TOILET
BOARD COALITION

SANITATION ECONOMY MARKETS: INDIA

METHODOLOGY DEEP DIVE AND MARKET UPDATES

NOVEMBER 2020

ABOUT THE TOILET BOARD COALITION

Established in 2015, the Toilet Board Coalition (TBC) is a business-led partnership platform with the goal to accelerate the transition to the sanitation economy. Our ambition is to transform sanitation systems from unaffordable public costs into robust marketplaces of sustainable business value.

The TBC is facilitating private sector engagement; large-small company partnerships and public-private collaboration to contribute to the achievement of Sustainable Development Goal 6 - universal access to water and sanitation.

We run accelerator programmes and implement strategic projects dedicated to growing sanitation economy business solutions that are smart, circular and resilient to address the unmet sanitation needs of the world's most vulnerable.

The members of the Toilet Board Coalition believe that accelerating the sanitation economy will deliver significant benefits to business and society.

ACKNOWLEDGEMENTS

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We thank the Toilet Board Coalition members for their contributions, review of the piece and ongoing leadership in the sector.

DISCLAIMER

The contents of this paper provide a synthesis of our discussions and findings from the study. All information has been subject to the interpretation of the authors, the Toilet Board Coalition Secretariat, and does not necessarily represent the views of all Toilet Board Coalition members or those companies and experts who participated in the study.

FOREWORD

AS GLOBAL MARKETS BEND, SHIFT AND LOOK UP TO A REVIVAL UNDER THE WEIGHT OF 2020 AND COVID-19, WE HAVE SEEN INCREDIBLE RESILIENCE THROUGHOUT THE SANITATION ECONOMY AND MOST INNOVATIVE BUSINESSES IN THE SECTOR HAVE THRIVED.

With COVID-19, our world has restored the crucial role of sanitation and hygiene in the context of human health and wellbeing and begun appreciating the interdependence of health and stable ecological and environmental systems. Against this backdrop we have observed some entrepreneurs capitalising on the situation - growing and developing their businesses with speed to meet heightened demand and new opportunities around improved sanitation services that ensure health. Others have weathered stoutly the quiet of cities shut down and services at a stand-still for a season. A silent revolution is ongoing, the sanitation economy is expanding with sustainable and resilient business models, in spite of and alongside COVID-19. And our work at the Toilet Board Coalition has never felt more relevant.

EXECUTIVE SUMMARY

IN 2017 THE TOILET BOARD COALITION SET OUT TO ESTABLISH A MARKET ESTIMATION OF THE POTENTIAL OF THE SANITATION ECONOMY.

It was the first of its kind. Organisations such as the United Nations had done calculations around the cost of not having universal access to sanitation (UN Sustainable Development Goal 6.2) and the potential additions to GDP, once universal access was achieved. We have been pioneers in looking at sanitation from the lens of business opportunity and introduced in 2017 the sanitation economy approach.

The members of the Toilet Board Coalition have come together to align and amplify private sector engagement and investment in the sanitation sector. With each passing year, it has become increasingly clear to the global development community the importance and value of a business-based approach to sanitation. What we have seen, since the 2017 publication of the initial piece on India and its methodology, is an opening of doors throughout India to this approach. The exercise of attaching a number to the market opportunity of sanitation has brought the potential into perspective for businesses and governments. We have seen greater attention, innovation and engagement across the sector as a response.

Therefore we have rigorously revisited the market estimate methodology, with the specific intention for it to be replicated across Asia and new regions. Our ambition is to catalyse similar private sector engagement, investment and the transformation of sanitation perspectives we have seen in India over the last four years into new regions, through the application of this methodology on a global scale.

The methodology has been sharpened and updated to our 2020 context. Appropriately, our first exercise is an update and extension of the market estimations for India. In 2017 we calculated numbers for 2021, so the following pages take the refined methodology and relook at the numbers for 2021. We then build towards 2025 for medium-term future and 2030 at the close of the UN's Sustainable Development Goals (SDGs), when our collective work should result in universal access to sustainable, safely-managed sanitation systems being a reality.

$97 BILLION

SANITATION ECONOMY MARKET OPPORTUNITY IN 2021

$148 BILLION

SANITATION ECONOMY MARKET POTENTIAL BY 2030

$86 BILLION
Toilet Economy

$6 BILLION
Circular Sanitation Economy

$6 BILLION
Smart Sanitation Economy

Enclosed in this piece of work is a detailed description of the market estimation methodology, updated findings for India and a first look at how this methodology could be applied elsewhere, with first calculations of sanitation economy market potential in Indonesia and the Philippines. We have included example breakdowns of the methodology in each section to guide the reader in understanding how we have arrived at the numbers. In an effort to present this information in as succinct a manner as possible, the additional breakdowns of the methodology for each product and service can be found can be found following the references.

We have found that our work in 2017 was indicative of the growth we would see. Where there are significant deviations from the previous numbers, it is often due to something additional being brought into or removed from scope. Reassuringly, despite an increasingly rigorous methodology and greater data availability, most of our estimations for 2021 were correct.

In principal, the market estimations are a formula of population and market value of products and services, with considerations for cultural and national context. The products and services included are not exhaustive to the sanitation economy but, rather, align with the market in consideration. They were selected based on data availability, pertinence to our current entrepreneurial network and relevance. Data sources are from reputable published work by government and trusted sources, combined with on-the-ground knowledge and insights from the Toilet Board Coalition's entrepreneur network. This follows the methods used in 2017. What differs for this 2020 revisit to the methodology is the sharpened threshold of acceptable data sources and increased breadth and depth of scope.

It is important to note that we are estimating the potential addressable market of the sanitation economy operating at scale in a particular geography. These estimates, therefore, do not reflect the current reality. As the sanitation economy scales, the market reality and this work will come into alignment. For instance: if the toilet resources (the TBC's name for human waste) are not collected from sanitation facilities across the country, the products and market estimations of the circular sanitation economy cannot be realised. Many of the businesses graduating from the Toilet Board Coalition's accelerator programmes are already addressing portions of this market through their products and services, as are the broader private and development sectors, so the market numbers listed should not be considered wholly untapped opportunities. Indeed it is our relationships with those tapping into this market potential that provide us with the data to estimate how the market can develop.

TOILET ECONOMY

Cleaning and maintenance of public toilets (specifically offices, educational settings, hotels and hospitals) remains one of the most significant market opportunities. Combined with the market for menstrual health and hygiene (MHH) products, the Toilet Economy remains the largest potential market.

CIRCULAR SANITATION ECONOMY

We've expanded our scope to drill down into the specific opportunity of nitrogen, phosphorus and potassium as outputs from the circular sanitation economy. These prove a very significant market opportunity, which is also reflected in the Toilet Board Coalition's upcoming report with UN Food & Agricultural Organisation on the sanitation economy and sustainable agriculture.

SMART SANITATION ECONOMY

The biggest development since our 2017 work comes in the smart sanitation economy. Our market estimation remains along the same growth curve as our 2017 work. But as we undertook these calculations there was a drastic difference in the availability of relevant data. In 2017 we worked from scarce, trusted data and took a calculated leap to name $6 billion as the 2021 estimation. In 2020, we have grown more conservative in our data sourcing but now can confidently point to $5.6 billion as a minimum for this market in 2021. In truth, we feel this market is exponentially larger but the sector still lacks a plethora of trusted data sources to confidently calculate a more indicative number. Along those lines, we have been more specific on the opportunities that correlate to that number, laying the groundwork for an influx of new data in this area over the coming three to five years and a revisit to this domain.

EXECUTIVE SUMMARY

KEY MESSAGES

ABOUT THIS PAPER

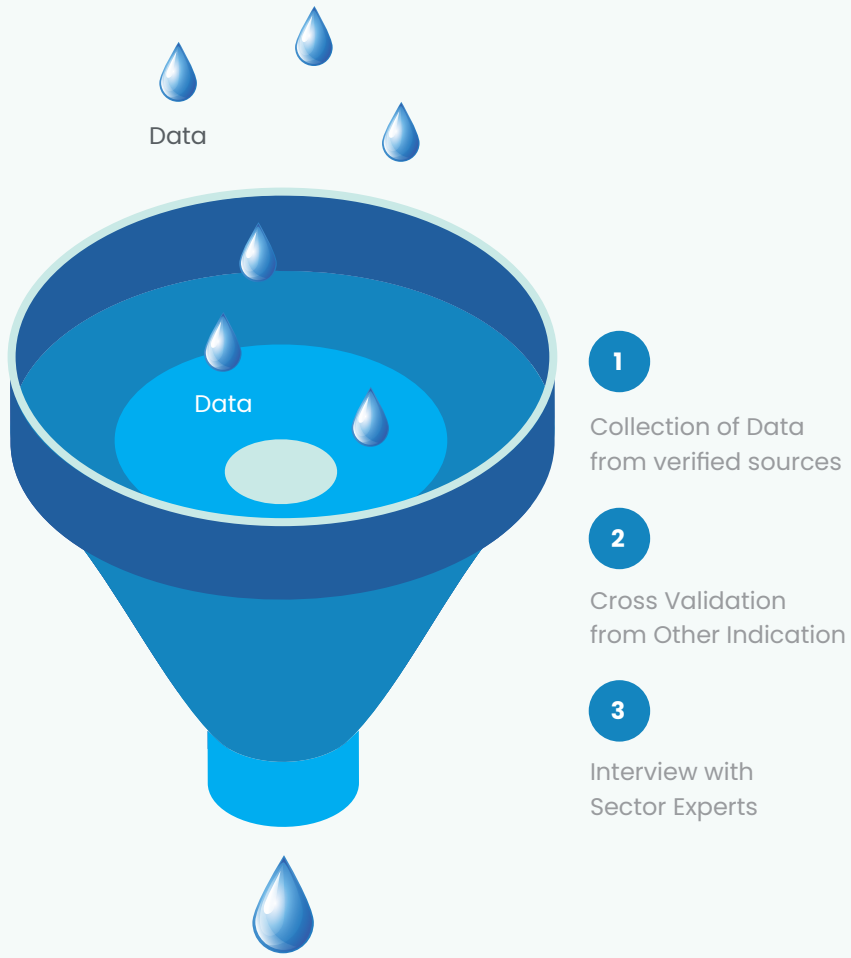
OBJECTIVES OF THE EXERCISE

The objective of the study is to estimate the size of the sanitation economy markets of products and services, renewable resource flows, data and information at a country level for India, drawing inspiration from the 2017 sanitation economy report for the country, deep diving into products and services for the toilet economy, circular sanitation economy and smart sanitation economy. For this piece of work we have specifically focused on refining the market estimation methodology, with an eye towards its application beyond India.

APPROACH FOLLOWED

The overarching approach followed for the estimations was a **modified top-down approach**. In this approach, high-level chunks of information at the feature or design level were estimated and were decomposed progressively into smaller chunks or work-packets as information was expanded. For this approach, extensive secondary research to collate verified data from the published government or trusted sources was collated and cross-verified with other indicators. Care was taken to scan each source of information in terms of the following aspects:

- **Specification** - How specific is the data and how relevant is it for the project objective?
- **Error** - Whether the data has any error. What is the source of such an error? Is this error a significant one? Can the error be addressed easily?
- **Current** - How recent Is the data?
- **Objective** - What was the objective with which the data was collected?
- **Nature** - What is the nature of the data?
- **Dependability** - How reliable is the source of data?



Comprehensive projections for Toilet Economy, Circular Sanitation Economy and Smart Sanitation Economy

The team referred to 50+ leading publications from government, leading consulting firms, research institutions, notifications, press releases and interviews with entrepreneurs. An elaborate depiction of the secondary sources referred to has been provided at the close of the report.

