GPS Renewables

Reinventing Biogas for Urban Spaces

What we started off to do..

For any queries contact - Jidesh@gpsrenewables.com

Why in Cities ?

Cities occupy **~3%** of the world landmass but consumes **66%** of world's energy and accounts for **70%** of global CO_2 emissions

Source: c40.org

India is Overwhelmed

Bengaluru's waste creates mounds of problems in Mavallipura

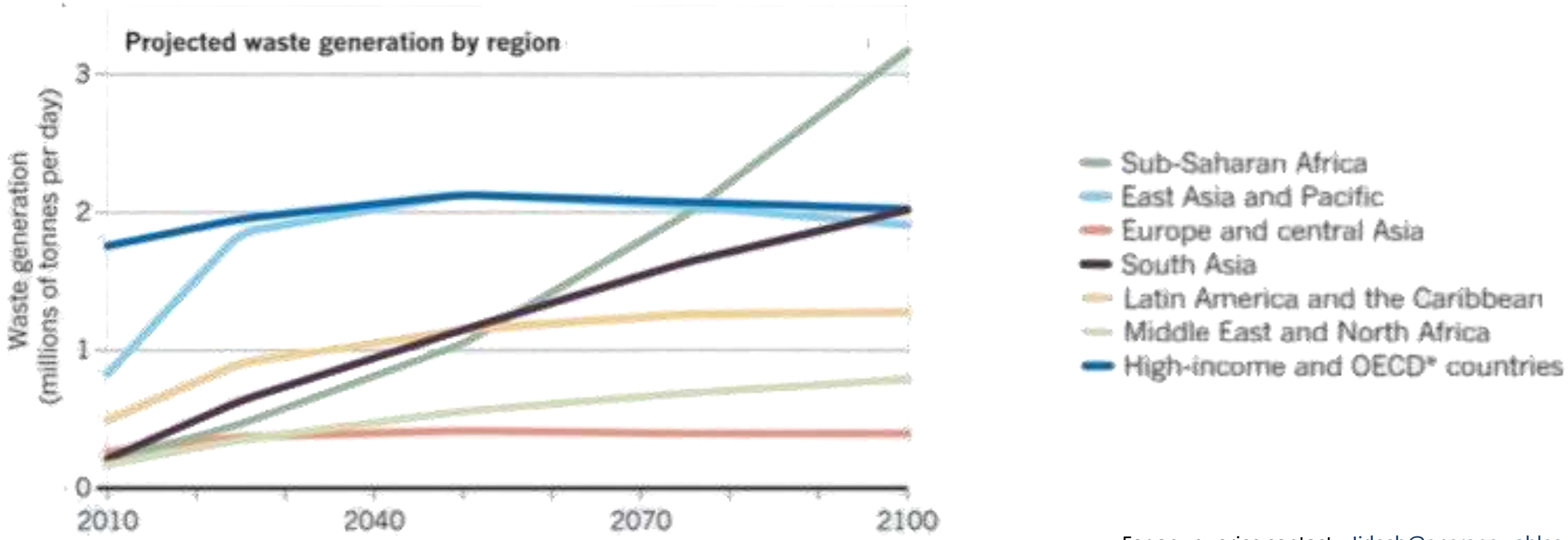
Mavallipura, which is some 30 km from Bengaluru, was once known for its greenery. People residing there were largely dependent on agriculture.

But over a period of time, when the landfill site was identified at Mavallipura to dump Bengaluru's garbage, the soil, water and air got polluted, making the lives of villagers in and around Mavallipura miserable. Around 10 to 12 villages were affected including Mavallipura, Guddadahalli , Jaragbandekaval and other places. There were a few deaths due to garbage that triggered protests. Many villagers suffered from skin allergies, respiratory diseases and other ailments.

Decentralized waste management is the need of the hour

The Future of Waste Management

- **Decentralized WM models** currently account for **<1% market share**. A significant chunk of the **future waste is expected to be processed by decentralized models, especially in emerging economies**
- Global waste expected to grow faster than human population growth | This **growth to come from emerging economies**, which have lower processing %age



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Company Overview

WAMTECH (WAste Management TECHnology) firm based out of Bangalore | Established in 2012 by **IIM, IIT & NIT** graduates

CLIENTELE

ITC HOTELS RESPONSIBLE LUXURY
TAJ Hotels Resorts and Palaces
JW MARRIOTT
Sheraton HOTELS & RESORTS
The Oberoi Group
Philips Foundation
Microsoft
CATERPILLAR FOUNDATION CATERPILLAR
Shapoorji Pallonji
intel
BOSCH
Reliance Industries Limited
SAINT-GOBAIN
Cummins
AKSHAYA PĀTRA

INTERNATIONAL AWARDS

Ashden Sustainable solutions, bet
MIT Technology Review INNOVATORS UNDER 35
The Tech Awards
WWF CLIMATE SOLVER

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What we created – The BioUrja™

- 50-100% Higher Energy Efficiency
  > 140m³ gas/ ton of waste, that's 70KGs LPG eq or 200 units electricity
- Modular and Customizable Design
  > Prefabricated aesthetic components that utilize dead spaces
- Remote Monitoring Suite and Client Dashboards
  > Ensures 99% uptime, minimal human intervention in operations
- 30-50% Lesser Space Requirement
  > 1 ton waste per day processing plant occupies only 49m²
- Lowest Water Usage
  > 100 liters versus 1000 liters/ton of waste in other biogas plants

