



AHEAD, ALWAYS.

**Autonomous & Water-Less
Solar Plant Cleaning Robot**

Exponentially Growing Solar Utility Market in India

2018: 20 GW of solar capacity



2022: 100 GW of solar capacity *



* Approx. 60 GW is Solar Utility Projects

Overall
MARKET SIZE
in India

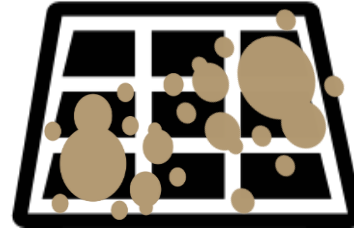
\$180
Million

Assuming an average of 1.2 robots per MW,
at unit price of USD \$ 2,500 at scale



Bhadla Solar Park, Jodhpur | 05/01/2017

Problem: **SOILING LOSSES**



Solar modules
keeps getting dirty



Drop in generation &
revenue

** 2.2 Lakhs per MW, Annually*



High Energy Loss *

Extremely high losses in arid regions

** During dust storms & no cleaning thereafter*

Current Cleaning methods are NOT EFFECTIVE !



Manual wiping with water hose



Manual wiping with tractors



Manual wiping with automatic nozzles

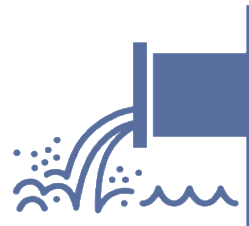
! Majority of the market uses this



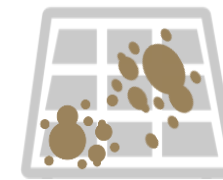
Electrocution Hazard



Inefficient Cleaning (Avg. Loss: 2-4%)



Waste of clean Water - 1.6 Billion Liters annually*



Heavy Losses During Dust Storms



Labour Intensive

*With current installed capacity of 20 GW; 4000 L per MW; 20 washes annually

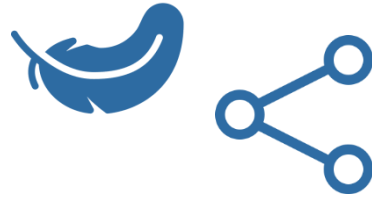
NOCCA S100: Waterless | Autonomous | Shareable | Customizable



NOCCA S100: Key Features & Differentiators



Can overcome dimensional irregularities



Lightweight & shareable



Can be incorporated into existing systems



Seasonal tilt compatible



Wireless monitoring & control



Works at as low as 0° tilt angle



Water-less and Automatic

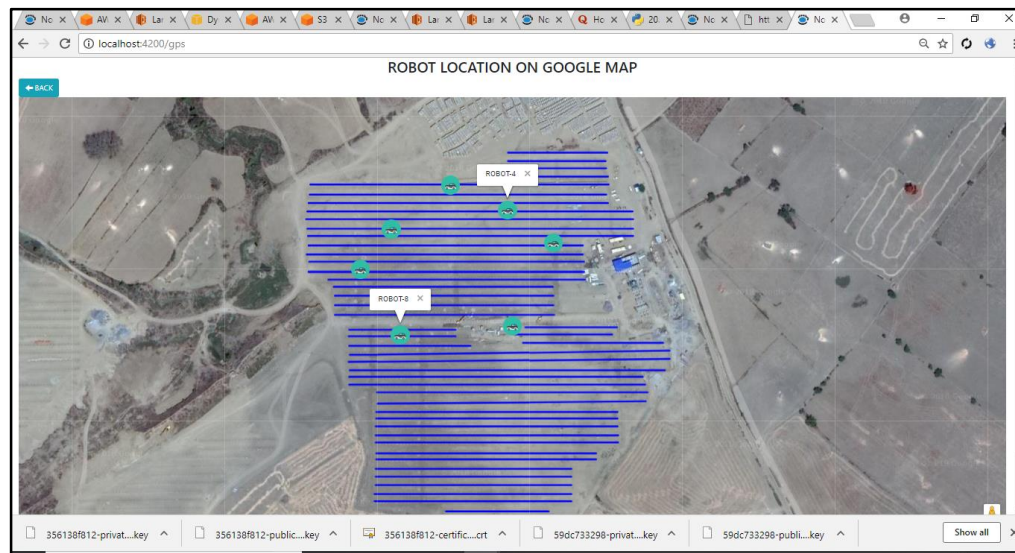
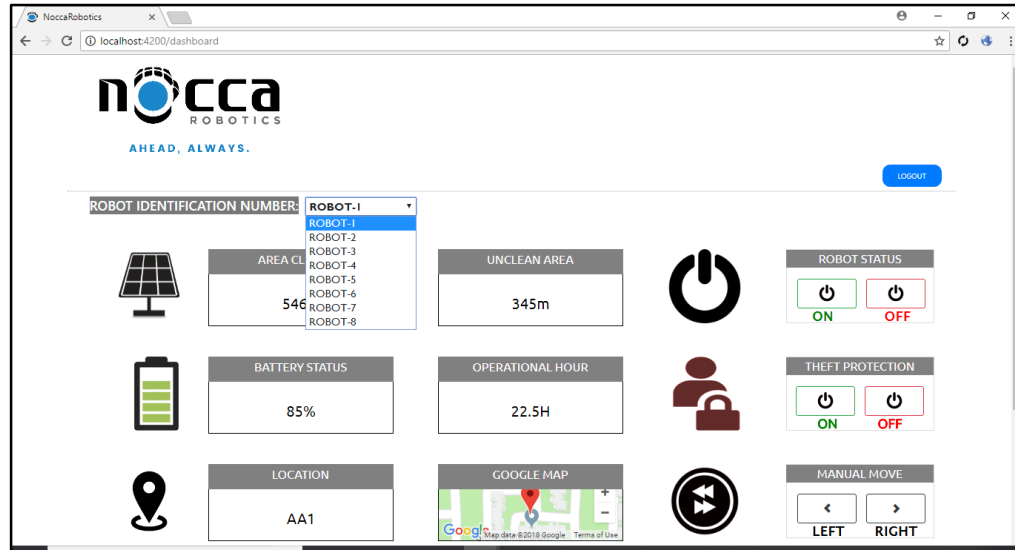


