STeP Sanitation Technology Platform

Determining the Economically Optimal Capacity Of A Decentralized Faecal Sludge Treatment Plant

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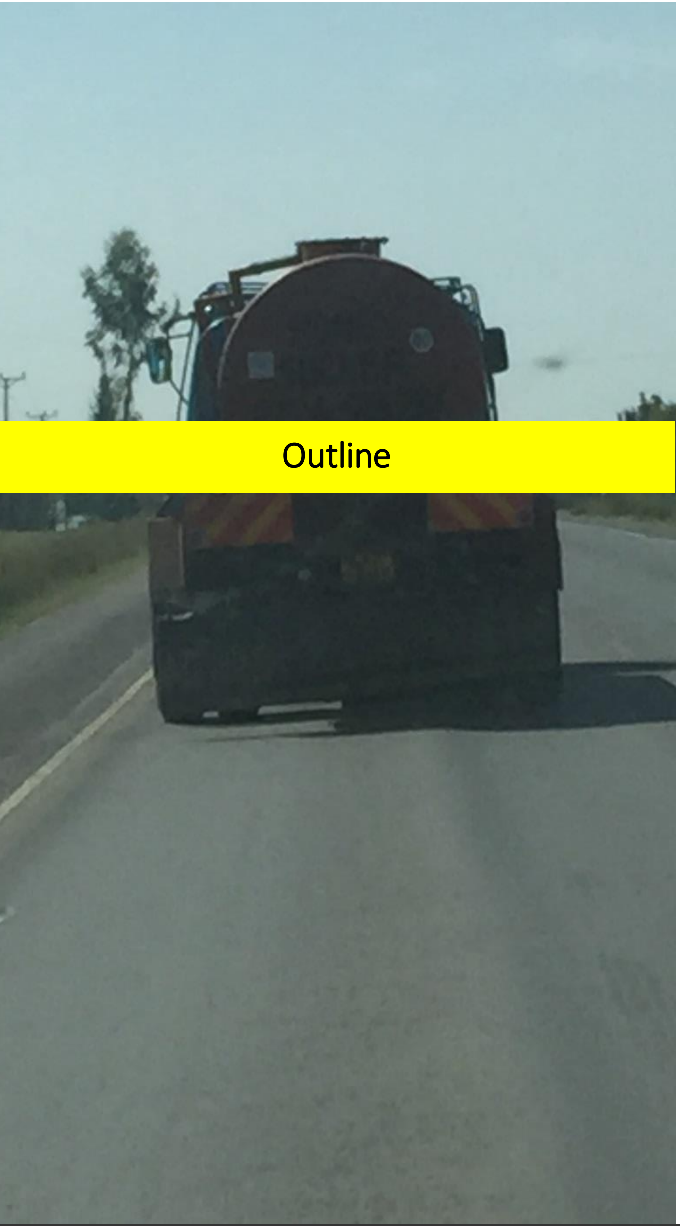
The Sanitation Technology Platform



Outline

Introduction

Approach

Illustrative Results

Summary

As a supplier of pre-engineered FS treatment technologies, what capacity should I offer?

Increasing Scale

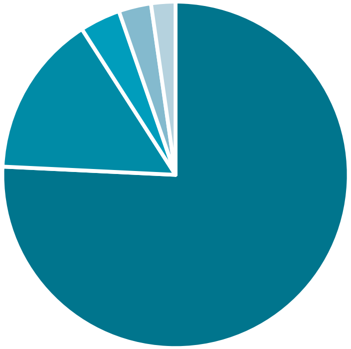
6 m^3 / day	80 m^3 / day	150 m^3 / day
		
Devanahalli Plant	Dumaguete City	Lapulapu-Cordova Septage Treatment Plan
Devanahalli, India	Dumaguete, Philippines	Cordova, Philippines

Devanahalli Plant photo source: Vishwanath, S. [Photograph]. Retrieved from http://www.thehindu.com/features/homes-and-gardens/the-management-of-sludge/article8004903.ece

Why does capacity matter?