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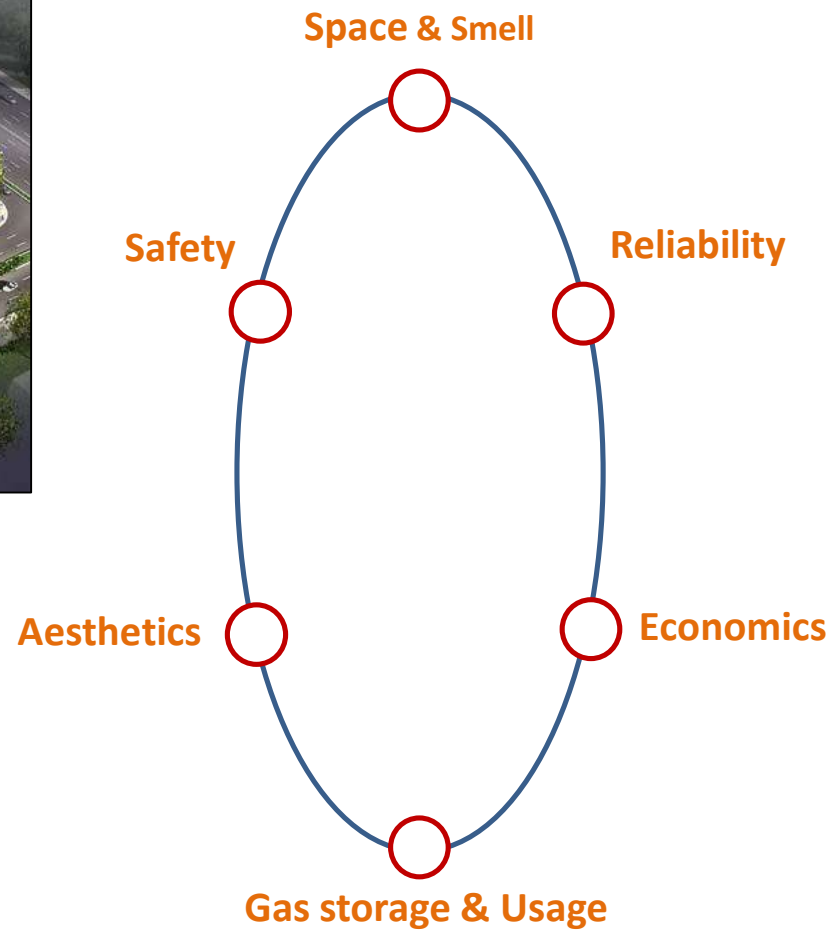
Aerial view of Delhi Aerocity

Dense cluster of Hotels and Commercial Complexes

JW Marriott Delhi - The Problem(s) …

JW Marriott, Aerocity, New Delhi

JW Marriott, New Delhi did not have a single piece of land open to the sky for setting up a biogas plant. – which prevented such an institution from setting up a traditional captive biogas plant



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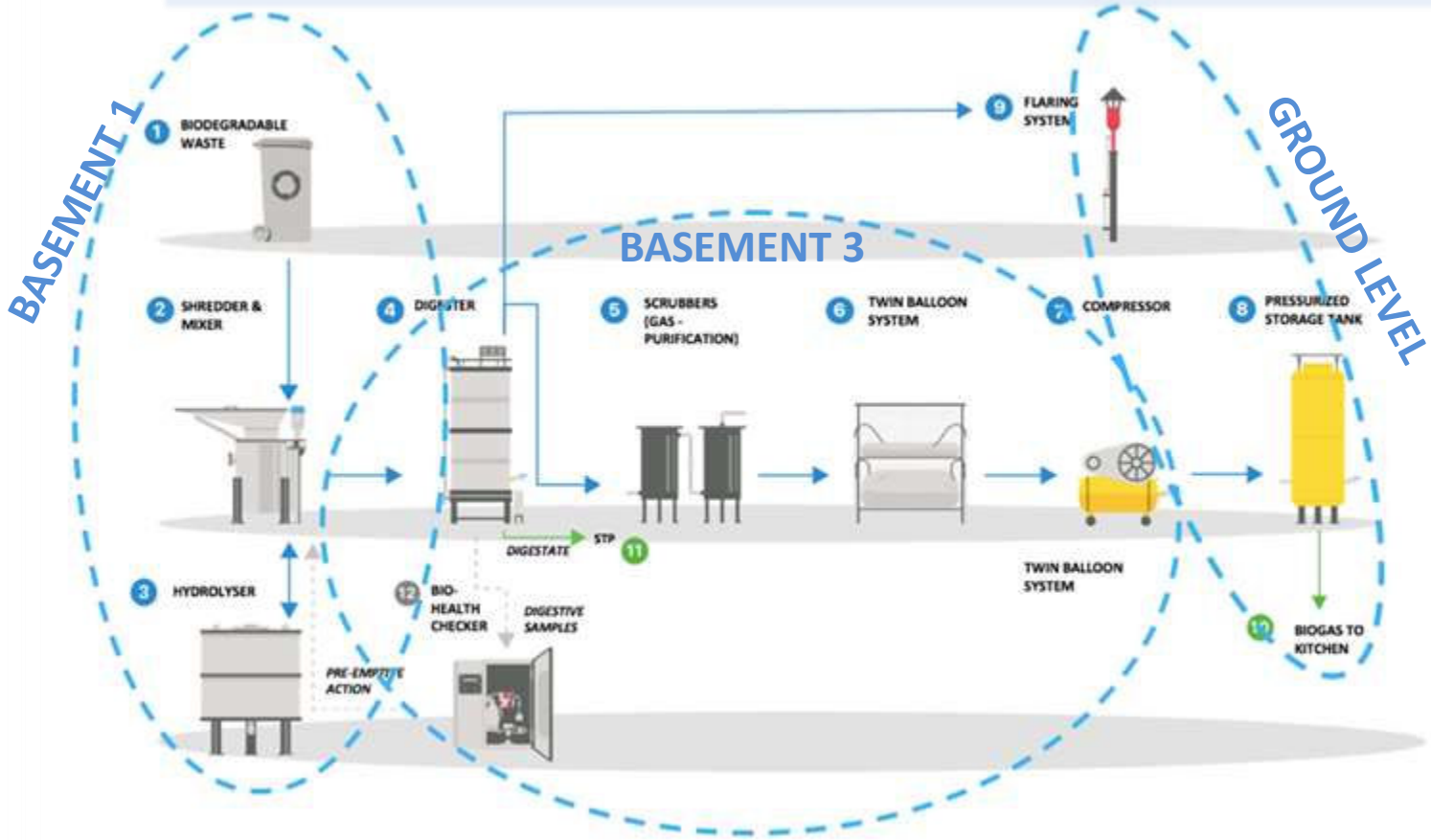
BioUrja: …the Solution…

