USBI BIOCHAR 2018

Development of a CHAB+CHP Faecal Sludge Treatment Pyrolysis Unit

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Agenda

- Biomass Controls background
- Global sanitation situation and market opportunity
- The Biogenic Refinery solution
- Meeting International Standards requirements
- The CHP development process and solution

Background

Berta Moya

- Biochemical and environmental engineer, expert in resource recovery from biological residues.
- Four years experience in the sanitation sector, recently completed a PhD in resource recovery from human excreta, in particular nutrient recovery and fertiliser production.

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- Experience with biochar batch and continuous fed systems since 2010
- Feedstock experience includes: slash, agricultural residues, cardboard, manure, cord wood, human solid waste, and municipal organic waste.
- Bringing the vision of the Circular Economy into reality with human-centered innovations that harness the potential of waste streams by generating energy, clean water and biochar products.

Global Sanitation Coverage

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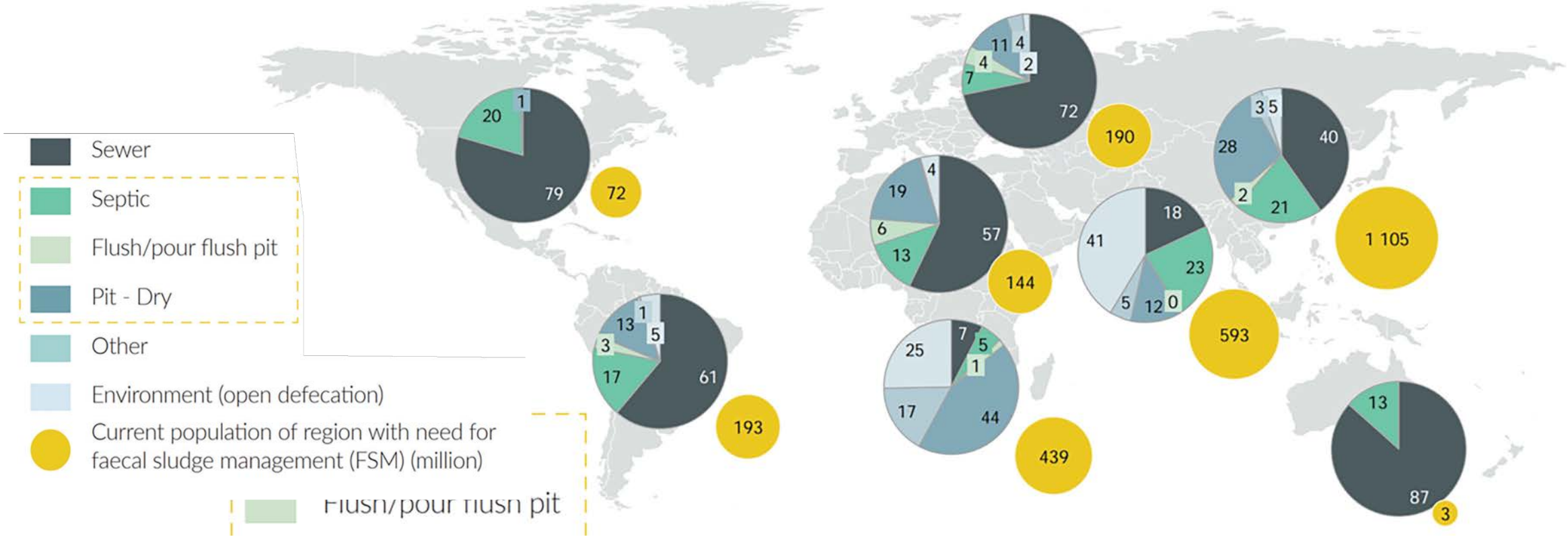
Population (%) served by different types of sanitation systems



Source: Cairns-Smith et al. (2014, Fig. 8, p. 25, based on data from WHO/UNICEF JMP). Courtesy of The Boston Consulting Group.

