Small and sparse</td>
<td>Low sewer coverage and high FS generation</td>
<td>High</td>
<td>State</td>
<td>Medium</td>
</tr>
<tr>
<td>10</td>
<td>United Sisters</td>
<td>Big and sparse</td>
<td>Low sewer coverage and high FS generation</td>
<td>High</td>
<td>Cluster</td>
<td>Low</td>
</tr>
<tr>
<td>11</td>
<td>New and Shiny</td>
<td>Medium and dense</td>
<td>Higher sewer coverage and low FS generation</td>
<td>High</td>
<td>State</td>
<td>High</td>
</tr>
<tr>
<td>12</td>
<td>Institution</td>
<td>Small and dense</td>
<td>Low sewer coverage and high FS generation</td>
<td>High</td>
<td>Institution</td>
<td>High</td>
</tr>
</tbody>
</table>

**Note:** (1) We will iterate on these segments as we gather more information, both primary and secondary.
**Insights: Some key insights inform the final segmentation method adopted (1 of 2)**

<table>
<thead>
<tr>
<th>Population of a city is the most significant variable, and drives decision making, access to finance, and supply of FS and infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Insight:</strong> The population of a city impacts the other variables significantly, for instance- ‘sprawling megacities’, or cities above a million typically have the ULBs independently driving decision making</td>
</tr>
<tr>
<td><strong>Evidence:</strong> For example, access to funds is directly co-related with the size of a city (all cities above the size of one lakh have access to Amrut funding); user recovery rates are higher in cities of a certain size (Bangalore has 99% recovery rate)</td>
</tr>
<tr>
<td><strong>Implications on segmentation:</strong> Population has been used as the starting variable, followed by other variables for segmentation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Topography and climate of a city can have significant implications on the optimal sanitation solution</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Insight:</strong> The topography of a city can affect the city's choice of solution (e.g. hilly areas find sewerage to be difficult and extremely expensive, due to the terrain); dry and arid regions would struggle with getting sewerage because they do not have adequate water supply</td>
</tr>
<tr>
<td><strong>Evidence:</strong> Shillong has opted for an FSTP, Maharashtra has released a directive with the mandate that any sewerage plans for cities with less than 140 LPCD of water supply will not be sanctioned</td>
</tr>
<tr>
<td><strong>Implications on segmentation:</strong> Two of our final segments are defined by their respective topographies and climate (hilly segment, and dry and arid segment)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ecosystem varies at the state-level. Additionally, megacities1 and smaller adjacent towns have a positive ecosystem</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Insight:</strong> Ecosystem depends on the state the city is in. Moreover, cities close to megacities tend to have a positive ecosystem since they tend to fall within the Development Authority of the megacity</td>
</tr>
<tr>
<td><strong>Evidence:</strong> Despite being of a similar size, Patna and Indore have drastically different approaches to sanitation, a reflection of their respective states i.e., Bihar has a poorer ecosystem compared to Maharashtra</td>
</tr>
<tr>
<td><strong>Implications on segmentation:</strong> The variable ‘enabling ecosystem’ has been recalibrated as one of the following: (i) ‘special focus for the city’ (ii) ranking of states under public affairs index2 (iii) proximity to a megacity. Cities of a certain size and with a certain state level ecosystem are clustered together as segments.</td>
</tr>
</tbody>
</table>

---

1 Cities with a population above 8 million 2 Public Affairs Index uses 82 indicators across 10 themes to measure the quality of governance in the states of India. The themes are (i) Essential Infrastructure (ii) Support to Human Development (iii) Social Protection (iv) Women and Children (v) Crime, Law and Order (vi) Delivery of Justice (vii) Environment (viii) Transparency and Accountability (ix) Fiscal Management (x) Economic Freedom Source: Dalberg analysis
### Insights: Some key insights inform the final segmentation method adopted (2 of 2)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4</strong></td>
<td><strong>5</strong></td>
</tr>
<tr>
<td><strong>Although density is theoretically an important variable, government agencies de-prioritize it in favor of population</strong></td>
<td><strong>States cluster small towns, especially around large cities – for shared sanitation and MSW solutions</strong></td>
</tr>
<tr>
<td><strong>Insight:</strong> Large sparser cities are favored over small denser towns for sewerage</td>
<td><strong>Insight:</strong> States cluster small towns to implement a sanitation strategy to share costs and benefits over a larger population.</td>
</tr>
<tr>
<td><strong>Evidence:</strong> In all state FSM plans, the decision to adopt an FSM solution is a function of population and in rare cases, water supply. Density doesn’t feature independently</td>
<td><strong>Evidence:</strong> Bihar has created a cluster of small towns around Patna; this cluster will have a shared MSW solution.</td>
</tr>
<tr>
<td><strong>Implications on segmentation:</strong> Density is not a direct component of demographics variable, as it doesn’t inform decision making on sanitation solutions. ‘Demographics’ has been re-defined to mean population.</td>
<td><strong>Implications on segmentation:</strong> ‘Cluster based decision making’ is not a variable, as a lot of smaller cities employ this as a go-to market strategy. Hence, cluster-based decision-making will be considered in the GTM phase.</td>
</tr>
</tbody>
</table>

Source: Dalberg analysis
Refined approach: After refining the approach, there are four final variables that are inputs into the final segmentation.

1. Demographics
2. Type of decision making entity
3. Topography and climate
4. Presence of an enabling ecosystem

Note: (1) Enabling ecosystem here is a combination of ranking of states under the public affairs index and special focus for the city.
Refined approach: The ingoing variables have been re-defined based on the insights shared earlier.