A state-of-the-art biogas plant with a disruptive layout. In case of JWM Delhi, based on the usable spaces, the plant has been **uniquely spread across 3 floors.** The plant can process 1 ton of food waste per day and replace up to 90 SCMD of PNG with clean fuel via dual fuel burners. The plant pays back for itself in 3-4 years



Space Utilization

i. 28 sqm space in basement 3 with approx. 3.6m height clearance. Digester was site fabricated so that it could be accommodated in the basement

ii. 17.5 sqm space in basement 1

iii. 13 sqm space in ground floor

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JW Marriott Basement 3: Digester & Hydrolyser

28 SqM

JW Marriott ground floor : Storage vessel

13 SqM

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Impact at JWM

Plant cost $55K to set up, will achieve 3 YR payback

Average capacity utilization has been 80%

1st JWM property in the world to have captive biogas

*CO_2 Mitigation has been calculated using IPCC AR5 20YR GWP of Methane
^ All data is pre covid lockdown

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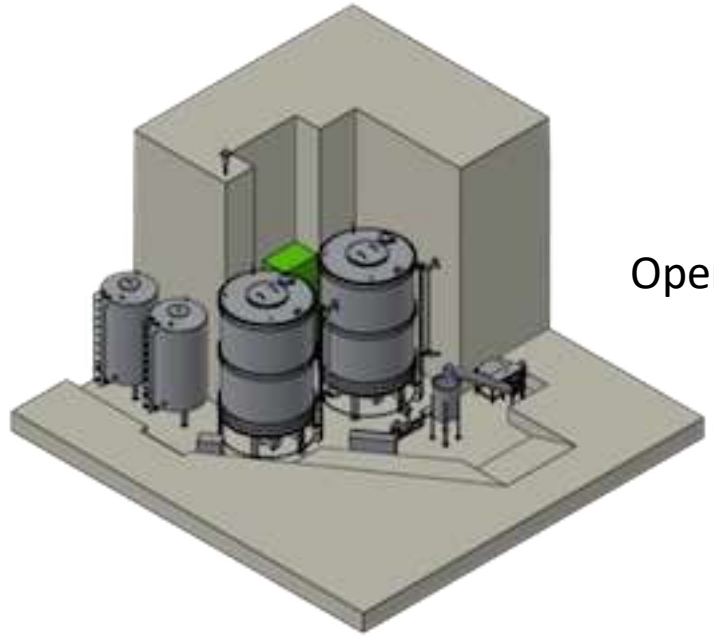
Some more examples where we have led with Modularity

Space Optimization at a Tech Park



Operational from 2015

2 tpd biourja setup @ Infosys, Bangalore (1/7 Infosys Sites)

clockwise from top right:

1) *view from outside of shed housing the plant*
2) *plant 3D layout*
3) *view from inside of shed*

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Distributed layout across 2 floors of ITC Maratha

