



# IV CONGRESO PALMERO CPAL 2023

SANTO DOMINGO DEL CERRO

LA ANTIGUA GUATEMALA - 2023





# Technology to Decarbonize Palm Industrialization:

## Experiences in Malaysia and Indonesia

Presented by

**ECOSCIENCE MANUFACTURING & ENGINEERING  
Sdn. Bhd. (EME)**



# COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

## THREE MAIN AREAS THAT PALM OIL INDUSTRY HAS TO IMPROVE AND INVEST TO COMPLY WITH MALAYSIAN STATUTORY REQUIREMENTS:

1. MANAGING WATER POLLUTION.
2. MANAGING AIR POLLUTION.
3. REDUCING GREEN HOUSE GAS (GHG) EMISSIONS.



# MANAGING WATER POLLUTION: CHALLENGE

- MILLERS IN CERTAIN STATES OF MALAYSIA HAVE TO COMPLAIN WITH STANDARDS OF 20 PPM BOD.
- MANY CASES MILLERS HAD TO LOOK INTO CHEMICAL AND MECHANICAL TERTIARY TREATMENT PROCESSES FOR POME.
- SEQUENTIAL BATCH REACTOR, MEMBRANE, NANO BUBBLE TECHNOLOGY, CERAMIC MEMBRANE AND CHEMICAL FOR SS REMOVAL ARE THE CURRENT TECHNOLOGIES IN WHICH SOME MILLERS HAVE ENGAGED.
- THE RESULTS ARE MIXED.

# MANAGING WATER POLLUTION: PROVEN EME SOLUTION

- EME R&D APPLICATION OF NON-THERMAL WET PLASMA TREATMENT FOR POME
- A 10 TPH TREATMENT PLANT AT ONE OF THE PALM OIL MILLS OPERATIONAL SINCE OCTOBER 2023, REPLACED THE CURRENT INSTALLED MEMBRANE TECHNOLOGY AT THE FINAL DISCHARGE POND
- NON-THERMAL WET PLASMA SYSTEM IS A FULLY FUNCTIONAL PHYSICAL TREATMENT TECHNOLOGY WHICH REDUCES THE CARBON FOOTPRINT OF CHEMICAL USAGE VIA ADVANCE OXIDATION PROCESS

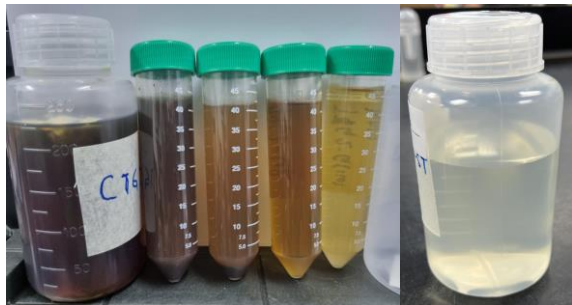


# MANAGING WATER POLLUTION: PROVEN EME SOLUTION

## INFLUENT

### DESIGN POME INFLUENT QUALITY

Parameter	Water Influent Quality
Flow Rate	10 m <sup>3</sup> /hr
pH	7.0 – 9.0
COD, mg/L	≤ 500 mg/L
BOD <sub>5</sub> , mg/L	≤ 100 mg/L
Suspended Solids (SS), mg/L	≤ 500 mg/L
Oil & grease (O&G), mg/L	≤ 1 mg/L
Ammoniacal Nitrogen	≤ 100
Conductivity, us/cm	≤ 3000 - 5500
Color ADMI	≤ 1500



Verification Test  
Result with  
sequential colour  
changes from  
Prototype

## AND DISCHARGE QUALITY

### POME DISCHARGE QUALITY

(SAMPLE DATED ON 28<sup>TH</sup> DECEMBER 2023)

Parameter	Water Discharge Quality
Flow Rate	10 m <sup>3</sup> /hr
pH	9.3
COD, mg/L	≤ 100 mg/L
BOD <sub>5</sub> , mg/L	≤ 20 mg/L
Suspended Solids (SS), mg/L	≤ 25 mg/L
Oil & grease (O&G), mg/L	≤ 5 mg/L
Ammoniacal Nitrogen	ND
Conductivity, us/cm	≤ 3000 - 5500
Color ADMI	≤ 100



