Pi GREEN
INNOVATIONS PVT. LTD.

Pi Green Innovations

- Patented “Filterless Technology” for PM reduction at source and from ambient air.
- Patent in over 30 countries including India, USA, UK, European Union, China and Singapore with positive Patent Cooperation Treaty (PCT) in 152 countries
- Product: Retrofit for DG sets (RECD), Ambient Air Purifier and Customized solutions
- Pipeline: After Treatment solutions for Industrial Boiler, Crematoriums and Retrofit for Heavy Transport Vehicles (HTV).

2016

First Prototype developed

2018

Seed capital

Product development

Pi Green wins the Smogathon, Poland

2019

Angel Investment

WWF Climate Solver Award
UNDP Air Pollution Solution Challenge Award

2020

ISO 8178 D2 5 mode cycle test done at ARAI

Pi Green enters the DG set retrofit market

2021

Patents granted in Singapore and EU.

Pi Green raises $4.5 Mn in series A round led by Opus Group

2022-23

Patent for India received.

Partnership with Cummins India, Caterpillar India Pvt Ltd, Sudhir Power Sterling Gensets, Kohler

Pi Green Innovations

Filterless Technology patented in over 30 countries






Awards and Accolades

UNDP

Smogathon

WWF

ACT Grants

Problem Statement

> US$ 150 Billion

Economic cost of air pollution to the Indian economy *

5.9% of GDP

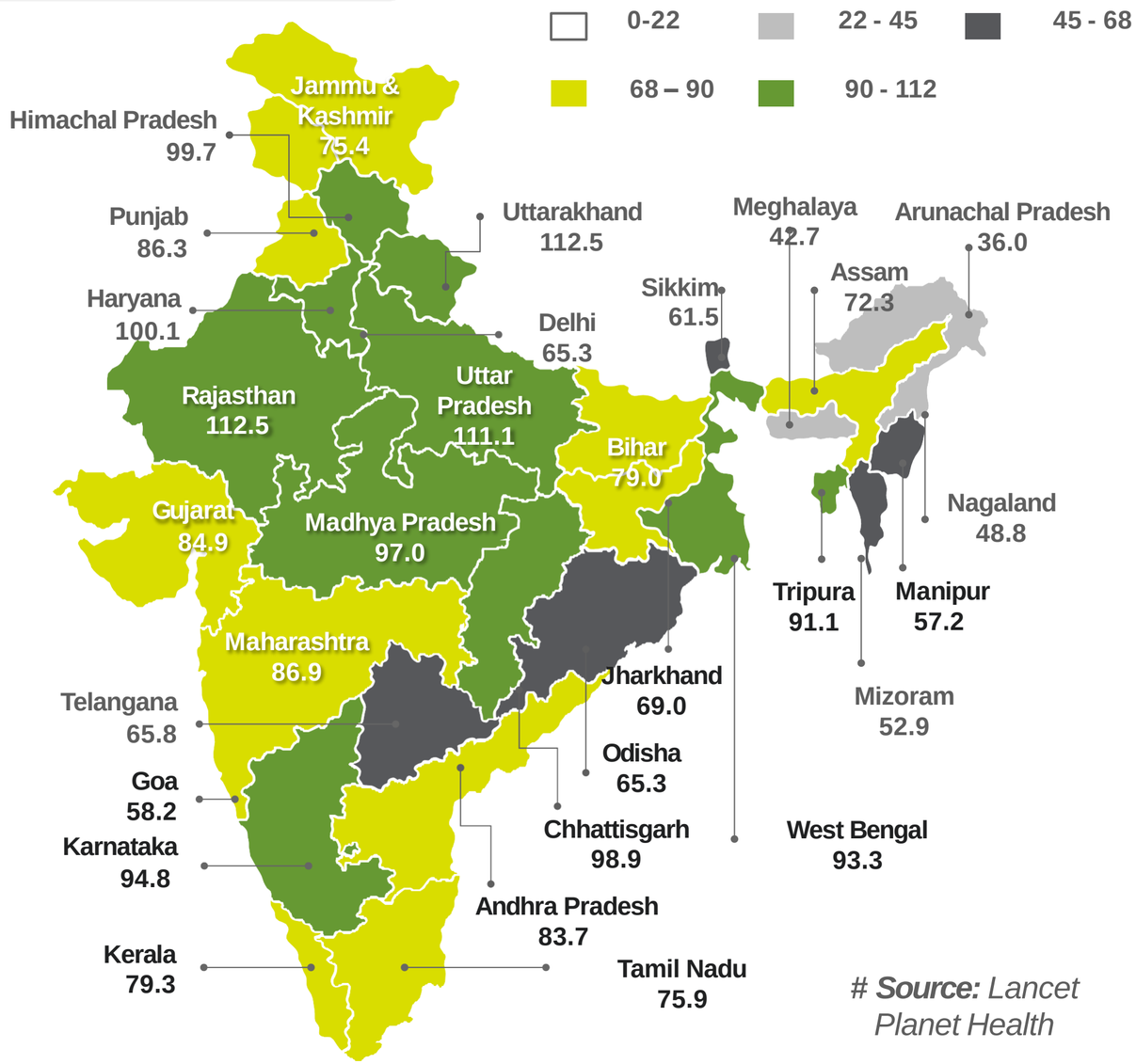
Level of Morbidity & Mortality has costed the Indian economy *