Innovative Sanitation Market

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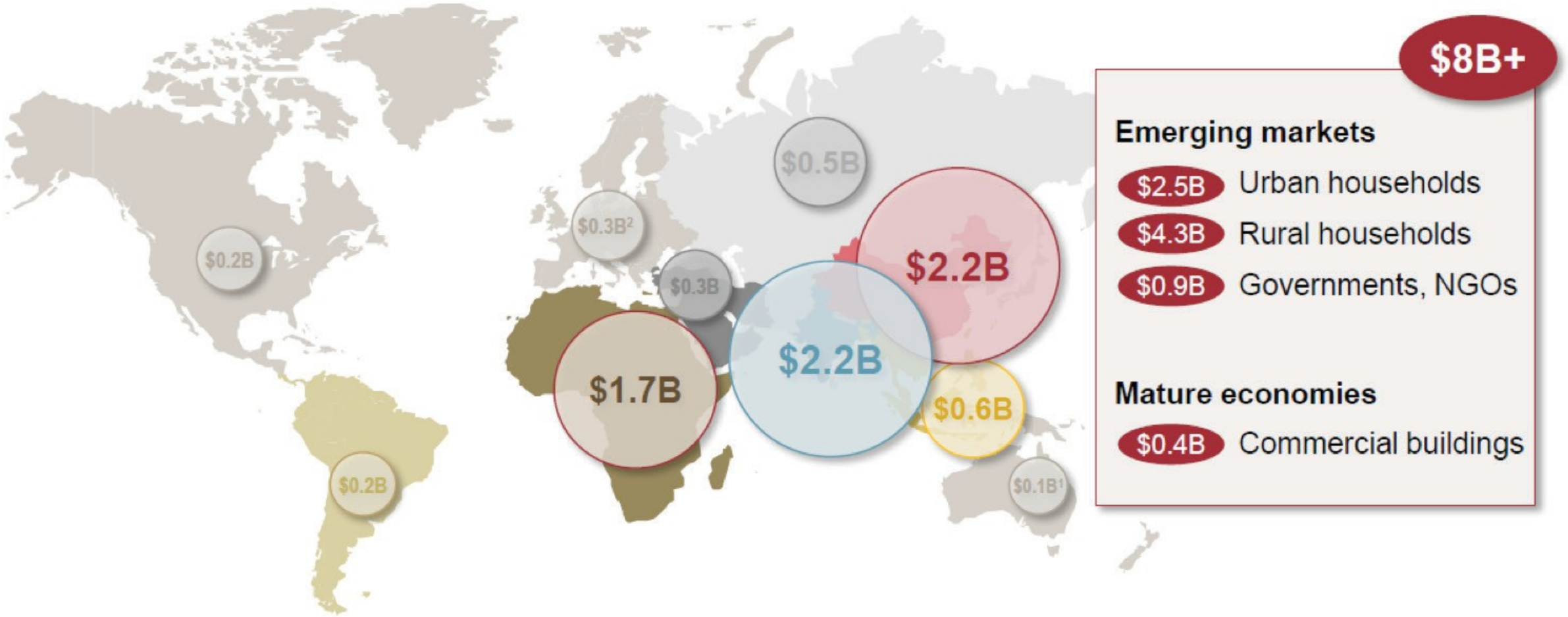

$8B+

Emerging markets

- $2.5B Urban households
- $4.3B Rural households
- $0.9B Governments, NGOs

Mature economies

- $0.4B Commercial buildings

Opportunity of Biochar Production

2.7 billion people worldwide need faecal sludge management solutions

350 600 tons of sludge per day

1528 mega tons of sludge per year

▶

90 mega tons of sludge per year on a dry basis

▶

27 mega tons of biochar (30% conversion) could fill Madison Square Gardens 7 times

18 megatons of biochar (20% conversion)

9 megatons of biochar (10% conversion)