1. Demographics
   - Population (number of people)
   - Density (persons per sq. km)

2. Topography and climate
   - Average Rainfall p.a. (mm)
   - Elevation (m)

3. Supply of FS and infrastructure
   - Sewer coverage (percentage HH covered by sewers or conversely with OSS)
   - Current STP capacity (MLD)
   - Quantity and quality of fecal sludge (FS) generated
   - Quality of fecal sludge (FS) generated

4. Type of decision making entity
   - State (top-down pressure)
   - Cluster of cities
   - Urban local body (ULB)
   - Commercial entity (airport, restaurant, colleges, etc.)

5. Presence of an enabling ecosystem
   - Completion of toilet construction as part of SBM (percentage)
   - Presence of a city sanitation plan
   - Stand w.r.t. centralized vs decentralized systems
   - Rankings of states based on Public Affairs Index

6. Access to Finance
   - Funding gap for FSM
   - Presence of related taxes (property, sanitation, etc.)
   - Ease of accessing credit
   - Eligibility for special schemes (e.g., AMRUT)

- Prioritized
- Dependent
- Deprioritized
**Final segments:** These changes have been incorporated to create a final list of segments, with a few eliminations and changes in definition.

<table>
<thead>
<tr>
<th>Ingoing segments</th>
<th>Final segments</th>
<th>Key variables</th>
<th>Decision to retain or reject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprawling Megacity</td>
<td>Sprawling megacity</td>
<td>Type of entity</td>
<td>✓</td>
</tr>
<tr>
<td>Rising Metro</td>
<td>Rising metro</td>
<td>Population</td>
<td>✓</td>
</tr>
<tr>
<td>Nurtured Star</td>
<td>Nurtured star</td>
<td>Topography and climate</td>
<td>✓</td>
</tr>
<tr>
<td>Unruly Survivor</td>
<td>Unruly survivor</td>
<td>Ecosystem</td>
<td>✓</td>
</tr>
<tr>
<td>Dry and Arid</td>
<td>Dry and arid</td>
<td>Special focus</td>
<td>✓</td>
</tr>
<tr>
<td>Small and Meek</td>
<td>Small and meek</td>
<td></td>
<td>Decision-making is independent, hence subsumed within rising metro</td>
</tr>
<tr>
<td>Steady Roller</td>
<td>Steady roller</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Hill City</td>
<td>Hill city</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Little Prodigy</td>
<td>Little prodigy</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>United Sisters</td>
<td>United-sisters</td>
<td></td>
<td>Cluster-based decision-making will be considered in the GTM phase</td>
</tr>
<tr>
<td>New and Shiny</td>
<td>New-and-shiny</td>
<td></td>
<td>✓ Absorbed within megacities or rising metros</td>
</tr>
<tr>
<td>Institutions</td>
<td>Institutions</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

**Definitions of each of these segments is discussed in the following slide**
Final segments: As a result, nine final segments were selected for prioritization and go-to-market phase

<table>
<thead>
<tr>
<th>Segment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprawling Megacity</td>
<td>Cities with a population above 8 million</td>
</tr>
<tr>
<td>Rising Metro</td>
<td>Cities with a population between 1 million and 8 million, and in states with a positive ecosystem</td>
</tr>
<tr>
<td>Unruly Survivor</td>
<td>Cities with a population between 1 million and 8 million, in states with poor ecosystem</td>
</tr>
<tr>
<td>Dry and Arid</td>
<td>Cities with a population between 0.1 million and 1 million, in dry areas</td>
</tr>
<tr>
<td>Steady Roller</td>
<td>Cities with a population between .1 million and 1 million, in non-dry areas</td>
</tr>
<tr>
<td>Hilly City</td>
<td>Cities with a population of more than 0.1 million, or AMRUT cities below 0.1 million and a hilly topography</td>
</tr>
<tr>
<td>Small and Meek</td>
<td>Cities with a population less than 0.1 million, with no special focus</td>
</tr>
<tr>
<td>Little Prodigy</td>
<td>Cities with a population less than 0.1 million, with a history of activities in FSM and/or located near a sprawling megacity</td>
</tr>
<tr>
<td>Institutions</td>
<td>Residential and public institutional entities</td>
</tr>
</tbody>
</table>

(1) Public Affairs Index (2017) below 0.45, except for Odisha and Meghalaya due to their focus on FSSM (2) Cities with lower than 700 mm average rainfall in a year (3) Elevation higher than 1000 m
Detailed profiles of segments
For each of the segments, definitions set out below have been used to determine their possibility for sewerage and respective feasibility for OP

<table>
<thead>
<tr>
<th>Variable</th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived possibility of expanding sewerage</td>
<td>Plans to achieve 100% sewerage in the near future</td>
<td>Active plans to achieve sewerage, finance or water supply a constraint</td>
<td>Little to no possibility of getting sewerage</td>
</tr>
<tr>
<td>Access to Finance</td>
<td>Access to central and state government schemes + high ULB own funds + High user fee recovery + private sector investment</td>
<td>Access to central and state government schemes, but limited user fee recovery and private sector investment</td>
<td>ULB completely reliant on central/state grants for operations, few viable revenue streams</td>
</tr>
<tr>
<td>Existing O&amp;M ability</td>
<td>Existing ULB capacity to operate treatment solutions and adequate private sector presence</td>
<td>Some challenges in ULB’s own capacity to operate, limited private sector presence</td>
<td>Little to no operational capacity, private sector operators absent</td>
</tr>
<tr>
<td>Demand for end-products</td>
<td>Advanced market linkages to procure and sell end-products to households and industries</td>
<td>Some demand for specific end-products but linkages are limited</td>
<td>Little to do demand for end-products, no market exists</td>
</tr>
</tbody>
</table>
Segment profiles
Sprawling Megacity (1 of 2)