Another unique feature of this approach was the fact that it aimed to arrive at the universal figures of numbers of toilets under each sub-component, before using existing market-based assumptions (validated from real stakeholders in the market) and statistics-based growth rates to estimate the future scenario of products and services. The modelling technique also attempts to build up an algorithm, which has several sub-components, that can be updated in line with the real-time price revisions across various geographies.

TOILET ECONOMY

- Household Toilets
- Community Toilets
- Public Toilets
- O&M and high-relevance auxiliary products

CIRCULAR SANITATION ECONOMY

- Biogas
- Electricity
- Biochar
- Agricultural Products
- Animal Feed
- Regenerative Health Products

SMART SANITATION ECONOMY

- Health Data
- Smart Technologies
- Smart Logistics
- Data Analytics & Applications
- Smart Cities

REFRESH

THE SANITATION ECONOMY

The sanitation economy is a growing marketplace of products and services, renewable resource flows, data and information that is transforming cities, communities, and businesses and driving progress towards the Sustainable Development Goals.

The Toilet Board Coalition has previously published 14 reports on the Sanitation Economy, unpacking its value and impact across sectors, supply chains and cities. Our 2019 report, 'Scaling Up The Sanitation Economy' details the sustainable and scalable business models we see operating in this space and the financial scenarios of the scaling from a government and private sector perspective. Learn more at: https://www.toiletboard.org/resources

In this model, all natural and biological resources (energy, nutrients, water), as well as valuable information about human health and behaviours, are used to generate value within three domains: the toilet economy, circular sanitation economy, and smart sanitation economy. Each offers business models with new revenues, while providing economic, environmental and social benefits.

Grounded in collaboration between private and public sectors, the sanitation economy is a place where innovation, entrepreneurship and investment bring new business opportunities to what used to be seen as an unaffordable public cost.

The sanitation economy harnesses one of the population's most consistent and yet overlooked daily activities to provide valuable resources and information to our population. It is a source of energy, nutrients and water that uniquely grows with the population.

The sanitation economy links three distinct areas for business and societal benefit:

THE TOILET ECONOMY: Products and services that provide safe toilet access for all, whether public or private. This spans centralised and decentralised, sewered and non-sewered, high and low water tables, low-income to high, rural, urban and peri-urban. Toilet designs apply circular sanitation economy principals to minimise waste and greenhouse gases and capture data to feed the smart sanitation economy.

THE CIRCULAR SANITATION ECONOMY: Toilet resources (The TBC's preferred term for human waste) feed into a system which replaces traditional waste management with a circular economy approach. It connects the biocycle, using multiple forms of biological waste, recovering nutrients and water, creating value-adding products such as renewable energy, organic fertilisers, proteins and more.

THE SMART SANITATION ECONOMY: Digitised sanitation systems that optimise data for operating efficiencies, maintenance, plus consumer use and health information insights. Sanitation is included in smart cities' architecture, monitoring public toilet usage, sewage treatment and health indicators, and detects needs for maintenance and repair throughout the system.

THE SANITATION ECONOMY

MARKETPLACE

Sanitation as a business opportunity instead of an unaffordable cost

Sanitation as a solution provider, offering not only sanitation, but cost savings and environmental improvements to food/agriculture, consumer goods, energy, health, waste, water and other industries

PREVENTATIVE HEALTH

HEALTH DATA
Nutrition & health data can inform public officials, the healthcare and pharmaceutical community and individual users

TOILET ECONOMY

HOUSEHOLD

- CONTAINER TOILETS
- TOILET SHELTER
- BIO TOILETS

PUBLIC

- PUBLIC & COMMUNITY TOILET BLOCKS
- PORTABLE TOILETS

- LAUNDRY SERVICES
- MAINTENANCE AND REPAIR
- PERSONAL HYGIENE PRODUCTS
- CLEANING
- FEMININE CARE PRODUCTS
- PAN/TOILET FIXTURE

Consumer biological waste
- toilet waste
- kitchen waste
- animal waste
- compostable packaging & other items

Industrial biological waste
- toilet waste,
- food / market waste,
- agricultural & food waste
- farm waste
- compostable packaging & other items

BIOLOGICAL WASTE INPUTS

CONSUMER USE DATA
Consumer insights data related to consumer behaviour & product usage. Customer relationship management, marketing, advertising & product decisions

TOILETS & PRODUCTS DESIGNED FOR REUSE OF RESOURCES

TOILET ACCELERATOR
SMART SUSTAINABLE SANITATION FOR ALL

SYSTEM OPERATIONS DATA
Manufacturers, operators, and service companies can access status information to inform the need for maintenance, repair, cleaning, waste collection, etc.

SMART SANITATION ECONOMY

DISTRIBUTION
Relevant data is communicated back to the user through mobile applications and services

SOFTWARE/DATA PROCESSING & ANALYTICS
Sensor sends molecular characterisation data to cloud based cognitive computing platform where data is analysed and organised

SENSORS & DATA CAPTURE
Sensors in household, business, community and public toilets capture molecular characterisations of waste and transmit data through connected networks and devices

CIRCULAR SANITATION ECONOMY

COLLECTION & TRANSPORT OF BIOLOGICAL WASTE

PROCESSING
Resource recovery plants process and refine the collected waste through various technologies to produce safe valuable products

HOMES, BUSINESS, FARMERS, MANUFACTURERS, CITIES
Upcycled products from Toilet Resources are sold back to businesses, cities and individuals to complete the loop

PRODUCTS

ENERGY PRODUCTS

Fuel, electricity, heat
- Biogas for local factories & electricity to the grid
- Bio diesel for transport
- Bio charcoal to replace wood/coal

WATER

Water recovery and purification of wastewater
- Local agricultural irrigation
- Water intensive factory processes
- Further treatment to produce drinking water

AGRICULTURAL PRODUCTS

Compost, organic fertilisers, nutrients such as nitrogen and phosphorus
- Non-food crops: forest free fibre crops, flower crops, etc.
- Food crops

PROTEIN RICH MATERIALS

Such as oils and protein meal
- Protein oils for consumer toiletry goods and potentially cosmetics
- Protein "meal" for pet and farm animal feed

Materials for INNOVATIVE PRODUCTS
- Faecal matter for pharmaceutical (biome) regenerative health products and procedures
- Bio-plastics

SENSORS

- IN TOILETS
- TOILET ADJACENT
- IN BATHROOM
- INFRASTRUCTURE

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TOILET BOARD COALITION

THE SANITATION ECONOMY AND THE SUSTAINABLE DEVELOPMENT GOALS

The sanitation economy takes sanitation beyond SDG6 and becomes an enabler for water and food security, mitigates climate change and advances human rights. It places sanitation at the centre of a new grid which fundamentally realigns flows of nutrients, water, energy, data and capital.

13

7

Climate Action / **Affordable and Clean Energy**
Contributions to slow climate change by producing renewable energy and reducing carbon and methane emissions, helping businesses meet low carbon targets, while also helping agricultural systems adapt to changing rainfall patterns.

Sanitation can create new economic value and becomes solution provider for urgent business and societal issues that address many of the Sustainable Development Goals - from water security, to climate change, food security and human rights.

6

Clean water and Sanitation
Providing water security through new sources of clean water for agricultural and industrial use, reduced contamination of existing water sources, lower water use in sanitation, and reduced need for irrigation.

2

Zero Hunger
Providing food security by improving soil health, agricultural productivity, climate change resilience, and reducing plantation operating costs through organic fertilisers and soil conditioners .

3

Good Health and Well-being
Improving the health of workers, both with sanitation's traditional function of preventing disease transmission, and also by providing real-time data for preventative and reactive healthcare for employees.

9

Industry Innovation and Infrastructure
Enabling innovation, sales, marketing and consumer research opportunities with consumers in developing markets.

5

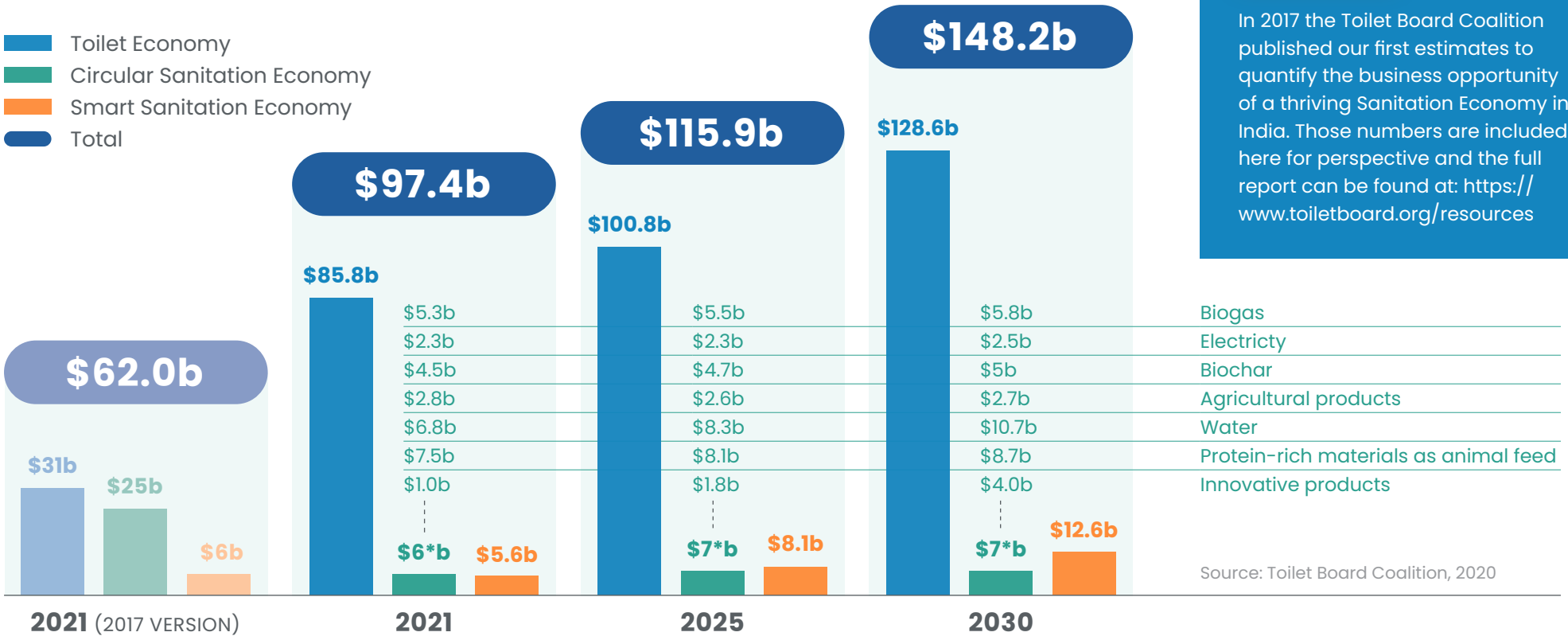
Gender Equality
Enabling female empowerment and health benefits.

12

Responsible Consumption and Production
Creating a waste pathway for all forms of compostable (biological) waste, preserving nutrients and energy in the process, and enabling the replacement of plastic items with compostable alternatives.

THE SANITATION ECONOMY QUANTIFIED

That table below summarises the annual market opportunity for each of the three sanitation economy domains in 2021, 2025 and 2030. All estimates are presented in USD and notes whether they are in the millions or billions. All calculations were undertaken in local currency and later converted to USD at a rate of 1 USD = 75 INR



Source: Toilet Board Coalition, 2020

In 2017 the Toilet Board Coalition published our first estimates to quantify the business opportunity of a thriving Sanitation Economy in India. Those numbers are included here for perspective and the full report can be found at: https://www.toiletboard.org/resources

*Because the circular sanitation economy market opportunities are generated from the same quantity of resources, in our methodology, there is overlap between these numbers and not all can be simultaneously fully realized. We have therefore identified a sample indicative number to summarise the opportunity.

