The Sanitation Technology Platform

Please Note: This report is a good faith effort by RTI International to accurately represent information available via secondary and primary sources at the time of the information capture. The report is confidential and proprietary and only for internal uses and not for publication or public disclosure.
TABLE OF CONTENTS

Task Background and Objectives

Technical Approach

Biological Waste Technologies

Anaerobic Technologies with Biogas Capture
For partners, STeP developed a modest landscape of biotoilet systems.

In support of the Indian Institute of Technology (IIT)-Madras analysis of the Defence Research and Development Organisation (DRDO) biotoilet systems, the Sanitation and Technology Platform (STeP) conducted a secondary data review and analysis of bio-based waste treatment technologies that could be compared to, and possibly compete with, the DRDO-developed biodigester.

This report serves as an overview of the types of companies and technologies in this space and is not an exhaustive list. We consider it a living document to be added to overtime.

In addition to our support of IIT Madras’ testing of DRDO technologies, this report may also be useful to commercial and technology partners of the Gates Foundation as they orient themselves to the companies offering products in the space, compare technical features, and explore pricing and business models.
STeP has identified and characterized technologies and constructed representative (not comprehensive) company and technology profiles of products sold in India and, in some cases, globally. These examples serve as a small subset of what may be hundreds of other firms offering similar technologies.

The report is based on secondary analysis (vs. primary interviews) from publically available information, as presented on websites and company-provided technical data. Moving forward, STeP may undertake primary interviews to deepen the insights and gather data not available via secondary analysis.

This PowerPoint includes:

- Company profiles of representative firms actively promoting technologies in India;
- Technology profiles of products divided into two categories (described in more detail on a subsequent slide): those that perform (1) biological treatment and (2) anaerobic digestion with biogas capture; and
- When available, data that include cost, capacity, and business model insights.

These examples provide illustrative examples of products and companies producing and installing systems.
STeP turned to secondary data, including technical data sheets, to assess and profile various technologies.

STeP’s technical approach aimed to:

• Aggregate secondary information sources,
• Analyze publicly available data,
• Map technology space, and
• Characterize companies and products on the market in India.

Data sources included:

• Organization Web sites,
• Technical data sheets, and
• Published reports.
Profiled companies offer either biological treatment technologies or anaerobic digestion with biogas capture.

**Biological Treatment Technologies**
Technologies rely on anaerobic and/or aerobic bacterial processes with byproducts that include water (e.g., greywater), sludge, and, in some cases, “soil amendments.” These technologies span a broad range of applications/use cases, from community scale to single households.

**Anaerobic Digestion with Biogas Capture**
These technologies process under anaerobic conditions to generate biogas, which has a range of applications, including conversion to electricity, heat, and for cooking. Some companies are established players in sanitation, while others have historically focused on bioenergy production.

<table>
<thead>
<tr>
<th>Companies with Biological Treatment Technologies</th>
<th>Both</th>
<th>Anaerobic Digestion with Biogas Capture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stone India</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sun-Mar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sintex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biotech Services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Akar Impex Pvt. Ltd.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shubham</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biotech Services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AbstraPure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SULABH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sundaram Fabricators</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daksha</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-Sustain</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Companies with Biological Treatment Technologies

Technologies rely on anaerobic and/or aerobic bacterial processes with byproducts that include water (e.g., greywater), sludge, and, in some cases, “soil amendments.” These technologies span a broad range of applications/use cases, from community scale to single households.

Anaerobic Digestion with Biogas Capture

These technologies process under anaerobic conditions to generate biogas, which has a range of applications, including conversion to electricity, heat, and for cooking. Some companies are established players in sanitation, while others have historically focused on bioenergy production.
Stone India Ltd has dedicated 35% of its business to manufacturing and distributing the Enbiolet toilet to individual households.

Company Profile

Stone India Ltd has a long history of developing products designed for the railway industry; more recently, the company has diversified product offerings including solar and sanitation. Stone India Ltd has invested in developing its own patented technology, supported by funding from the Technology Demonstration and Development Program (TDDT) and Bill & Melinda Gates Foundation.2

Location: Kolkata, India

Size: 200–500 employees

Revenue: In FY13, Stone India Ltd had INR 104 crore Rupees (USD 15.7 million) revenue with future growth focused on biotoilets and solar power.

Primary customers: WSH customers are predominantly at the individual household level. Secondary customers include Corporate Social Responsibility (CSR) programs and NGOs operating under the SBM banner.

Marketing: The Ministry of Urban Development and Ministry of Drinking Water and Sanitation Web sites feature the technology, and the Confederation of Indian Industry (CII), which provides guidance for CSR initiatives, has recommended the technology.

Business model: Stone India Ltd manufactures and distributes manufactured Enbiolet units through its own subsidiary, Stone Biotech Pvt. Ltd.7 The operation and maintenance (O&M) of the systems after installation is generally taken on entirely by the client.8, 9 A more developed business model for full commercialization is being developed in India through a TDDT grant and in Bangladesh through a commercialization pilot program run by ICCO Cooperation, with funding from the Bill & Melinda Gates Foundation.2, 10

Web site: http://www.stoneindia.co.in/
The Enbiolet toilet is targeted for individual household users as well as small and medium-sized businesses.

Technology Profile
The technology relies on aerobic bacteria to safely treat human waste through a system of treatment tanks. A solar panel powers a pump to transport water to an overhead tank for use as flush water.