Segment definition
Cities with a population greater than 8 million

Key features
- Major parts of the city have sewerage or expect sewerage in the next 10 years
- Vertical growth and high density with limited sewerage in the periphery
- Availability of land for a treatment plant is a huge problem, often due to civic resistance
- FS generated does not necessarily reach the STPs and often dumped illegally
- ULB / Board is financially strong and has high user recovery rates, given educated population

“Sewerage system is the best option, FSM at the best is a temporary solution”

Key quote

Bangalore Water Supply and Sewerage Board (BWSSB)
Vertical growth and high density in Bengaluru

Relevant type of waste

<table>
<thead>
<tr>
<th>Waste Type</th>
<th>Most relevant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grey water</td>
<td></td>
</tr>
<tr>
<td>Black water</td>
<td></td>
</tr>
<tr>
<td>Fecal Sludge</td>
<td></td>
</tr>
<tr>
<td>STP solids</td>
<td></td>
</tr>
<tr>
<td>MSW</td>
<td></td>
</tr>
</tbody>
</table>

Key variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of entities</td>
<td>6 Cities</td>
</tr>
<tr>
<td>Population covered</td>
<td>88 Million</td>
</tr>
<tr>
<td>Total FS generated</td>
<td>12,080 KLD</td>
</tr>
<tr>
<td>Average FS generated per city</td>
<td>2000 KLD</td>
</tr>
<tr>
<td>Perceived possibility of expanding sewerage</td>
<td>Low Medium High</td>
</tr>
<tr>
<td>Access to finance</td>
<td>Low Medium High</td>
</tr>
<tr>
<td>Existing O&amp;M ability</td>
<td>Low Medium High</td>
</tr>
<tr>
<td>Demand for end products</td>
<td>Low Medium High</td>
</tr>
<tr>
<td>Average Sewerage</td>
<td>67 %</td>
</tr>
<tr>
<td>Total STP capacity</td>
<td>12,035 MLD</td>
</tr>
<tr>
<td>Total MSW generated</td>
<td>40,400 TPD</td>
</tr>
<tr>
<td>Average MSW generated per city</td>
<td>6730 TPD</td>
</tr>
</tbody>
</table>

Segment need and size

- Parts of the city are unsewered, either due to expanding periphery or being in certain very dense pockets, but the aim is to achieve 100% sewerage in near future
- In addition to ULB revenue, the support from state and national schemes is higher
- There is interest from investors as well to invest in infrastructure projects
- Strong access to technical expertise, but might face operational challenges
- Peripheral industrial areas demand water and energy, with certain internal city applications (e.g. watering local parks)
- No demand for fertilizers, due to lack of proximity to agricultural land

Segment profile

- Vertical growth and high density in Bengaluru

- Urban infrastructure is the best option, FSM at the best is a temporary solution

- ULB / Board is financially strong and has high user recovery rates, given educated population

- Access to finance

- Existing O&M ability

- Demand for end products

- In addition to ULB revenue, the support from state and national schemes is higher

- There is interest from investors as well to invest in infrastructure projects

- Strong access to technical expertise, but might face operational challenges

- Peripheral industrial areas demand water and energy, with certain internal city applications (e.g. watering local parks)

- No demand for fertilizers, due to lack of proximity to agricultural land

Bangalore Water Supply and Sewerage Board (BWSSB)
Vertical growth and high density in Bengaluru

Key quote

“Sewerage system is the best option, FSM at the best is a temporary solution”

Bangalore Water Supply and Sewerage Board (BWSSB)
Vertical growth and high density in Bengaluru

Key quote

“Sewerage system is the best option, FSM at the best is a temporary solution”
Segment profiles
Sprawling Megacity (2 of 2)

Key stakeholders
City Water Supply and Sewerage Board
Municipal Corporation

Procurement
- Traditional procurement is the most common as city mostly relies on its own funds, whether through central or state schemes, or its revenue streams
- Government either decides on a technology and floats a tender, or floats a tech-neutral tender and then reviews the technologies proposed. Tech-neutral procurement is more common, and energy production is a high value proposition in some megacities (e.g. energy is a core input requirement in tenders)
- Other sectors (e.g. education) have seen private sector led procurement, but this isn’t common in sanitation

Unmet need / key value proposition
1. **Coverage**: Pockets within & periphery of these cities
2. **Integrated waste management**: MSW (++) and STP Bio-solids (+)
3. **Land**: Stackability and low footprint in the face of extreme land availability pressures

Potential OP use case
- **Growing periphery population and need for an immediate solution generates opportunities for an intermediate solution**

<table>
<thead>
<tr>
<th>Size of solution</th>
<th>Form of application</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 MLD</td>
<td>Treat solids from STP</td>
</tr>
<tr>
<td>5 KLD</td>
<td>Treat fecal sludge</td>
</tr>
<tr>
<td></td>
<td>Treat FS+MSW</td>
</tr>
</tbody>
</table>

* Mumbai does not have a city water supply and sewerage board, and hence Municipal Corporation of Greater Mumbai (MCGM) becomes the primary stakeholder
Segment profiles
Rising Metro (1 of 2)

Segment definition
Cities with a population between 1 million and 8 million, and in states with a favorable ecosystem\(^1\)

Key features
- Partial UGD coverage with promise of full coverage
- Old pockets as well as periphery of the city have FS generation, however desludging ecosystem is underdeveloped, with many private players dumping FS
- The ecosystem is positive overall
- Solid Waste Management is a priority compared to fecal waste management

Key quote
“Any project around waste to energy, is not economically viable if intake is less than 500 metric ton”

Segment need and size

<table>
<thead>
<tr>
<th>Key variables</th>
<th>Cities</th>
<th>Number of entities</th>
<th>43</th>
<th>Relevant type of waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Sewerage</td>
<td>41</td>
<td>Average</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Total STP capacity</td>
<td>6610</td>
<td>MLD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total FS generated</td>
<td>22,800</td>
<td>KLD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average FS generated per entity</td>
<td>530</td>
<td>KLD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived possibility of expanding sewerage</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Access to finance</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Existing O&amp;M ability</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Demand for end products</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Feasibility of market entry for OP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dense area in older part of the Jaipur city
240 MLD STP in Indore

---

\(^1\) Public Affairs Index (2017) above 0.45, in addition to Odisha and Meghalaya due to their focus on FSSM
Procurement

- Similar to sprawling megacities, traditional procurement is common; one of the most common bid requirement is operational capacity (e.g., In Indore, there is a preference for vendors who can operate and maintain the facility as well for at least 3 years, this is slated to increase to 10 years).
- However, programmatic procurement and developmental procurement might also be observed, where cities either rely on central schemes (e.g., Smart Cities) or blended capital from multi-lateral investments (e.g., ADB).