Manufacturer’s perspective:

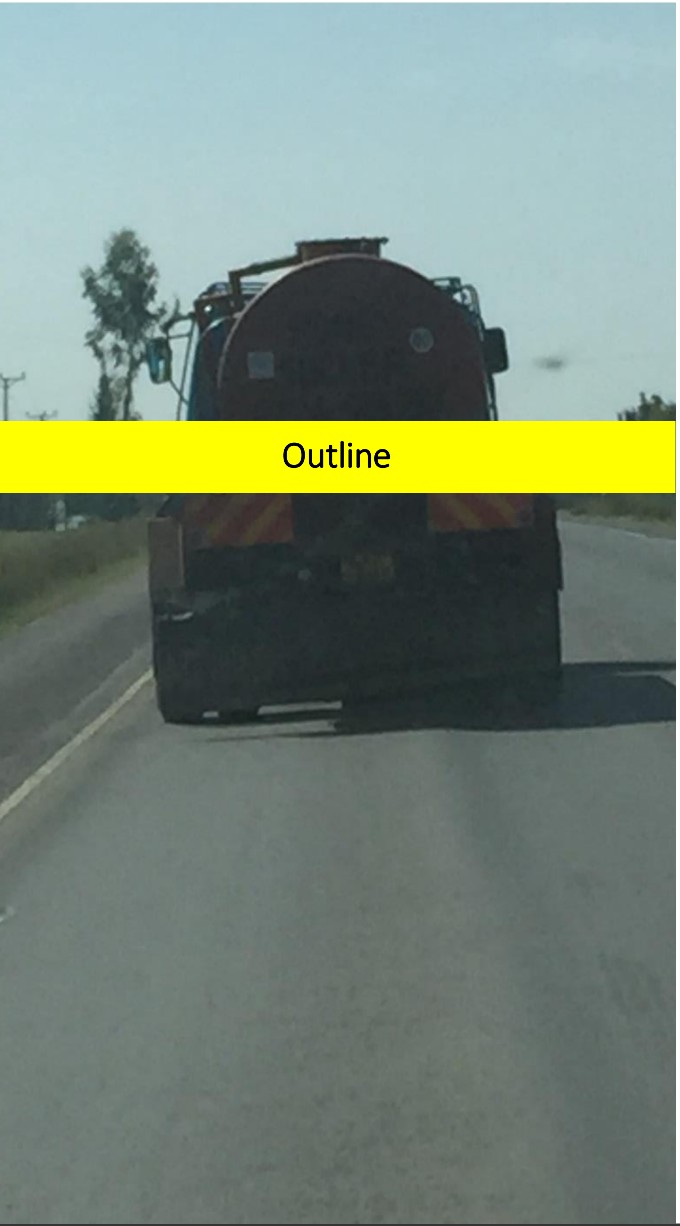
Product must capture significant share of market



Society’s perspective:

Minimize cost of Fecal Sludge Management

↓ $ / m^3



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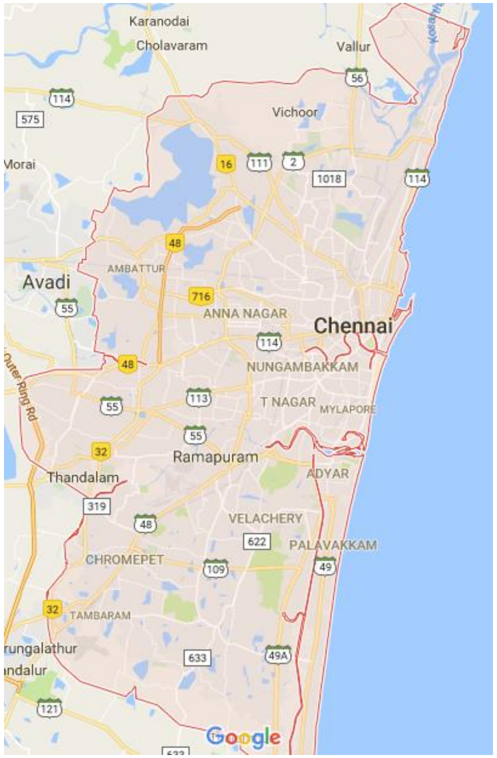
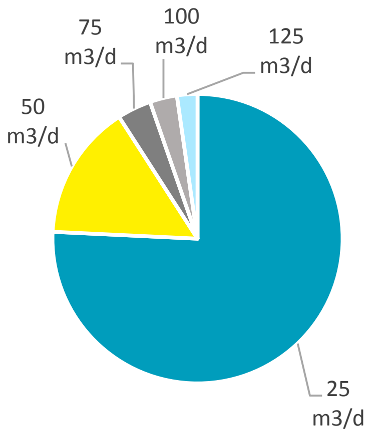
To establish economically optimal capacity, the evaluation needs to be conducted at city level and then synthesized.