Cost:
- Capital cost: $650–$1,950
- Subsidized cost: $365–$450

O&M: The reported operational cost is <$0.05 per day, including a refill of biocleaner and disinfectant and simple toilet pan cleaning.

Claimed outputs: Treated water and carbon dioxide

Other features:
- In spore form, bacteria have a listed shelf-life of 3–4 years.
- As described, a smaller volume of bacteria is required vs. DRDO (10 mL for a 300 L tank vs. 100 L for a 300 L tank for the DRDO system).
- The aerobic digestion process can complete much more quickly (around 24 hrs) than anaerobic processes, thus requiring a smaller retention tank.

Sources:
BIOLOGICAL TREATMENT TECHNOLOGIES

Akar Impex is a private, Indian-based company that designs and constructs a wide range of wastewater treatment plants globally.

Company Profile
Akar Impex Pvt Ltd is a private company (established in 1896) that provides consultancy, erection, commissioning, turnkey projects, manufacturing, and O&M contracts in the field of wastewater treatment, sewage treatment, water treatment, and municipal solid waste composting plants. Many products, such as those shown at left, are designed for mobility. Although based in India, Akar has supplied plants to 20 countries on 5 continents.

Location: Noida, India
Size: 51–100 employees
Revenue: INR 2 to 5 crore Rupees revenue (USD 301,903 to USD 754,759), approximate (2010–2011)²

Primary customers: The international portfolio includes clients from India, East/Middle Africa, the Middle East, and Southeast Asia. Key sectors include the textile and hotel industries, with a secondary emphasis on residential complexes.

Marketing: Marketing efforts include expanding client list referrals and listings on commercial Web sites such as IndiaMART.com and other online marketing platforms.³

Business model: Exports account for 75% of total sales. The Akar team consists of design engineers, on-site engineers, servicing technicians, civil engineers, and administrative support staff. As a result of Akar’s applied model, most personnel visit sites to carry out surveys, address customer needs, and carry out the erection/commissioning of plants. Support teams make regular visits to customers’ sites to ensure proper functioning throughout the life cycle of their products as well as operational assistance and pilot runs for new installations. Akar has three manufacturing facilities for all wastewater treatment equipment and offices around India.⁴

Web site: http://www.akarimpex.com/

Sources:
Akar Impex offers a prefabricated, fully enclosed unit with residential, commercial, and industrial applications.

**Technology Profile**

Akar offers a prefabricated, fully enclosed unit. Pretreatment removes coarse particles, grit, oil, and grease. Oxygen is then dissolved into the wastewater through a moving bed bioreactor (MBBR) to encourage digestion by bacteria. The unit has a reported capacity of 20 kl per day to 1 MLD. Treated sewage is then chlorinated and transferred to an external treated water tank. Sludge is pumped to a filter press or hydrocyclone for conversion to sludge cakes for fertilizer.

**Product:** Akar Dynamic Bioreactor (ADBR) System/Akar Containerized Sewage Treatment Plant (ACONSET)

**Cost:** INR 20 lakh Rupees\(^2\) (USD 30,188)

**O&M:** The O&M is minimal and generally performed by Akar O&M specialists as part of post-purchase support.

**Claimed outputs:** Chlorinated water and dry fertilizer

**Other features:**
- Target applications include residential colonies and townships, institutional areas, shopping malls, hospitals, hotels/resorts, labor colonies, and construction sites.
- “No foul smell—plant is fully enclosed.”
- The unit is easily transportable and is mounted on a skid.
- The reported treatment process retention time is reduced by more than 60%, and space and energy savings are more than 60%.
- There is no major civil concrete work required on site.

**Sources:**
Biotech Services provides wastewater and septic solutions, as well as components. (e.g., UV algae control, microbes, media, and chemicals)

**Company Profile**

Established in 2005, Biotech Services provides a variety of sewage water and water treatment plants, equipment solutions, and turnkey projects for wastewater treatment.

**Location:** Noida (UP), India

**Size:** <20 employees

**Revenue:** INR 2.5 to 5 crore Rupees (USD 377,360 to USD 754,720) revenue, approximate

**Primary customers:** Primary customers are large industries and housing complexes. Clients include LNJ Bhiwara Group, Oswal Group, KDS Cotton Poly Thread Industries, GlaxoSmithKline Consumer Health Care Ltd, Hind Agro Industries Ltd, and Gopal Group (Fortune Resort Grace).²

**Marketing:** No marketing information is available.

**Business model:** Biotech Services is an integrated manufacturer, supplier, and service provider. The company integrates STORMIX Submersible Jet Aerators produced in Italy into its units for superior quality.

**Web site:** [http://www.biotechservices.in/about-us.html](http://www.biotechservices.in/about-us.html)

Sources:
1. [http://www.biotechservices.in/about-us.html](http://www.biotechservices.in/about-us.html)
The electrocoagulation plant uses electrolysis to move coagulated and suspended particles to the surface to be skimmed off.

**Technology Profile**

The technology is a three-part system: brine electrolyser, electrocell, and activated carbon filter. It requires 5 kW to treat 100 KL/D of wastewater. Salt is added to the wastewater, followed by electrochemical oxidation.

**Product:** Electrocoagulation for sewage treatment

**Cost:** “50% of the cost of normal STP”

**O&M:** No O&M information is available.

**Claimed outputs:** The technology produces hydrogen and oxygen, and moves coagulated and suspended particles to the top, where they are skimmed off and removed. Treatment products include pathogen-free water, settled sludge removed for disposal, or a filter press for use as fertilizer.