Key stakeholders

- Municipal Corporation
- Urban affairs under UDHD

Potential OP use case

- Treat fecal sludge
- Treat solids from STP
- Treat MSW

Unmet need / key value proposition

1. **Coverage**: Pockets within & periphery of these cities
2. **Cost**: Much more cost effective as compared to sewerage
3. **Integrated waste management**: MSW (++) and STP Bio-solids (+)
4. **Land**: Stackability and low footprint in the face of extreme land availability pressures

Size of solution

- **5 MLD**

Form of application

- Treat solids from STP
- Treat fecal sludge
- Treat MSW

Growing population with positive ecosystem generates opportunities for both MSW and FS

Most relevant
Segment profiles
Unruly Survivor (1 of 2)

Segment definition
Cities with a population between 1 million and 8 million, in states with an unfavorable ecosystem
- High density and minimal sewer coverage, with a big number of septic tanks, especially in the old, dense region of the city; minor presence of latrine pits as well
- Desludging of septic tanks is difficult because of highly dense regions, making access to FS challenging
- Unfavorable ecosystem because of difficult access to finance, poor ULB capacity, and unfavorable indicators of development
- Absence of segregation system for MSW

Key features
- “Funds from National and State level schemes are assigned to UDHD and not us because of the poor capacity in terms of skilled human resources in MC.”

Key quote

Patna city

Segment need and size

<table>
<thead>
<tr>
<th>Key variables</th>
<th>Number of entities</th>
<th>Cities</th>
<th>Average Sewerage</th>
<th>33 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population covered</td>
<td>Total STP capacity</td>
<td>2700 MLD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total FS generated</td>
<td>Total MSW generated</td>
<td>12,000 TPD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average FS generated per entity</td>
<td>Average MSW generated per entity</td>
<td>800 TPD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived possibility of expanding sewerage</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Access to finance</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Existing O&amp;M ability</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Demand for end products</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
<td></td>
</tr>
</tbody>
</table>

Key quote
“Funds from National and State level schemes are assigned to UDHD and not us because of the poor capacity in terms of skilled human resources in MC.”

Perceived possibility of expanding sewerage
- High population demands for UGD but possibility of sewerage gets limited by high density pockets
- Strong reliance on National/State level schemes
- Dependency on external support, like CSR funds as the ULB’s self generated funds are limited
- Challenging to find skilled man-power and funding for opex
- Some demand of biochar from surrounding agricultural land, and latent demand for treated water from surrounding industrial clusters

(1) Public Affairs Index (2017) below 0.45, except for Odisha and Meghalaya due to their focus on FSSM
1. **Cost**: Much more cost effective as compared to sewerage

2. **Integrated waste management**: MSW (++) and STP Bio-solids (+)

3. **Land**: Stackability and low footprint in the face of extreme land availability pressures

### Key stakeholders
- UDHD
- Municipal Corporation

### Unmet need / key value proposition
- **Cost**: Much more cost effective as compared to sewerage
- **Integrated waste management**: MSW (++) and STP Bio-solids (+)
- **Land**: Stackability and low footprint in the face of extreme land availability pressures

### Potential OP use case
- **Treat fecal sludge**
- **Treat solids from STP**

### Size of solution
- **5 MLD**

### Form of application
- **Treat solids from STP**
- **Treat fecal sludge**
- **Treat FS+MSW**

**High presence of septic tanks and absence of SWM system in the city**
Segment profiles
Dry and Arid (1 of 2)

Segment definition
Cities with a population between 0.1 million and 1 million with annual rainfall less than 700 mm

- Characterized by low sewerage, these cities are usually in the North-western and western states of India – Punjab, Haryana, Rajasthan and Gujarat
- Low rainfall and resulting water shortage limit the viability of sewerage, especially when these cities don’t have the large population to command resources for expensive water projects
- However, given the reasonable population, sewerage is often promised and not delivered because of practical constraints

Key features
“The city ULBs have to work better with the water boards to ascertain the likelihood of sewerage, and then take a call”

Key quote

Salt-desert near Kutch in Gujarat

Dry city from Rajasthan

Segment need and size

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of entities</td>
<td>52</td>
</tr>
<tr>
<td>Cities</td>
<td></td>
</tr>
<tr>
<td>Population covered</td>
<td>14 Million</td>
</tr>
<tr>
<td>Total FS generated</td>
<td>4800 KLD</td>
</tr>
<tr>
<td>Average FS generated per entity</td>
<td>90 KLD</td>
</tr>
<tr>
<td>Total STP capacity</td>
<td>N.A. MLD</td>
</tr>
<tr>
<td>Total MSW generated</td>
<td>4400 TPD</td>
</tr>
<tr>
<td>Average MSW generated per entity</td>
<td>85 TPD</td>
</tr>
</tbody>
</table>