Sequential colour changes from  
the 10TPH Treatment Plant



# MANAGING WATER POLLUTION: PROVEN EME SOLUTION

- **THE INSTALLATION OF NON-THERMAL WET PLASMA TECHNOLOGY ON POME DEMONSTRATED THE REMARKABLE POTENTIAL OF WET PLASMA TECHNOLOGY IN EFFICIENTLY DEGRADING COMPLEX ORGANIC COMPOUNDS, REMOVING SUSPENDED SOLIDS, AND ELIMINATING HAZARDOUS COMPONENTS WITHIN SHORT TREATMENT TIME.**
- **IT IS EVIDENT THAT WET PLASMA TECHNOLOGY HOLDS GREAT POTENTIAL FOR REVOLUTIONIZING POME. ITS ATTRIBUTES, INCLUDING HIGH EFFICIENCY, COST-EFFECTIVENESS, AND ENVIRONMENTAL FRIENDLINESS, POSITION IT AS A VIABLE SOLUTION TO THE CHALLENGES FACED BY THE PALM OIL INDUSTRY.**
- **THE SUCCESS OF THIS DEMONSTRATION PLANT PROVIDES STRONG FOUNDATION FOR DESIGNING AN EFFICIENT, COST-EFFECTIVE, AND ENVIRONMENTALLY FRIENDLY TREATMENT SYSTEM.**



## MANAGING WATER POLLUTION: IMPLEMENTATION AREAS EME NON- THERMAL WET PLASMA TREATMENT TECHNOLOGY:

- TERTIARY TREATMENT FOR BOD 100 FINAL DISCHARGE POND TO MEET BOD20 + COLOUR REMOVAL DISCHARGE (CURRENT COMPLIANCE STANDARD IMPLEMENTED BY D.O.E) OR COMPLY TO STANDARD A OR B
- TERTIARY TREATMENT POST BIO-OXIDATION PROCESS (E.G. BIOGAS SECONDARY TREATMENT) TO MEET BOD20 + COLOUR REMOVAL DISCHARGE (CURRENT COMPLIANCE STANDARD IMPLEMENTED BY D.O.E) OR COMPLY TO STANDARD A OR B
- SERVE AS PRE-TREATMENT PLANT FOR WATER-RECYCLING WHICH ENABLES RO SYSTEM TO BE IN PLACE AND DEAL ONLY WITH SALT REMOVAL TO MEET THE DESIRED CONDUCTIVITY. CURRENTLY, EME IS DEVELOPING PULSED RO WITH COMBINATION OF PULSED ELECTRODIALYSIS AS THE CORE SYSTEM FOR WATER-RECYCLING.





# MANAGING AIR POLLUTION: CHALLENGE

RECURRING HAZE AFFECTING COUNTRIES IN SOUTH EAST ASIA IN THE SECOND HALF OF YEAR 1997, IN AUGUST 2005, IN 2006 AND AGAIN IN 2015 HAD LED TO A MORE STRINGENT REGULATIONS IMPOSED ON PALM OIL MILLERS ALTHOUGH THE HAZE WAS ATTRIBUTED TO CULTIVATION IN INDONESIA.

THE FOLLOWING ARE AMONG PROHIBITIONS AND REQUIREMENTS OF THE NEW REGULATIONS:

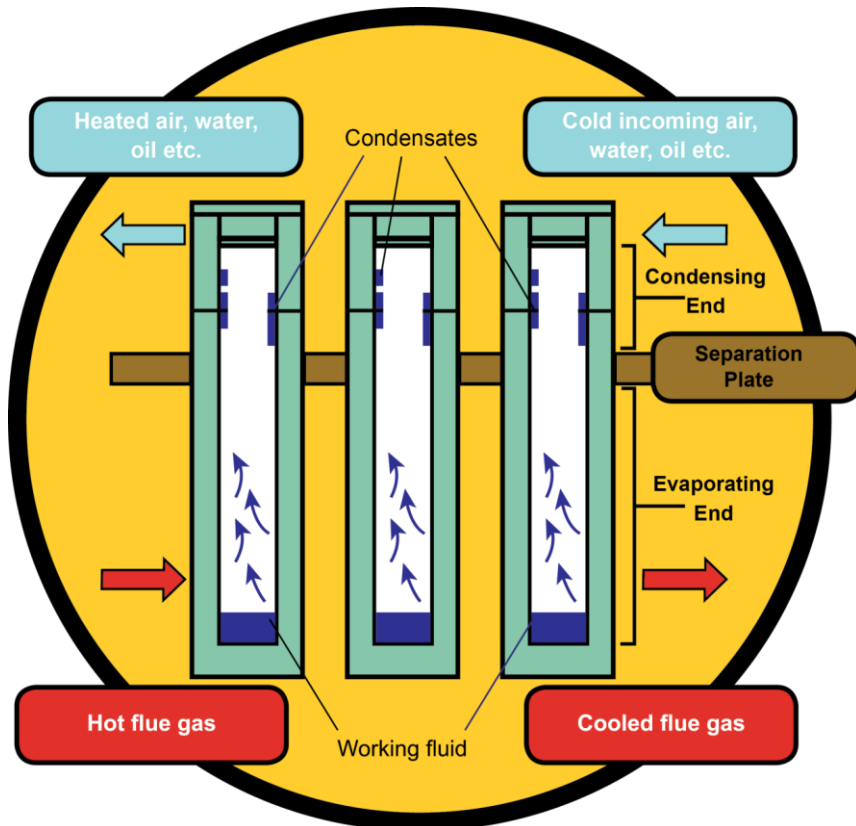
- NO MORE INCINERATION OF EMPTY BUNCHES
- PARTICULATE MATTER (PM) FROM BOILER CHIMNEY REDUCTION FROM 400 MG/NM<sup>3</sup> TO 150 MG/NM<sup>3</sup>
- COMPUTERISED ENVIRONMENT MANAGEMENT SYSTEM



# MANAGING AIR POLLUTION: CHALLENGE

- HEAT RECOVERY FROM INDUSTRIAL FLUE AND EXHAUST GASES CONTAIN LARGE AMOUNTS OF VALUABLE ENERGY SAVINGS, TOGETHER WITH SIGNIFICANT REDUCTIONS IN CO<sub>2</sub> AND CARBON EMISSIONS.
- HOWEVER, THIS OPPORTUNITY HAS BEEN LARGELY UNEXPLOITED DUE TO TECHNOLOGICAL BARRIERS AND THE LACK OF A SIMPLE, RELIABLE SOLUTION CAPABLE OF RECOVERING THIS WASTE HEAT ENERGY, WHICH WOULD PROVIDE A REALISTIC RETURN ON INVESTMENT.
- BY SWITCHING TO THE MOST ENERGY-EFFICIENT TECHNOLOGY AVAILABLE, COMPANIES CAN MAKE HUGE SAVINGS AND SIGNIFICANTLY REDUCE ENVIRONMENTAL IMPACT.

# MANAGING AIR POLLUTION: PROVEN EME SOLUTION



- TECHNOLOGICAL ADVANCEMENT IN THE DESIGN OF HEAT PIPES AND THE TECHNIQUES USED TO MANUFACTURE THEM ALLOWS THE HEAT PIPES TO BE UTILIZED AS THE CORE COMPONENT FOR WASTE HEAT RECOVERY IN HEAT EXCHANGERS FOR INDUSTRIAL APPLICATIONS.
- HEAT PIPES HEAT EXCHANGER ARE CONFIGURED TO HANDLE DIFFERENT FUEL TYPES AND CHALLENGING HEAT RECOVERY ENVIRONMENTS

