Gree ENERGY

Hamparan Project – Impact Report.

2025

SUPPORT AND RECOGNITION :

Certified B Corporation

B20 SUSTAINABILITY 4.0 AWARI
A joint European-Indonesian Proje

B20 INDONESIA 2022 BUSINESS

Seed Capital Assistance Facility

FFEM FONDS FRANÇAIS POUR L'ENVIRONNEMENT MONDI

AFD AGENCE FRANÇAISE DE DÉVELOPPEMENT

جائزة دبي الدولية لأفضل ممارسات التنمية المستدامة
Dubai International Best Practices Award for Sustainable Development

Gree Energy: Meet your project partner.

In Indonesia, over 90% of food processors lack modern wastewater and methane capture facilities, leading to **water pollution from 320 million population-equivalent** and **emitting over 50 million tonnes of CO2 eq annually based on methane's 20-year GWP**, highlighting a critical near-term climate impact.

Gree Energy empowers food processors in emerging countries to deploy biogas solutions that treat industrial wastewater and significantly reduce methane emissions.

Our Mission.

We fight climate change by scaling profitable biogas solutions that transform food industry waste into valuable resources for people and the planet.

A team of **15 engineers, financiers and sustainability experts** with a local presence in the field, in Indonesia.

Gree Energy is the only B-Corp certified biogas solution provider in Asia.

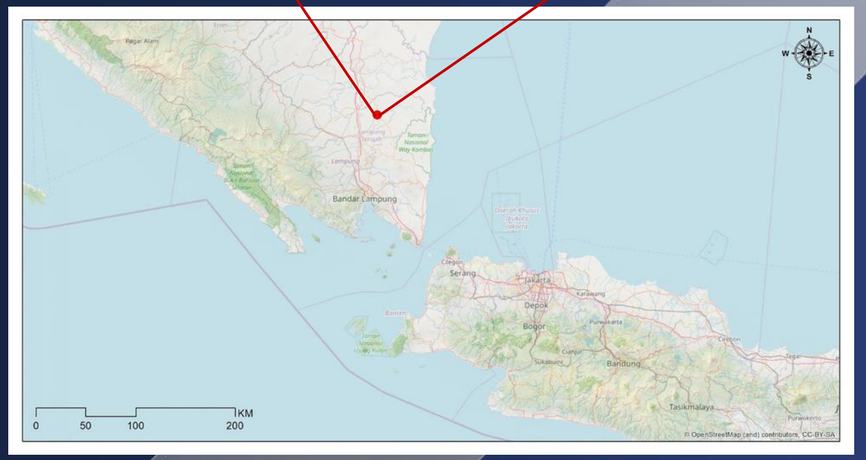
Certified B Corporation

> ***We are pleased to work with GREE under the Seed Capital Assistance Facility (SCAF) to advance a just energy transition. Biogas solutions can help reduce our greenhouse gas emissions while providing energy equity and connectivity for all***
> MARK RADKA, CHIEF, ENERGY & CLIMATE BRANCH, UNEP

About this Report

Gree works towards reducing carbon emissions in agriculture and food supply chains on a large scale. Our projects not only help reduce greenhouse gas emissions, but also create job opportunities, improve public health, and provide clean water and sustainable energy. These factors play a significant role in achieving sustainable development aligned with the UN Sustainable Development Goals.

We annually monitor and report the positive impacts of our projects using the UN SDG framework. This report focuses on the progress and performance of the Hamparan Biogas project from 1st January until 31st December 2025 and its contribution towards achieving the UN Sustainable Development Goals. We have identified four SDGs directly impacted by the Hamparan Biogas project. These goals include:



Hamparan
Geo-Coordiantes: 4°41'25.2"S 105°22'38.1"E

Hamparan Project

Project Details

Project host
PT Hamparan Bumi Mas Abadi
(partner with 4,000 smallholder farmers)

Location
Terbanggilir Ilir, Lampung, Indonesia

Biogas feedstock
Cassava starch wastewater

Biogas-to-energy
3 MWe grid connected

Carbon credits
30,327 (636,867 over 21 years project term)

Cumulative Climate Impact
3.5 Million ton of CO2eq captured over lifespan

Commercial operation date
Dec 2020

Gree's role
Project development, construction, carbon development

Reducing methane emissions from a cassava starch factory and generating clean energy

Problem Statement

Hamparan Bumi Mas Abadi is a large cassava starch factory, an essential ingredient in Indonesian cuisine. The production of cassava flour, however, generates volumes of polluted water, the equivalent of wastewater produced by a population of 280,000 daily. In its turn, the wastewater, is a source of methane emission, a hazardous gas and climate super-pollutant.