Key variables

- Higher population than town councils raises the expectation for sewerage, but water scarcity limits chances of a functioning sewer system
- Eligibility and reliance on National/State level schemes like AMRUT
- ULB funds are limited, and willingness to use it for FSM is low
- Challenging to find skilled manpower/vendor and funding opex
- Moderate demand for fertilizers by farmers in the region, but incineration might harm quality
- Water scarcity is much higher than that can be satisfied by OP, but need exists

Feasibility of market entry for OP

Access to finance

- Low
- Medium
- High

Existing O&M ability

- Low
- Medium
- High

Demand for end products

- Low
- Medium
- High

Relevant type of waste

- Grey water
- Black water
- Fecal Sludge
- STP solids
- MSW

Salt-desert near Kutch in Gujarat

Dry city from Rajasthan

Most relevant
Unmet need / key value proposition

1. **Feasibility**: Sewerage not tenable for a large part of these cities
2. **Water reuse**: OP producing water as a by-product
3. **Integrated waste management**: MSW (+)

**Potential OP use case**

- **Size of solution**: 5 MLD
- **Form of application**
  - Treat solids from STP
  - Treat fecal sludge
  - Treat FS+MSW

**Procurement**

- Procurement is usually programmatic, with cities relying on central schemes to procure solutions (e.g. AMRUT funds); a common challenge cited is competing need of water supply which might affect the funding available for FSM
- Procurement is usually top-down, with UDHD procuring solutions for a cluster of cities, or influencing decision to procure/adopt a certain solution

**Key stakeholders**

- **Water board**
- **City ULB**
- **UDHD**
Segment profiles
Steady Roller (1 of 2)

Segment definition
• Cities with population between 0.1 million and 1 million with annual rainfall more than 700 mm
• Cities with little to no sewerage, and large number of septic tanks, making fecal sludge collection and treatment a concern
• Dumping of FS in storm water drains is common, no regulation of private operators dumping
• Enabling ecosystem does exist, but needs to strengthened specifically for sanitation
• Some cities within the segment have seen proclivity to prioritize sanitation (e.g. Warangal)

Key features
“Even before philanthropic investment, we had the momentum to implement solutions, our property ta recovery rate is more than 90%”

Key variable

<table>
<thead>
<tr>
<th>Key variables</th>
<th>Number of entities</th>
<th>Population covered</th>
<th>Total FS generated</th>
<th>Average FS generated per entity</th>
<th>Perceived possibility of expanding sewerage</th>
<th>Access to finance</th>
<th>Existing O&amp;M ability</th>
<th>Demand for end products</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>344 Cities</td>
<td>97 Million</td>
<td>33500 KLD</td>
<td>100 KLD</td>
<td>Low Medium High</td>
<td>Low Medium High</td>
<td>Low Medium High</td>
<td>Low Medium High</td>
</tr>
<tr>
<td>Relevant type of waste</td>
<td>Grey water</td>
<td>Black water</td>
<td>Fecal Sludge</td>
<td>STP solids</td>
<td>MSW</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Most relevant**

Segment need and size

- Very little chances of sewerage being extended to the cities within these segments, even if there is interest
- Access to central government schemes (e.g. AMRUT, Smart Cities) but funds might have to be spent on competing needs (e.g. water supply)
- Limited operational capacity with the ULBs to operate plants
- Limited demand for end-products, no market linkages exist even if interest can be generated from surrounding clusters. Most end-products are used by ULB for internal purposes

Tide OP in Warangal

Feasibility of market entry for OP

Access to finance

- Low
- Medium
- High

Existing O&M ability

- Low
- Medium
- High

Demand for end products

- Low
- Medium
- High
**Segment profiles**

**Steady Roller (2 of 2)**

### Key stakeholders

- **Municipal Corporation**
- **CDMA**

### Procurement

- Most common form of procurement is programmatic or development procurement (most cities within this segment are currently procuring sanitation solutions through Amrut funds or Smart Cities Program); some cities are starting to explore hybrid annuity models, however, success remains to be seen.
- Some cities also rely on state government grants (e.g., Warangal receives 300 crores from the state government every year for spending on development needs).

### Potential OP use case

- **Size of solution**: 5 MLD
- **Form of application**
  - Treat solids from STP
  - Treat fecal sludge
  - Treat FS+MSW

### Unmet need / key value proposition

1. **Cost**: Much more cost effective as compared to sewerage
2. **Integrated waste management**: MSW (+)

**Unmet need / key value proposition**

**Size of solution**

**Form of application**

- FSM is the primary requirement, there might be demand for MSW as well.
Segment profiles

Hilly City (1 of 2)

**Segment definition**
CITIES WITH A POPULATION OF MORE THAN 0.1 MILLION, OR AMRUT CITIES BELOW 0.1 MILLION AND A HILLY TOPOGRAPHY⁴

- Sewer systems have limited viability (~INR 40,000 per capita), hence FSSM is the preferred alternative.
- Land availability is an issue because of higher density, as well as low Government land ownership.
- Most cities belong to the ‘90-10 states’ (North-eastern states, J&K, Uttarakhand and Himachal Pradesh).
- Desludging rates are high and can range from INR 5,000 to INR 25,000 depending on distance.

**Key features**

- Sewer systems have limited viability (~INR 40,000 per capita), hence FSSM is the preferred alternative.
- Land availability is an issue because of higher density, as well as low Government land ownership.
- Most cities belong to the ‘90-10 states’ (North-eastern states, J&K, Uttarakhand and Himachal Pradesh).
- Desludging rates are high and can range from INR 5,000 to INR 25,000 depending on distance.