THE TOILET ECONOMY

MARKET INSIGHTS

Our 2017 estimate for 2021 was on the right path. The market has developed roughly as anticipated. This time we have gone much deeper into public toilets than in 2017, breaking out ten different kinds of public toilet which were deemed out of scope in 2017. We've also added estimations for menstrual health products and hand soap. Hence the Toilet Economy number has more than doubled since our 2017 work.

The services market for public toilets, cleaning and maintenance is over $27 billion for 2021 – that's nearly 30% of the full Toilet Economy market potential. The significant increase here is due to cleaning services for all the public toilets now also being in scope. As we see populations becoming increasingly urban and larger percentages of women working, we anticipate this number will only strengthen and we advocate stronger focus on and investment in entrepreneurs in this space.

FOCUS ON HEALTH

Preventing infections is one of the key objectives of the innovations, technologies, products and services that make up the Toilet Economy, e.g., handwashing with soap after the use of a toilet is a primary line of defence around infectious diseases and with COVID-19. Similarly, cleaning, sanitisation and O&M of toilets is aimed at addressing filth and malodour; a primary trigger of disgust that can lead to individuals turning to open defecation and other infectious disease-spreading behaviours.

Given the advancements of Swachh Bharat Movement (SBM), the rural household toilet market has slowed but we've seen growth in community toilet and portable toilet solutions for lower-income scenarios. With a focus on lower income urban populations, we see great opportunity in India for innovative toilet technologies in both a community module and household context that enable the capture and treatment of the waste. The resources and value that these technologies unlock, once operational and at scale, must be taken into consideration when up-front investment is considered.

As India has moved beyond the first phase of eliminating open defecation, many rural populations now move from their initial toilet purchase to the market for upgraded products.

Offices and educational settings are significantly larger opportunities, at both product and service level, when compared to other public toilet contexts, as they are serving the largest portion of the population when not at home.

Bio-toilet technologies are a unique-to-India specific estimation, as they are used on trains which see very high traffic patterns on a daily basis.

We would like to note that the market opportunity for menstrual health and hygiene products is specifically linked to disposable pad use. We are seeing rapid innovation and acceleration in this product space and anticipate an estimation for this product area to evolve as further products can be taken into scope once more data is available.

EXAMPLE OF METHODOLOGY BREAKDOWN

The toilet economy was split into products and services. Estimates of establishments (offices, airport, metro stations, etc) were arrived at by collation of data from trusted sources. Estimated numbers of toilets per establishment were arrived at on the basis of interaction with planners and architects. The cost of products for maintainence of toilets and manpower was calculated as per existing norms to arrive at the estimate for the current year. For future projections, revision at existing rates was considered. This was on the basis of exhaustive secondary research and interaction with entrepreneurs/sector experts working in the domain.

For example: to arrive at **soap usage/handwash figures** for urban and rural India, the urban and rural household numbers were derived for 2021 using Census 2011 figures and applying 1% growth rate per annum. The urban and rural household size calculated was also as per the 2011 census. Next, the National Family Heath Survey 2021 was referred to, in order to arrive at percentage of usage of soap for handwashing in urban as well as rural contexts. It was assumed that the percentage would remain constant for the period of the study. Urban and rural spends per month on handwashing were arrived at based on information sources. This was multiplied by 12 to arrive at yearly figures. All calculations were performed on a local currency level, which was then converted to million/billion USD figures using the existing exchange rates.

PRODUCT OR SERVICE	2021	2025	2030
Household or Community			
Rural household toilets	$20.2m	$23.2m	$24.3m
Upgrade in rural households to twin pit latrines	$8,425.00m	$8,768.00m	$9,215.20m
Urban household toilets	$2,941.90m	$3,061.40m	$3,217.50m
Community toilets	$7.3m	$7.6m	$8m
Portable toilets/container-based sanitation	$95.7m	$99.6m	$104.6m
Public			
Bio toilets	$80m	$80m	N/A
Bus stations - only interstate	$0.03m	$0.03m	$0.03m
Schools/college/universities	$618m	$772.6m	$1,004.30m
Metro stations	$0.19m	$0.23m	$0.3m
Railway stations	$6.6m	$5.9m	$8.6m
Airports	$0.2m	$0.2m	$0.2m
Malls	$0.6m	$0.6m	$0.8m
Hotels/accommodation units	$29.2m	$25.6m	$29.2m
Restaurants and cafés	$2m	$1.8m	$2.2m
Hospitals	$16.6m	$13.9m	$18.8m
Offices	$995.2m	$870.8m	$1,119.60m
O&M and high-relevance auxiliary products			
O&M (cleaning) for community	$91.7m	$134.3m	$216.3m
O&M (cleaning) for public	$27,453.18m	$40,083.64m	$64,394.83m
Hand washing using soap	$2,820.10m	$2,935.36m	$3,085.09m
Menstrual health and hygiene products	$42,204m	$43,918m	$46,158m
Total	**$85.8b**	**$100.8b**	**$128.6b**

Source: Toilet Board Coalition, 2020

THE TOILET ECONOMY

2021

O&M (Cleaning) for Public
$27,453M

$995.2M
Offices

$29.2M
Hotels/Accommodation Units

$6.6M
Railway Stations

$80M
Bio Toilets in Trains

$618M
Schools/Colleges/Universities

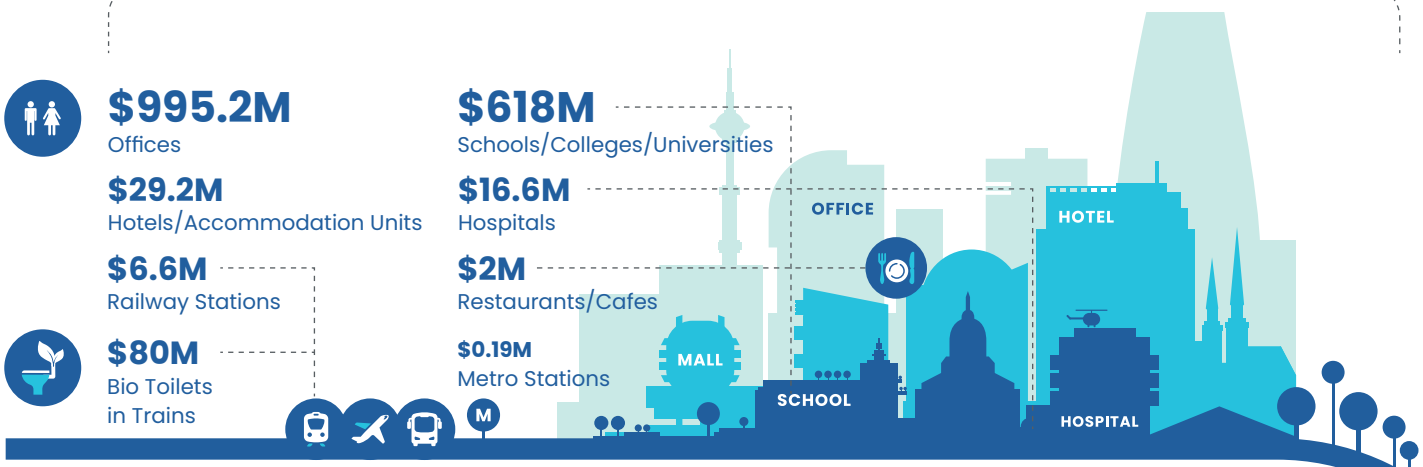
$16.6M
Hospitals

$2M
Restaurants/Cafes

$0.19M
Metro Stations

$42,204M
Menstrual health & hygiene products

$2,820M
Hand Wash



$0.2M Airports
$0.03M Bus Stations
$0.6M Malls

$95.7M
Portable Toilets/Container-based Sanitation

$91.7M
O&M (Cleaning) for Community

$7.3M
Community Toilets

$8,425M
Upgradation in Rural to Twin Pit Latrines

$20.2M
Rural Household Toilets

$2,942M
Urban Household Toilets

Source: Toilet Board Coalition, 2020

CIRCULAR SANITATION ECONOMY

MARKET INSIGHTS

The collection and treatment of toilet resources (the Toilet Board Coalition's preferred term for human waste) is imperative not only from an environmental and public health perspective, but also from a business perspective. It is the addition of these services and the services of the Smart Sanitation Economy that shifts Sanitation Economy business models into profitable territory. To learn more please read 'Scaling the Sanitation Economy'.

We have significantly adapted the method of calculation used in our 2017 report for this publication due to the Toilet Board Coalition's work on the Toilet Resource Calculator. In 2017 market estimates were derived from looking at the total waste streams available within India – sanitation, municipal, industrial and agricultural. We then calculated from those numbers what could be realised. For this publication we have focused on waste only from sanitation systems and household systems.

Demand for bio-energy production has risen globally and the markets for biogas, electricity from biogas and biochar reflect that shift as well.

We have added to our scope specific market estimates for nitrogen, phosphate and potassium. As the population grows, the world will face a decrease in arable land per person, driving up demand for phosphorous in fertilizer in order to produce sufficient food for humans and animals. As the market responds to these changes, we will certainly see changes in the pricing of these valuable resources, which will only increase the opportunity to capture and recycle them from sanitation economy systems. To learn more about where we see the opportunities, please read https://www.toiletboard.org/resources.

In 2017 our water estimate included market pricing for water through the sanitation economy being recycled to potable quality. We do see technologies that make this a viable option but we feel, for the scope of this current report, that there are ample opportunities in the market for non-potable water and potable water should be looked at separately. This has resulted in a lower water estimate than was scoped in 2017.

India is rapidly urbanising, with urban population increasing to 46% of the total by 2025.* Consequently, there is an increasing trend of large apartment complexes housing thousands in a single community. Centralised waste water treatment systems in major cities, however, remain inadequate in terms of capacity and treatment quality, resulting in continuing pollution of water bodies and environment. Amidst these trends, per capita availability of water is falling and reaching crisis levels across most large cities in India. In response, we are seeing several Urban Local Bodies (e.g. Bangalore) respond with an evolution of policy – for complexes surpassing 50 households it is now mandatory for the community to have its own waste water treatment plants. Similarly, Chennai is mandating rainwater harvesting systems, opening up the feasibility of decentralised solutions that address water stress and promote recycling/conservation of water. These innovations reduce the burden on ground water extraction, reduce spending on purchased water through water tanker businesses and lend value to the recycled water which may be utilised for non-potable purposes e.g. flushing toilets.

* McKinsey Global Institute. (2010). India's urban awakening: Building inclusive cities, sustaining economic growth. Available here.

EXAMPLE OF METHODOLOGY BREAKDOWN

The basis of calculation of the first four components of the circular sanitation economy was the TBC's Toilet Resource Calculator (learn more here). Taking the same into consideration and extrapolating the same on Indian population numbers, the amount of toilet resource was calculated in quantity terms per annum. Extensive research for unit cost was conducted and average value was multipled by the quantity to arrive at estimates for the sub-components. **It must be noted here that the sub-components are mutually exclusive and may not add up to a total figure as they would do for the rest of the economies under consideration.**

E.g. To arrive at **biogas generated figures** for 2021, 2025 and 2030, the TBC calculator for waste resources was used. Population figures were derived on the basis of the 2011 census and a 1% growth rate per annum was applied to arrive at figures for 2021, 2025 and 2030 respectively. Since, in the TBC calculator, the biogas output was assumed at MJ of heat, this was converted to KwH of energy use and existing energy costs were applied in order to arrive at final estimates of biogas production.