1 Determine economically optimal OP at city-level

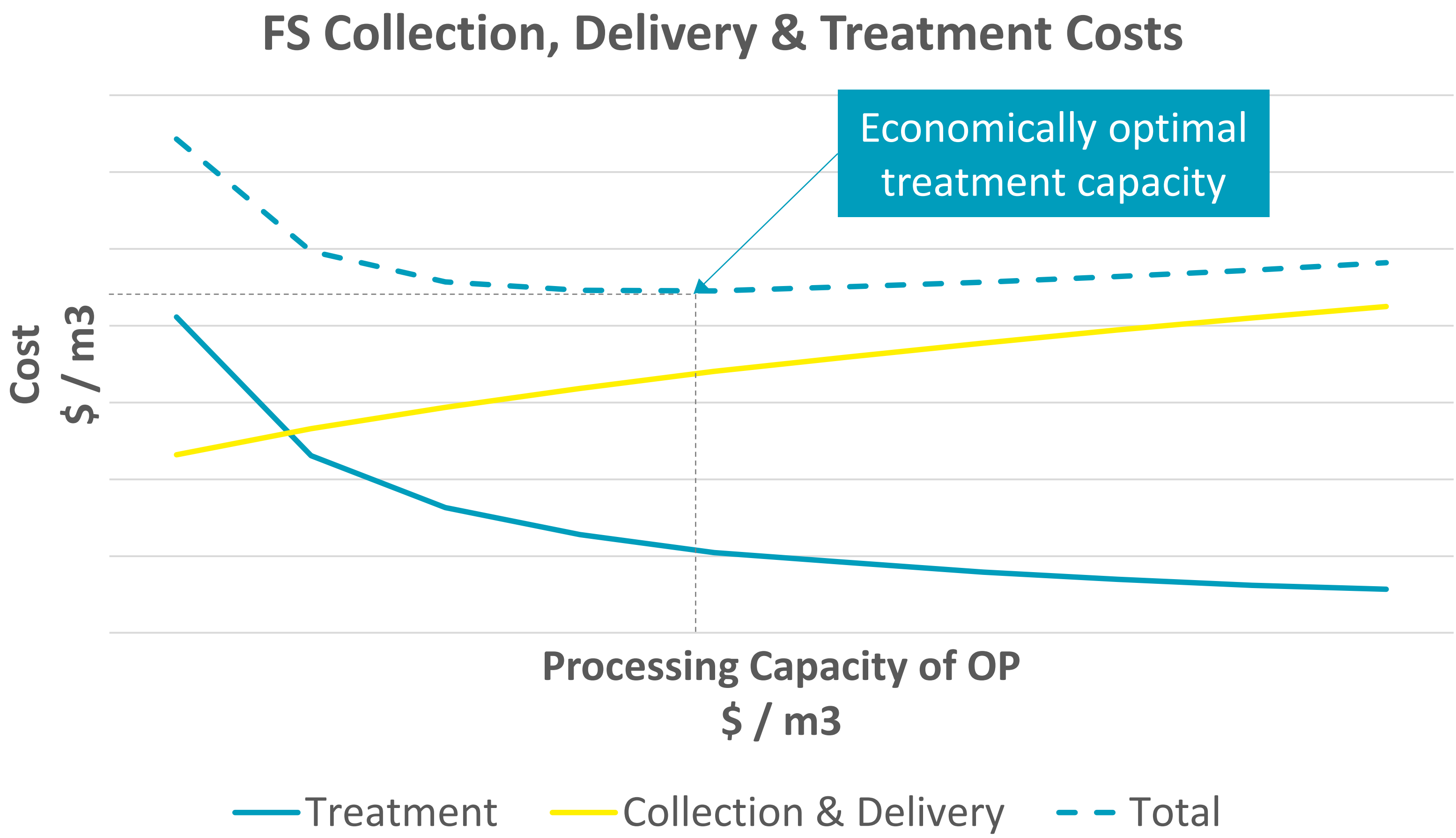
2 Synthesize across countries of interest



Country Name	AccentC	Population Density (people / km2)	Optimal J-OP scale, considerin g city size
Côte d'Ivoire	Touba	2,269	50
Congo, the De	Aketi	8,416	0
Congo, the De	Bandundu	4,438	50
Congo, the De	Basoko	4,890	50
Congo, the De	Beni	5,198	50
Congo, the De	Binga	172	50
Congo, the De	Boende	23	0
Congo, the De	Bolobo	527	0
Congo, the De	Boma	5,205	200
Congo, the De	Bondo	220	0
Congo, the De	Bosobolo	629	0
Congo, the De	Bukama	11,391	0
Congo, the De	Bulungu	6,701	50
Congo, the De	Bumba	6,499	50
Congo, the De	Bunia	18,101	50
Congo, the De	Businga	229	0
Congo, the De	Buta	1,867	50
Congo, the De	Butembo	4,219	100
Congo, the De	Demba	1,710	0
Congo, the De	Gandajika	3,797	100
Congo, the De	Gbadolite	2,069	50
Congo, the De	Gemena	4,264	50
Congo, the De	Ilebo	2,854	50
Congo, the De	Inongo	135	0