**Other features:**

- The quality of treated wastewater ensures a BOD of less than 10 ppm.
- The system can handle a shock load.
- Customers include AD Hydro Power Ltd, Pearls Gateway Towers, Fortune Resort Grace, Jindal Mectec Pvt Ltd, Maxfaith Engineers Ltd, Tehri Hydro Development Corporation, and G.E. Water (Bengaluru).
Biotech Services provides microbial blends and aerators to support aerobic digestion and speed processing time.

**Technology Profile**

Biotech Services offers proprietary blends of 50+ microbes, “Effective Microorganisms”, to grow on fluidized media in the bioreactor tank and provide a synergistic degradation of the organic and hydrocarbon pollutants. A diaphragm pumps air to provide additional dissolved oxygen for microbe growth and homogeneous effluent mixing. EMs are also sold as “septic tank treatments” as pictured at left.

**Product:** EM cultures to be added to compact sewage treatment plants.

**Cost:** Effective microbes (EM) 106 Rs (USD 1.60)/batch

**O&M:** O&M information is not listed.

**Other features:**

- “Eliminates foul smell.”
- The technology restores clogged soak pits.
- Clients include BMD Private Ltd (LNJ Bhilwara Group), Applied College of Engineering and Management (Palwal), MIIT (Pune), and Rajasthan Spinning and Weaving Mills Ltd.
- EMs operate in the bioreactor tank with continuous aeration, having a retention time of 6 to 8 hours, a pH between 5 and 10, and a temperature less than 55°C.

Sources:
Biotech Services offers Bugsy, a septic tank aeration unit, to improve the performance of existing systems.

Technology Profile
Bugsy is a compact aeration system used to treat small and variable quantities of sewage or industrial wastewater by upgrading existing ETP/STP without any civil modification or work. It has a small aerating pump that consumes 40 W to 200 W of power, combined with MBBR media for the attached growth of a proprietary blend of microbes, a blend of 52 cultures and fungi. Bugsy has a capacity of 500 L to 60,000 L per day.²

**Product:** Bugsy septic tank aeration unit

**Cost:** INR 1.24 lakh Rupees (USD 1,871)/set¹

**O&M:** Aerating pump does not require any regular maintenance. Sludge removal every 2 years. Negligible operating cost and no dedicate manpower required.

**Claimed outputs:** Carbon dioxide, water, and dead biomass

**Other features:**
- “With a transfer efficiency of about 12.5%, it has the capacity to degrade 3 kg of BOD per day, which translates to 1.8 kg of BOD per day.”
- It can reduce BOD by 85% to 95%.
- “System saves 100% of the water used in homes.”
- “Normal intrinsic bacteria from within the sludge and sewage is not adapted to shock loads, pH, and temperature variations. We provide a special bacterial culture ‘Biorganic’… containing 56 strains of bacteria and fungi. Every milliliter contains a million colony forming units.”
- Plastic MBBR media (fluidized) ensures the active growth of media and higher biomass, resulting in lower retention time for treating sludge.

Sources:
1. [http://www.biotechservices.in/septic-tank-aeration-unit.html](http://www.biotechservices.in/septic-tank-aeration-unit.html)
BIOLOGICAL TREATMENT TECHNOLOGIES

Sun-Mar is a small Canadian company that has been developing composting toilets since the late 1970s and is striving to globalize.

Company Profile
Based in Canada, Sun-Mar sells composting toilets into North American markets. With initial product introductions in the 1970s, the company has expanded to produce 22 models and export units internationally.

Location: Burlington, Canada
Size: 16 employees
Revenue: $2.76 million annual revenue
Primary customers: Sun-Mar sells to the North American market, providing a range of products, including 22 models from 6 different product families.
Marketing: Sun-Mar markets both direct sales and indirect sales through dealers, magazines, and online retailers. Indirect sales are often the result of partnerships with renewable energy companies.4

Business model: The purchase of the unit is Sun-Mar’s primary revenue source. Sun-Mar also sells Compost Sure, or cleaners such as Sun-Mar Compost Quick sold in addition. Sun-Mar manufactures units and sells them both directly as well as through intermediate dealers. The company also exports units to 22 countries.

Sun-Mar is currently involved in a human-centered design program, aimed to develop production and business models for slums in Bangladesh. The program is run by ICCO Cooperation in conjunction with SanMarkCITY, Sushtha Shasthya Kendra (DSK), and International Development Enterprises (iDE), with funding from the Bill & Melinda Gates Foundation. Pending a technical evaluation, the technology will be linked to private-sector agencies to make it available commercially in large scale.


Sources:
Composting toilets include a holding tank that rests under or behind the interface. Costs range from $1,600 to $2,000.

**Technology Profile**

Aerobic bacteria biologically inactivate waste using Sun-Mar’s patented composting drum. Solid waste must always be followed by a scoop of bulking material. When the toilet is half-full, the catchment receptacle is emptied to the catchment tray and allowed to sit for 30 days, producing compost. Some models have electrical heaters to maintain optimal biological conditions and a 30 W ventilation fan.

**Product:** Sun-Mar composting toilet

**Cost:** $1,595–$1,950

**O&M:** Add a peat moss mixture and rotate the catchment receptacle every 2 to 3 days. Clean the toilet bowl with Sun-Mar Compost Quick or hot water mixed with baking soda or vinegar.