97%

Population exposed to Particulate Matter in excess of WHO specified air quality levels.

 # Deaths per 100,000 due to Air Pollution in 2017

Figure 2: Deaths per 100,000 in India due to Air Pollution in 2017



*# **Source:** Lancet Planet Health*

** Source: Finding Solutions to Air Pollution in India: The Role of Policy, Finance, and Communities - ORF Special Report No. 120, September 2020, Observer Research Foundation.*

Current Scenario

Enough damage is done to the environment.

Globally over 7 million air pollution related deaths every year.

What We Do

We innovate, improvise and resolve various air pollution problems by reducing PM from sources such as DG sets, Boilers, crematoriums, Jaggery Processing units etc as well as from Ambient air.

Thus, contribute significantly toward a cleaner, greener future.

How We Do It

How does the Carbon Cutter Work

1 Carbon Cutter Machine (CCM) is installed after the source Exhaust.

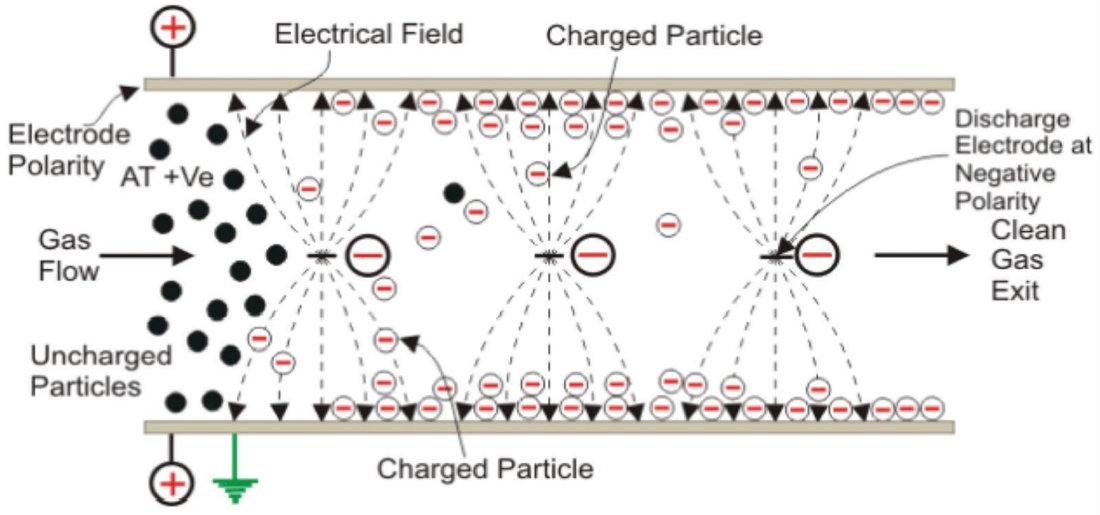
2 Flue gas enters the CCM and is confronted with Corona discharge in the ESP module.