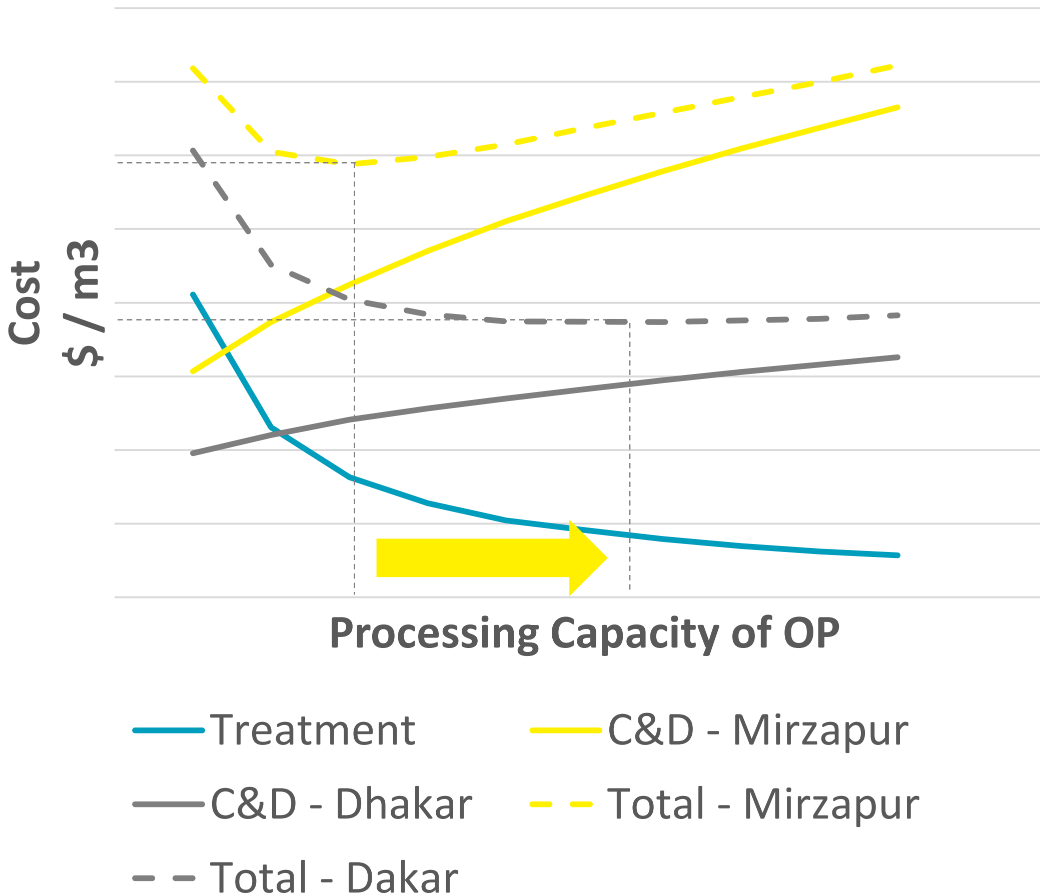
Economically optimal capacity is the capacity at which a city's <u>total</u> fecal sludge management cost is minimized.



A city's population density has a significant influence on economically optimal capacity.

Illustrative Example: radius required to collect 100 m³ / day from two urban areas in Bangladesh:

- Mirzapur: 3,000 / km², 3 km radius required
- Dhakar: 23,000 / km², 1 km radius required