**Claimed outputs:** Compost

**Other features:**
- The toilet is certified by the National Science Foundation (NSF) Standard 4.
- Installation is quick and simple (DIY), requiring no plumbers or electricians.
- Sun-Mar produces its own compost mix, with ~60% wood shavings and ~40% peat moss and hemp.
- Units carry a 5-year warranty on a fiberglass tank and a 3-year warranty on all other parts.

Sources:
2. [https://letterstocreationists.wordpress.com/2015/03/14/comparison-of-composting-toilets-towards-a-global-commode/](https://letterstocreationists.wordpress.com/2015/03/14/comparison-of-composting-toilets-towards-a-global-commode/)
Shubham is a small, Ahmedabad-based company delivering water treatment plants, above and below ground.

Company Profile
Shubham is an end-to-end service provider founded in 2005, delivering cost-effective and sustainable water, wastewater, and energy utility infrastructure solutions to businesses and communities. Shubham offers water treatment plants, sewage treatment plants, reverse osmosis plants, and others and claims to have executed over 500+ installations across India and abroad.

Location: Ahmedabad, India
Size: 26 to 50 employees
Revenue: INR 10 to 25 crore Rupees (USD 1.5 million to USD 3.8 million) revenue
Primary customers: Customer base is generally private-sector companies. Notable clients include Reliance Fresh, Indian Oil, Rainbow, Larsen and Toubro, Home Town, ESSAR, and Aditya Birla Group.
Marketing: Marketing is conducted via catalogs, brochures, Web sites, and newsletters. Shubham has a strong online marketing presence through social media (e.g., Twitter and Facebook) and commercial vendor sites such as IndiaMART.com and TradeIndia.com.
Business model: Shubham provides extensive postinstallation O&M as part of a packaged support plan for purchased systems.
Web site: http://shubhamindia.com/
Shubham offers a prefabricated MBBR system with electrical controls that deliver on-line messaging and reporting.

**Technology Profile**

The “Plug and Play” prefabricated MBBR waste treatment system includes a seven-step treatment process: (1) inlet screening, (2) primary/anoxic tank—denitrification (optional), (3) aeration tank with UV resistance biomedia, (4) secondary settling tank with PP tube media, (5) chlorine contact tank, (6) RAS and sludge removal, and (7) tertiary treatment for polishing using sand and carbon filters. The organic load range is listed as 1–20 kg BOD/(me*d), capacity 10 M3 to 1,000 M3 per day.¹

**Product:** Bio Accelerator 360°™

**Cost:** Not listed

**O&M:** The system is operated by electrical/microprocessor controls with online reporting and messaging.²

**Claimed outputs:** Treated water for reuse and greywater applications

**Other features:**
- The system is factory tested and has minimal field assembly.
- It is ideal for housing projects, schools and hostels, industrial offices and parks, small communities, rural schools, and hospitals.

Sources:
Aastropure is a full-service engineering firm that builds wastewater and sewage treatment plants; recycles water for flushing.

Company Profile
Aastropure is a full-service ISO 9001:2008 certified company that undertakes concept development, design, construction, and erection of turnkey engineering and infrastructure projects for a wide range of applications. Projects include reverse osmosis plants, membrane bioreactors, a membrane system for process applications, a membrane system for dairy applications, water treatment plants, effluent treatment plants, sewage treatment plants, and compact sewage treatment plants.

Location: Ahmedabad, India
Size: Not available
Revenue: Not available
Primary customers: Industrial complexes, municipal corporations, Nagar Palikas, hotel industries, and residential colonies
Business model: Aastropure relies on production and design engineers to develop custom-capacity wastewater solutions for its clients. Units are manufactured at the Aastropure manufacturing facility, and after-sales servicing is available for installed units.


Sources:
2. Images: http://ahmedabad.all.biz/ultra-filtration-system-g414848#.Vnv1ni6k1H4
**Technology Profile**

Aastropure is designing, manufacturing, and erecting compact sewage treatment plants for industry, special economic zones, municipal corporations, Nagar Palikas, hotels, and residential colonies.

Treated sewage can be recycled for gardening, flushing, or for other process applications for industries. Aastropure optimizes the size and power consumption of plants to accommodate the application.

**Product:** Compact sewage treatment plant

**Cost:** Not available

**O&M:** Aastropure offers after-sales servicing

**Claimed outputs:** Treated sewage for gardening, flushing, or industrial applications

**Other features:**
- Plants are supplied fully preassembled and tested, enabling them to be installed in their final location in 1 day.
- The aeration system comprises a blower, an air supply pipe, fine bubble diffusers, and an air relief valve.
- The technology also features an automatic sludge recirculation system.

Sources:
Companies with Biological Treatment Technologies

Technologies rely on anaerobic and/or aerobic bacterial processes with byproducts that include water (e.g., greywater), sludge, and, in some cases, “soil amendments.” These technologies span a broad range of applications/use cases, from community scale to single households.

Anaerobic Digestion with Biogas Capture

These technologies process under anaerobic conditions to generate biogas, which has a range of applications, including conversion to electricity, heat, and for cooking. Some companies are established players in sanitation, while others have historically focused on bioenergy production.

Profiled companies offer either biological treatment technologies or anaerobic digestion with biogas capture.
Sintex is a publicly traded company that offers a wide range of prefabricated water tanks and septic systems.

Company Profile
Sintex is a publicly traded company active in a broad range of industries, including prefabricated structures, textiles, electrical products, water management products, sanitation products (both biogas and waste treatment systems), solar energy products, telecom infrastructure support, and industrial tanks.