Operational from 2017

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Case Study 2

- 50-100% Higher Energy Efficiency
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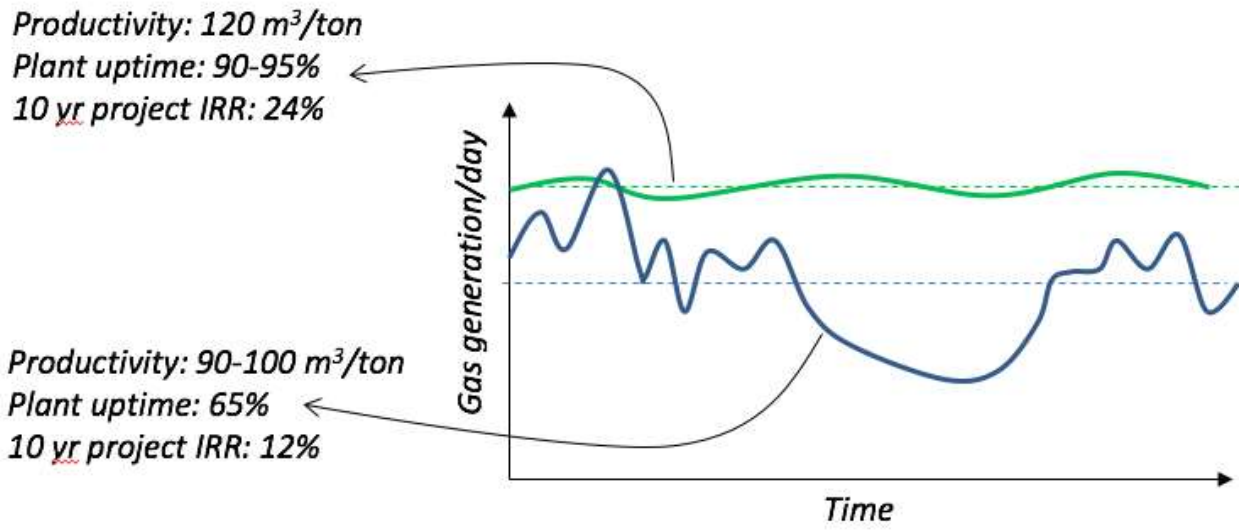
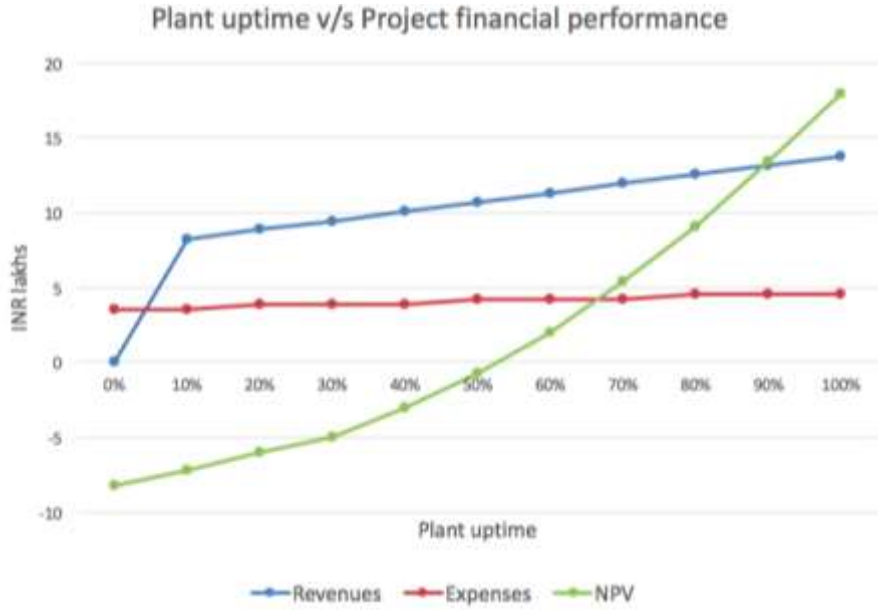
GPS' IoT & AI driven Solution for Plant Health Monitoring

The Reliability Problem

THE NEED FOR BIOMAINTENANCE:

Biogas plants are prone to frequent breakdowns especially in fluctuating conditions. Can ruin project viability if not addressed





CHALLENGES:

- pH is a lagging indicator. Easy to measure, but not of much use
- Gas Chromatography (GC) is an apt health tracking device, but not viable at captive scales (<5TPD)
- Reactive action decision making very people dependant. Prone to human errors

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GPS' Solution to the GC Challenge

- GPS' patented auto-titrator (Bio-health Checker) sits at every BioUrja plant, which can be operated by any unskilled person.
- At the push of a button, the Bio-health Checker performs titration, and automatically emails the titration results to GPS HQ. This data then is fed into a **statistical model**, **which tries to mimic a GC**.
- The model has been built upon years of data from multiple GPS plants and every additional plant added makes the system more robust (network effect)

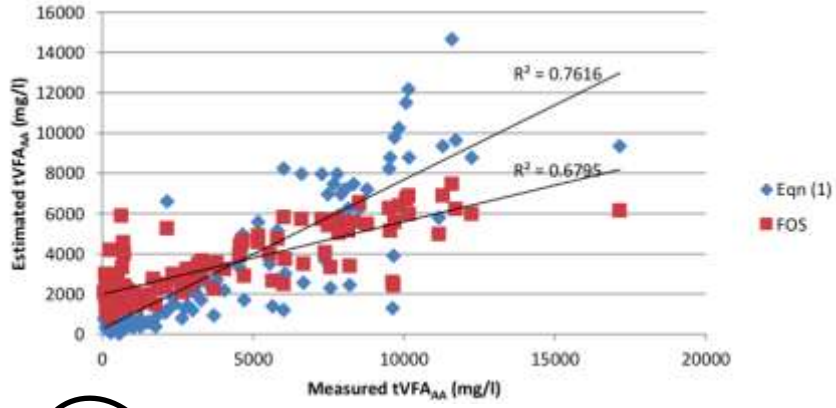
Patented biohealth checker

Titration data

Proprietary biohealth parameter calculator

Regression

Results similar to GC



Sample total VFA estimate v/s actual data

R^2: 0.76, $p < 0.05$

For healthy plants, $R^2 > 0.9$ and $p < 0.05$

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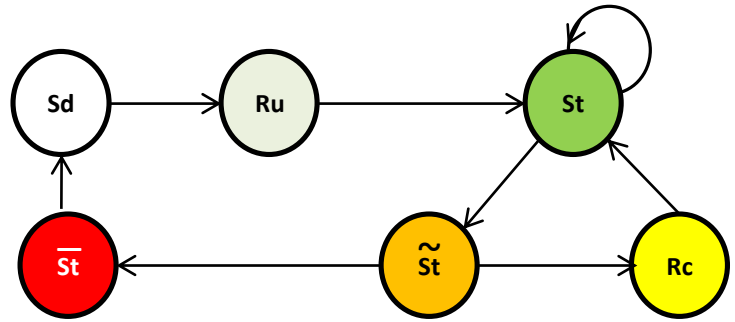
GPS' Solution to the Human Challenge