Biomass Controls, LLC

Biogenic Refinery

- **Input:** max. 80% moisture
- **Process:** pyrolysis
- **Outputs:** biochar, heat, electricity
- **Operation:** decentralised, off-grid (2019)
- **Communities:** from 450-35,000 users
- **Location:** from Alaska to India

Biogenic Refinery – Intro

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Inputs

- Faecal matter
- Manures
- Agricultural residues
- Municipal sludges

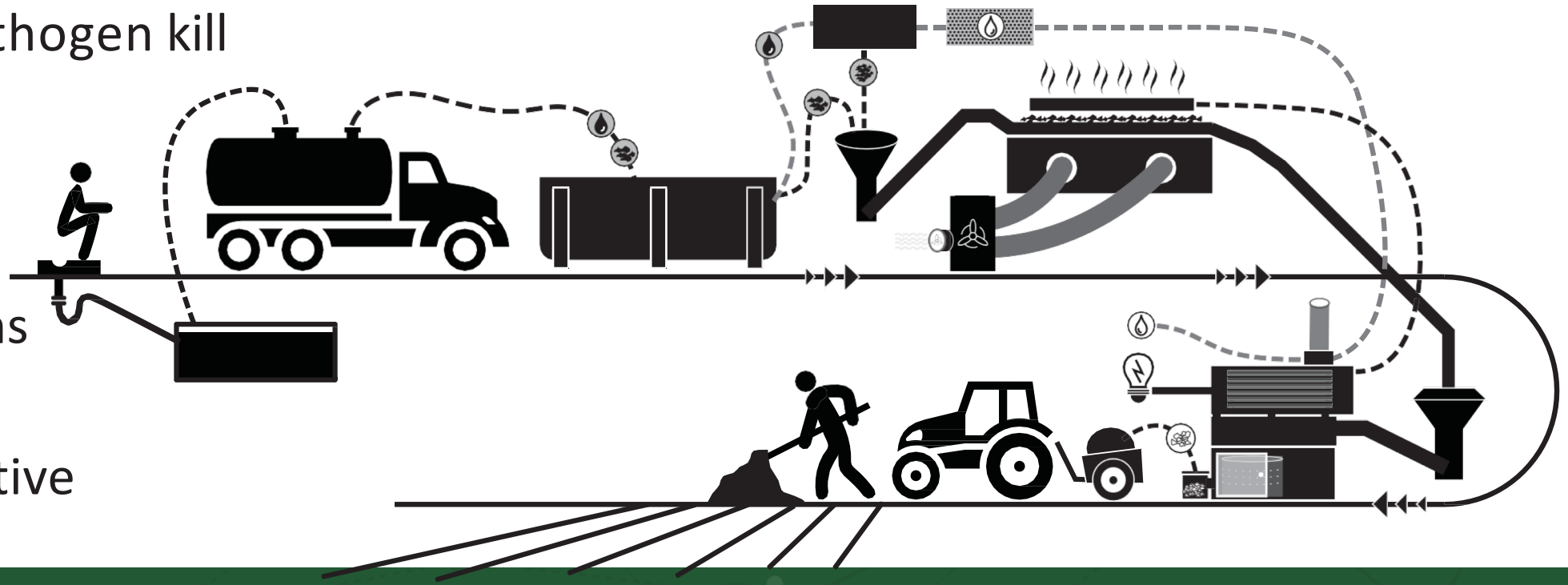
Biogenic Refinery – India

Biogenic Refinery – Alaska

ISO/PC 318 – currently under review

OFF-SITE

- Communal scale
- Complete pathogen kill
- Emissions quality
- Output concentrations
- Energy neutral / positive



Energy independence requirement:

- "… able to perform the intended functions of the treatment unit relying exclusively on energy from its defined input (3.1.3) 228 during steady state operation."