Rain and dust proof

Technical Features

Maximum coverage area in sq. mt. / full charge	↑2200 Sq. mt.
Average Cleaning time/sq.mt.	~540 sq.mt./hr
Weight	37 Kg
Cleaning mode	Dry cleaning
Brush cloth material	Microfiber cloth (from 3M)
Charging Source	Independent Panel/Direct from Inverter
Max. obstacle climb height in length direction	40 mm
Max. gradability along length direction of array	25°
Compatible tilt angles	-35° to 35° (Including 0°)
Battery Capacity & type	24V, 20 Ah LiFePO ₄

Web Portal (Control & Monitoring)



- Web portal to control and monitor the robots
- Manual override for left and right motion
- Real time theft and emergency alert
- Real time cleaning data and robot parameters monitoring
- Live location monitoring
- Robot control via SMS during offline mode
- Cleaning and Emergency SMS Alerts to Operator and O&M team

Value Proposition on a Scalable Basis

Case Study for 50MW plant in Mahoba (UP)

	Nocca S100	Manual Cleaning
CAPEX Requirement (80 Robots)	Rs. 176 Lacs	N/A
Frequency of Cleaning	Every 3-4 days	2 Times a Month
Annual Cleaning Cost / AMC Cost for 50 MW	Rs. 7.50 Lacs	Rs. 35.20 Lacs
Annual Soiling Loss for 50 MW	↓ Rs. 18 Lacs	~ 107 Lacs

ROI for Robotic Cleaning on 50 MW

Within 24 Months of Implementation

Only **80** Nocca S100 can clean **100%** compared to ~ **310** Ecoppia E4 cleaning just **57%** of 50MW

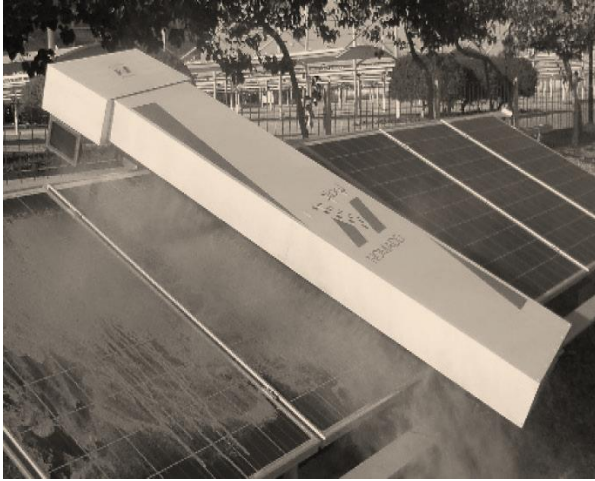
¹ Estimated Unit Selling Price of Rs. 2.2 Lacs / Robot

² RO Plant required to ensure treated water is used to clean panels ; otherwise panels lose efficiency / can get damaged