3 PM acquires surface charge and enables it to be migrated & agglomerate on the collection surface

4 Patented automatic cleaning solution takes away the agglomerated PM and is collected in powder form.

5 Pi Green device separates dry soot in a collection bin that has to be collected periodically

6 Dry Sooth used as raw materials for Ink/ Paint industry



Single Stage ESP Model

Applications

- Industrial Boiler
- Heavy Vehicles
- Crematoriums
- Jaggery Processing Units
- Net Zero Machine

BEFORE | AFTER

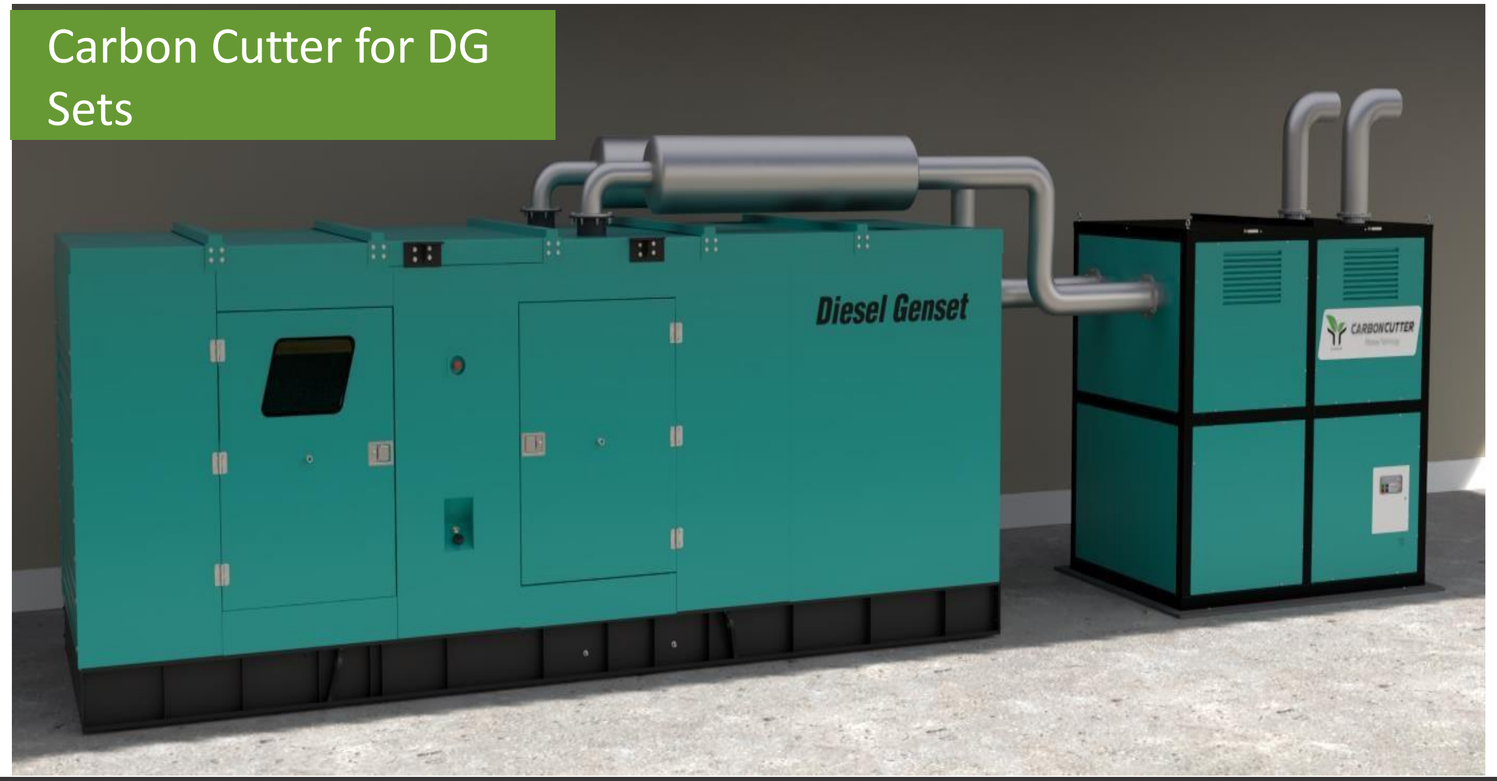
Carbon Cutter for Diesel Generators- **Pollution at Source**

National Green Tribunal Order- 681/2018

*"For DG Sets already operational, ensure usage of either of the two options: (a) use of **retrofitted emission control equipment** having a minimum specified PM capturing efficiency of at least 70%, type approved by one of the 5 CPCB recognized labs; or (b) shifting to gas-based generators by employing new gas-based generators or retrofitting the existing DG sets for partial gas usage."*

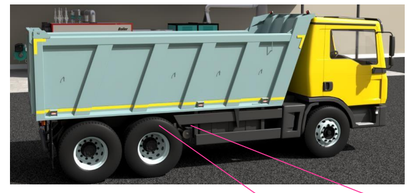
State Pollution Control Boards' Notifications

1. Tamil Nadu
2. Karnataka
3. Andhra Pradesh
4. Kerala
5. Goa
6. Gujarat
7. Haryana
8. Delhi
9. Jammu & Kashmir
10. Maharashtra



Our Products

Carbon Cutter for DG Sets



Carbon Cutter for Heavy Vehicles

Carbon Cutter for Boilers

RepAir- Ambient Air-Purifier

Applications

Carbon Cutter
Retrofit for DG sets (RECD)

Product tested with Automotive Research Association of India, ARAI, Pune and International Centre for Automotive Testing (ICAT), Manesar.