PRODUCT	2021	2025	2030
Biogas	$5,294m	$5,509m	$5,790m
Electricity	$2,250m	$2,341m	$2,461m
Biochar	$4,544m	$4,729m	$4,970m
Compost	$2,474.5m	$2,574.98m	$2,706.33m
Nitrogen	$135.48m	$140.90m	$148.17m
Phosphate	$82.18m	$85.52m	$89.88m
Potassium	$121.93m	$91.04m	$95.69m
Water	$6,803.9m	$8,274.5m	$10,728.7m
Black Solider Fly Larvae – Animal Feed	$7,461m	$7,764m	$8,161m
Faecal matter for pharmaceutical (biome) regenerative health products	$975.7m	$1,769.1m	$4,014.2m

Source: Toilet Board Coalition, 2020

FOCUS ON HEALTH

Through the Swachh Bharat Movement, over 100 million toilets have been built, primarily in rural areas in India, over the last few years. These are mostly pit latrines which, once filled up, will quickly become an environmental and health challenge. Already in high ground water table areas (e.g. the state of Kerala) this is a looming threat. Application of circular models to recover value is not only lucrative business-wise, it is crucial for preventing infectious disease epidemics.

THREE SCENARIOS OF THE CIRCULAR SANITATION ECONOMY IN INDIA

As the markets mentioned above are calculated based on the availability of toilet resources to be treated and transformed into these products the markets become somewhat mutually exclusive. To give a lens of what this could look like within India we have highlighted three scenarios below.

FOCUS ON BIOGAS

The treatment process for the production of biogas also produces a smaller amount of compost through the process. If India were to focus their resource generation from toilet waste on biogas production they would also have compost at a market value as noted below:
5,294m in biogas
670.18m in compost
Total: $5,964,180 Annual Market Opportunity

FOCUS ON COMPOST

The treatment process for compost utilizes all the input resources. So if all India's toilet resources were prioritized for compost their maximum immediate term financial value would be **$2,474, 500**. It should be noted here that this process, however, preserves the highest quality value of the toilet resources and returns that value to the soil so not only the immediate term financial value should be considered.
Total: $2,474,500 Annual Market Opportunity

FOCUS ON ANIMAL FEED

Given India's immense livestock population, the treatment process resulted in black soldier fly larvae which can be used for animal feed for poultry and fish is also of unique interest. Similar to compost, the black soldier fly process utilizes all the toilet resources and retains a higher nutrient profile for the waste which would be more favorable from a circular economy perspective.
Total: $7,461,000 Annual Market Opportunity

2021

$5,294M
Biogas

$2,250M
Electricity

$4,544M
Biochar

$2,475M
Compost

$7,461M
Animal Feed

$135M
Nitrogen

$82M
Phosphate

$122M
Potassium

$6,804M
Water

$976M
Faecal matter for pharmaceutical (biome) regenerative health products

Source: Toilet Board Coalition, 2020

SMART SANITATION ECONOMY

MARKET INSIGHTS

We are seeing rapid innovation across the smart sanitation landscape. Compared to three years ago, we now see most of the entrepreneurs in our network are speaking about this and working to integrate digitised processes into their operations and product and service offerings.

In light of COVID-19, we also see a rise in interest for automated cleaning of public toilets to ensure stricter hygiene protocols.

In 2017, when the Toilet Board Coalition first put a market estimate on the size of the smart sanitation economy, we were working from scarcely-available relevant data. A remarkable advance has occurred in this area, where we now have much more data to work with. We have held to the strictest line of conservative thinking and, again, believe this market is much larger than these numbers indicate – particularly in light of the COVID-19 pandemic and increased value and interest in public health monitoring through sanitation and wastewater systems. In light of that perspective, we have chosen to be much more specific with the products and their respective estimates. This will enable us to revisit and build on these numbers without confusion in the coming years.

Many of these markets may seem negligible to the current reader, we include them for the specific purpose of establishing a baseline from which we will be able to chart growth over the coming years.

Health data is specific to the pathology market and looking very specifically at what is already being collected and tested. This is the prime area where we anticipate rapid evolution of technologies and services on a public health and consumer health level, and is due to a natural trend of the market towards preventative personalised precision health care. Technology for sampling, analysis and transfer of this kind of data are currently in commercial development and we hope to have much greater information and experience in this area in the next three to five years.

The most developed area of this market is sensor technology for the collection and transport of waste. This has been proven as a powerful cost reduction enabler and is becoming commonplace technology for many operators in the space.

Particularly in India, given the on-going commitment to sustainable sanitation services for the population and the strength of the technology sector in the country, the integration of sanitation systems into smart city operations is a significant opportunity. We do not anticipate seeing the same level of opportunity in future estimates for other developing markets. India's commitment in 2015 to the development of 100 Smart Cities and the rejuvenation of 500 additional ones is exemplary.

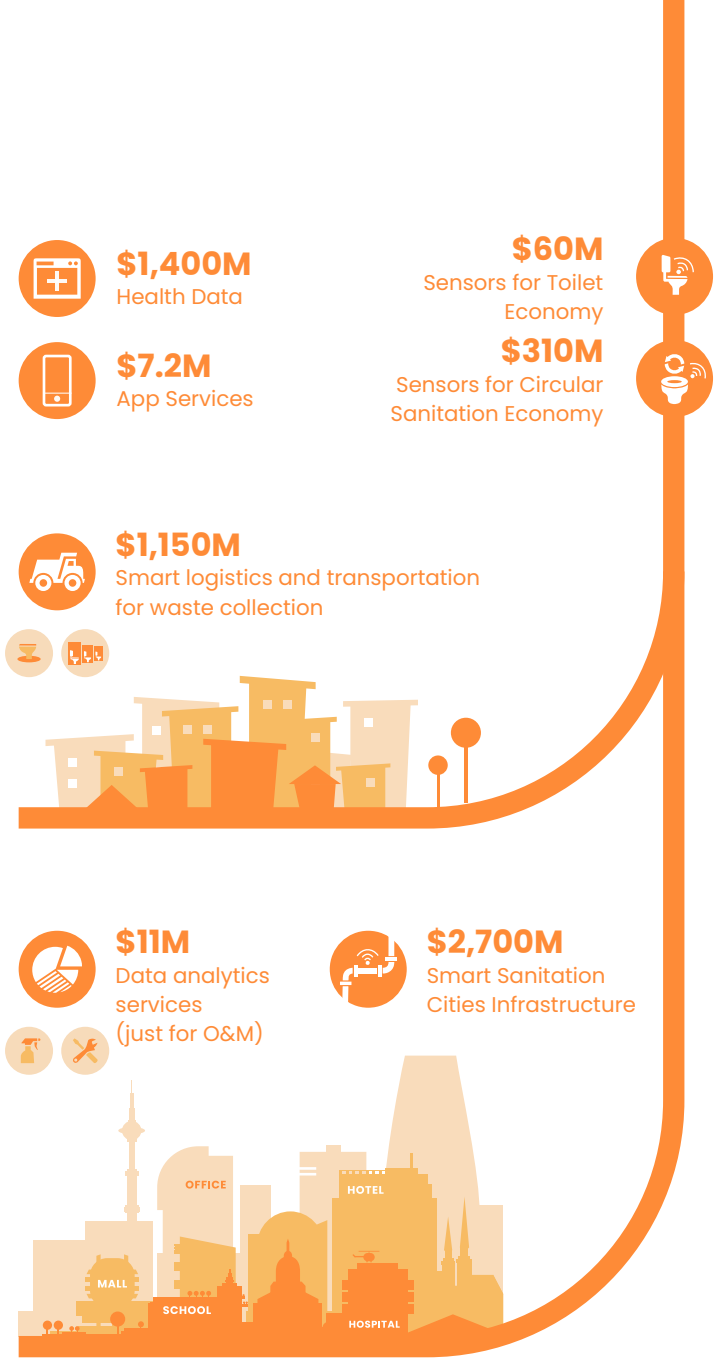
EXAMPLE OF METHODOLOGY BREAKDOWN

The smart sanitation economy was based on futuristic concepts of monitoring health or ironing out infrastructure bottlenecks, based on the emerging digital landscape. In relation to each of the sub-components, data from trusted sources were referred to and cross-referenced with other data points. For example: smart logistics and transportation for waste collection was cross-referenced with total community and portable toilets in the urban slums. Average price points in force at present and average rate of growth as it exists now have been used for projecting the future scenario.

For example: for estimating the sensor-fitted toilet technologies, the number of toilets in public spaces that had been calculated in the toilet economy was used as the starting point. It was assumed that an organic growth in adoption of sensors would occur in those toilets. It was also assumed that the sensors would require replacement every four years. The average cost of a sensor module at existing market rates was considered. All calculations were performed on a local currency level, which was then converted to million/billion USD figures, using existing exchange rates.

PRODUCT OR SERVICE	2021	2025	2030
Health data	$1,400m	$2,600m	$4,700m
Sensors for Toilet Economy	$60m	$170m	$280m
Sensors for Circular Sanitation Economy	$310m	$130m	$130m
Smart logistics and transportation for waste collection	$1,150m	$1,680m	$2,700m
Data analytics services (just for O&M)	$11m	$32m	$78m
App services	$7.2m	$9.1m	$8.7m
Smart Sanitation Cities Infrastructure	$2700m	$3,600m	$4,700m
Total	**$5.6b**	**$8.1b**	**$12.6b**

Source: Toilet Board Coalition, 2020



Source: Toilet Board Coalition, 2020

EMERGING IN THE SANITATION LANDSCAPE

Developments in India since 2017, accelerated by COVID 19, have resulted in a clear trend emerging in the demand for improved sanitation and hygiene.

In the case of public sanitation facilities, entrepreneurs are designing modern digital-enabled toilets with affordable access. Several thousands of such toilets are already functioning, with innovative business models. This momentum has picked up and is likely to lead to across-the-board upgrading of public sanitation infrastructure, and reliable cleaning and maintenance services are in demand. We expect that entrepreneurship-led models will become increasingly investible.

New categories and segments of businesses are emerging and/or are set to grow and are already attracting investments.

- Biodegradable sanitary pads and environmentally-friendly MHH products and their disposal services
- Intimate/feminine hygiene
- Novel toilet-cleaning and surface hygiene propositions (moving away from harsh chemicals)
- Physical means of disinfection of products, objects, and surfaces (e.g. UV-based)
- Packaged and compact, plug and play wastewater treatment plants
- Spatial disinfection services

With MHH expected to grow exponentially over the next few years, menstrual waste management is emerging as a new challenge. Relevant innovative disposal and circular economy models are on the horizon and scaling these will be crucial.

Besides investment and business leader engagement, the area of developing standards for use, reuse, treatment and application of the sanitation economy products and services will facilitate realisation of the potential of the sanitation economy. While circular sanitation for agriculture is already being practiced informally across the outskirts of cities, setting standards and guides will assure governments of the safety of the food supply chain and help entrepreneurs to move up the value chain and develop standardised sanitation economy products and services. TBC is pioneering sanitation standards and has recently developed a "Star Rated Public Toilet Guide" aimed at improving public sanitation facilities, making them clean, hygienic and safe for users.

To realise the full potential of the opportunities outlined in this publication which relate to the circular sanitation economy, it is important that policy-makers and business leaders view this from the dual lenses of "consequences of inaction" and "rewards of action".