The Solution

The Hamparan project treats the industrial wastewater of a cassava starch factory, captures its fugitive methane emissions and transforms these environmental liabilities into renewable energy which is then distributed by the national utility to 19 surrounding villages.

Our biogas projects not only generate ESG impact but go beyond to demonstrate exceptional technical performance, encompassing energy output, efficiency, and reliability.

97%+
Water pollution removal (BOD and COD)

88%+
Anaerobic conversion efficiency (COD to CH_4)

92%+
H_2S removal (up to 1 ppm in gas)

93%
Net energy efficiency of biogas-to energy system

IN ADDITION, WE HELP OUR PARTNERS BY PROVIDING:

- 0 Lost Time Injury during construction
- European Safety Standards
- Long term reliability
- Very low OPEX cost

INTERNATIONAL SUSTAINABILITY STANDARDS AND CERTIFICATIONS:

Certified B Corporation · Verified Carbon Standard, A VERRA STANDARD · IFC International Finance Corporation, WORLD BANK GROUP · IRIS+

Project Host Details

PT. Hamparan Bumi Mas Abadi is a starch factory Hamparan Bumi Mas Abadi is a local Indonesian company that produces around 40,000 tonnes of native starch per year from cassava roots locally sourced from approximately 4,000 smallholder farmers. The cassava starch factory has been operational since 2009 and employs almost 100 workers.
Hamparan's cassava starch factory passed Gree's ESG safeguard standards:

- Deforestation risk: Satellite monitoring has shown that 99.8% of the supply base is free from deforestation, and the remaining 0.2% have been determined to have low risk.
- Business integrity and compliance: verification by ADIT, the European leader in integrity due diligence, and Gree's team, has been carried out and identified low risk

100%

Deforestation-free assesed

Business integrity and compliance: low risk

Notes:
1. Based on personal communications with Udin Hasanudin, director of the Faculty of Agriculture at the University of Lampung indicating that the average smallholder farmer in Lampung owns 2 ha with an average yield of 20 MT/ha for cassava root.

SDG Impact contribution in 2025

1st January until 31st December 2025

Climate Change

Annual Impact: **18,677 Verified Carbon Units**

Cumulative Impact: **3+ Million tonnes CO2 eq** reduced over Lifespan*

Energy for All

4,689,415.00 kwh delivered, enough to supply 10,482 people with clean and reliable power

Clean Water

97%+ organic pollution removed

Clean Air

2.52 tons of hydrogen sulfide emissions avoided

853 tons of methane emissions avoided

The Sustainable Development Goals our Hamparan project fulfills:

3 GOOD HEALTH AND WELL-BEING

6 CLEAN WATER AND SANITATION

7 AFFORDABLE AND CLEAN ENERGY

13 CLIMATE ACTION

DUBAI IABP WINNER

DUBAI INTERNATIONAL BEST PRACTICES AWARD IN CLIMATE CHANGE AND REDUCING POLLUTION

13 CLIMATE ACTION

B2O RUNNER-UP

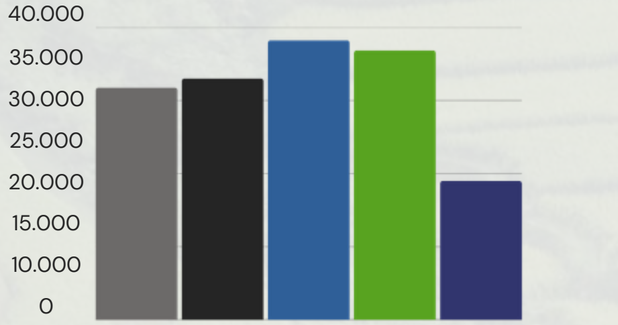
B2O INDONESIA SUSTAINABILITY 4.0 AWARD IN CLEAN WATER AND SANITATION

6 CLEAN WATER AND SANITATION

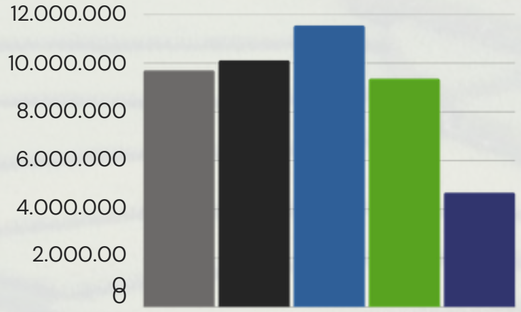
Watch our Award-Winning Video Here:

Notes:
*Emissions reductions calculated using the 20-year Global Warming Potential (GWP20) for methane. Project lifespan is 20 years.