Location: Kalol, India

Size: >4,000 employees

Revenue: FY14 revenue of 5864.8 crore Rupees (USD 885.3 million)

Primary customers: Active in nine countries

Marketing: Not available

Business model: Sintex has 13 manufacturing facilities in India and approximately 37 manufacturing facilities on four continents. The company offers products under various brands, including Sintex (premium tanks), Reno (standard tanks), and Renotuf (value-for-money tanks). Subsidiaries include Sintex NP SAS, Sintex Wausaukee Composites, Inc., Bright AutoPlast Limited, and Sintex Infra Projects Limited. Sintex is highly integrated, able to provide a wide variety of processing tools with a globally established supply chain. Plants are suitable for farms; roadside dhabas; canteens; and kitchens operating in religious places, industries, and hotels.

Sintex is expecting an 18%–20% growth in its prefabrication business in FY16.

Web site: http://www.sintex.in/solutions.html

Sources:
A Sintex/Aqua Nishihara (Japanese company) collaborative product is sanctioned by CPHEEO as one of the preferred technologies.

**Technology Profile**

The Sintex and Aqua Nishihara product is a compact, polyethylene modular tank with 1,200 L to 6,000 L capacity. The first stage is a settling tank, where settled sludge is stabilized by anaerobic digestion; the reported treatment efficiency is 30%–40% BOD removal. The second stage is an aerobic zone in which air bubbles are pumped through blowers to allow microorganisms time to digest the remaining organic material; the reported BOD removal is around 60%–70%.\(^1\)

**Product shown:** PWTS-STBF series  
**Cost:** None listed  
**O&M:** Sludge is removed once per year.  
**Claimed outputs:** Treated water can be reused for gardening.  
**Other features:**  
- The product results from a collaboration with Aqua Nishihara Corporation (Japan).  
- The Central Public Health Organization (CPHEEO), Government of India sanctioned the product as one of the preferred technologies for decentralized sewage treatment in India.  
- The product requires an electrical connection.

Sources:  
Sintex has a compact fiberglass reinforced plastic tank for the aerobic treatment of sewage water for medium/large applications.

**Technology Profile**

Sintex’s compact tank is used in a decentralized manner for the aerobic treatment of sewage water. It is a complete underground system with no footprint. The first stage allows settled sludge to be stabilized by anaerobic digestion (a reported efficiency of ~30% BOD removal). The aeration zone with MBBR plastic media, where air is bubbled through, provides more efficient digestion (a reported efficiency of 60%–65% BOD removal). The final stage involves a sedimentation zone where final organic sludge is pumped back to the primary sedimentation zone to increase efficiency.\(^3\)

**Product shown:** NBF series STP plant  
**Cost:** Not listed  
**O&M:** Sludge is removed once in 3 years.\(^3\) Sludge handling occurs once between 12 and 18 months.\(^4\)

**Claimed outputs:** Treated water can be used for gardening.

**Other features:**
- The product is the result of a collaboration with Aqua Nishihara Corporation (Japan).
- CPHEEO, Government of India sanctioned the product as one of the preferred technologies for decentralized sewage treatment in India.
- The product is ideal for medium to large residential complexes and commercial complexes with 10 to 150 residents.
- The fiberglass reinforced plastic material is inert to corrosion, with a lifetime of >50 years.

**Sources:**
1. [http://www.sintex.in/solutions.html](http://www.sintex.in/solutions.html)  
Sintex offers DIY kits with channel partners, including NGOs and others involved in organic farming missions.

**Technology Profile**
The kits have capacities from 0.2 CUM to 4 CUM. Using tough polyethylene as a single molded piece without seams, joints, or welds, the unit is ready to install, use, maintain, and dismantle. A spider mechanism provides constant pressure for cooking gas. The 1 CUM plant requires space of around 2 m x 2 m and needs 12–13 kg biomass.

**Product:** Sintex biogas plant

**Cost:** 1 CUM plan INR 19,000

**O&M:** Not listed

**Claimed outputs:** Biogas and nutrient-rich fertilizer

**Other features:**
- The technology is MNRE-approved and validated by IIT Delhi.
- It can be installed over- or underground.
- It has a listed payback period of less than 2 years.
- Beneficiaries include dairy farmers, agriculture departments, and other government agencies.
- Service providers/channel partners install units and provide post-installation services.
- Channel partners include NGOs and other people involved in organic farming missions.
- It is designed primarily for semi-urban and rural settings.

"Sintex Industries has come up with a 'ready-to-use biogas plant' to address the problem of wet-waste. Within 2 years, the cost of the product is recovered,"

- Amit K. Doshi
  Deputy manager of products and international business, Plastic Division.

**Sources:**
1. [http://www.hedon.info/article1522](http://www.hedon.info/article1522)
2. BIOTECH Biogas in South India.pdf
Sulabh is a well-known NGO that has seen the widespread adoption of pit-based toilets and is developing biogas technology.

Company Profile

Sulabh is an NGO founded in 1970 as an organization dedicated to the development and implementation of community toilet technologies, biogas, and biofertilizer technologies for India. “1.2 million residences and buildings use the Sulabh pout-flush toilets, and more than 10 million people each day use Sulabh-designed public toilets”\(^1\)

**Location:** New Delhi, India

**Size:** Sulabh has over 60,000 volunteers, including technocrats, managers, scientists, engineers, doctors, and architects.