Inaction has a very high probability of resulting in:

- Higher GHG emissions
- Environmental pollution of water, land, soil and air
- Infectious disease epidemics and other related adverse impacts on health

Actions, including investments and favourable policy changes that lend scale to innovations, will:

- Generate wealth, create jobs, livelihoods and GDP growth
- Build environmental resilience for the country
- Improve the health and wellbeing of people

The sanitation economy is creating new avenues for employment, livelihoods and micro-entrepreneurship, with digital as the key business lever and safety, hygiene, and protection from infections as a consumer user driver. The government is keen to leverage the innovation within the WASH start-up ecosystem and is open to partnerships that will help achieve scale. The vision is to take Indian innovations to scale for India and for the world, as well as to bring innovative technologies and business models that address WASH issues to India.

SANITATION ECONOMY
IN SOUTH EAST ASIA

As mentioned at the outset, our intention is to catalyse this change through an upcoming series of market estimates, ultimately to unlock these conversations and this change at national and global levels. In 2019 we partnered with the Water Research Commision of South Africa to look at how this translates to a South African context. WSSCC has given strategic leadership for market estimates for Kenya and Nigeria, which are in development, to be published shortly and they will be available here.

Each national context brings its own unique data profile and cultural context, first to look at how these numbers translate outside India but, within Asia, we have teken a preliminary look towards the Philippines and Indonesia.

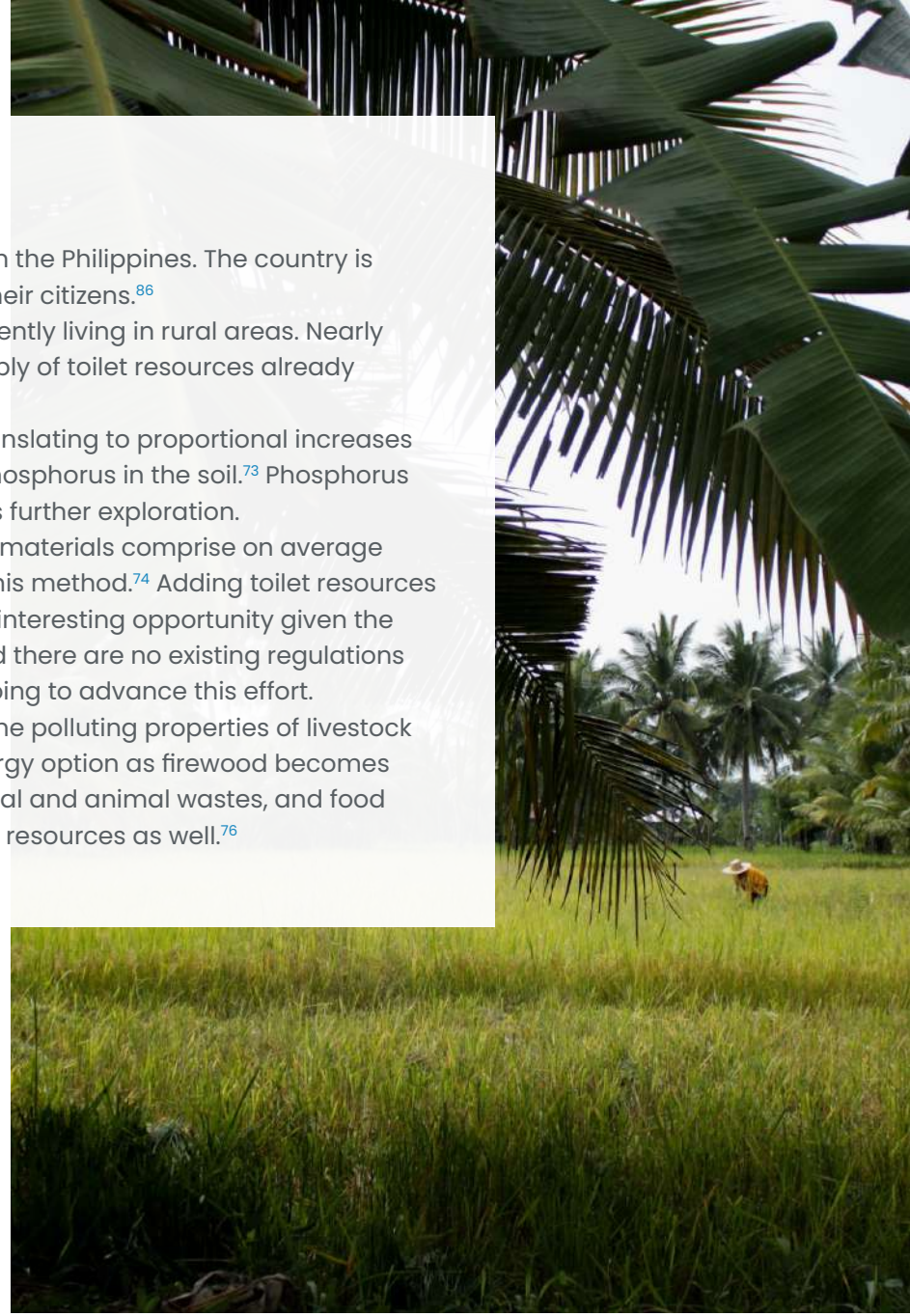
For example, the market for compost in both the Philippines and Indonesia is estimated to be considerably stronger than the market in India. When considering the differences in population size this is quite remarkable. We've double checked the numbers and it comes down to the price of fertilisers in these markets. Hence, we signal this as a particularly interesting business opportunity worth exploring.

The Ian
Maluku, Indonesia

PHILIPPINES

Despite a growing economy, 9 million people currently lack access to improved sanitation in the Philippines. The country is rapidly urbanizing and cities are challenged in delivering water and sanitation services to their citizens.[86]

- The Philippines is a highly agricultural country, with a majority of the population still currently living in rural areas. Nearly 50% of the work force is employed in agriculture. This means there is a steady, local supply of toilet resources already present in rural areas that could be treated for re-use in agricultural settings.[73]
- There is also an increasing consumption of fertiliser in the Philippines and yet it is not translating to proportional increases in crop yields. It is understood this is because of an imbalance between nitrogen and phosphorus in the soil.[73] Phosphorus from toilet resources could be a distinct opportunity for the Filipino market and warrants further exploration.
- Government policies have advocated for local composting initiatives as biodegradable materials comprise on average over half of municipal solid waste.[84] There has been a reluctance however to embrace this method.[74] Adding toilet resources to composting efforts would likely face behavioural change challenges but could be an interesting opportunity given the political will behind composting. It should be noted that while composting is encouraged there are no existing regulations on the handling and use of these biosolids however, several studies and efforts are ongoing to advance this effort.
- Biogas technologies are slowly gaining acceptance thanks to a growing awareness of the polluting properties of livestock and environmental concerns. It is increasingly being seen as a favoured renewable energy option as firewood becomes less available. Biogas generation currently integrates domestic urban wastes, agricultural and animal wastes, and food processing, distillery, and industrial wastes but could reasonably extend to include toilet resources as well.[76]



PRODUCT	2021	2025	2030
Menstrual Health & Hygiene	$710m	$750m	$804m
Handwashing	$571m	$603m	$647m
Biogas	$1,067m	$1,128m	$1,209m
Electricty	$453m	$479m	$514m
Biochar	$2,264m	$2,394m	$2,566m
Compost	$3,809.27m	$4,027.11m	$4,317.02m
Protein “meal” for pet and farm animal feed	$1,378m	$1,457m	$1,562m

Source: Toilet Board Coalition, 2020

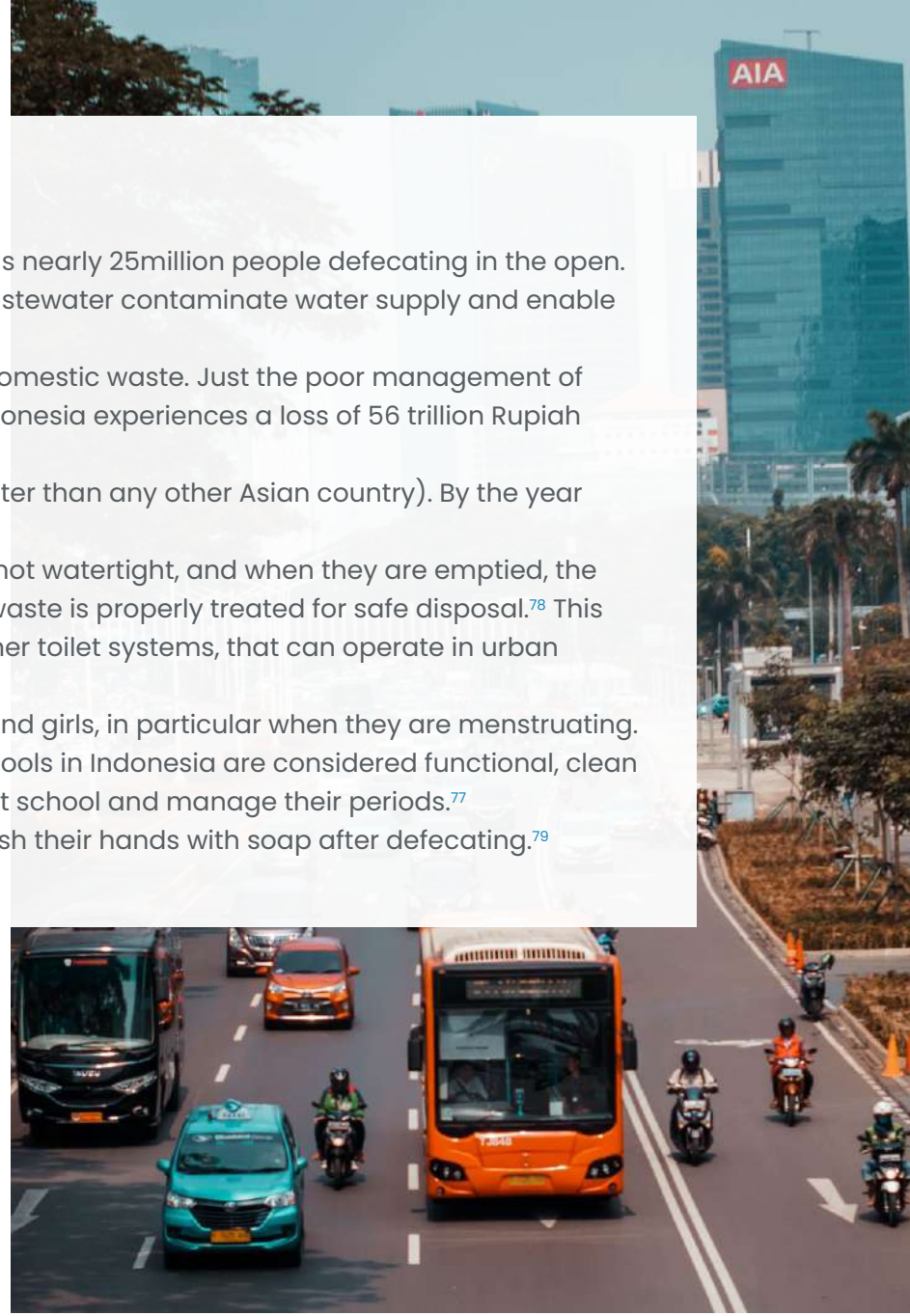
INDONESIA

Indonesia, one of the world's largest populations at 264 million inhabitants, currently has nearly 25million people defecating in the open. This poses enormous risks to Indonesian's health as open defecation and untreated wastewater contaminate water supply and enable the spread of infectious diseases.[77]