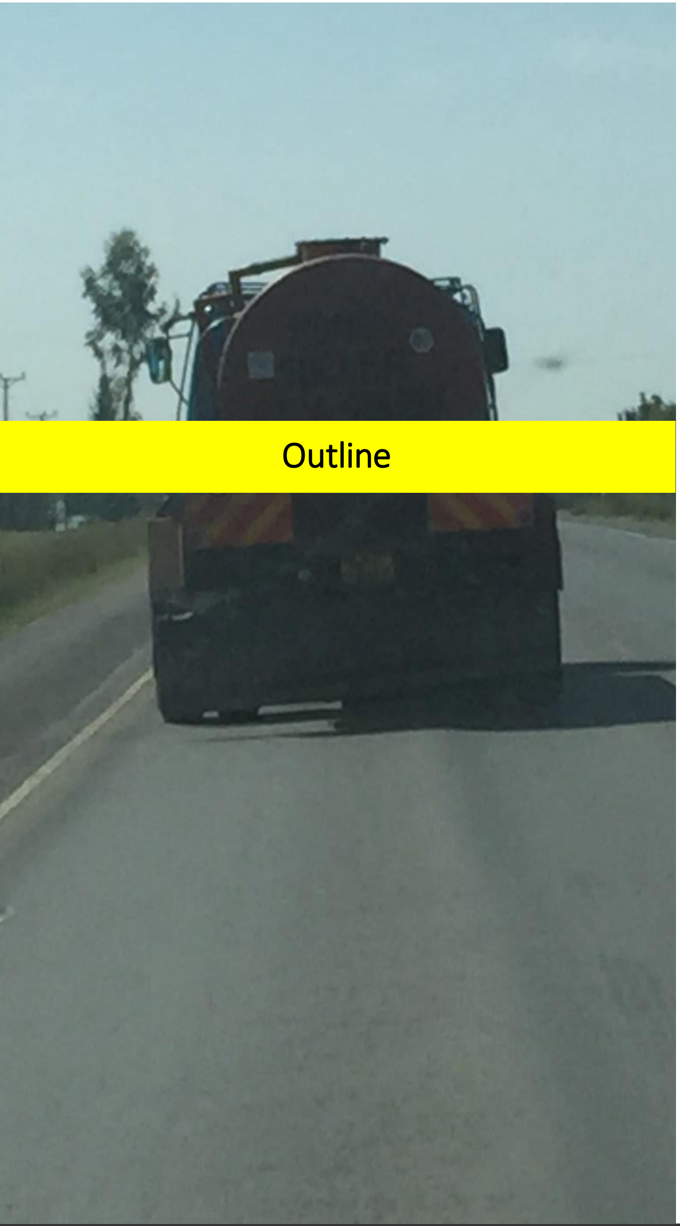


Other aspects of the approach

1. Illustrative OP / FSTP Model
2. Performed analysis for ~4,000 towns & cities (>10,000 pop) across 13 countries*
3. Modeling considered a range of country & city-specific variables:

	Collection and Transport	Treatment
Country-specific factors	• Labor requirements & costs • Truck capacity & speed • Truck capital & operating costs • Diesel costs	• End product prices • Labor costs
City-specific factors	• Population density	• Target FSM population.

* Côte d'Ivoire, Congo, the Democratic Republic of the, Dominican Republic, Ghana, Haiti, India, Kenya, Nigeria, Pakistan, Philippines, Senegal, South Africa, Bangladesh