- Once one has the GC (or GC replica) results, a supervisor (ideally a **biogas expert) needs to decide on the next actions**.
- **Every biogas plant is unique** – which makes monitoring & action decision making extremely challenging. If left to a team of people, the **actions can be non-uniform and prone to human errors**.
- GPS has addressed this problem by creating a **FSM (Finite State Machine) model** of different plant states: Seed (Sd), Ramp-up (Ru), Stable (St), Not so stable (S̃t), Unstable (S̲t) &Recovering (Rc). The plant state movement (and corresponding action) is decided by the BiogasBot

Solution Overview:

- Proprietary FSM model for plant biohealth status (*as shown on the right*)
- Chatbot based next state & corresponding action predictor | Works on local data (plant's own data trends, since every plant is unique) & global data (standard parameters)



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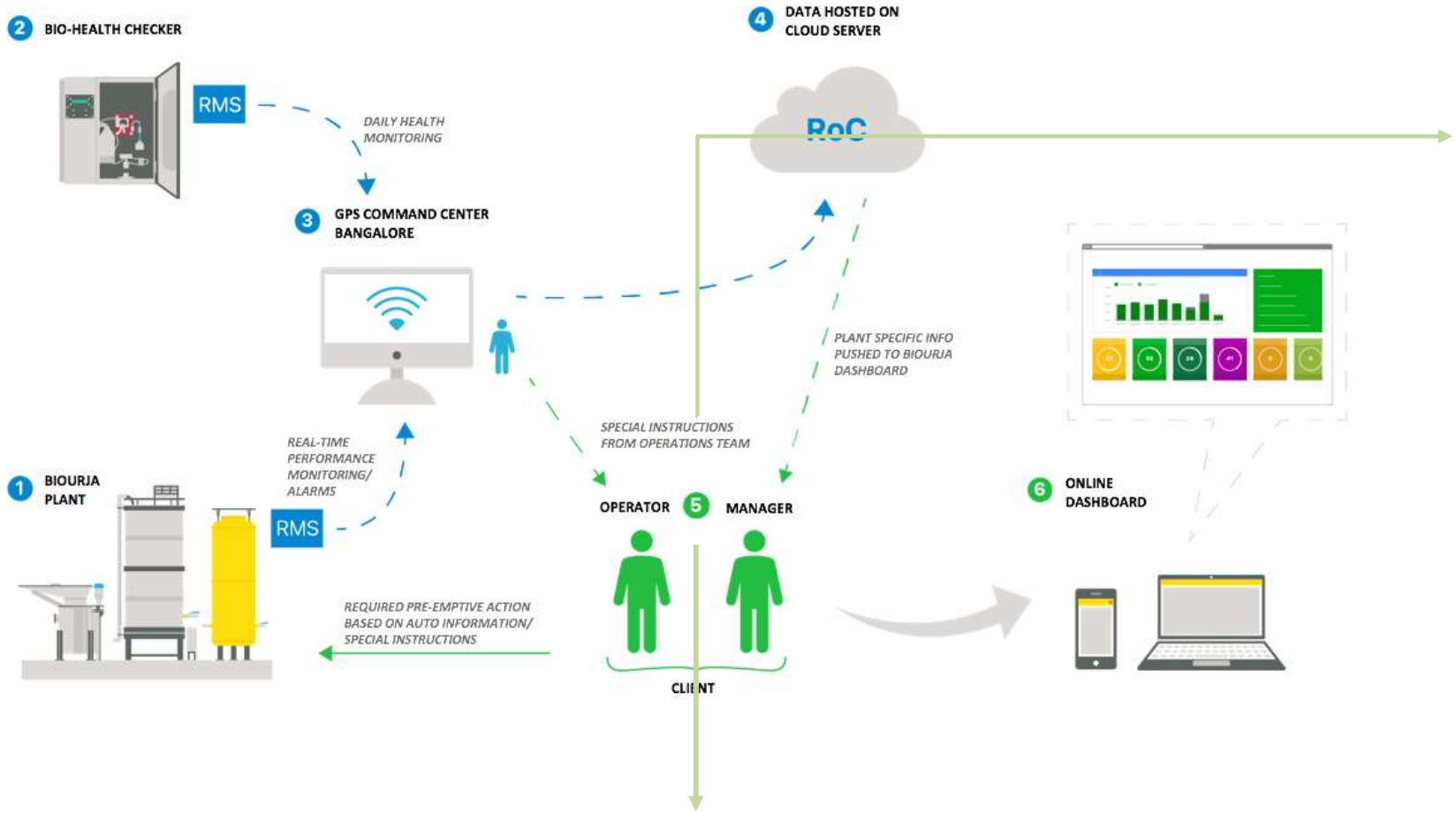
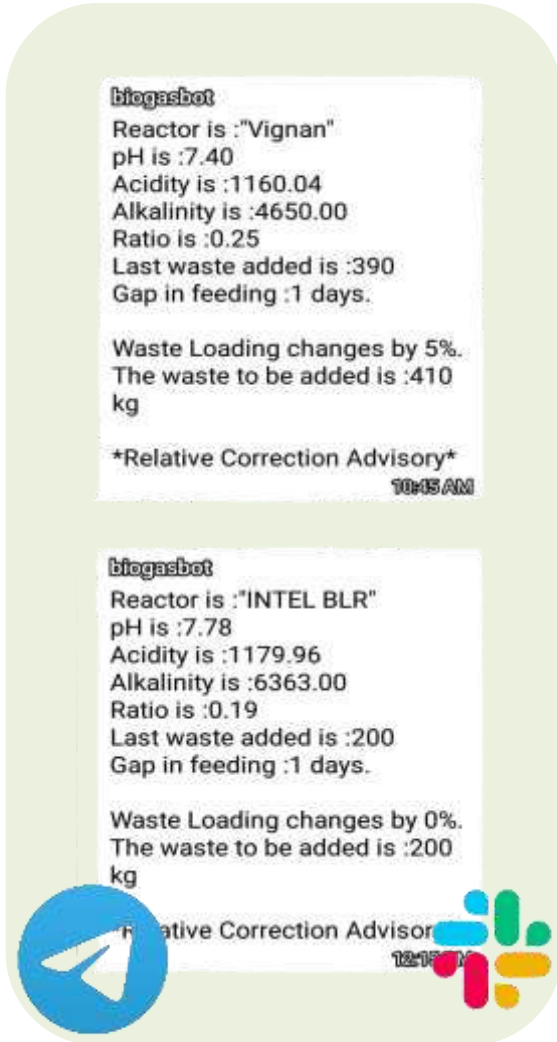
Overview of the RMS System