- Roughly 68% of Indonesia's rivers are heavily polluted, with 70% of that being from domestic waste. Just the poor management of sanitation has already raised the cost of water treatment by 25%. It is estimated Indonesia experiences a loss of 56 trillion Rupiah ($4.2 billion) each year due to its poor sanitation.[79]
- Much like the Philippines, Indonesia is currently experiencing rapid urbanization (faster than any other Asian country). By the year 2025 it is expected that 67.5% of the country's population will live in cities.[78]
- Septic tanks are currently the preferred technology in urban contexts but most are not watertight, and when they are emptied, the faecal sludge is often just moved to open spaces or riverbanks. Only 5% of human waste is properly treated for safe disposal.[78] This presents an enormous opportunity for sanitation products and services, like container toilet systems, that can operate in urban contexts and are optimised for the collection and treatment of toilet resources.
- As with the rest of the world, poor WASH facilities disproportionately affect women and girls, in particular when they are menstruating. A 2015 report for UNICEF Indonesia found that only 9% of WASH facilities in urban schools in Indonesia are considered functional, clean and light - this presents significant hurdles for menstruating girls to safely remain at school and manage their periods.[77]
- The Ministry of Health estimates that only 12% of children between ages 5 and 14 wash their hands with soap after defecating.[79]

PRODUCT	2021	2025	2030
Menstrual Health & Hygiene	$4,917m	$5,131m	$5,412m
Handwashing	$4,281m	$4,702m	$5,579m
Biogas	$1,450m	$1,513m	$1,596m
Electricty	$616m	$643m	$678m
Biochar	$7,651m	$7,984m	$8,421m
Compost	$31,250m	$32,609m	$34,391m
Protein "meal" for pet and farm animal feed	$12,564m	$13,110m	$13,827m

Source: Toilet Board Coalition, 2020



CALL TO ACTION

The stage is set for an expanding, entrepreneurship- and scale-led, multi-billion-dollar sanitation economy in India. The largest variable in our market estimations is never demand - as sanitation, particularly when delivered through a sanitation economy approach, is recession-proof and built on our biological needs. As the Toilet Board Coalition has graduated cohorts of scale- and investment-ready business models in the sanitation economy, we now call on the investment and government bodies to rise to the occasion. We must gather round these entrepreneurs with our support as they are the engines of change driving us towards successful achievement of the SDGs.

As mentioned at the outset of this piece, we undertake this work because we see the shift in perspective that it enables. There is more work to be done, more market potential to understand as we build thriving sanitation economy marketplaces across the globe.

1 GOVERNMENTS

We call on you to work closely with stakeholders representing all sizes and aspects of the private sector, who can advise on how to build policies that enable innovation whilst ensuring improved quality of service to the customers, India's citizens. It can be too easy to focus on big business – it is imperative that the innovators in this space, the entrepreneurs on the front lines of battle, have a seat at the table and a voice in the discussion. At the Toilet Board Coalition, we intentionally bring together these two ends of the private sector spectrum – for this is where the real magic happens.

2 INVESTORS

We call on you to do more of what you're already doing. We see a new era of investment dawning as you continue to learn about the opportunities in this space. Educate yourselves on the realities of sanitation economy businesses, as it is a unique sector. Read our 2019 Scaling the Sanitation Economy report, which details the business models and investment mechanisms needed in the space. Then continue to get creative and collaborate with one another.

3 EVERYONE

It is high time we put behind us the notion that sanitation is an unaffordable cost that solely the public sector must bear. Across development sectors we are seeing the value of working closely with the private sector (again we reiterate – ALL sizes of the private sector) to achieve the Sustainable Development Goals. Sanitation is certainly no different. A sanitation economy approach reduces the cost of sanitation and produces the new revenue, resources and information that our world is in desperate need of.

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METHODOLOGY & ASSUMPTIONS

CIRCULAR SANITATION ECONOMY

India Population 2021 - 2030 was estimated applying growth rate per annum as 1%

Step 1	Using the TBC Toilet resource calculator we arrived at following figures'
	Toilet Resource (in Lts.)
	Solid Feaces (in MT)
	Bio Gas (in MJ of Heat)
	Electricity (in KwH)
	Biochar (in MT)
	Compost (in MT)
	Nitrogen (in MT)
	Phosphate (in MT)
	Potassium (in MT)
	Water (in Lts.)
	Black Soldier Larvae (in MT)

	This was followed by multiplying by unit cost (in Rs./ Unit)	
Price Assumptions	Bio Gas (in KwH)	5.43/ KwH of Electricity
	Electricity (in KwH)	5.43/ KwH of Electricity
	Biochar (in Kgs)	12/ Kg
	Compost (in Kgs)	4/Kg
	Nitrogen (in Kgs)	20/Kg
	Phosphate (in Kgs)	18/Kg
	Potassium (in Kgs)	18/Kg
	Black Soldier Larvae (in MT)	30/Kg

Step 2	Next we converted into commonly available units
	Bio Gas (in KwH)
	Electricity (in KwH)
	Biochar (in Kgs)
	Compost (in Kgs)
	Nitrogen (in Kgs)
	Phosphate (in Kgs)
	Potassium (in Kgs)
	Water (in Lts.)
	Black Soldier Larvae (in MT)

	Steps	Source/ Assumption
Waste Water Calculations (Industry & Agriculture)	India has following population in different types of towns and villages	Class I - 468 Class II - 474 Class III - 1373 Class IV - 1683 Class V - 1749 Class VI - 424 Villages - 664369
	Average Population has been considered for each category as per the assumption. This was arrived at, drawing nuances from secondary literature review and interaction with experts	Class I - 500000 Class II - 75000 Class III - 35000 Class IV - 15000 Class V - 7500 Class VI - 2500 Villages - 1500
	Average supply per town was tabulated, drawing nuances from secondary literature review and interaction with experts	Class I - 179 Class II - 179 Class III - 120 Class IV - 120 Class V - 100 Class VI - 100 Villages - 50
	No. of Towns were multiplied with townwise average population and with Amount of water supplied per day in those cities in litres per capita per day	
	80% of the total supply goes into processing... rest is treated as loss (through process or evaporation)	80% of the total quantum is processed. The planning takes place in this mode
	This was then added to arrive at the total quantum of water generated for the domestic segment	
	Using the above figures and assuming the norm as indicated in the subsequent coloumn figures for Agriculture, Industry and Domestic was estimated for 2021	Agriculture - 87% Industry - 8% Domestic - 5%
	For 2022 - 2030, population, industrial and agricultural growth rates were assumed as indicated in the next coloumn	Agriculture - 2.9% Industry - 3.6% Population - 1%
	It is assumed that 63% of domestic wastewater generated is being treated and 60% of industrial waste water is being treated. For Agriculture, it is assumed that no water is being recycled	
	Cost of per million litre treatment for domestic was assumed as Rs. 6000 and for industrial it was assumed as Rs. 10000. This was used to multiply the respective figures of domestic and industrial to arrive at INR figures	
	This was then divided by 75 and further by 10^6 to arrive at water treatment opportunity in Mn USD.	

	Steps	Estimated Figures	Source/ Assumption
Waste Water Calculations (Decentralized Waste Water Treatment Plant)	Total No. of Housing Societies	134531	Registrar of Co-operative Societies
	Assuming 20% Societies are large and have in excess of 200 flats - 2021	26906	
	No. of Apartments	5381240	200 Apartments/ society 1 Apartment for 1 Household
	Total Population = Multiplying no. of Apartments*Average Household size	21524960	Average Household Size = 4
	Wastewater generation	2905869600	135 Lts/ capita
	Dividing by STP of 1 Lakh Lts. Capacity	29059	STP capacity = 100000 Lts Per Day
	Estimated market Size (in Rs.)	87176088000	Cost of STP = Rs. 3000000/ unit
	Estimated market Size (in Mn USD) - 2021	1162.3	
	Estimated market Size (in Mn USD) - 2025	1278.6	We are assuming 10% growth every 5 years
	Estimated market Size (in Mn USD) - 2030	1406.4	We are assuming 10% growth every 5 years

	Steps	Estimated Figures	Source/ Assumption
Protein Rich Materials	As per 2018 estimates the Indian animal feed market was estimated at 400.5 Bn INR		Assumed YOY growth rate 8% per annum
	2021 figures (in USD Mn) - Projecting and converting into USD Mn	6726.9	
	2021 figures (in USD Mn)	269.1	4% of total fish and chicken feed comes from sanitation market
	2025 figures (in USD Mn)	366.1	
	2030 figures (in USD Mn)	537.9	
	Black Soldier Larvae (in USD Mn)		
	2021 figures (in USD Mn)	7461	Toilet Resource Calculator
	2025 figures (in USD Mn)	7764	
	2030 figures (in USD Mn)	8161	
	To cross check assumption that Black Soldier Larva being only used as chicken and animal feed		
	Percentage in 2021	3.6	More or less validates the assumption
	Percentage in 2025	4.7	
	Percentage in 2030	6.6	

	Steps	Source/ Assumption
Faecal matter (biome) for Pharmaceutical health product	We based our assumption on Indian Demographic make up of income group	wef_future_of_consumption_fast-growth_consumers_markets_india_report_2019.pdf
	The report gave a break up of Low, Lower Mid, Upper Mid and High Groups, So we calculated the break up for the years 2021 to 2030	
	Dividing the population nos by 4 we arrived at no of households who fall in different earning categories	
	In 2021, we assumed all High earning Households will be taking the Biome Treatment	Biome Treatment = Rs. 7000
	In 2025, 10% of the Upper Mid income households and all of High income households will use the treatment	Biome Treatment = Rs. 5000
	In 2030, 20% of the Upper Mid income households and all of High income households will use the treatment	Biome Treatment = Rs. 5000

METHODOLOGY & ASSUMPTIONS

TOILET ECONOMY

Category	Steps	Methodology	Assumptions
Household Toilets	1	We took the population nos as per Census 2011 and using YOY growth rate found the estimated population size for 2025 and 2030	Population growth rate was assumed at 1% per annum
	2	We split the population into Urban and Rural geographies based on the last census figures available	
	3	We estimated the no. of Urban and Rural Households	Average Household size (Urban - 4.0, Rural - 4.6)
	4	We estimated the exclusive usage of latrine based on data published in NSSO 76th Round	Urban - 77.6%, Rural - 63.2%. Assumption :- 1 Household = 1 Latrine
	5	We multiplied the above figure (4) with cost of product/ month * no. of months in an year for urban areas	Estimated spent on Toilet cleaning products per month - Rs. 200
	6	For rural areas cleaning product has been assumed as follows - with cost of product/ month * no. of months in an year *percentage of population adopting	Average Product cost = Rs. 40 Adoption percentage 2021 - 30% , every year revised at the rate of 10% No. of months in an year = 12
	7	We multiplied the above figure (4) with cost of installation of additional pit for rural areas	Estimated spent on2nd Pit Latrine - Rs. 5000/ pit
	8	We finally divided the figure (7) by Rs. 75 and divided the same by 10^6 to arrive at USD Mn figures	USD = INR Exchange rate was assumed as 1 USD = INR 75

Category	Steps	Methodology	Assumptions
Soap Usage	1	We took the estimated Urban and Rural household figures from the estimations of Household toilets	
	2	We used percentages derived from National Family Health Survey for soap usage for both Urban and Rural geographies	82.6% for Urban and 52.3% for Rural
	3	Urban and Rural spend on Soaps per month was multiplied to derived figure in (2)	Rs. 100 for Urban and Rs. 75 for Rural
	4	We added Urban and Rural figures	
	5	We finally divided the figure (7) by Rs. 75 and divided the same by 10^6 to arrive at USD Mn figures	
	6	We multiplied by 12 to arrive at the annual figures	