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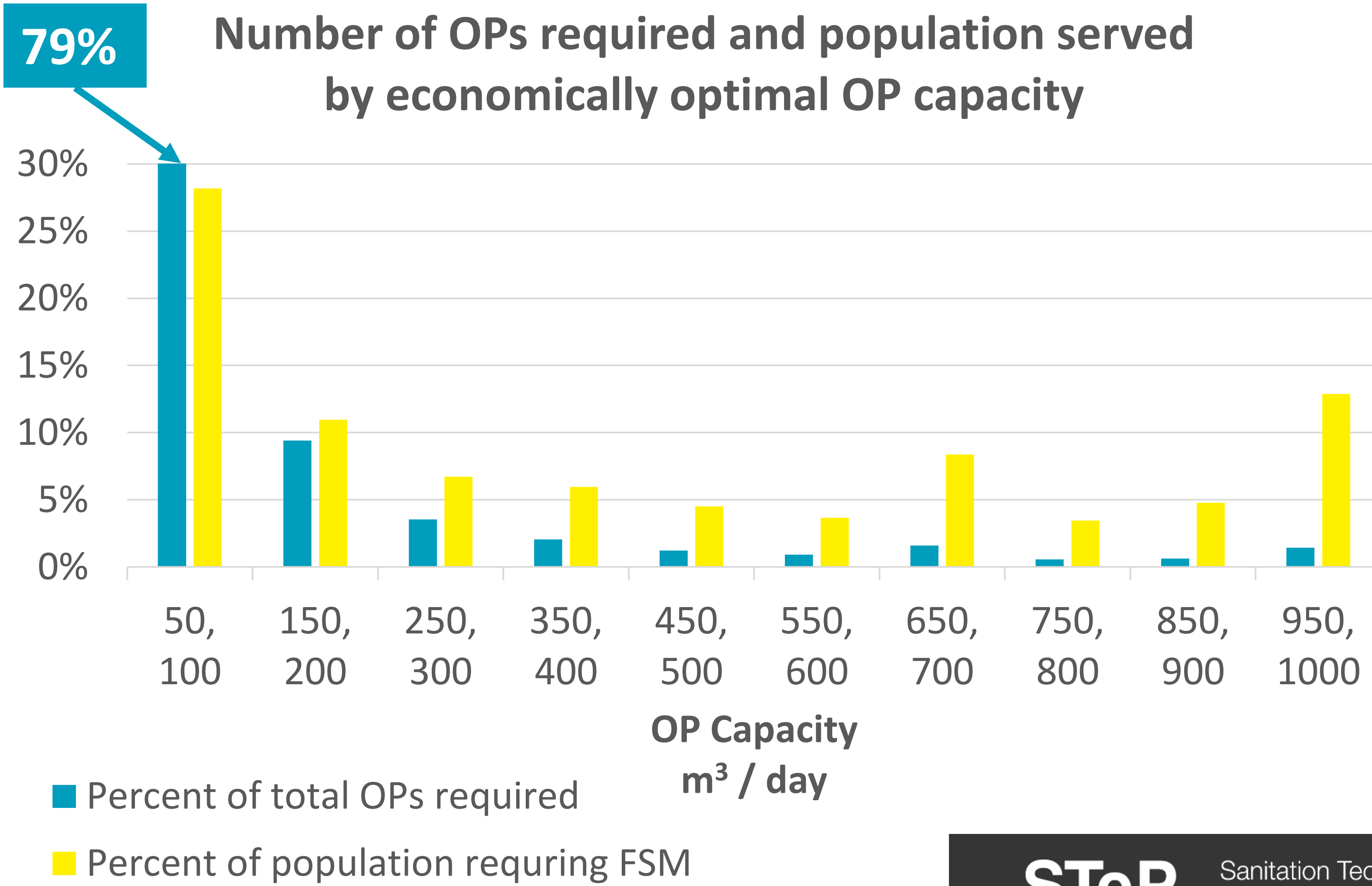
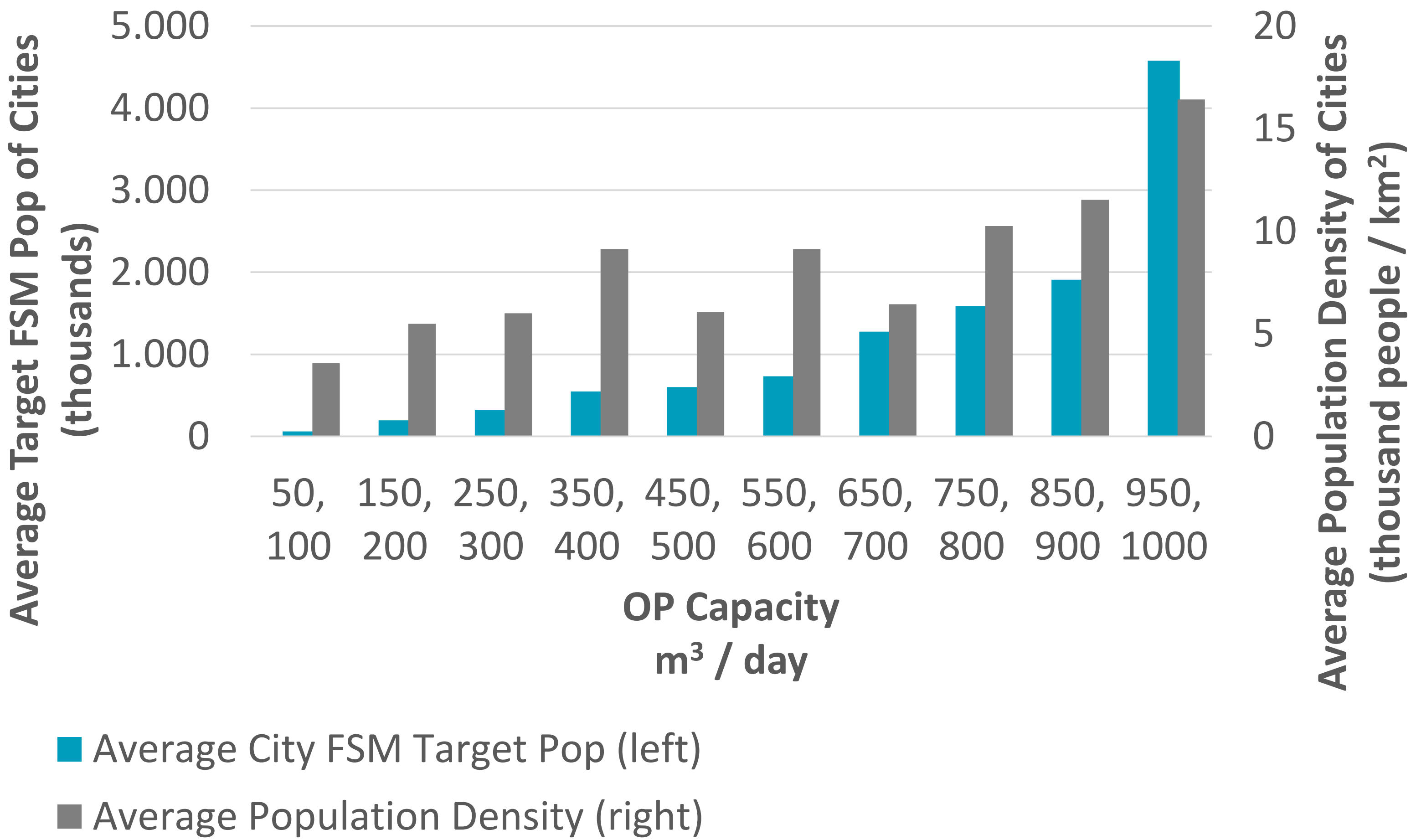