**Primary customers:** Bus stations, railway stations, markets, low-income communities (through partnership with government entities or NGOs), and individual households

**Marketing:** Sulabh runs a number of outreach and training sessions, gaining exposure directly to communities, and maintains close partnerships with the World Health Organization (WHO), United Nations Development Program (UNDP), and the Government of India.\(^2\) A recent collaboration with UN-HABITAT has led to an Memorandum of Understanding for expansion to Ethiopia.\(^3\)

**Business model:** Sulabh manufactures its own specially designed toilet pans and runs its own well-established delivery system. Profits are raised through 10% commissions for toilet construction as well as any surplus from “pay-and-use” collections. Land and construction costs of community toilets are covered by local government authorities.\(^4\) O&M costs are covered through a pay-per-use model.\(^2\) Maintenance of toilets located in low-income communities are cross-subsidized from income generated by wealthier or busier areas.\(^3\)

**Web site:** [http://www.sulabhinternational.org/](http://www.sulabhinternational.org/)
Two-pit systems come in 10+ models priced $31–$275, should be emptied at 2-year intervals, and claim to be “pathogen free.”

Technology Profile
Two collection pits are used alternately. When one pit is full, waste is diverted to the second pit. In about 2 years, the sludge is digested and “is almost dry and pathogen free,” making it safe for handling as a fertilizer and soil conditioner.

Product: Sulabh Shauchalaya two-pit composting toilet

Cost: Toilets come in 11 models, ranging in price from $31 to $275

O&M: Pits should be emptied after 2-year intervals, with a periodic cleaning of the squat pan.

Claimed outputs: Night soil

Other features:
- The specially designed 20 mm water seal requires only 1–1.5 L of water for flushing.
- Pits are generally designed for 3-year desludging intervals.
- Pits requires less space than septic tank toilet systems.
- “When constructed in homogenous soil, horizontally, bacteria do not travel more than 3 metres, and vertically the seepage is not more than 1 metre”.1
- The toilet model has been time-tested implemented in more than 1.2 million houses all over India.2

Sources:
Sulabh offers community toilets linked to biogas digesters. Plant construction is estimated to be $2,000.

Technology Profile
Sulabh offers a community toilet linked to biodigester tanks. The secondary UV treatment of water is used to remove remaining pathogens, and secondary scrubbing of biogas removes hydrogen sulfide. Capacity ranges from 30 CUM to 60 CUM depending on the size and needs of the community.¹

Product: Sulabh community toilet biogas plant

Cost: Toilet stalls come in 11 models ranging from $31 to $275 per toilet; biogas plant construction and connection are estimated around $2,000.²

O&M: Periodic desludging, occasional activated carbon filter change, periodic UV bulb change, and cleaning of the toilet pan

Claimed outputs: One cubic foot biogas is produced from the human excreta of per person per day. Human excreta based biogas contains 65-66% methane, 32-34% carbon dioxide and, rest the hydrogen sulphide and other gases in traces. Solids are used as fertilizer.

Other features: No manual handling of waste is required.

Sources:
Profiled companies offer either biological treatment technologies or anaerobic digestion with biogas capture.

**Biological Treatment Technologies**
Technologies rely on anaerobic and/or aerobic bacterial processes with byproducts that include water (e.g., greywater), sludge, and, in some cases, “soil amendments.” These technologies span a broad range of applications/use cases, from community scale to single households.

**Anaerobic Digestion with Biogas Capture**
These technologies process under anaerobic conditions to generate biogas, which has a range of applications, including conversion to electricity, heat, and for cooking. Some companies are established players in sanitation, while others have historically focused on bioenergy production.
Biotech Renewable Energy, offers education and advocacy for renewable energy, and performs R&D and tech. development.

Company Profile
Established as an NGO in 1994, Biotech Renewable Energy aims to implement, promote, popularize, and research waste management, nonconventional energy programs, and energy conservation programs. The company refers to itself as “a synonym for environment, energy, power, ecofriendliness, hygiene, and health.”

Location: Thiruvananthapuram, Kerala

Size: Not available

Revenue: Not available

Primary customers: Domestic households, institutional plants (e.g., hostels, schools, and hospitals), and municipal government public toilet digesters

Marketing: Direct sales or licensed Biotech dealers; tradeshows (Biotech Expo); offer training and educational programs on renewable energy and use of biogas technologies

Business model: Units are prefabricated; however, Biotech retains engineers and masons as part of its installation service as needed. Once installed, the team offers training to the family. O&M is designed to be simple, and is performed by members of the household. Limited examples exist where Biotech has taken on the O&M for large-scale municipal projects.

Web site: http://www.biotech-india.org/

Sources:
1. BIOTECH Biogas in South India.pdf
Biotech claims the cost of the floating drum biodigester can be covered in two years through cooking gas and liquid fertilizer.

**Technology Profile**

Biotech offers a floating drum-type biodigester seeded with 100 kg cow dung. Most units are also equipped to collect food waste, allowing for increased biogas yields and more nutrient-rich night soil. Domestic plants commonly have 1 m³ to 6 m³. Institutional models range from 4 m³ to 10 m³ capacity. Municipal plants usually have 25 m³ capacity.¹ The suggested installation time is about 1–4 hours depending on the model and location.²

**Product:** Prefabricated fiberglass reinforced plastic biodigesters

**Cost:** $360 for 1 m³ and $790 for 2 m³ ¹

**O&M:** Estimated at INR 150 Rupees (USD 2.27) per year for the first 4–5 years, performed by the household.¹ Maintenance includes cleaning particulates from gas tubes, adding kerosene to the water jacket to eliminate mosquitoes, and cleaning the toilet.