# MANAGING AIR POLLUTION: PROVEN EME SOLUTION

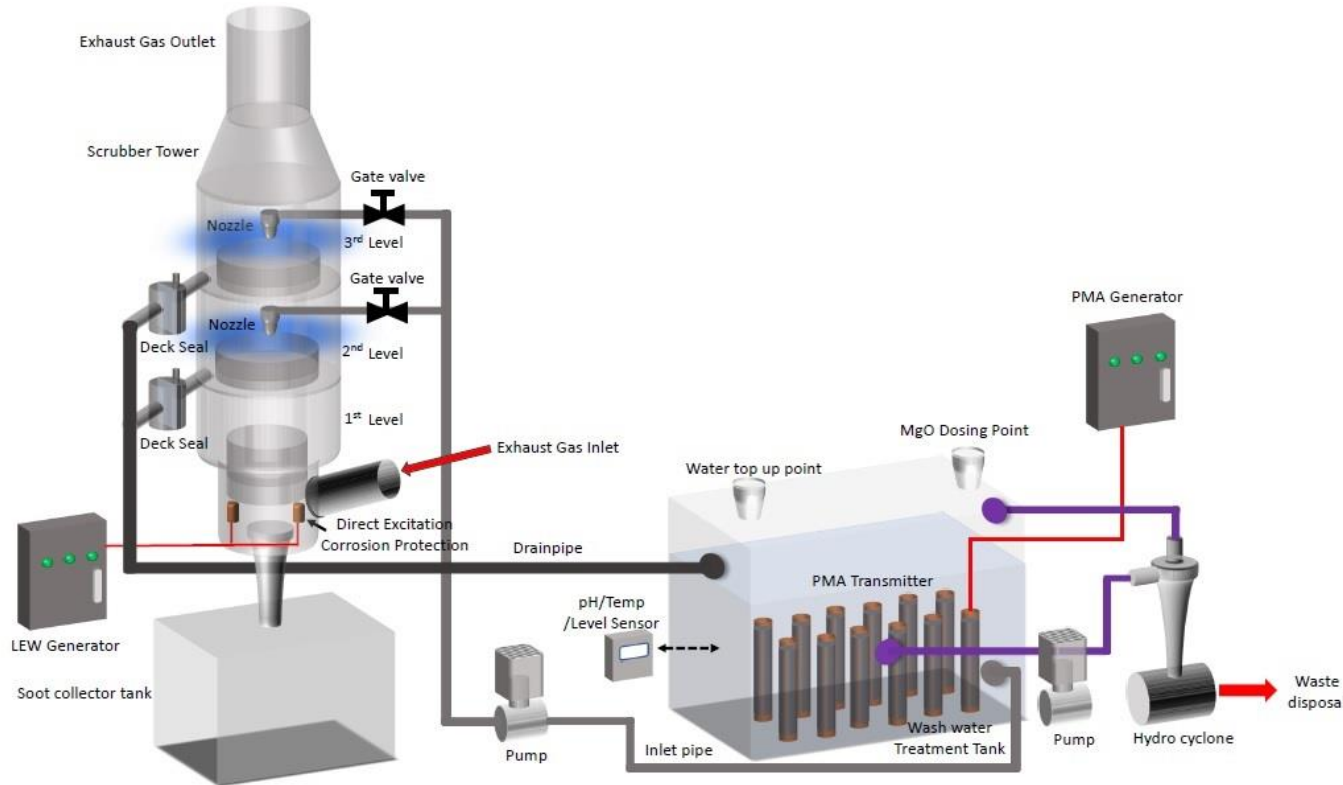
Exhaust Temp In	260 C
Exhaust Temp Out	140 C
Air Temp In	30 C
Air Temp out	120 C
Exhaust Mass Flow	36,253 Kg/h
Air Mass Flow	52,000 Kg/h
Weight of unit	23,000 Kg
Exhaust pressure drop	500 Pa
Energy Recovered	1.3 MW



- **DUAL UNIT COMBUSTION AIR PRE-HEATER WITH FULL SS304**
- **SMOOTH PIPES**
- **HIGH PARTICULATE MATTER EXHAUST FROM UP TO 70% EFB**
- **LOW FOULING, EASY CLEANING AND MAINTENANCE, HIGH RELIABILITY**
- **ISOTHERMAL**
- **FAST REACTION AND DOES NOT REQUIRE PREHEATING**
- **OPERATIONAL SINCE 2015**



# MANAGING AIR POLLUTION: PROVEN EME SOLUTION



- USE OF EXCITED WASH WATER TO DIVIDE THE EXHAUST GAS STREAM THROUGH SPRAY NOZZLE TO ACCELERATE THE PARTICULATE MATTER ABSORPTION AT THE GAS/WATER DROPLET INTERFACE
- LIGHT WEIGHT AND NOVEL WET SCRUBBER APPROACH
- ASSURANCE OF STEEL SCRUBBER PROTECTED AGAINST CORROSION VIA THE PH OPERATING RANGE OF 7.5 TO 9.5 AND BY DIRECT EXCITATION PROTECTION SYSTEM