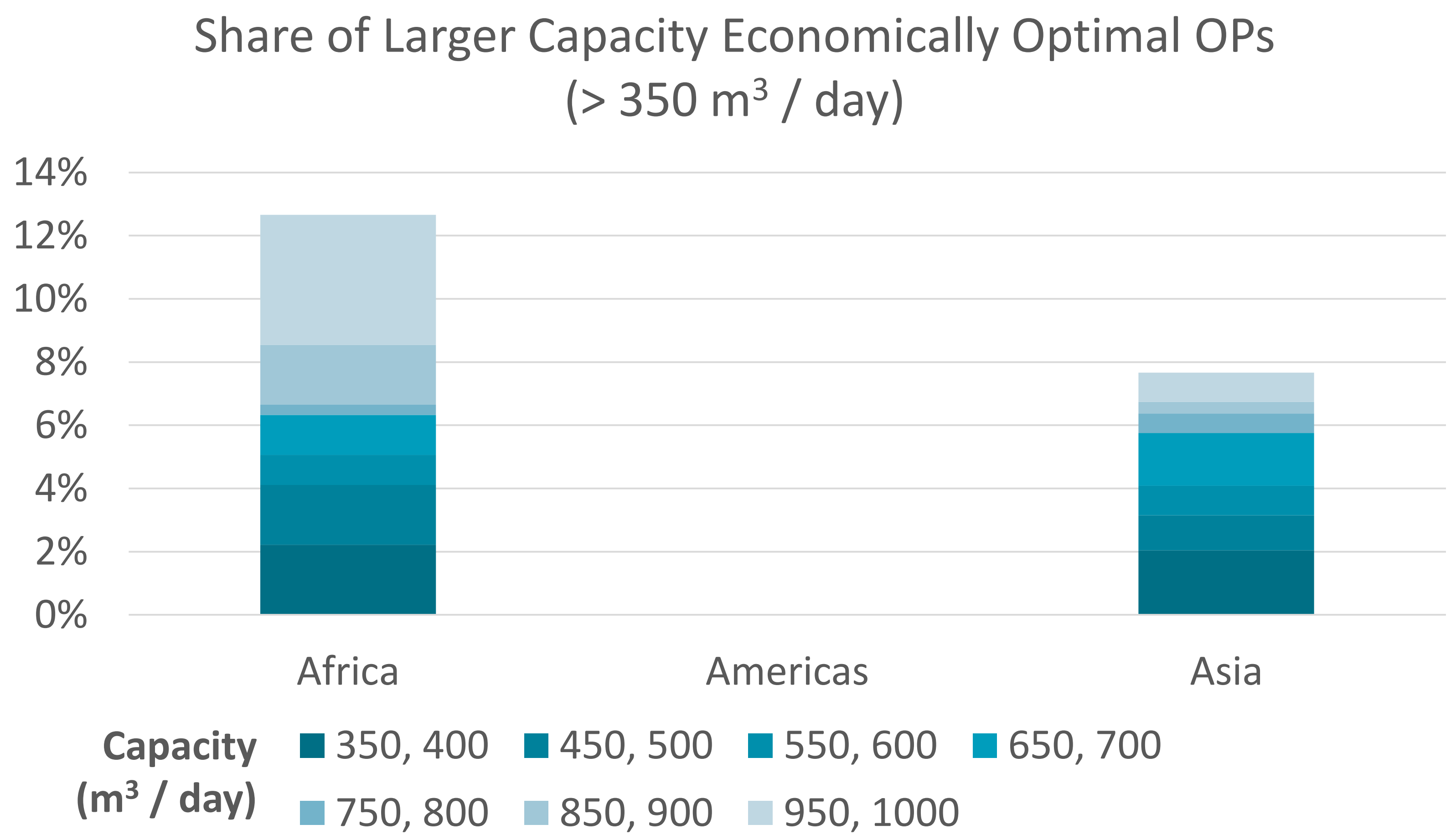
The biggest category is for 50 & 100 m^3/day scale systems, but there is still potential need for larger scale systems.