Design capability
125kVA- 10,000kVa.

Over 400 installations completed successfully.
Installations in 8 states in India.

Type Approval Certification- Status as on Aug’23

Sr. No	Type Approval Certificate	Date of Issue	Range Covered (kVA)	CPCB-1	CPCB-2	Class
1	ARAI/MoEF/RECDTA/PGIPL-R1/2022-01	4th Nov 2022	225-320	WIP	COMPLETED	I
2	ARAI/MoEF/RECDTA/PGIPL-R2/2023-02	8th May 2023	330-500	COMPLETED	COMPLETED	I
3	ARAI/MoEF/RECDTA/PGIPL-R3/2023-04	31st July 2023	350-910	WIP	COMPLETED	I

Key Highlights

1. Only RECD manufacturer in India to have covered all DG sets **from 225kvA to 910kVA CPCB-2**.
2. Only RECD manufacturer in India to have **CLASS-1** RECD certification.
3. No increase in secondary emission.
4. Least **backpressure** across RECD of less than 1 kpA.

Competitive Advantage vs Conventional Solutions- DG Retrofits

Parameter	Pi Green Carbon Cutter	Diesel Oxidation Catalyst (DOC)+ Partial Flow Filter or Partial Oxidation Catalyst	DOC+ Diesel Particulate Filter	Water Scrubber
PM capturing efficiency	80%-90%	60%-75%	>90%	NA
Operational Cost	Negligible	Moderate (Fuel penalty due to backpressure)	High (Fuel penalty due to backpressure)	Moderate to High (Wash fluid and chemical requirement)
Impact on Engine	Negligible and control parameter	Variable backpressure (>25kpa)	Variable backpressure (>35kpa)	Backpressure due to High energy
Ease of Maintenance	Ease to service	Non serviceable	Ash Cleaning soot removal	complex and requires frequent cleaning.
Robustness to exhaust challenges	Yes	No	No	Probably yes

CRITERIA/PARAMETERS	CARBON CUTTER RECD	CONVENTIONAL AFTERTREATMENT SYSTEM	ADVANTAGE TO THE CUSTOMER
EXHAUST BACK PRESSURE	LOWEST POSSIBLE AND CONSTANT (0.3-1.5 kPA)	VARIABLE – CAN REACH 20+kPA WITH SOOT LOADED SYSTEM	NO IMPACT ON FUEL ECONOMY NO ENGINE RELEAIBLITY ISSUES
CHEMICAL AGING	NO CHEMICALS USED HENCE DOES NOT AGE AT ALL	HYDROTHERMAL AGING REDUCES PM REGENERATION EFFICACY	PRODUCT LONGEVITY AND CONSISTENT EFFICIENCY OVER LIFE
ENERGY EFFICIENCY	VERY LOW POWER CONSUMPTION (ELECTRICAL)	FUEL PENAULTY DUE TO BACK PRESSURE AND REGENRATION	LOW LIFE CYCLE COST
ROBUSTNESS	OPEN FLOW SYSTEM AND CAN CATER WIDER SOOT CHALLENGE RATES	SIGNIFICANT FLUE GAS CHALLENGE (filter) FOR CAPTURE AND SOOT REGENERATION	WORRY FREE OPERATION AND MAINTENANCE
FAILURE MODES	ROBUST FOR VARIETY OF DUTY CYCLES. NO SUSCIPTIBLE COMPONENT	DPF/PFF CRACKING IS PRIMARY AND FREQUENT FAILURE MODE FOR PASSIVE SYSTEMS	NO DOWNTIME AND LOW MAINTENANCE COST
DIAGNOSTICS	FULL AUTHORITY DIAGNOSTICS AND PROGNOSYS WITH TELEMATICS	BASIC DIAGNOSTICS FUNCTIONALITY	Pi GREEN MONITORS HEALTH OF RECD CONTINEOUSELY WITH PROMPT SERVICE IF REQUIRED
VALUE FOR MONEY	LONG TERM AND WORRY-FREE SOLUTION	REQUIRES CONSTANT MAINTENANCE AND SERVICE WITH INDIRECT OPERATIONAL COST PENAULTY	A WISE INVESTMENT THAT WILL COMPLY FOR 10-15 YEARS AT NO HIDDEN COST. LOW OVERALL TCO

Regeneration- Necessary Evil for DPF

Combustion of engine oil and fuel additives in the combustion chambers leads to accumulation of ash in DPF.