**SCHEMATIC DIAGRAM OF PM REMOVAL BY WET SCRUBBER SYSTEM**



# MANAGING AIR POLLUTION: PROVEN EME SOLUTION KEY PROCESSES OF WET SCRUBBER SYSTEM

- EXHAUST GAS CLEANING PROCESS

THE DIRTY EXHAUST GAS STREAM WILL ENTER SIDE WAY OF THE SCRUBBER CHAMBER LAYER 1. SOME SMALL AMOUNT OF THE PARTICLE WILL IMPACT THE WALL AND COLLECTED IN THE BOTTOM INVERTED CONE SHAPE COMPARTMENT. THE MANY PART OF THE PARTICULATE MATTER WILL BE REMOVED BY THE NOZZLE'S SPRAYED EXCITED WASH WATER AT LAYER 2 AND 3. THE CLEANED GAS WILL THEN FLOW OUT OF THE SCRUBBER TOP AND RE-ENTER THE EXISTING 1.4 M DIAMETER CHIMNEY AT AROUND 8 TO 9M LEVEL FROM THE GROUND LEVEL.

- WASH WATER CIRCULATION, EXCITATION AND SPRAYING PROCESS

THE WASH WATER LADEN WITH PARTICULATE MATTER WILL THEN FLOW THROUGH THE SCRUBBER WATER SEAL AT RESPECTIVE LAYER BACK TO THE WASH WATER TREATMENT TANK. IN THIS WATER TREATMENT TANK, THE WASH WATER WILL BE EXCITED BY THE EREXSO PMA TRANSMITTER. THE EXCITED WASH WATER WILL THEN PUMP BY THE CLOSED LOOP CIRCULATING PUMP TO THE LAYER 2 AND 3 FOR SPRAYING.

- RESIDUAL SIDE STREAM CIRCULATION AND REMOVAL PROCESS

A SIDE STREAM RESIDUAL REMOVAL SYSTEM EQUIP WITH A SMALL PUMP. HYDRO-CYCLONES AND SLUDGE COLLECTION TANK WILL BE USED TO REMOVAL THE PARTICULATE MATTER IN THE WASH WATER FOR OTHER REUSE FUNCTION.



# MANAGING AIR POLLUTION: SYSTEM DESIGN PARAMETERS

<b>Boiler Capacity</b>	<b>: 20 ton/hr</b>
Designed Gas Flow rate	: 54000 ft <sup>3</sup> /min
Operation	: 24 hrs/day
Exhaust Gas Quality	
Temperature	: 250 -300 °C
Dust Concentration	: 400 - 700 mg/Nm <sup>3</sup>
Treated Gas Quality	
Temperature	: <60 °C
Dust Concentration	: <150 mg/Nm <sup>3</sup>
Wash Water	
Flowrate	: 300 ± 50 m <sup>3</sup> /hr
Pressure	: 3.0 ± 0.5 bar
Temperature	: 50 ± 10 °C
Water Consumption	: 0.5 – 1.0 m <sup>3</sup> /hr



# MANAGING GHG EMISSIONS: CHALLENGE

- IN PALM OIL MILLS, MORE THAN 90% OF GHGS WERE EMITTED FROM POME. POME ALSO HAS THE POTENTIAL TO RELEASE METHANE GAS INTO THE ATMOSPHERE. THE EFFECT OF METHANE ON CLIMATE CHANGE IS 23 TIMES MORE SIGNIFICANT THAN THE EFFECT OF CO<sub>2</sub>.
- NEW MILLS AND EXISTING MILLS SEEKING TO INCREASE THE ANNUAL CAPACITY BEYOND 270,000 TONS FFB ARE MANDATED TO INSTALL BIOGAS CAPTURE FACILITIES.
- IN RESPONSE TO DEMANDS FOR SUSTAINABLE PRODUCTION OF PALM OIL, MILLERS HAVE INVESTED IN BIOGAS CAPTURING PLANTS. BIOGAS IS THEN USED AS A FUEL IN THE BOILERS, GENERATING POWER FOR SUPPLY TO THE GRID OR CONVERTING BIOMETHANE PRODUCED TO BIO COMPRESSED NATURAL GAS.