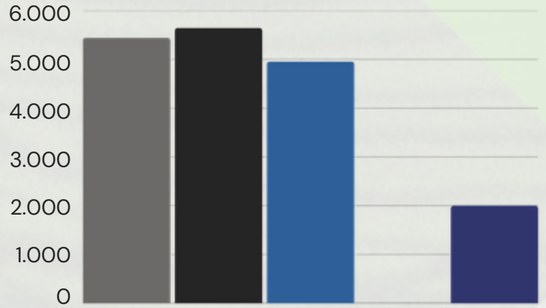
Impact Progress 2021-2025



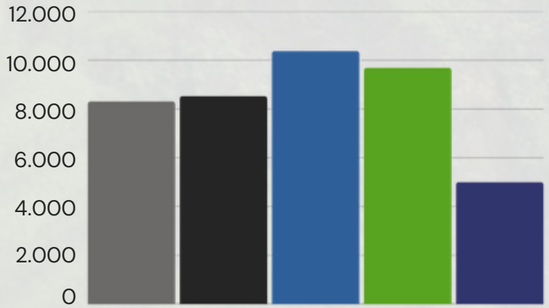
Carbon Units emission reductions* (VCU)
SDG 13 (Climate Action)



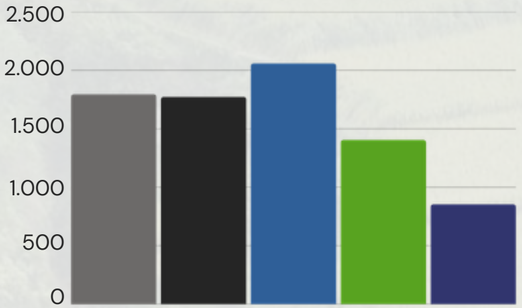
Electricity generation (kwh)
SDG 7 (Clean and Reliable Energy)



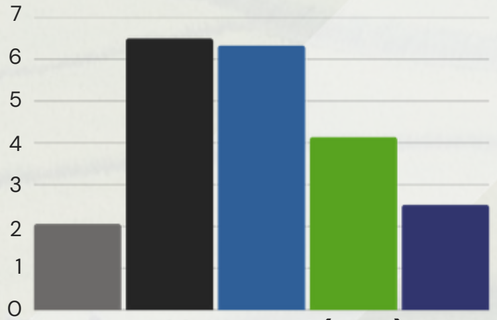
BOD removal (tons)
SDG 6 (Clean Water and Sanitation)



COD removal (tons)
SDG 6 (Clean Water and Sanitation)



CH4 emission reduction (tons)
SDG 3 (Clean Air)



H2S removal (tons)
SDG 3 (Clean Air)

2021 2022 2023 2024 2025

Notes:
*GWP 100 of methane

Gree Harvest: Nurturing Soils, Cultivating Future

Enhancing soil and crop health, our initiative distributes natural fertilizers from biogas byproducts to local smallholders, rich in nutrients and stable carbon, aiding carbon sequestration and sustainable agriculture. Aligned with SDGs 1, 2, 12, and 13, we aim to reach 600 smallholders, improving yields at minimal cost. To sustain and expand this effort, we invite partners to support a recurring annual budget, ensuring long-term benefits for communities and the environment. Join us in making a lasting impact.

APPENDIX

SDG Contribution
Data Source & Monitoring

SDG 3

CLEAN AIR

Problem at Stake.

Hydrogen sulfide is a toxic air contaminant that naturally occurs during wastewater treatment. The odor can be extremely strong and foul and induce tearing of the eyes and lead to headache, nausea, or vomiting from overstimulation. It is fatal when concentrations are over 500-1000 ppm and exposure to 10-500 ppm can cause respiratory symptoms and eye irritation[1]. In the US, the Clean Air Act section 112 (5) requires any facility emitting more than 10 tons of H2S per year to develop a risk management plan and obtains a "Prevention of Significant Deterioration" permit.