**Treatment products:** Produces cooking gas, treated wastewater, and enriched night soil

**Other features:**

- Fiberglass reinforced plastic biodigesters can easily be transported, requiring only a small flatbed truck for smaller units.
- Gas generated from the waste of a family of 3–5 members is sufficient to work a single burner stove for more than 2 hours every day.
- Biotech claims that the cost of the unit can be covered in under 2 years through the production of cooking gas and liquid fertilizer.²

Sources:
1. BIOTECH Biogas in South India.pdf
A Tamil Nadu company, Sundaram, focuses on biogas technologies from livestock and food waste; includes custom-built generators.

**Company Profile**

Sundaram is a “leading turnkey agency in biomethanation projects for thermal and power generations since 1985.” It is distinctively focused on anaerobic digestion technologies that convert waste to biogas from inputs that include livestock and food waste.

**Location:** Namakkal, India

**Size:** 51–100 employees

**Revenue:** Annual revenue INR 10 to 25 crore Rupees (USD 1.5 million to USD 3.8 million) (2012)

**Primary customers:** Primary customers are institutions. Sundaram has installed 100+ institutional night soil biogas plants, 75 community night soil biogas plants, and 10 night soil biogas plants for apartments. Sundaram has additional installations at municipality and corporation bus stands (2012). The company focuses on customers in six districts in Tamil Nadu (Salem, Namakkal, Dharmapuri, Trichy, Tanjore, Vilupuram, and Erode).

**Marketing:** Dedicated market research team conducts studies to understand the latest market demands.

**Business model:** Organizational focus is on biological ETP waste sludge-based biogas plant and converting diesel generators for biogas compatibility. Sundaram maintains a state-of-the-art warehouse facility for storage, maintenance, and repairs.


**Sources:**
ANAEROBIC TECHNOLOGIES WITH BIOGAS CAPTURE

Technologies include fiberglass-based biogas plants, above or below ground, with inputs that include food and human waste.

**Technology Profile**

Technologies include a number of models/configurations of biogas plants such as the KVIC model, NEDA model, or Deenabandhu model. Capacity ranges from 1 kWh to 5 Mwh. Anaerobic biogas reactor facilitates the anaerobic degradation of blackwater, sludge, or biodegradable waste. Tanks can be built above or below ground; prefabricated tanks or brick-constructed chambers can be built depending on space, resources, and volume of waste generated.

**Product:** Night soil-based biogas plant  
**Cost:** Not available  
**O&M:** Not available  
**Treatment products:** Biogas and nutrient-rich water  
**Other features:** The technologies are approved by MNRE, KVIC, TEDA, and DRDA.

Sources:
Daksha is a small engineering firm that designs and builds packaged sewage treatment plants for schools, residences, and hospitals.

**Company Profile**

Started in 2011 as Daksha Greentech International, the company manufactures and supplies a broad range of effluent treatment plants, water treatment plants, packaged drinking water plants, sewage treatment plants, pressure sand filters, activated carbon filters, and swimming pool filters. Daksha is an ISO 9001:2008-certified company.

**Location:** Bangalore, India

**Size:** 11–25 employees

**Revenue:** INR 1 crore Rupee (USD 150,944) (2011–2012)

**Primary customers:** Primary customers are schools, universities, hostels, hospitals, and residential layouts. Previous clients include Esteem, Metro Depot, JSW Steels, Jindal Aluminum, M.J. Developers, RWF, Primex International, Ocio Hospitalities, NCC Ltd, and URC Constructions Pvt Ltd.

**Business model:** Daksha provides training to clients for the O&M of plants. Plants generate 0.75 CUM, cost INR 1.1 lakh Rupees (USD 1,660), and have a 7-day delivery time. Daksha has an entire O&M Contract Services Division and in-house manufacturing.

**Web site:** [http://www.dakshagreentech.in/profile.html](http://www.dakshagreentech.in/profile.html)

---

Sources:
1. [http://www.dakshagreentech.in/biogas-plant.html](http://www.dakshagreentech.in/biogas-plant.html)
2. [http://www.dakshagreentech.in/profile.html](http://www.dakshagreentech.in/profile.html)
Daksha offers small biogas production technologies out of “extensive demand” from households.

Technology Profile
Daksha claims to offer small-scale biogas plants based on “extensive demand” from households. Plants are effective in recycling the wet waste generated. The product featured in the picture on the left is connected near sewage lines.

Cost: Model listed below is 1.1 lakh Rupees (USD 1,660).

O&M: Not listed

Treatment products: Cooking gas comprises methane, carbon dioxide, and hydrogen sulfide.

Other features: Installation takes 2–3 days at any site.

Sources:
1. [http://www.dakshagreentech.in/biogas-plant.html](http://www.dakshagreentech.in/biogas-plant.html)
Kings Industries is a small company offering biogas plants and a range of large, industrial drying equipment (e.g., for manure).

Company Profile
Established in 2010, Kings Industries is engaged in the manufacturing and supply of pollution control systems. The product line includes biogas plants, industrial evaporators, and ion exchange systems.

Location: Coimbatore, India
Size: 26–50 employees
Revenue: INR 10 to 25 crore Rupees (USD 1.5 million to USD 3.8 million) (year unknown)\(^1\)
Primary customers: Not listed
Marketing: Minimal information is available.
Business model: Kings Industries specializes in offering services for O&M and hardware for water treatment systems. The company is vertically integrated, providing manufacturing through to delivery. Roughly 30% of manufactured products are exported.\(^2\)

Sources:
Kings Industries, based in Coimbatore, India, offers small biogas production technologies.