IoT approach for tracking the health of the plant 24x7 -> Using proprietary statistical models to mimic Gas Chromatography -> And finally letting GPS' in-house developed BiogasBot, to arrive at the apt pre-emptive action and communicate it via chat to reduce human errors





BiogasBot - GPS' Expert System, *which mimics a biogas expert for decision making*

GPS' proprietary backend data platform

Screenshots of GPS' backend data platform, which stores data from all plants, including the Biohealth Checker (titration raw) data as well as data points from other sensors such as pH, temperature, gas flow rate, etc.

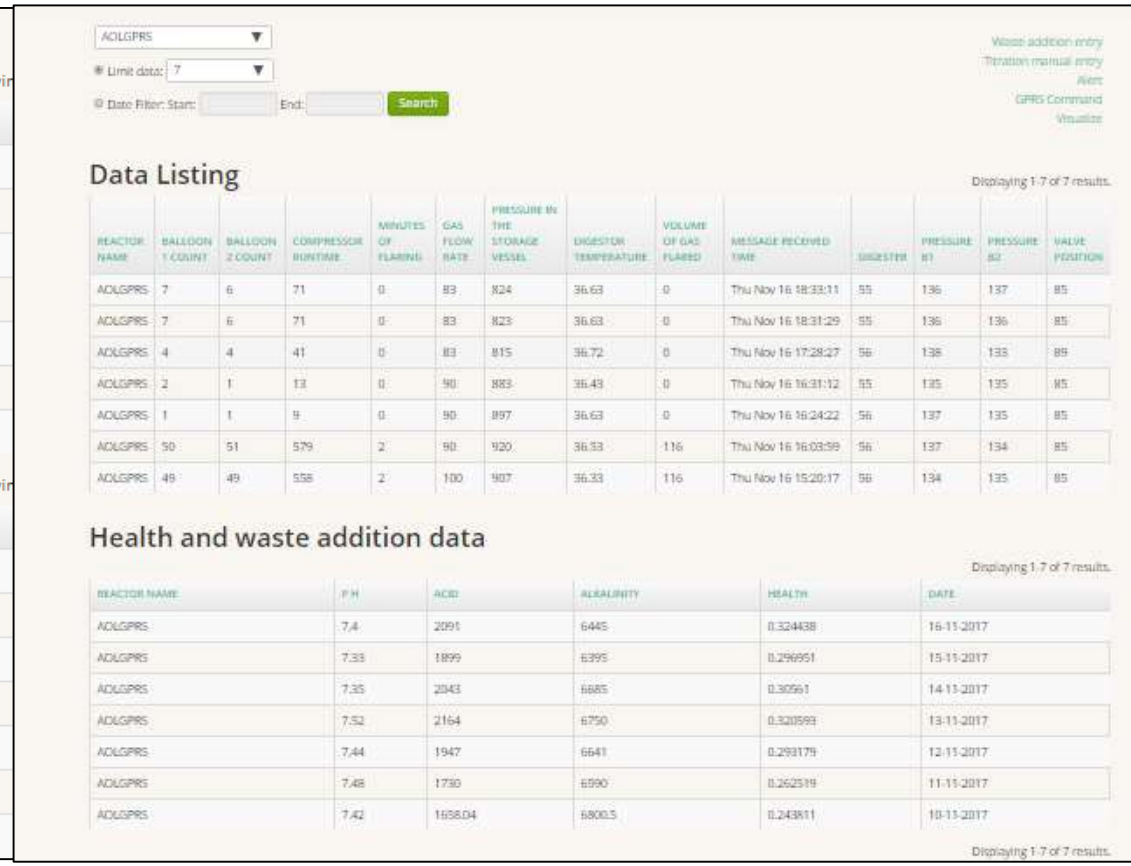
Health and waste addition data

Displayir

REACTOR	P H	ACID	ALKALINITY	HEALTH	DATE
TAJDELHI	7.57	1813.67	9732.38	0.186354	11-12-2018
TAJDELHI	7.69	1915.76	10116.8	0.189365	09-12-2018