Category	Steps	Methodology	Assumptions
Bus Stations* (Only Interstate Bus Terminuses)	1	We scanned and amassed all available data from trusted source from State Road Transport Corporation Websites	10 Toilets/ ISBT
	2	For Products - Multiplied no. of toilets * Cost of products/ month/toilet* no. of months	Rs. 400/ toilet cleaning product
	3	For Services - Multiplied no. of toilets *Salary/month*2 Sweepers*12 months	Rs. 10000/ sweeper/month
	4	For Products - Product cost was assumed as indicated	2021-2022 - Rs. 400 2023 -2024 - Rs. 300 2025 - 2030 - Rs. 400
	5	For Services - Salary Revision for services	Salary Revision at the rate of 10% per annum

Category	Steps	Methodology	Assumptions
	1	Statewise no. of Malls were collated from available online sources	
	2	Based on the Square foot commercial space no. of floors were assumed as indicated in the next column	Less than 150000 - 3 150000 - 300000 - 4 300000 - 600000 - 5 600000 - 1500000 -6 1500000 - 2000000 -7 Above 200000 - 8
	3	No. of toilets = No. of Floors *2 Toilets/ Floor	
Malls	4	For Products - Multiplied no. of toilets * Cost of products/ month/toilet* no. of months	Rs. 1200/ toilet cleaning product
	5	For Services - Multiplied no. of toilets *Salary/month*2 Sweepers*12 months	Rs. 10000/ sweeper/month
	6	For Products - Product cost was assumed as indicated	2021-2022 - Rs. 1200 2023 -2024 - Rs. 1000 2025 - Rs. 1100 2026 - 2027 - Rs. 1200 2028 - 2029 - Rs. 1320 2030 - Rs. 1450
	7	For Services - Salary Revision for services	Salary Revision at the rate of 10% per annum

Category	Steps	Methodology	Assumptions
Schools & Colleges	1	Total No. of Schools and Colleges and Universities was collated from Ministry of HRD, ASER Reports	
	2	Based on the Type of Institution, and As per DISE Report, No of toilets/ institute was arrived at	Primary School - 6 Upper Primary School - 6 High / Secondary School - 6 Intermediate/ Senior Secondary School - 6 Standalone Institutions - 10 Colleges - 10 Universities - 20
	3	Total No. of toilets = No. of Institution *No. of Toilets/ Institute	
	4	For Products - Multiplied no. of toilets * Cost of products/ month/toilet* no. of months	Rs. 400/ toilet cleaning product
	5	For Services - Multiplied no. of toilets *Salary/month*2 Sweepers*12 months	Rs. 6000/ sweeper/month for base year
	6	For Products - Product cost was assumed as indicated	Sanitization will go up for next 2 years post covid before reducing a bit and then again regaining its' trajectory 2021 - Rs. 400 2022 - Rs. 600 2023 - Rs. 600 2024 - Rs. 500 2025 - Rs. 500 2026 - Rs. 600 2027- Rs. 600 2028 - Rs. 650 2029 - Rs. 650 2030 - Rs. 650
	7	For Services - Salary Revision for services	Salary Revision at the rate of 10% per annum 2021 - Rs. 6000 2022 - Rs. 6600 2023 - Rs. 7260 2024 - Rs. 7986 2025 - Rs. 8784 2026 - Rs. 9622 2027- Rs. 10584 2028 - Rs. 11642 2029 - Rs. 12806 2030 - Rs. 14087

Category	Steps	Methodology	Assumptions
Metro Stations	1	We scanned and amassed all available data from trusted sources like Ministry of Urban Development and respective State Urban Departments	
	2	Next, we procured the no. of Stations per project	
	3	Following step 2, we multiplied 4 Toilets/ Station	2 Toilets for male and 2 Toilets for female/ station, except crossover station, where nos. can be high
	4	For Products - Multiplied no. of toilets * Cost of products/ month/toilet* no. of months/ annum	Sanitization will go up for next 2 years post covid before reducing a bit and then again regaining its' trajectory 2021 - Rs. 750 2022 - Rs. 750 2023 - Rs. 500 2024 - Rs. 500 2025 - Rs. 600 2026 - Rs. 600 2027- Rs. 700 2028 - Rs. 750 2029 - Rs. 800 2030 - Rs. 800
	5	For Services - Multiplied no. of toilets *Salary/month*2 Sweepers*12 months	Salary Revision at the rate of 10% per annum 2021 - Rs. 10000 2022 - Rs. 11000 2023 - Rs. 12100 2024 - Rs. 13310 2025 - Rs. 14641 2026 - Rs. 16105 2027- Rs. 17716 2028 - Rs. 19487 2029 - Rs. 21436 2030 - Rs. 23579
	6	Figures were converted to USD	1 USD = INR. 75

Category	Steps	Methodology	Assumptions
Airports	1	We sourced data from Airport Authority of India publications and also from Ministry of Tourism Publications	
	2	Next, we gathered data on the size of terminal buildings (in Sq.ft.)	
	3	Following step 2, We estimated the no. of toilets/ Airport	Above 100000 sq.ft. terminal building - 40 Toilets/ Airport 20000 - 70000 - 20 Toilets 10000 - 20000 - 10 Toilets 1000 - 10000 - 6 Toilets Less than 1000 - 4 Toilets
	4	For Products - Multiplied no. of toilets * Cost of products/ month/toilet* no. of months/ annum	Sanitization will go up for next 2 years post covid before reducing a bit and then again regaining its' trajectory 2021 - Rs. 1200 2022 - Rs. 1200 2023 - Rs. 1000 2024 - Rs. 1000 2025 - Rs. 1100 2026 - Rs. 1200 2027- Rs. 1200 2028 - Rs. 1320 2029 - Rs. 1320 2030 - Rs. 1450
	5	For Services - 4 Sweepers * 12 Months *3 shifts	Salary of 1 Sweeper and Revision at the rate of 10% per annum 2021 - Rs. 10000 2022 - Rs. 11000 2023 - Rs. 12100 2024 - Rs. 13310 2025 - Rs. 14641 2026 - Rs. 16105 2027- Rs. 17716 2028 - Rs. 19487 2029 - Rs. 21436 2030 - Rs. 23579
	6	Figures were converted to USD	1 USD = INR. 75

Category	Steps	Methodology	Assumptions
Hospitals	1	We sourced data from Ministry of Health & Family Welfare and State Departments of Health on no. of Public and Private Hospitals - Statewise	An Average Hospital was assumed to be of 4 Stories with 2 Toilets in each Story
	2	Thus multiplying by 8 we arrived at total no of toilets/ State	
	3	For Products - Multiplied no. of toilets * Cost of products/ month/toilet* no. of months/ annum	Sanitization will go up for next 2 years post covid before reducing a bit and then again regaining its' trajectory 2021 - Rs. 1500 2022 - Rs. 1500 2023 - Rs. 1250 2024 - Rs. 1250 2025 - Rs. 1400 2026 - Rs. 1500 2027- Rs. 1500 2028 - Rs. 1600 2029 - Rs. 1600 2030 - Rs. 1700
	4	For Services - 2 Sweepers * 12 Months *3 shifts	Salary of 1 Sweeper and Revision at the rate of 10% per annum 2021 - Rs. 10000 2022 - Rs. 11000 2023 - Rs. 12100 2024 - Rs. 13310 2025 - Rs. 14641 2026 - Rs. 16105 2027- Rs. 17716 2028 - Rs. 19487 2029 - Rs. 21436 2030 - Rs. 23579
	5	Figures were converted to USD	1 USD = INR. 75

Category	Steps	Methodology	Assumptions
Offices	1	We sourced data from Economic Census carried out by Ministry of Statistics & Programme Implementation, Government of India	An Average Hospital was assumed to be of 4 Stories with 2 Toilets in each Story
	2	No. of establishments with at least 1 employee has been taken as consideration for the calculations for both urban as well as rural settings. However, no. of establishment at the aggregate level has been considered.	1 Toilet per establishment has been considered
	3	For Products - Multiplied no. of toilets * Cost of products/ month/toilet* no. of months/ annum	Sanitization will go up for next 2 years post covid before reducing a bit and then again regaining its' trajectory 2021 - Rs. 400 2022 - Rs. 400 2023 - Rs. 300 2024 - Rs. 325 2025 - Rs. 350 2026 - Rs. 375 2027- Rs. 400 2028 - Rs. 425 2029 - Rs. 425 2030 - Rs. 450
	4	For Services - 1 Sweeper * 12 Months	Salary of 1 Sweeper and Revision at the rate of 10% per annum 2021 - Rs. 10000 2022 - Rs. 11000 2023 - Rs. 12100 2024 - Rs. 13310 2025 - Rs. 14641 2026 - Rs. 16105 2027- Rs. 17716 2028 - Rs. 19487 2029 - Rs. 21436 2030 - Rs. 23579
	5	Figures were converted to USD	1 USD = INR. 75

Category	Steps	Methodology	Assumptions
Railway Stations	1	We sourced no of stations from different divisions of Indian Railways. Indian Railways have classified stations based on different categories as indicated in the adjacent coloumn	NSG 1 - Revenue - > 500 Crs, Footfall > 20 Million NSG 2 - Revenue > 100 Crs - 500 Crs, Footfall 10 - 20 Million NSG 3 - Revenue > 20 Crs - 100 Crs, Footfall 5 - 10 Million NSG 4 - Revenue 10 - 20 Crs, Footfall 2- 5 Million NSG 5 - Revenue 1 -10 Crs, Footfall 1 - 10 Million NSG 6 - Revenue < 1 Crs, Footfall upto 1 Million SG 1, SG 2, SG 3 for which criteria could not be located HG 1 - Revenue > 5 Million, Footfall > 0.3 Million HG 2 - Revenue 0.5 - 5 Million, Footfall - 0.1 - 0.3 Million HG 3 - Revenue < 5 Million, Footfall < 0.1 Million
	2	We apportioned the no. of stations basis data sourced from few zones. The total figures by categories of stations were available	The no of Toilets were as per data obtained from a previous release of Indian railways, wherein no. of toilets/ station was indicated. NSG 1 - NSG 3 - 12 Toilets NSG 4 - NSG 6 - 10 Toilets SG 1 - 6, SG 2 - 2, SG 3 - 4 All HG's - 2 Toilets each
	3	Multiplying No. of Stations in each category * No of Toilets gave us the total no of toilets. Hence 10571 Stations had 82276 Toilets	
	4	For Products - Multiplied no. of toilets * Cost of products/ month/toilet* no. of months/ annum	Sanitization will go up for next 2 years post covid before reducing a bit and then again regaining its' trajectory 2021 - Rs. 500 2022 - Rs. 500 2023 - Rs. 400 2024 - Rs. 400 2025 - Rs. 450 2026 - Rs. 500 2027- Rs. 500 2028 - Rs. 550 2029 - Rs. 550 2030 - Rs. 650
	5	For Services - 4 Sweeper * 3 Shifts*12 Months* Monthly salary*No. of Stations	Salary of 1 Sweeper and Revision at the rate of 10% per annum 2021 - Rs. 10000 2022 - Rs. 11000 2023 - Rs. 12100 2024 - Rs. 13310 2025 - Rs. 14641 2026 - Rs. 16105 2027- Rs. 17716 2028 - Rs. 19487 2029 - Rs. 21436 2030 - Rs. 23579
		Figures were converted to USD	1 USD = INR. 75