Stop and go operation or low load operation will result in accumulation of soot as compared to high load operation resulting in incremental backpressure on the engine.

To limit the excessive backpressure a capable ACTIVE regeneration system is required.

Such active regeneration results fuel injection in the exhaust assembly which further passed through the DOC to generate heat resulting in fuel penalty.

Fuel oxidizes in DOC and leads to increase of heat in DPF, but for active regeneration to be effective, temperature of a minimum of 550 degree C is required which the engine does not generate even at FULL LOAD.

Even if this temperature is achieved (theoretically) will result in cleaning the DPF of PM but metal oxides (ASH) cannot be regenerated. It has to be removed physically by using ultrasound based enzyme bath or in some cases by reverse blowing the DPF.

At 40% blockage, DPF must be cleaned (means downtime to the engine or after treatment system).

Regeneration- Necessary Evil for DPF

At lower load, there is not adequate temperature post exhaust muffler to kick in passive regeneration.
High backpressure results in Power deration, fuel penalty and engine reliability issues.
Passive regeneration can be executed @ minimum 280- 450 degree at DOC with Nitrogen Oxide and Nitrogen Dioxide.
Equilibrium or Continuous Regenerative Trap (CRT which is a feature of the competition) rate of challenge due to soot and rate of regeneration is equal is difficult to achieve.
Backpressure keeps increasing with operation then equilibrium is never achieved and active regeneration is not a feature with the competition, hence such solution will never work in the field unless DG is operated @ 75% (approx.) at all times.
Backpressure of 20kPVA will be formed for which is BS VI engine is designed not the older engines.
Certification requires 100% torque hence temperature is achieved.
Does the competition has ACTIVE regeneration?? And if yes, at what periodic intervals, what is fuel consumption during such operation.

Product Envelope

Sr. No	RECD Model Name	kVA Range Catered	Dimensions (LXWXH)	Power Consumption (W)	Weight (kgs)
1	CCM-F-250	225-320	2532 X 1411 X 2361	650	1100
2	CCM-F-400	330-400	2532 X 1411 X 2866	1200	1805
3	CCM-F-500	>400-500	3390 X 1411 X 2866	1200	2200
4	CCM-FP-600	>500-625	2532 X 2336 X 2361	1300	2300
5	CCM-FP-700	>625-750	2532 X 2336 X 2866	2300	2750
6	CCM 1000	1010	2895 X 2100 X 2871	1500	2700
7	CCM 1250	1250	2895 X 2100 X 3219	2200	3000
8	CCM 1500	1500	2895 X 2970 X 2871	2200	3800
9	CCM 2000	2000	2895 X 3840 X 2871	3200	5000
10	CCM 2500	2250 & 2500	2895 X 3840 X 3219	3200	6000

Key clients

TATA
REALTY AND INFRASTRUCTURE LIMITED

ITC'S HOTEL GROUP

TITAN

adani
Ports and Logistics

TVS

Hero

BOSCH

Brakes India Private Limited

SAINT-GOBAIN

YAMAHA
Revs Your Heart

murugappa

Key clients

asianpaints

भारतीय विमानपत्तन प्राधिकरण
AIRPORTS AUTHORITY OF INDIA

adani wilmar

KANSAI NEROLAC PAINTS LIMITED

ABB

DAIMLER

RENAULT NISSAN

SCHAEFFLER

DENSO

Pidilite

Danfoss

DEEPAK FERTILISERS AND PETROCHEMICALS CORPORATION LIMITED

KRISHNA MARUTI LTD.

Our Projects

Adani Ports & Logistics

India Yamaha

ITC Packaging & ITC Welcome

In The News

Pi Green Innovations: Partnership with Cummins for sale of RECD for DG Sets

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Pi Green Innovations: Filtering Air without a filter

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Pi Green Innovations Wins the “Fit For Purpose Track” Award at the India Clean Air Challenge (ICAC)

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THANK YOU