TAJDELHI	7.52	2375.16	8563.88	0.277346	08-12-2018
TAJDELHI	7.65	2017.84	8118	0.248564	07-12-2018
TAJDELHI	7.76	2068.89	8963.62	0.23081	06-12-2018
TAJDELHI	7.63	2477.25	7702.88	0.321601	05-12-2018
TAJDELHI	7.77	2222.02	7087.88	0.313497	04-12-2018

Displayir

REACTOR	DATE	WASTE NEEDED	WASTE ADDED	ADDITIONAL INFORMATION	SLURRY	ADDED FROM HYDROLYSER
TAJDELHI	11-12-2018	300	200	Shortage	25	275
TAJDELHI	10-12-2018	300	150	Shortage	25	275
TAJDELHI	09-12-2018	300	150	Shortage	25	275
TAJDELHI	08-12-2018	300	200	Shortage	25	275
TAJDELHI	07-12-2018	300	300	Fed Successfully	25	275
TAJDELHI	06-12-2018	300	150	shortage	25	275
TAJDELHI	05-12-2018	0	0	Maintenance Work	0	0



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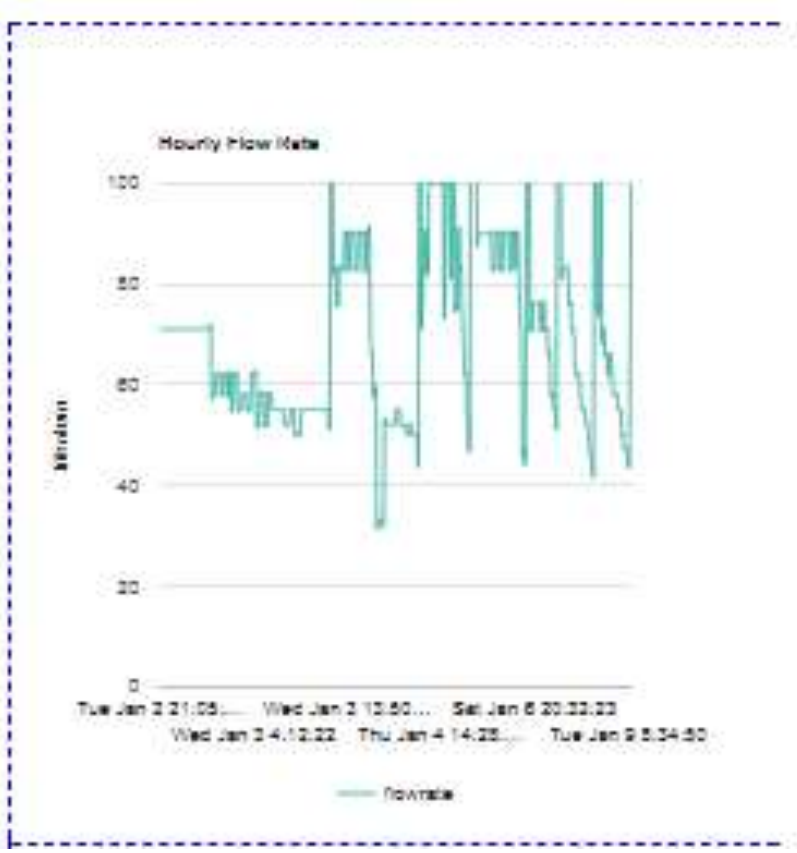
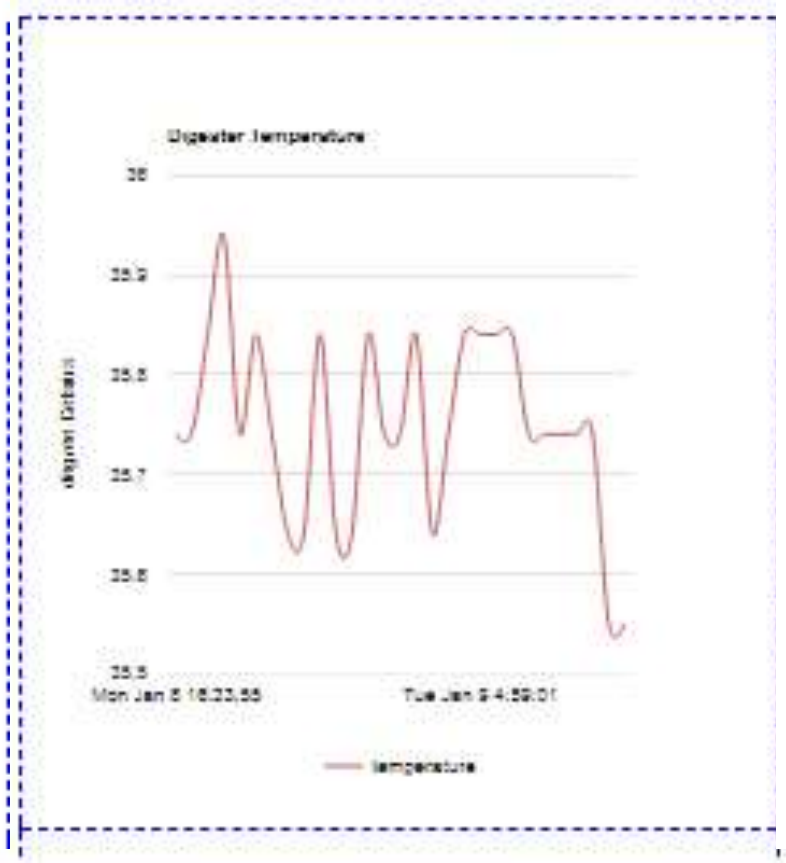
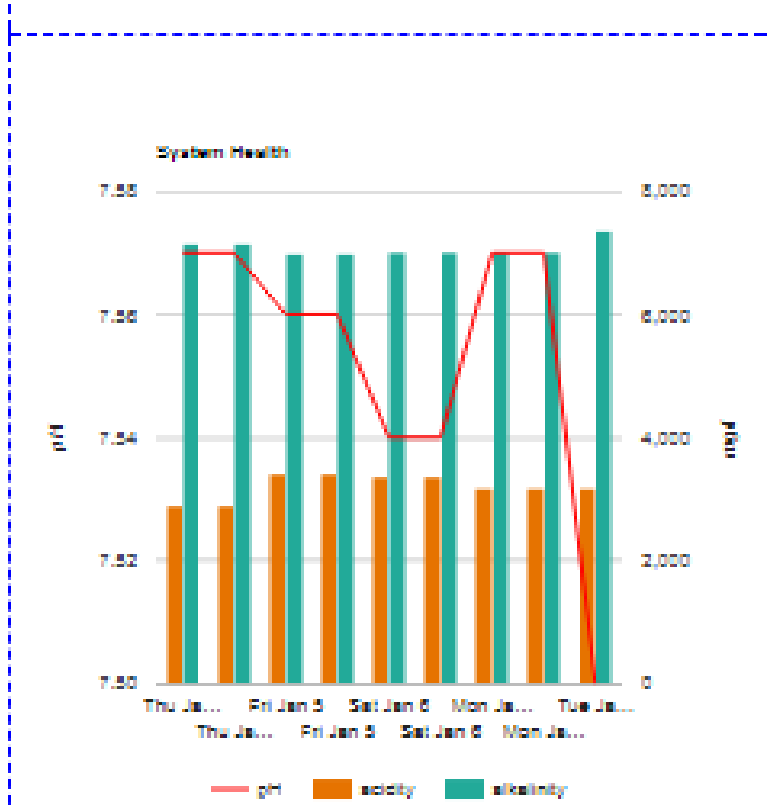
GPS' proprietary backend data platform