Source: IWA 28:2018, Draft 3

Energy independence is declared through the following steps:

1. Defined Inputs (design/max/min)
2. Operational electrical requirements, EFSP
3. Energy output, E_{out}
4. Energy independence, $E_{ind} = E_{out} - E_{FSP} \geq 0$

Combining CHAB and CHP

- "Micro-CHP" treatment unit proven feasible in practice.
- ORC is an appropriate, commercially available energy recovery technology.
- Sufficient electrical energy is generated to run entire system, in compliance with ISO PC318 Energy Independence.

Biogenic Refinery

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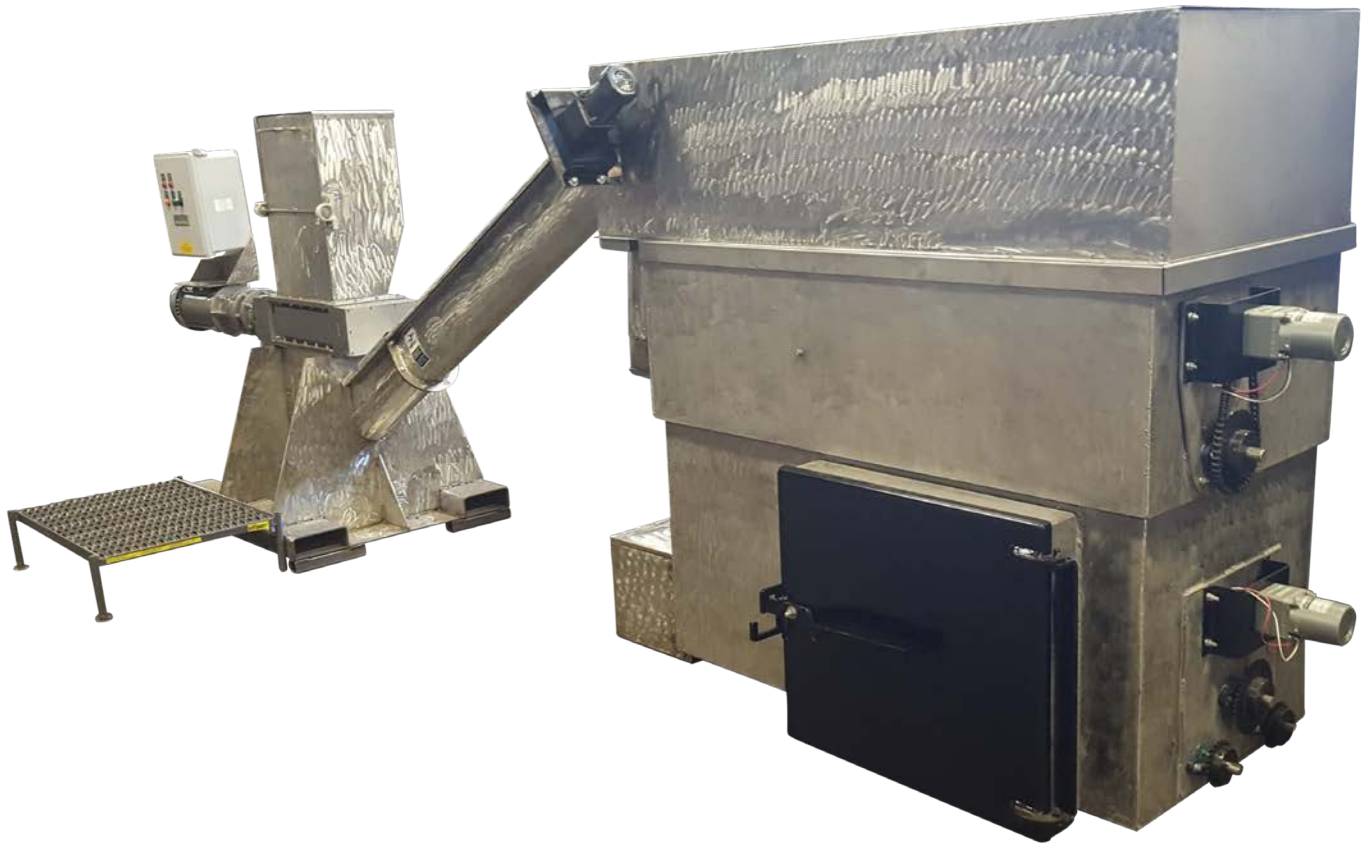