# MANAGING GHG EMISSIONS: PROVEN EME SOLUTION

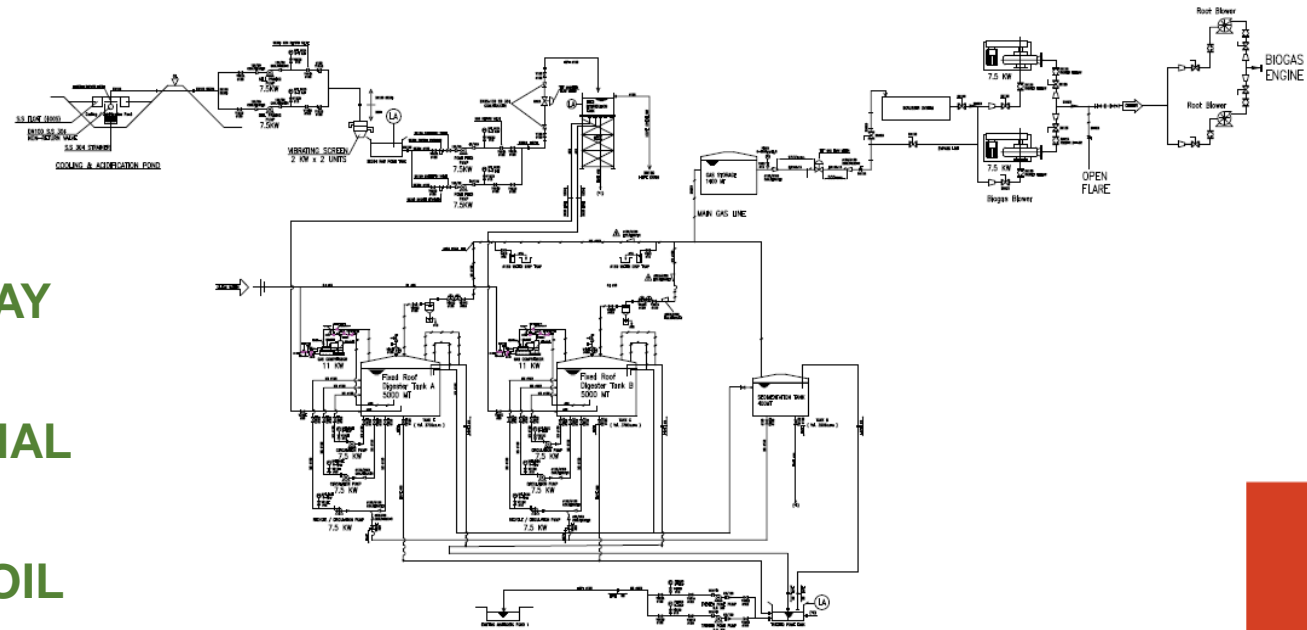


- **TREATMENT AND CAPTURE OF BIOGAS USING CONTINUOUS STIRRED TANK REACTOR (CSTR) ANAEROBIC DIGESTION PROCESS WHICH THE REMOVAL EFFICIENCY UP TO 80% AND BOD REMOVAL EFFICIENCY UP TO 95% WITH A HYDRAULIC RETENTION TIME OF 18-20 DAYS**
- **MITIGATE METHANE EMISSIONS THAT WOULD OTHERWISE ESCAPE FROM LANDFILLS OR MANURE LAGOONS**
- **UTILIZATION OF BIOGAS GENERATED FROM METHANE CAPTURE FOR ELECTRICITY ALLOWS TRANSITION TO RENEWABLE ENERGY USAGE**
- **GHG EMISSIONS REDUCTION**



# MANAGING GHG EMISSIONS: PROVEN EME SOLUTION PROJECTS COMPLETED IN MALAYSIA, INDONESIA AND AFRICA

- 720 M3 POME/DAY BIOGAS PLANT AT JERAM PADANG PALM
- OIL MILL, BAHAU, NEGERI SEMBILAN.
- POWER GENERATION TO GRID 2 MW
- 360 M3 POME/DAY BIOGAS PLANT AT PALM BAY PALM OIL MILL, LIBERIA, AFRICA
- POWER GENERATION OF 500 KW FOR INTERNAL FACILITIES
- 700 M3/DAY BIOGAS PLANT AT AWALA PALM OIL MILL, GABON, AFRICA
- INCLUDING POWER GENERATION PLANT (800KW).