“OUR WASTE WILL ONLY GO DOWNHILL AND AFFECT THEM, SO IT IS IMPORTANT FOR US TO MANAGE OUR WASTE BETTER”

**Open drain in Shillong with no sewerage**

**Relevant type of waste**

<table>
<thead>
<tr>
<th>Grey water</th>
<th>Black water</th>
<th>Fecal Sludge</th>
<th>STP solids</th>
<th>MSW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Key variables**

<table>
<thead>
<tr>
<th>Number of entities</th>
<th>12 Cities</th>
<th>Average Sewerage</th>
<th>22 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population covered</td>
<td>4 Million</td>
<td>Total STP capacity</td>
<td>N.A. MLD</td>
</tr>
<tr>
<td>Total FS generated</td>
<td>1430 KLD</td>
<td>Total MSW generated</td>
<td>1300 TPD</td>
</tr>
<tr>
<td>Average FS generated per entity</td>
<td>120 KLD</td>
<td>Average MSW generated per entity</td>
<td>110 TPD</td>
</tr>
</tbody>
</table>

**Segment need and size**

- Perceived possibility of expanding sewerage: Low, Medium, High
  - Most hill cities have very low sewerage, driven by difficulty caused by topography and high private land ownership.

**Feasibility of market entry for OP**

- Access to finance: Low, Medium, High
  - Only the AMRUT cities have some outlay for sewerage/FSM; AMRUT is the main reason why these towns are thinking of FSSM.
- Existing O&M ability: Low, Medium, High
  - Due to the remoteness of the region, local skills are poor and O&M is challenging. For e.g., MSW processing center in Shillong closed down because of poor O&M.
- Demand for end products: Low, Medium, High
  - Poor industrial centers like NE states don’t have much of a demand, while industrial regions in HP (e.g., Solan) could have demand for water.

(1) Elevation higher than 1000 m
Segment profiles
Hilly City (2 of 2)

Key stakeholders

Department of Urban affairs
ULB
Consultant

Unmet need / key value proposition
1. **Feasibility:** Sewerage not tenable for a large part of these cities
2. **Integrated waste management:** MSW (++)
3. **Land:** Stackability and low footprint in the face of extreme land availability pressures

Potential OP use case
- **Size of solution**
  - 5 MLD
- **Form of application**
  - FSM is the primary requirement, because almost all of the city relies on OSS
  - Treat solids from STP
  - Treat fecal sludge

Procurement
- Traditional procurement is the most employed path in this segment as well. The hilly states have historically been perceived as marginalized due to distance from the Center, and have not received much support from either development or private sector – thus procurement by these methods is not seen either
- All hilly states are Special Category States, meaning that they are considered more historically disadvantaged in contrast to other Indian states and need more Central assistance - this can imply an increased suitability for Programmatic procurement

Unmet need / key value proposition

Form of application

Consultant
Treat FS+MSW

Most relevant
**Segment profiles**  
**Small and Meek (1 of 2)**

**Segment definition**
- Cities with a population of less than 1 lakh, with no special focus
- No expectation of UGD and many towns are not 100% ODF
- Almost 100% reliance on central/state funds - very low ULB capacity
- Space a constraint for both building septic tanks, and desludging
- MSW collection is regular, but there is no segregation and effective treatment

**Key features**
- “It is perfectly fine to dry untreated fecal sludge in farms, and then use it after a few days. We are not really thinking about treating it.”

**Key quote**

**Relevant type of waste**

<table>
<thead>
<tr>
<th>Grey water</th>
<th>Black water</th>
<th>Fecal Sludge</th>
<th>STP solids</th>
<th>MSW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Key variables**

<table>
<thead>
<tr>
<th>Number of entities</th>
<th>3524 Cities</th>
<th>Population covered</th>
<th>112 Million</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total FS generated</td>
<td>15,320 KLD</td>
<td>Total MSW generated</td>
<td>19,050 TPD</td>
</tr>
<tr>
<td>Average FS generated per entity</td>
<td>4 KLD</td>
<td>Average MSW generated per entity</td>
<td>5 TPD</td>
</tr>
</tbody>
</table>

**Segment need and size**

- Perceived possibility of expanding sewerage: Low, Medium, High
  - Very little possibility, due to both capex requirement and operational complexities, FS priority might depend on the state level ecosystem

**Feasibility of market entry for OP**

- Access to finance: Low, Medium, High
  - Complete reliance on state/national funds
  - Own tax receipts are used up in running the ULB
  - FS can become a reality only if UDHD provides allocated funds for it

- Existing O&M ability: Low, Medium, High
  - No capacity within ULB, as well as within the private sector. Some instances of MSW treatment, however, success has been limited

- Demand for end products: Low, Medium, High
  - Some demand for manure, however, using untreated sludge is common practice

**Images**

- Deep pit for fecal waste inside small homes in Fatuah town
- MSW pick up in Fatuah town
Segment profiles
Small and Meek (2 of 2)

**Key stakeholders**
- Town council
- UDHD
- Chairman of town council

**Unmet need / key value proposition**
1. **Cost**: Much more cost effective as compared to sewerage
2. **Integrated waste management**: MSW (+)
3. **Low operational overheads and complexity**: Lack the skills and capacity
4. **Unmet need**: Greywater

**Potential OP use case**
- Treat fecal sludge
- Treat solids from STP
- Treat FS+MSW

**Procurement**
- While sanitation solutions are procured via traditional methods, they can either happen for individual ULBs or for a bunch of them together via the state government. States are key stakeholders here, as ULBs do not have enough funds, capacity, or political power to make their own decisions.
- This segment does not hold enough promise to attract support from private sector, development organizations, or even central schemes. Given the state of things, this is a good segment to invest in FSM via developmental procurement, as the possibility for sewerage is quite low

**Size of solution**
- 5 MLD

**Form of application**
- Treat solids from STP
- Treat fecal sludge
- Treat FS+MSW

**FS treatment made a priority for small and meek towns in certain states, however, lack of adequate FS generation might be a key risk**
Segment profiles
Little Prodigy (1 of 2)