Category	Steps	Methodology	Assumptions
Hotels (Accommodation Units)	1	We sourced no. of Hotels from a recently concluded study for Ministry of Tourism	
	2	We estimated the no. of toilets in different category of hotels. It was not difficult as we had the different category of rooms. Thus we had 2,23,446 rooms from 7774 Hotels	1 Toilet per room except suites and family rooms, which had 2 toilets
	3	For Products - Multiplied no. of toilets * Cost of products/ month/toilet* no. of months/ annum	Sanitization will go up for next 2 years post covid before reducing a bit and then again regaining its' trajectory 2021 - Rs. 1500 2022 - Rs. 1500 2023 - Rs. 1200 2024 - Rs. 1200 2025 - Rs. 1400 2026 - Rs. 1400 2027- Rs. 1500 2028 - Rs. 1500 2029 - Rs. 1500 2030 - Rs. 1500
	4	For Services - 4 Sweeper * 3 Shifts*12 Months* Monthly salary*No. of Hotels	Salary of 1 Sweeper and Revision at the rate of 10% per annum 2021 - Rs. 10000 2022 - Rs. 11000 2023 - Rs. 12100 2024 - Rs. 13310 2025 - Rs. 14641 2026 - Rs. 16105 2027- Rs. 17716 2028 - Rs. 19487 2029 - Rs. 21436 2030 - Rs. 23579
		Figures were converted to USD	1 USD = INR. 75

Category	Steps	Methodology	Assumptions
Community Latrines	1	We took 2011 census figures of people living in slums and applied population growth rates for India in general. Thus we arrived at 2021 figures	"Households (in Million) as per 2011 Census:- Notified Slums - 4.965 Recognized Slums - 3.834 Identified Slums - 5.034 Population growth rate applied - 1% per annum "
	2	Assuming 1 community toilet per household, we arrive at estimated total no. of community toilet	As per Census 2011 - 34% of the population will not be having access to toilets and on a conservative estimate, with Swaccha Bharat Abhiyan taking place in last 2 years, it is assumed that 10% households will not be having toilets in their household and will be availing community toilets. For Notified Slums we are assuming all households have a toilet of their own
	3	For estimating revenue from products to maintain the toilet - we are assumed Rs. 200/ toilet/ month. Hence, We multipled the no of toilets* Cost of products*No. of months	Cost of Products = Rs. 200
	4	For estimating revenue from services to maintain the toilet - we are assumed Rs. 2500/ toilet/ month in the base year i.e. 2021. Hence, we multipled the no of toilets* Cost of services*No. of months	"2021 - Rs. 2500 2022 - Rs. 2750 2023 - Rs. 3025 2024 - Rs. 3328 2025 - Rs. 3660 2026 - Rs. 4026 2027- Rs. 4429 2028 - Rs. 4872 2029 - Rs. 5359 2030 - Rs. 5895"

Category	Steps	Methodology	Assumptions
Portable Toilets	1	We took 2011 census figures of people living in slums and applied population growth rates for India in general. Thus we arrived at 2021 figures	Households (in Million) as per 2011 Census:- Notified Slums - 4.965 Recognized Slums - 3.834 Identified Slums - 5.034 Population growth rate applied - 1% per annum
	2	We assumed identified slums have portable toilets.Thus divided the identified slum households by 10	10 households have access to 1 toilet
	3	We multiplied No. of toilets * installation & maintenance cost/ annum to arrive at the market size	Installation & Maintenance cost = Rs. 25,000/- per annum. We are assuming the cost to remain constant for next 10 years

Category	Steps	Methodology	Assumptions
Bio Toilets	1	We took no. of Passenger coaches of Indian Railways, which the ministry has thought off converting into Bio toilets	India currently has 75000 coaches
	2	We estimated the no. of toilets that need to be converted to bio toilets and phased that out over a period of 5 years	1 passenger coach has total 4 toilets. Cost of 1 Bio Toilet has been assumed at Rs. 100000/-.
	3	We multiplied No. of toilets * maintainence cost/month*no. of months to arrive at the market size per annum	Maintenance cost = Rs. 100/ month

Category	Steps	Methodology	Assumptions
Feminine Hygiene	1	India female population was taken as per 2011 census and growth rate of 1% per annum was computed to arrive at 2021 figures	Growth rate 1.1% per annum
	2	Urban/ Rural female popuation was taken into consideration based on the ratio as per Census 2011 and added back to provide the total frmale population	Urban Female = 48.1% Rural Female = 48.6%
	3	Taking Fertile female population from NFHS 2018 and also from Census 2011, we arrived at the estimated fertile female population in the country	Fertile Female = 61%
	4	We multiplied fertile female population*Cost of Sanitary Napkin* No of days of period*No. of changes*No. of months to arrive at estimates	Cost of 1 Napkin = Rs. 5 No. of days of period = 5 No. of changes = 3/ day No. of months = 12
	5	Population growth at 1% per annum was used to estimate the future	

Category	Steps	Methodology	Assumptions
O&M for Decentralized STP for Waste Water Treatment in Housing Societies (Mn USD)	1	We mined data from Registrar of Co-operative Societies (Central) and visited State Housing co-operative socieites and and State Real Estate Regulatory Authority websites to arrive at no. of registered housing co-operative societies	
	2	Zeroing down on no. of societies	20% of the Societies are large and have at least 200 flats each
	3	Zeroing down on no. of flats	Multiplied by 200 based on aforesaid rationale
	4	Arriving at average Population by multiplying this with Household Size	Average Urban Household Size = 4
	5	Multiplying population figures in Step 4 with 135	Average Waste water generation per capita = 135 LPCD
	6	Estimated no. of STP's required = Dividing figures indicated above with 100000	STP having treatment capacity of 100000 lpcd
	7	Estimated Market Size = Dividing by Rs. 3000000	Erection Cost - Rs. 3000000/ STP
	8	For Service = No. of estimated STP's * existing market rate of maintainence of STP having similar treatment capacity	Estimated cost of maintenance per annum = Rs. 614000/-
	9	Dividing by 75 and 10^6 to arrive at Mn USD figures	

METHODOLOGY & ASSUMPTIONS

CIRCULAR SANITATION ECONOMY

Category	Steps	Methodology	Assumptions
Health Data	1	Secondary Research indicated 400 Bn turnover in 2016 as per Redseer, and 860 Bn turnover in 2020 as per Markets & Markets estimation. We calculated the growth rate and filled in the intermediate values i.e. 2017 -19.	CAGR was calculated as 21%
	2	Using the same growth, the market was estimated till 2030 but was found to be a little inflated	
	3	Hence to get a realistic figure regression analysis was undertaken in both linear and polynomial modes. Polynomial equation had an R2 value of 1 and hence a better fit.	
	4	10% of the total pathological market was assumed to be from human waste i.e Urine and stool and are considered to be hazardous, if contaminated. Hence, for the sake of calculations 10% of the pathological market was considered to be coming from Urine or Stool	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4500995/ https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5784295/

Category	Steps	Methodology	Assumptions
Sensor and Smart technologies for toilets: footfall, operations and maintenance, usage behaviours, pathogen detection, early disease circulation, disease prevalence by community (USD Bn)	1	The no. of Toilets in community, portable, railway stations, airports and malles were considered for calculation	
	2	It was assumed that the toilets in the aforesaid establishments would adopt smart technology in a phased out manner as per the plan indicated in the next coloumn	2021 - 5% 2022 -5% 2023 - 5% 2024 -10% 2025 - 10% 2026 - 10% 2027 -10% 2028 - 15% 2029 -15% 2030 - 15%
	3	It was assumed that the sensors would need a replacement every 4 years. i.e. the one installed in 2021 will need to be replaced in 2025, thus creating a replacement demand	
	4	This was multiplied by average cost of sensor module, which was approximately 100000/- per installation.	
	5	Finally addition of all categories and dividing by 75 and 10^9 to arrive at a consolidated USD Bn figures.	1 USD = INR 75

Category	Steps	Methodology	Assumptions
Sensor and Smart technologies for waste treatment: flow and quality of toilet resources (sewage), operations and maintenance, usage behaviours, pathogen detection early disease circulation, disease prevalence by community	1	India has following population in different types of towns	Class I (Population above 100000) - 468 Class II (50000 - 99999) - 474 Class III (20000 - 49999) - 1373 Class IV - (10000 - 19999) - 1683 Class V - (5000 - 9999) - 1749 Class VI - Less than 5000 - 424
	2	Assumed revenue = Rs. 1 Cr/ installation/ town	
	3	TIER I, II,III will be installed in 2021	
	4	50% installation of TIER IV,V,VI will be completed in 2025	
	5	Rest 50% installation of TIER IV,V,VI will be completed in 2030	
	6	It was assumed that the sensors would need a refresh every 9 years. i.e. the one installed in 2021 will need to be replaced in 2030, thus creating a replacement demand	

Category	Steps	Methodology	Assumptions
Smart logistics & transportation for waste collection	1	Estimated no. of Community and Public toilets were taken as the starting point	
	2	Operation and maintenance cost/ toilet was assumed as Rs. 185/ month in 2021	
	3	O&M Cost would be revised @10% per annum. Thus, the cost of calculation was as follows, as indicated in the next :-	2021 - Rs. 185/- 2022 - Rs. 204/- 2023 - Rs. 224/- 2024 - Rs. 246/- 2025 - Rs. 271/- 2026 - Rs. 298/- 2027 - Rs. 328/- 2028 - Rs. 361/- 2029 - Rs. 397/- 2030 - Rs. 436/-
	4	The no. of toilets was multiplied by no. of months, viz = 12 and O&M Cost per month to arrive at logistics and transportation cost per annum	
	5	This was divided by 75 and 10^9	

Category	Steps	Methodology	Assumptions
Data Analytics Services	1	The no. of Toilets in community, portable, railway stations, airports and malles were considered for calculation	
	2	It was assumed that one time maintenance cost per annum would be charged (as per existing norms) - understood in consultation with entrepreneurs in the space	2021 - 20000 2022 -22000 2023 - 24200 2024 -26620 2025 - 29282 2026 - 32210 2027 -35431 2028 - 38974 2029 -42872 2030 - 47159
	3	It was assumed that maintenance cost per month would be charged (as per existing norms) - understood in consultation with entrepreneurs in the space	2021 - 350 2022 -385 2023 - 424 2024 -466 2025 - 512 2026 - 564 2027 -620 2028 - 682 2029 -750 2030 - 825
	4	The no. of toilets was multiplied by no. of months, viz = 12 and O&M Cost per month + 1 time cost per annum to arrive at logistics and transportation cost per annum	
	5	Finally addition of all categories and dividing by 75 and 10^9 to arrive at a consolidated USD Bn figures.	1 USD = INR 75

Category	Steps	Methodology
App Services	1	https://www.hyperlinkinfosystem.com/research/indian-app-development-industry-report-2020
	2	As per the above report, the App industry is estimated at $231 Mn for 2020
	3	Using polynomial regression equation, figures for 2030 was estimated
	4	As per the above report, 11% of the paid apps are on Tools in the Android platform. Thus 11% of the value was apportioned to the figure obtained in Step 3.
	5	It is assumed that 25% of the Apps in future will be having a linkage with Hygiene or Sanitation products or Services in the post COVID era. Thus 25% of the value was apportioned to the figure obtained in Step 4.

Category	Steps	Methodology	Assumptions
Smart Cities	1	TBC's deep dive economic study for sanitation market in Pune estimated a future market size of by-products to be US $ 66.57 million per annum.	
	2	100 Smart cities were thought to have a configuration like this. 10 cities would generate $66.57 Million/ annum and 90 cities would genrate $ 22.19 Million/ annum for year 1	
	3	For rest years the break up would be as follows:-	2021 - 90*66.57+10*22.19 2025 - 70*66.57+ 30*22.19 2030 - 55*66.57 + 45*22.19
	4	This was divided by 10^3 to arrive at $Bn figures	