Biogenic Refinery

Energy Recovery

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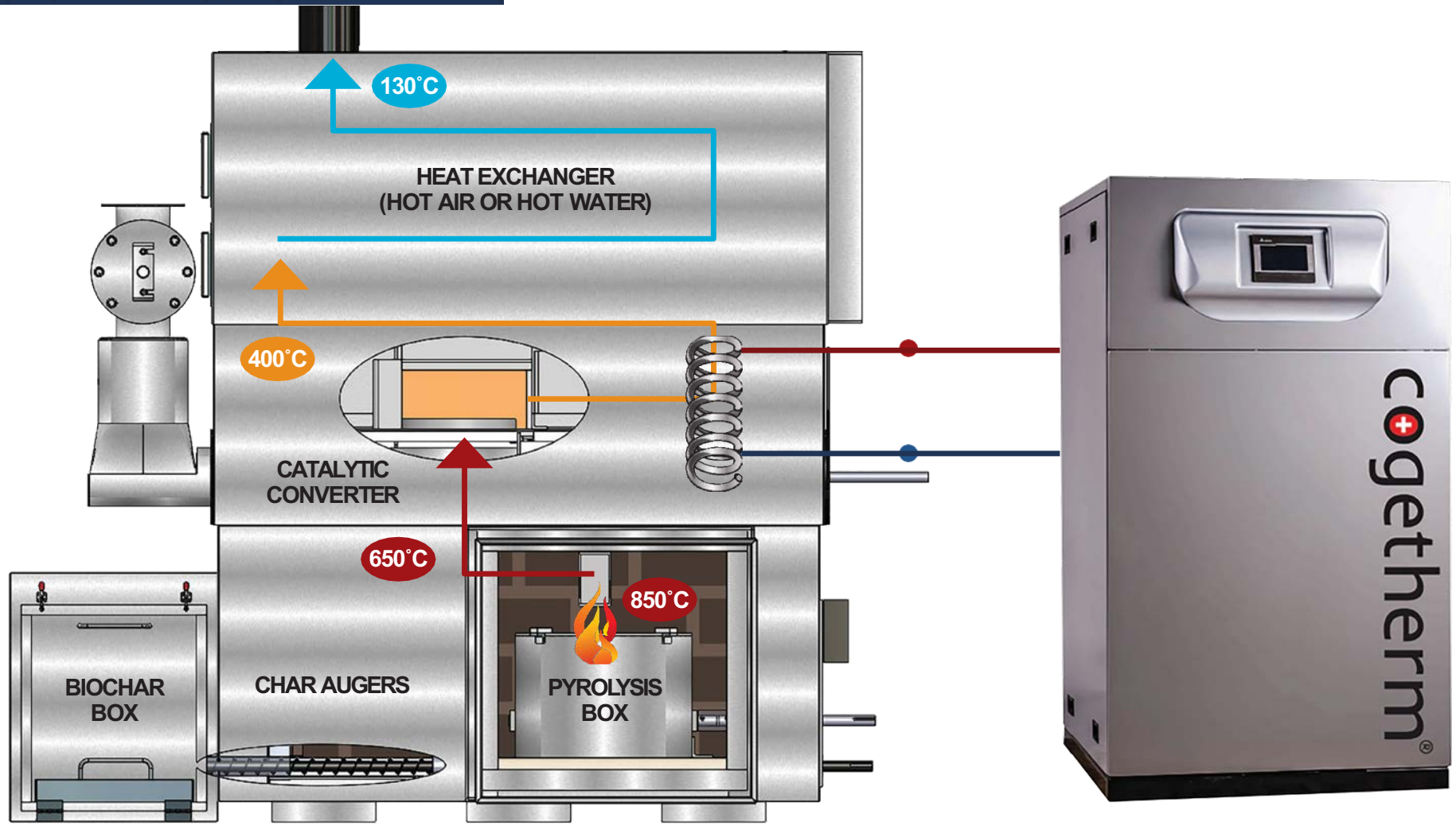