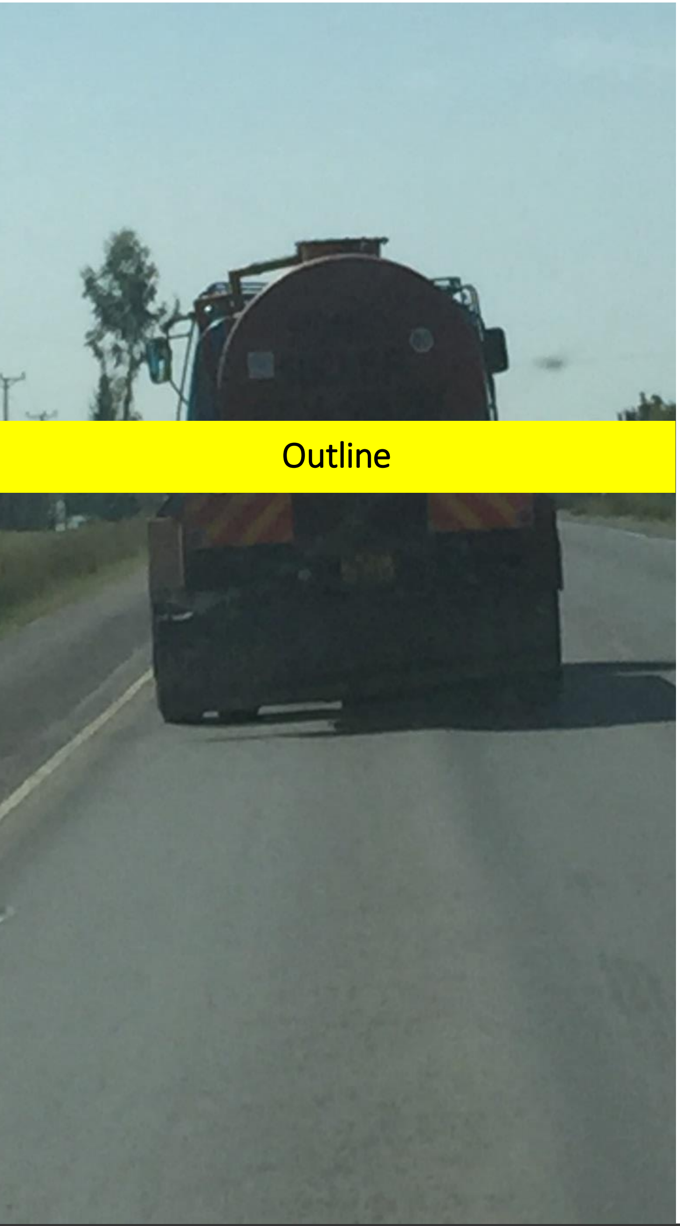


The economically optimal scale of OP increases with increasing population density and target FSM population



Larger African cities may benefit from larger capacity systems due to relatively low transport costs.





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In summary

- Matching capacity and city size minimizes costs.
- Total FSM cost is a trade-off:
  - Transport costs increase with scale.
  - Treatment costs decrease with scale.
- Population density significantly influences this trade-off.
- Consider other local & technology specific variables.
- Based on the example OP technology:
  - Need for small-scale solutions (e.g. 50-100 m^3 / day).
  - Smaller but important opportunity for larger systems.