Methane emissions, which mainly come from agricultural activities, waste disposal, and fossil fuel extraction, is a precursor of tropospheric ozone[2]. This gas is a potent greenhouse gas and air pollutant, responsible for over 1 million pollution-related deaths annually. Many crops are unable to tolerate tropospheric ozone, causing soy, wheat, rice, and maize to suffer annual yield losses of up to 15% [3].

Solution.

A hydrogen sulfide scrubber removes hydrogen sulfide from the biogas stream. It is installed downstream of the wastewater treatment facility to purify all the biogas captured. Hamparan's desulphurization removes on average 98.8% of the H2S contained in the biogas before the biogas is combusted into the gas engines and avoids 2.52 tons of H2S emissions.

Installing the anaerobic lagoon digester over the wastewater captures the methane emissions and converts it to produce electricity. Hamparan avoided tons of 852.84 CH4 in 2025.

Source:

1. Occupational Safety and Health Administration, United States Department of Labor https://www.osha.gov/hydrogen-sulfide/hazards
2. Abernethy, S., O'Connor, F. M., Jones, C. D., & Jackson, R. B. (2021, September 27). Methane removal and the proportional reductions in surface temperature and ozone. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *379*(2210), 20210104. https://doi.org/10.1098/rsta.2021.0104
3. *Tropospheric ozone | Climate & Clean Air Coalition*. (n.d.). Tropospheric Ozone | Climate & Clean Air Coalition. https://www.ccacoalition.org/en/short-lived-climate-pollutants/tropospheric-ozone

SDG 3

CLEAN AIR

Priority SDGs	Title of SDG	Hamparan Project Commitments	KPI (Unit)	Achieved 2025	Data Source & measurement frequency	Data Quality Assurance
	Ensure healthy lives and promote well-being for all at all ages	Remove hydrogen sulfide[1] (H2S) emissions as it a toxic air contaminant that occurs during wastewater treatment. Avoid methane emissions[2] (CH4) which are a primary source of tropospheric ozone which is a harmful air pollutant.	Tons of H2S removed (ton/year)	2.52 tons	Daily operation record, on-site measurement using portable gas analyzer & flowmeter	Portable gas analyzer & flowmeter to be maintained according to manufacturer's specifications
			Tons of CH4 removed (ton/year)	852.84 tons	Daily operation record, on-site measurement, recorded in datalogger	Gas analyzer, flowmeter & sensors to be calibrated and maintained according to manufacturer's specification

Notes:

1. Hydrogen sulfide (H2S) is fatal in concentrations over 500 – 1000 ppm and exposure to 10-500 ppm can cause respiratory symptoms and eye irritation . (Source: United States National Institute of Health).
2. Methane is a greenhouse (CH4) gas and air pollutant producing health-damaging tropospheric ozone that causes more than 1 million pollution-related deaths annually. (Source: Climate & Clean air Coalition)

SDG 6

CLEAN WATER AND SANITATION

B2O RUNNER-UP
B2O INDONESIA SUSTAINABILITY 4.0 AWARD IN CLEAN WATER AND SANITATION

Problem at Stake.

Food production generate large amounts of unavoidable wastewater, contaminated by residual organic materials from the raw crops during processing. Discharging such wastewater into the environment can lead to ecosystem degradation and present a public health risk. Proper treatment of wastewater is crucial for sustainable food production.

Solution.

With the installation of anaerobic wastewater treatment technology, over 97% of the organic pollution contained in the wastewater had been removed.

B2O SUSTAINABILITY 4.0 AWARDS | B2O INDONESIA 2022

Hamparan was awarded by the B20 Sustainability 4.0 awards as a runner-up in the clean water & sanitation category. The award celebrates businesses with major contributions in sustainable development in Indonesia. The B20 Sustainability was a side-event to the G20 held under the Indonesian presidency in 2022.