Visualize

Reactor Name : AD1GPRS







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RMS is key to scaling captive biogas plants and makes even small 100 KPD plants viable and scalable across geographies and creates a Network Effect

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Investment in cloud based RMS systems have led to minimal disruption of our plants even in the midst of a 2 month lockdown in India on account of COVID19

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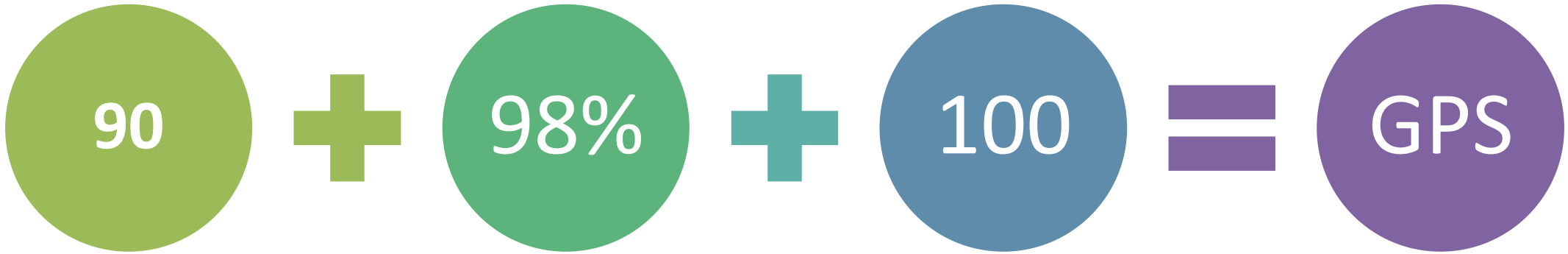
Where we are today



Biogas Installations in India, Sri Lanka and Bangladesh

Uptime in operations since 2014

Tons per day of waste processed

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Impact Potential

Methane Emission	➢ **75%** of organic waste is openly dumped in South Asia, leading to high methane emissions
Waste Generation	➢ India already generates **40 Mn Tons** of Organic Waste per year and civic infrastructure is unable to cope
Energy Substitution	➢ Can replace fossil fuel based LPG and coal based electricity at meaningful scale to be a viable urban fuel source

Key Trends

Regulation	➢ Solid Waste Management Rules 2016 in India mandate in-situ processing of waste by bulk waste generators. This is a trend across South & South East Asia
Carbon Pledges	➢ From Microsoft to Google, many global firms are driving the carbon neutral pledge and we see captive biogas as a key component to deliver that
COVID	➢ From wanting to create minimal contact self reliant facilities to enabling a green recovery, we believe that COVID could give a fillip to captive biogas

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THANK YOU

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