Biogenic Refinery KPIs

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Key Performance Indicators

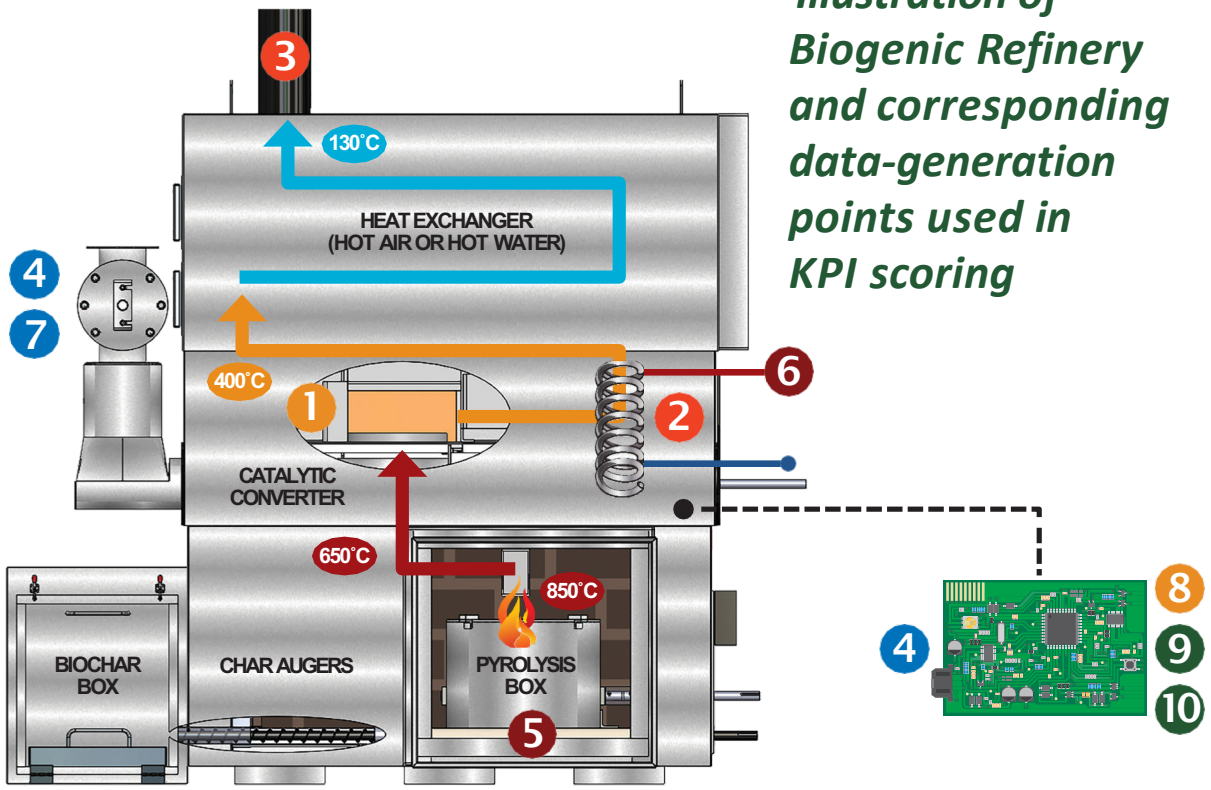

Illustration of Biogenic Refinery and corresponding data-generation points used in KPI scoring