SDG 6

CLEAN WATER AND SANITATION

Priority SDGs	Title of SDG	Solution	Hamparan Project Commitments	KPI (Unit)	Achieved 2025	Data Source & measurement frequency	Data Quality Assurance
	Ensure availability and sustainable management of water and sanitation for all		Remove organic pollutant indicated by biological oxygen demand (BOD) by treating industrial wastewater	Tons of BOD removed (ton/year)	1,937 tons	Sampling report by external lab conducted bi-annually	Samples and measurements are conducted bi-annually
			Remove organic pollutant indicated by chemical oxygen demand (COD) by treating industrial wastewater	Tons of COD removed (ton/year)	5,072 tons	Daily operation record, on-site measurement using COD colorimeter and other supporting lab equipment.	Samples and measurements shall ensure a 90/10 confidence/precision level

SDG 7

CLEAN AND RELIABLE ENERGY FOR ALL

Problem at Stake.

Lampung currently generates about 63% of its electricity from fossil fuels. However, the demand for electricity is increasing rapidly, with an annual growth of approximately 15%.[1] Prior to the project's launch, the average voltage in the local grid was 15.3 kV, which is insufficient for a reliable power supply. Ideally, voltage levels should be between 19 to 21 kV. Low voltage can cause damage to electrical appliances, reduce their performance, increase energy consumption, and even pose a risk of electrical fires.

Solution.

Hamparan converts the biogas it captures into electricity using reciprocal gas engines that have a nominal capacity of 2 x 1.5MW. In 2025, Hamparan exported 4,689,415.00 kWh of electricity to the local grid. The project had a positive impact on the local distribution grid, resulting in an average voltage of 19.71 kV and improving the primary power distribution in 19 villages.

Source:
1. Redaputri, A. P., & Barusman, M. Y. S. (2021, November 5). THE ANALYSIS OF RENEWABLE ENERGY MANAGEMENT TO GENERATE ELECTRICITY IN LAMPUNG PROVINCE INDONESIA. *International Journal of Energy Economics and Policy*, *11*(6), 347–352. https://doi.org/10.32479/ijeep.11549

SDG 7

CLEAN AND RELIABLE ENERGY FOR ALL

Priority SDGs	Title of SDG	Hamparan Project Commitments	KPI (Unit)	Achieved 2025	Data Source & measurement frequency	Data Quality Assurance
	Ensure access to affordable, reliable, sustainable, and modern energy for all	Generate clean and reliable power from capturing fugitive methane emissions from wastewater to produce biogas and converting it into electricity. Improve power supply reliability for local communities	Quantity of gross electricity supplied to the grid (MWh/year)	4,689,415.00 kwh[1]	Daily operation report through the electricity meter datalogger.	The external power meter was calibrated in 2019 by an officially accredited entity in compliance with national standards valid for 10 years.
			Reliability of electricity (kV)	19,71 kV[2]	Daily operation record, on-site measurement using electricity meter at transaction pole with local utility grid.	The external power meter was calibrated on 2019 by an officially accredited entity in compliance with national standards valid for 10 years.

Notes:

1. Equivalent to providing renewable electricity to 8,502 people Statistik PLN 2019. Tabel 19 : Rasio Elektrifikasi dan Energi yang Dikonsumsi per Kapita, p.20. Accessed on 5 May 2023. https://web.pln.co.id/statics/uploads/2020/11/Statistik-Indonesia-2019.pdf
2. The voltage on the local distribution grid increased to an average of 19.71 kV annually versus 15.3 kV before the project implementation

SDG 13

CLIMATE ACTION

DUBAI IABP WINNER
DUBAI INTERNATIONAL BEST PRACTICES AWARD IN CLIMATE CHANGE AND REDUCING POLLUTION

Problem at Stake.

Methane has a global warming potential of more than 84 times CO2 over a 20-year timeframe and accounted for roughly 30 percent of global warming since pre-industrial times[1] .Reducing methane pollution is the fastest way to slow global warming and avoid near-term and irreversible impacts such as collapsing glaciers.

Agriculture and food systems are the predominant sources of human-caused methane[2].

Solution.

Anaerobic digestion systems (or “biogas” systems) capture fugitive methane emissions and allows to use that methane in a beneficial way.

71,5% of the GHG emission reduction of Hamparan comes from methane capture. The rest comes from the reduction of the carbon footprint of the local grid, by replacing fossil power generation with biogas power.