Segment definition
Cities with population less than 0.1 million, with a history of activities in FSM (7 cities) and/or located near a sprawling megacity

Key features
- Pioneers in FS treatment, mainly driven by philanthropy. An integrated approach to FSSM is being piloted in many of these ULBs.
- Sewerage system is considered infeasible and too expensive
- Access to funding is high due to philanthropic presence and/or proximity to megacities

Key quote
“We are looking for unconventional low-cost solutions. Non-sewered solutions can bring quick wins”

Relevant type of waste
- Grey water
- Black water
- Fecal Sludge
- STP solids
- MSW

<table>
<thead>
<tr>
<th>Segment need and size</th>
<th>Key variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of entities</td>
<td>45 Cities</td>
</tr>
<tr>
<td>Total FS generated</td>
<td>640 KLD</td>
</tr>
<tr>
<td>Average FS generated</td>
<td>15 KLD</td>
</tr>
<tr>
<td>Population covered</td>
<td>3 Million</td>
</tr>
<tr>
<td>Total MSW generated</td>
<td>850 TPD</td>
</tr>
<tr>
<td>Average MSW generated</td>
<td>10 TPD</td>
</tr>
</tbody>
</table>

Perceived possibility of expanding sewerage
- Low
- Medium
- High

Access to finance
- Low
- Medium
- High

Existing O&M ability
- Low
- Medium
- High

Demand for end products
- Low
- Medium
- High

Segment profiles
Little Prodigy (1 of 2)

Relevant type of waste
- Grey water
- Black water
- Fecal Sludge
- STP solids
- MSW

Key variables
- Number of entities: 45 Cities
- Total FS generated: 640 KLD
- Average FS generated: 15 KLD
- Population covered: 3 Million
- Total MSW generated: 850 TPD
- Average MSW generated: 10 TPD

FSTP in Devanahalli
Map of cities under the Mumbai Metropolitan Development Authority

Key features
- Pioneers in FS treatment, mainly driven by philanthropy. An integrated approach to FSSM is being piloted in many of these ULBs.
- Sewerage system is considered infeasible and too expensive
- Access to funding is high due to philanthropic presence and/or proximity to megacities

Key quote
“We are looking for unconventional low-cost solutions. Non-sewered solutions can bring quick wins”

Feasibility of market entry for OP
- Perceived possibility of expanding sewerage:
  - Low
  - Medium
  - High

- Sewerage is considered infeasible due to its high cost and/or minimum water supply requirements, except for some cities close to megacities

- In cities with FSTPs, philanthropic funding is high even though ULB revenue is limited.
- Cities located near megacities’ receive funding from the megacity’s Development Authority

- Access to technical expertise due to the involvement of philanthropy / NGO currently, or proximity to megacity. Operational issues may arise once responsibility is handed over to ULB

- Demand for high-yield manure exists due to the prevalence of farming
- Some demand for water in ULBs close to megacities due to the presence of industries
Segment profiles
Little Prodigy (2 of 2)

Key stakeholders
- Philanthropy
- Megacity Development Authority
- DMA / UDHD
- ULB

Only for cities close to megacities

Unmet need / key value proposition
1. **Integrated waste management**: MSW (+)
2. **Low operational overheads and complexity**: Lack the skills and capacity
3. **Unmet need**: Greywater

Potential OP use case

<table>
<thead>
<tr>
<th>Size of solution</th>
<th>Form of application</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 MLD</td>
<td>Treat solids from STP</td>
</tr>
<tr>
<td>5 KLD</td>
<td>Treat fecal sludge</td>
</tr>
<tr>
<td></td>
<td>Treat FS+MSW</td>
</tr>
</tbody>
</table>

Setting up of FSTPs made a priority in many of these cities, added value proposition of OP needs to be highlighted

Procurement

- Most common form of procurement is development procurement (most cities within this segment procure sanitation solutions with the help of philanthropic funding and a guiding institute, which supports with DPR creation and facilitating technical approval)

- For cities that are in close proximity to ‘sprawling megacity’ development authorities, the procurement is usually traditional in nature, with the authority driving procurement for all cities/ towns within its mandate
Segment profiles

Institutions: Residential buildings (1 of 2)

Segment definition
- Residential apartments which have in-house STPs
- Apartments without STPs might not have demand for an FS only solution
- Many high rise apartments fall under the PCB mandate: new apartments with more than 50 units to have an in house STP
- Often, there exists a residents’ association that oversees operations of STP

Key features

Key quote
“The inhouse STP takes care of our fecal waste, but there is an acute shortage of space to set it, and the technical expertise to maintain the STP”

Relevant type of waste
- Grey water
- Black water
- Fecal sludge
- STP solids

Key variables
- Access to finance
  - Low
  - Medium
  - High
  - Buying and maintenance fees from the residents sufficient to cover the charges
- Existing O&M ability
  - Low
  - Medium
  - High
  - Acute scarcity of vendors who can manage STPs well
- Demand for end products
  - Low
  - Medium
  - High
  - The water is used internally, and the solids of the STP is low in quantity
Segment profiles

Institutions: Residential buildings (2 of 2)

Key stakeholders

Builder
Decides the STP and buys it

Residents association
Contracts operation of the STP

Vendor
Manages the STP

PCB

Unmet need / key value proposition

1. Integrated waste management: STP Bio-solids (+)

Potential OP use case

Size of solution

5 MLD

Form of application

Treat solids from STP

Treat fecal sludge

Treat MSW + FS

No independent FS generation for apartments with decentralized STPs, for the others, only an integrated solution required

Procurement

Builder buys the STP from a vendor with whom there is an existing relationship, and transfers the operations to the residents’ association

The residents’ association in consultation with the builder contracts the operations of STP to a vendor

The vendor maintains the STP in consultation with the residents’ association

(1) Pollution Control Board
Segment profiles:
Institutions: Public institutions (1 of 2)