KPI NO.	KPI NAME	KPI UNIT	INDICATOR PURPOSE
1	Start-up Time	minutes	Reduction of start-up emissions
2	Water Temperature	˚C	Increased thermal control; thermal efficiency; reduction of emissions
3	Gas Temperature	˚C	Condensation flag; catalyst performance; reduction of emissions
4	Air/Fuel Ratio	Ratio	Increased thermal chemical efficiency; reduction of emissions; failure flag
5	Thermal Generation	kW	Operational efficiency; sub-optimal operational specification flag
6	Thermal Efficiency	%	Operational efficiency; sub-optimal operational specification flag; electricity generation potential
7	Fuel Rate	%max	Operational efficiency; sub-optimal operational specification flag
8	Run Time	hours	Reliability indicator; failure flag
9	Electricity Consumption	kW	Operational efficiency; sub-optimal operational specification flag
10	Electricity Generation	kW	Performance indicator; system failure flag

Biogenic Refinery – Data Collection

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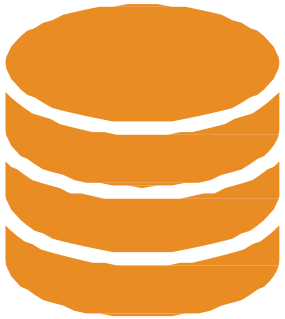
Sensors

- Temperature (air and water)
- Oxygen levels
- Flow rates
- Power usage

Database and kelv°n



- MySQL relational cloud database
- Real-time data access
- Web and mobile app, kelv°n: https://kelvinapp.io/

Biogenic Refinery – Data Collection

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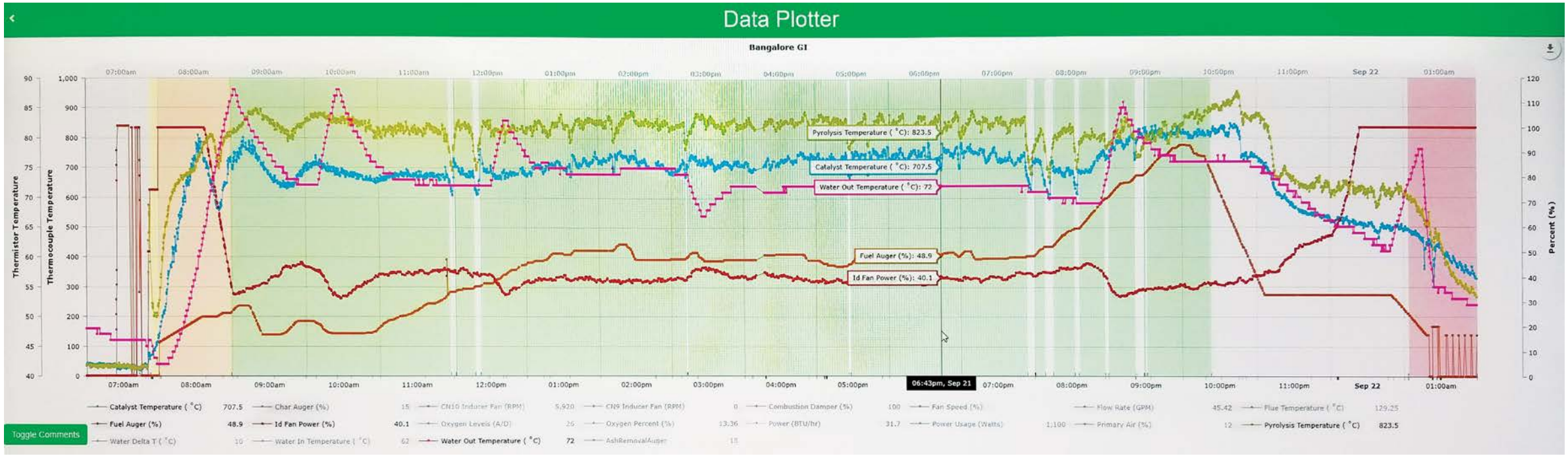

Next Steps

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- Field testing of CHAB+CHP unit in India
- Biogenic Refinery 4018 is used as demonstration Omni-Processor
- Characterise Biogenic Refinery biochar from faecal sludge produced under different operating conditions
- Determine the best applications for Biogenic Refinery biochar

Thank you!

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