جائزة دبي الدولية لأفضل ممارسات التنمية المستدامة
Dubai International Best Practices Award for Sustainable Development

Hamparan Project won Dubai International Best Practices Award for Sustainable Development in the category of addressing climate change and reducing pollution during World Government Summit 2024. The award, organised by the Dubai Municipality in collaboration with UN-Habitat.

1. *Methane emissions*. (n.d.). Energy. https://energy.ec.europa.eu/topics/oil-gas-and-coal/methane-emissions_en
2. *Importance of Methane | US EPA*. (2016, January 11). US EPA. https://www.epa.gov/gmi/importance-methane

SDG 13

CLIMATE ACTION

Priority SDGs	Title of SDG	Hamparan Project Commitments	KPI (Unit)	**Achieved 2025** (not yet verified)	Data Source & measurement frequency	Data Quality Assurance
	Take urgent action to combat climate change and its impacts	Capturing methane emissions which is 28 times more potent than CO2 over 100 years, released from traditional wastewater treatment practices.	Greenhouse gas emission reductions (tCo2e/year)	14,483[1]	Data collected and monitored according to emission reduction methodology based on the UNFCCC methodology AMS-III.H & AMS-I.D.	In the process of independent verification by VERRA
		The project also displaces the use fossil fuel-generated electricity of the local grid.	Greenhouse gas emission reductions (tCo2e/year)	4,195[2]	Data collected and monitored according to emission reduction methodology based on the UNFCCC methodology AMS-I.D.	In the process of independent verification by VERRA

Notes:

1. Equivalent to 3,148 CO_2 reduction in cars. Calculated using data from the World Bank whereby 4.6 CO2 emission in tCO2 equivalent per car per year
2. Equivalent to 912 CO_2 reduction in cars. Calculated using data from the World Bank whereby 4.6 CO2 emission in tCO2 equivalent per car per year

SDG 13

CLIMATE ACTION

Calculation of Methane Burned / Captured

Referring to AMS-III.H version 19.0 the amount of methane recovered during monitoring period, which is monitored ex post is defined as Mdy :

$$MDy = BGburnt,y \times wCH4,y \times DCH4 \times FE \times GWPCH4$$

Where:

$BGburnt,y$	= Biogas flared/combusted in year y (Nm3)
$wCH_{4,y}$	= Methane content of the biogas in the year y (volume fraction)
DCH_4	= Density of methane at the temperature and pressure of the biogas in the year y (t/m3) = 0.716 kg/m^3 [1]
FE	= Flare efficiency in year y (fraction). Since the biogas is combusted to gas engine, an efficiency of 100% may be applied
$GWPCH_4$	= Global Warming Potential = 84 [2]

The measurement calculation is performed on monthly basis before it is sum at the end to get the yearly figure.

In 2025, we captured 852.84 **tCH4,** equal to = 852.84 x 84 = **71,638 tCO2e** reduction or **1,432,771 tCO2e** reduction over 20 years PPA period.

Energy Displacement Emission Reduction

Referring to AMS-ID version 18.0 the baseline emission from electricity displacement are calculated as follows:

$$BE_y = EG_{PJ,y} * EF_{grid,y}$$

Where:

BE_y	= Baseline emissions in year y (tCO2)
$EG_{PJ,y} = EG_{PJ,facility,y}$	= EGPJ,facility,y = Quantity of net electricity generation supplied by the project plant to the grid in year y (MWh)
$EF_{grid,y}$	= Combined margin CO2 emission factor for grid connected power generation in year y (tCO2/MWh)

For 2025 measurement, here are the value that we use :

$EG_{PJ,y}$	= $EG_{PJ,facility,y}$ = 4,511.00 MWh
$EF_{grid,y}$	= 0.93 tCO2e/Mwh [3]
BE_y	= 4,511.00 x 0.93 = **4,195.23 tCO2e** reduction or **83,904.60 tCO2e** reduction over 20 years of PPA period

1. *The methane density under STP (Standard Temperature and Pressure) condition*
2. *In AMS-IIIH v.19 the default GWP value is 28 (GWP 100). For this impact report GWP 20 value is used = 84*
3. *The relevant electricity system for the project is the grid of Sumatera. The latest applicable emission factor for this grid is* $EF_{grid,2019}$ *= 0.93 tCO2e/MWh.*

Gree
ENERGY

Unlock the full power of Biogas with Gree Energy

Contact us to lead the way in a greener future :

gree-energy.com

nicolas@gree-energy.com