Technology Profile
The system promotes the anaerobic digestion or fermentation of biodegradable materials that is converted to usable fuel. Biogas generated can be used for heating or cooking purposes, or it can be used in a gas engine to convert the energy into electricity and heat.

Product: Biogas plant
Cost: Not available
O&M: Not listed

Treatment products: Biogas (65% methane, 35% carbon dioxide, and small amounts of hydrogen sulfide, moisture, and siloxanes)

Other features: The system has an operating temperature of 35°C–40°C.¹

Sources:
Shastas is a contracting firm with electrical, solar, wastewater, and biogas production technologies.

**Company Profile**
Established in 1987, Shastas is a contracting firm working in the field of electrical work (up to 11 KV), solar power plants, water supply systems, water treatment plants, waste management, biogas, household air-conditioning systems, and industrial fire fighting work. The company is also available for contracts for day-to-day O&M.

**Location:** Hyderabad, India

**Size:** Not available

**Primary customers:** Commonly government branches (enlisted DRDO contractors) or institutions


Sources:
A Pune company, Samuchit, focuses on biogas technologies from human waste streams for household use in urban and rural.

**Company Profile**

Samuchit Enviro-Tech was established in 2005 as part of a project conducted by Appropriate Rural Technology Institute (ARTI), an internationally acclaimed NGO based in India. However, over the years the scope of Samuchit has broadened to encompass all aspects of sustainable development, relevant to both rural and urban populations in the developing world. They are focused on providing environmentally sustainable energy and waste management solutions to rural and urban households and establishments in India.

**Location:** Pune, India

**Size:** < 25 employees

**Revenue:** Not listed

**Primary customers:** Primary customers are households in rural and urban areas. They supply a household biogas plant kit consisting of connectors for inlets and outlets, drain valve, gas cock assembly, and a single burner biogas stove. The kit also includes an instructional video for constructing individual biogas plants. The digester and gas holder tanks and inlet and outlet pipes have to be purchased locally.

**Marketing:** Not listed

**Business model:** Organizational focus is on household waste sludge-based biogas plant with minimal footprints in order to fit in urban environments.

**Web site:** [http://www.samuchit.com/](http://www.samuchit.com/)

---

**Sources:**
ANAEROBIC TECHNOLOGIES WITH BIOGAS CAPTURE

Technologies include fiberglass-based household biogas plants, with human waste inputs and biogas to be used as cooking gas.

Technology Profile
Samuchit supplies a household biogas plant kit consisting of connectors for inlets and outlets, drain valve, gas cock assembly, and a single burner biogas stove. The kit also includes an instructional video for constructing an individual biogas plant. The digester and gas holder tanks and inlet and outlet pipes have to be purchased locally. Limited knowledge of plumbing is needed in order to assemble the household product. “Hundreds of people across the world have constructed their own biogas plants from the instructional video and are happily using them.”

Product: Food waste based biogas plumbing kit that is installed and maintained by owner.
Cost: INR 25,000
O&M: Completely maintained and built by owner. Company assumes no liability.
Treatment products: 250-300 gm LPG equivalent per day
Other features:
- Samuchit offers customizable biogas plants for commercial/charitable kitchens. Service and maintenance contracts can be offered for larger biogas plants.
- They do not offer night soil based biogas systems.

Sources:
B-Sustain offers a wide range of commercial and domestic biogas plants ranging from 5-30,000 cubic meters per day.

Company Profile
B-Sustain develops bioenergy projects and technologies that contribute optimally towards a sustainable society. As an integrated technology company, B-Sustain has expertise in multiple aspects of environmental efficiency with a portfolio that covers all areas of biogas and biomass gasifiers manufacturing – regardless of the raw materials, the size of the plant or the process involved.

Location: Chennai, India
Size: Not listed
Revenue: Not listed
Primary customers: Not listed
Marketing: Minimal information is available.

Business model: B-Sustain is an integrated technology company that has expertise in design, manufacturing and installation of biogas plants. They build and manufacture systems from small households to large industrial systems for varying applications ranging from household cooking to industrial thermal purposes, power generation, and transportation fuel. ¹

Web site: http://bsustain.in/domestic.html

Sources:
B-Sustain offers manufacturing and supply Biogas plants, bottling units, and gasifiers for thermal and electricity generation.

Technology Profile
The system is a biomethanation process for treatment of biodegradable solid/liquid waste. Systems can be customized to intake food/vegetable waste, cattle waste, poultry waste, fish waste, or industrial organic wastes such as molasses. The biogas is then converted into useful forms of energy that can be applied thermally for cooking or for electricity though 100% biogas engines.

Product: Domestic and commercial Biogas plants pre fabricated.
Cost: Not available
O&M: Not listed

Treatment products: Biogas via pre fabricated models, industrial & Agricultural plants, Biogas bottling of high and low pressure methane compressors, biomass gasifiers, and biogas engines.
Other features: Thermal Plant Capacity : 5kg/hr to 2MT/hr Biomass loading. Power Plant Capacity: 5kw to 2MW Generation

Sources:
Other companies offering anaerobic digestion with biogas capture may be profiled pending additional research.

**Anaerobic Digestion with Biogas Capture**
These technologies process under anaerobic conditions to generate biogas, which has a range of applications, including conversion to electricity, heat, and for cooking. Some companies are established players in sanitation, while others have historically focused on bioenergy production.

Others that you’d like to see profiled? Please contact the STeP team.