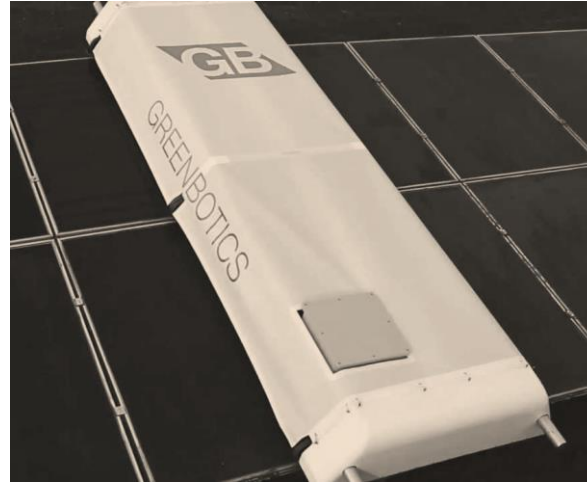
³ Currently at Rs 0.80 / panel * 4400 panels per MW * 2 times a Month * 10 Months annually * 50 MW

⁴ 5,000 units / day per MW * 300 days * Rs. 4.78 / unit (PPA) * 50 MW * Soiling Loss %

Competition - Technologically Advanced Products



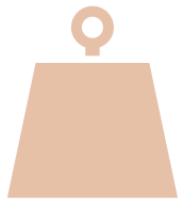
NOMADD
(Developed By KAUST)



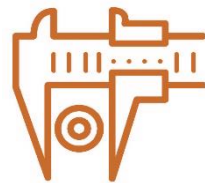
GREENBOTICS
(Acquired By Sunpower)



SOL-BRIGHT
(Kolchar X2)



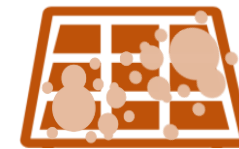
Extremely
Bulky & Heavy



High Dimensional
Accuracy required



Needs Water
to Clean



Cleaning Efficiency
Not Up to Par



Extensive Infra &
CAPEX required



Competition - ECOPPIA E4

Most Advanced Waterless Cleaning Solution; but lacks Market Compatibility & Commercial Viability



Radiation Dependent
(due to on-board charging)



Extensive Infra &
CAPEX required



Gravity Dependent;
inefficient at small tilt angles



Cannot be used in
multiple & short arrays



Complex Assembly &
Installation



Overall Extremely
Costly per MW

NOT FINANCIALLY VIABLE FOR
PLANTS WITH SHORT ARRAYS

Value proposition over other products

Case Study for 20MW Solar Plant in Bikaner (Currently Using Ecoppia E4)		
	Nocca S100	Ecoppia E4
No. of robots required for complete plant	26	63
Frequency of Cleaning	3 days	2 Days
Area cleaned in full charge	↑2200 Sqmtr	~2100 Sqmtr
Shareable	Yes (37Kg)	No (~110Kg)
Permissible Tilt angles	-35° to 35°	↑ 5°
Permissible Irregularities	40mm	↓ 5mm

Key Milestones

Sep'16 -
Apr'17

- Preliminary design development and field Survey of 450 MW of solar plants.
- Feedback on Concept design from Adani Green Energy Ltd (AGEL).

Apr'17 - Nov
'17

- Parameters benchmarking from visit to Mahoba (UP) plant.
- Prototype development & internal testing at SIIC IIT Kanpur; regular feedback from AGEL.

Dec'17 -
Jan'18

- Successfully tested the prototype at 50MW plant in Mahoba for 7 consecutive days.
- Full technical & commercial presentation to senior management at AGEL.

Feb'18 -
May'18

- **AGEL pilot order confirmed for 8 x NOCCA S100 robots to clean a 5MW block at Mahoba.**
- Procurement, manufacturing & testing of all 8 robots at our facility in SIIC, IIT Kanpur.

Current

- **AGEL Pre-Dispatch Inspection** completed on 26th May, 2018 and formal **OK** certification received.
- Robots delivered on mid-June; Commissioning to be done after site modifications by **AGEL**.
- Piloting with **Mahindra Susten in Rajasthan** & in discussions with **Tata International**.

TEAM NOCCA



HARSHIT RATHORE

BS, IIT Kanpur

Ex-Hardware Design Lead
Knox Innovations (Tilt45)



NIKHIL KURELE

B-Tech, IIT Kanpur

Ex-Design Engineer, Robotics
Bajaj Auto Ltd.



AMAN ARYA

BBA, Indiana University

Entwine Technologies
Knox Innovations (Tilt45)



AMAR KOTHARI

M-COM, Mumbai University

Frission Enterprises
India Impex (SUNLITE)



SAGAR MEHTA

BSBA, Carnegie Mellon

India Impex (SUNLITE)
Knox Innovations (Tilt45)

DISTINGUISHED MENTORS

MR. SAURABH SHRIVASTAVA

Director, Naukri.com & Dr. Lal Pathlabs Ltd
Founder Indian Angel Network
Director, GreenBank Capital Inc (Canada)

MR. NEIL BHASKAR

Chairman, Nova Group Of Companies
Managing Director, Princeton Global Solutions, LLC
Chairman, Bioventions Labs, US

DR. ANOOP SINGH

Associate Professor
Department of IME, IIT Kanpur
Advisor to Ministry of Power, Govt. Of UP