**Segment definition**
- Entities with a critical mass of people and the autonomy to make their own decision about their sanitation needs

**Key features**
- While there is potential availability of FS in ~400 major railway stations, the Board prefers that municipalities take care of their waste output, like they are mandated to
- Autonomous educational Institutions are like mini municipalities and take care of their own sanitation, but they have the resources to employ a traditional sewer system

**Key quote**
"If we start doing water and sewer, it will affect their (municipality’s) income" - Railways

**Relevant type of waste**
- Grey water
- Black water
- Fecal sludge
- STP solids

**Key variables**

<table>
<thead>
<tr>
<th>Feasibility of market entry for OP</th>
<th>Access to finance</th>
<th>Existing O&amp;M ability</th>
<th>Demand for end products</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
</tbody>
</table>

- Many competing needs and priority of sanitation and as a result financing for sanitation is low for both railways and educational institutions, both are currently funded by Central Govt.
- Limited O&M ability for both institutions due to competing priorities, and lack of experience in operating treatment plants
- End-products not considered a viable revenue source due to lack of market linkages and inadequacy of output
Segment profiles:
Institutions: Public institutions (2 of 2)

**Key stakeholders**
- Head of Institute
- Central Government
- Municipal Corporation

**Unmet need / key value proposition**
1. Low cost and low maintenance for educational institutions, however, very limited interest in an independent FS solution

**Potential OP use case**

<table>
<thead>
<tr>
<th>Size of solution</th>
<th>Form of application</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 MLD</td>
<td>Treat solids from STP</td>
</tr>
<tr>
<td>5 KLD</td>
<td>Treat fecal sludge</td>
</tr>
<tr>
<td></td>
<td>Treat MSW + FS</td>
</tr>
</tbody>
</table>

**Procurement**
- Creation of DPR by the Railways, with an external consultant
- Specify tech-neutral specifications.
- Low cost projects, do not expect PPP.
- Also believe that Private sector is not interested in PPP with railways

Tender release for competitive bidding usually with the following parameters

Awarding tender and start of work
### Key assumptions used to size the segments

<table>
<thead>
<tr>
<th>Description</th>
<th>Assumption</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition of unfavorable ecosystem</td>
<td>• Public Affairs Index below 0.45&lt;sup&gt;1&lt;/sup&gt;</td>
<td>• Public Affairs Centre, 2017</td>
</tr>
<tr>
<td>Definition of dry areas</td>
<td>• Average rainfall below 700 mm</td>
<td>• World Resources Institute, &quot;India Water Tool&quot; (2015)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• India Meteorological Department (1991 – 2002)</td>
</tr>
<tr>
<td>Per capita MSW generation (kg/capita/day)</td>
<td>• Population: More than 5 mn – 0.61</td>
<td>• India Infrastructure Research, “Municipal Solid Waste in India” (2017)</td>
</tr>
<tr>
<td></td>
<td>• Population: Between 1 to 5 mn – 0.425</td>
<td>• Rajendra, Mayuri, “Municipal SWM in India - Current State and Future Challengers: A Review” (2012)</td>
</tr>
<tr>
<td></td>
<td>• Population: Between 0.1 to 1 mn – 0.305</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Population: Less than 0.1 mn – 0.17</td>
<td></td>
</tr>
<tr>
<td>Per capita FS generation (LPD)</td>
<td>• 0.63</td>
<td>• U.S. Environmental Protection Agency</td>
</tr>
<tr>
<td>% HHs connected to piped sewer, septic tanks and public latrines in 2011</td>
<td>• District data used for all cities within the district</td>
<td>• Census 2011</td>
</tr>
<tr>
<td>Projection: % HHs connected to piped sewer and septic tanks in 2018</td>
<td>• 148 mn urban people will have septic tanks by 2017</td>
<td>• USAID India, 2010</td>
</tr>
<tr>
<td></td>
<td>• CAGR for % increases in states as per Swacch Sarvekshan Rankings&lt;sup&gt;2&lt;/sup&gt; = 3.34%, 1.67%, and 0.84%</td>
<td>• Swacch Bharat Urban, “Swacch Sarvekshan Survey” (2017)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Census 2011</td>
</tr>
<tr>
<td>Projection: % HHs connected to public latrines in 2018</td>
<td>• 4.48% assuming Swach Bharat Mission (Urban) meets its targets by 2019</td>
<td>• Census 2011</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Ministry of Housing and Urban Affairs, “SBM-U Guidelines (2017)”</td>
</tr>
<tr>
<td>% HHs connected to septic tanks and public latrines in the small and meek segment</td>
<td>• Average of district coverage of septic tanks and public latrines of cities below 1 lakh population</td>
<td>• Census 2011</td>
</tr>
<tr>
<td>% HHs connected to septic tanks and public latrines in the little prodigy segment</td>
<td>• Average of septic tank and public latrine coverage for class 2,3,4,5 and 6 cities (i.e., below 1 lakh population) in Urban India</td>
<td>• Indian Institute for Human Settlements, “Urban Water and Sanitation in India” (2014)</td>
</tr>
<tr>
<td>% HHs connected to sewerage</td>
<td>• Percentages taken for 2011 for the rising metro, steady roller and hilly city segments</td>
<td>• Census 2011</td>
</tr>
<tr>
<td></td>
<td>• Average of district coverage of sewerage of cities below 1 lakh population for the small and meek segment</td>
<td></td>
</tr>
</tbody>
</table>

<sup>1</sup> Except for Odisha and Meghalaya due to their focus on FSSM

<sup>2</sup> All states were divided into three equal quantiles based on Swacch Sarvekshan Rankings – average increase assumed for middle quantile, double of average for the top quantile and half of average for the bottom quantile of states