# MANAGING GHG EMISSIONS CHALLENGE: DISCARD OF EFB PROVEN EME SOLUTION: HIGH VALUE PELLETS

- IMPROPER DISCARD OF EMPTY FRUIT BUNCHES - EFB - RENDERS MASSIVE GREENHOUSE GASES.
- EME TECHNOLOGY CONVERTS EFB INTO ENVIRONMENTALLY SUSTAINABLE PELLETS. BY TURNING AGRI WASTE INTO PELLETS - WE REDUCE METHANE EMISSIONS.
- WHITE PELLET, COMMONLY USED FOR CO-FIRING PURPOSE, ARE USED FOR CO-FIRING AND BIOMASS FUEL REPLACEMENT
- HIGH VALUE BLACK PELLETS ARE USED AS DROP-IN REPLACEMENT FUEL FOR COAL-FIRED POWER PLANTS.
- EME IS CURRENTLY DESIGNING AND BUILDING THE WORLD'S FIRST EFB BLACK PELLET INDUSTRIAL PLANT IN MALAYSIA.

# MANAGING GHG EMISSIONS: EME PROVEN SOLUTION



**PRESSED AND  
SHREDDED EFB**



**STEAM EXPLODED EFB**



**BLACK PELLETS**

Test Items	Unit	Result	Method
Total Moisture, arb	%	4.1	ISO 18134-1
Inherent Moisture, adb	%	4.0	ISO 18134-3
Ash, adb	%	1.9	ISO 18122
Volatile Matter, adb	%	77.4	ISO 18123
Fixed Carbon, adb	%	16.7	BY CALCULATION
Gross Calorific Value, adb	mj/kg	21	ISO 18125
Net Calorific Value, arb	mj/kg	20	ISO 18125
Net Calorific Value, adb	mj/kg	20	ISO 18125
Net Calorific Value, db	mj/kg	21	ISO 18125
Sulfur, db	%	0.02	ISO 19579
Carbon, adb	%	52.01	ISO 16948
Hydrogen, adb	%	6.07	ISO 16948
Nitrogen, db	%	0.36	ISO 16948
Oxygen, adb	%	39.61	BY CALCULATION
Chlorine, arb	%	0.01	ISO 587
Sodium, Na (db)	ppm	75	ASTM D6349 - IN HOUSE
Potassium, K (db)	ppm	363	ASTM D6349 - IN HOUSE

**EME EFB BLACK PELLET IS THE WORLD'S**

**FIRST PELLET TO BE A DIRECT**

**DROP-IN COAL REPLACEMENT**

# MANAGING GHG EMISSIONS PROVEN EME SOLUTION

## OIL PALM BIOMASS

Oil Palm  
Trunk



Empty Fruit  
Bunch



Palm Kernel  
Expeller



PELLETS	STANDARD
Ash	4-6%
Moisture	Below 10%
Calorific Value	4,000 kcal/kg
Bulk Density	Above 600kg/m <sup>3</sup>
Pellet Diameter	8mm
Length	Below 40mm

## CONVENTIONAL WHITE PELLETS



# MANAGING GHG EMISSIONS EFB BLACK PELLETS VS CONVENTIONAL WHITE PELLETS

- **BLACK PELLET WILL GO THROUGH THERMAL TREATMENT, A SUPERIOR FUEL TO CONVENTIONAL WHITE PELLETS.**
- **ELIMINATION OF THE NEED FOR DRY STORAGE AND TRANSPORTATION**
- **BETTER GRINDABILITY AND LESS DUST FORMATION DURING HANDLING AND STORAGE**
- **HIGHER SPECIFIC ENERGY DENSITY.**
- **WHITE PELLETS ARE NOT REQUIRED TO GO THROUGH STEAM TREATMENT HENCE THEY ARE LESS EXPENSIVE TO PRODUCE BUT DISINTEGRATE WHEN WET**
- **POWER REQUIREMENTS FOR PULVERIZING BLACK PELLET ARE SIGNIFICANTLY LOWER THAN WHITE PELLETS**



# CLOSING REMARKS

**EME OFFERS UNIQUE PROVEN TECHNOLOGIES TO DECARBONIZE THE PALM INDUSTRY.**

**AN OPPORTUNITY FOR VISIONARY COMPANIES TO INVEST IN TRAILBLAZING AND ENVIROMENTALLY FRIENDLY HIGH-VALUE COST EFFICIENT SOLUTIONS IN THE WESTERN HEMISPHERE.**

**PLEASE COME AND VISIT US TO WITNESS UNPARALLEL PIONEERING SOLUTIONS AT WORK.**

**THANK YOU !**







# CALIFICA A NUESTRO CONFERENCISTA



Thing Jin Suan