

Increase Palm Oil Production Sustainability

POME methane capture and utilization

Kor Zwart, Yuca Waarts and Luc Bonten



Ex Ante Assessment

- Zebra Industries
- Dutch Company, owner of palm oil plant
- Palembang, Sumatra, Indonesia



Plant information

- Plan to double capacity to 100 thousand tons of FFB annually
- Transition from open POME pond to closed POME processing



Assessment of Effects on

- Economy, social welfare
- Environmental sustainability
- Nutrient recycling

Assessment of Effects on

- Economy, social welfare
- Environmental sustainability
- Nutrient recycling



Environmental Sustainability Assessment including

- Biogas production
- Savings in diesel consumption
- Effects on GHG emissions
- Further prospects biogas

Sustainability Methodologies Used

- UNFCCC – CDM
- EU – BIOGRACE

- Baseline: Original Situation
- Project: Capturing and utilization of biogas

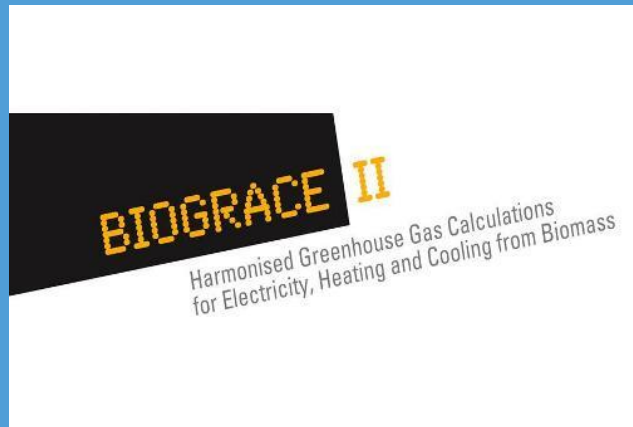
UNFCCC CDM GHG methodologies used

- Electricity production
- Methane recovery in wastewater treatment
- CO₂ emissions from leakage of fossil fuel combustion
- Emissions from flaring gases containing methane



EU-BIOGRACE methodology

- Renewable Energy Directive (2009/28/EC)
- Fuel Quality Directive (2009/30/EC)



- Here restricted to the CPO extraction process
- <http://biograce.net/>

Baseline Situation: Open POME Pond

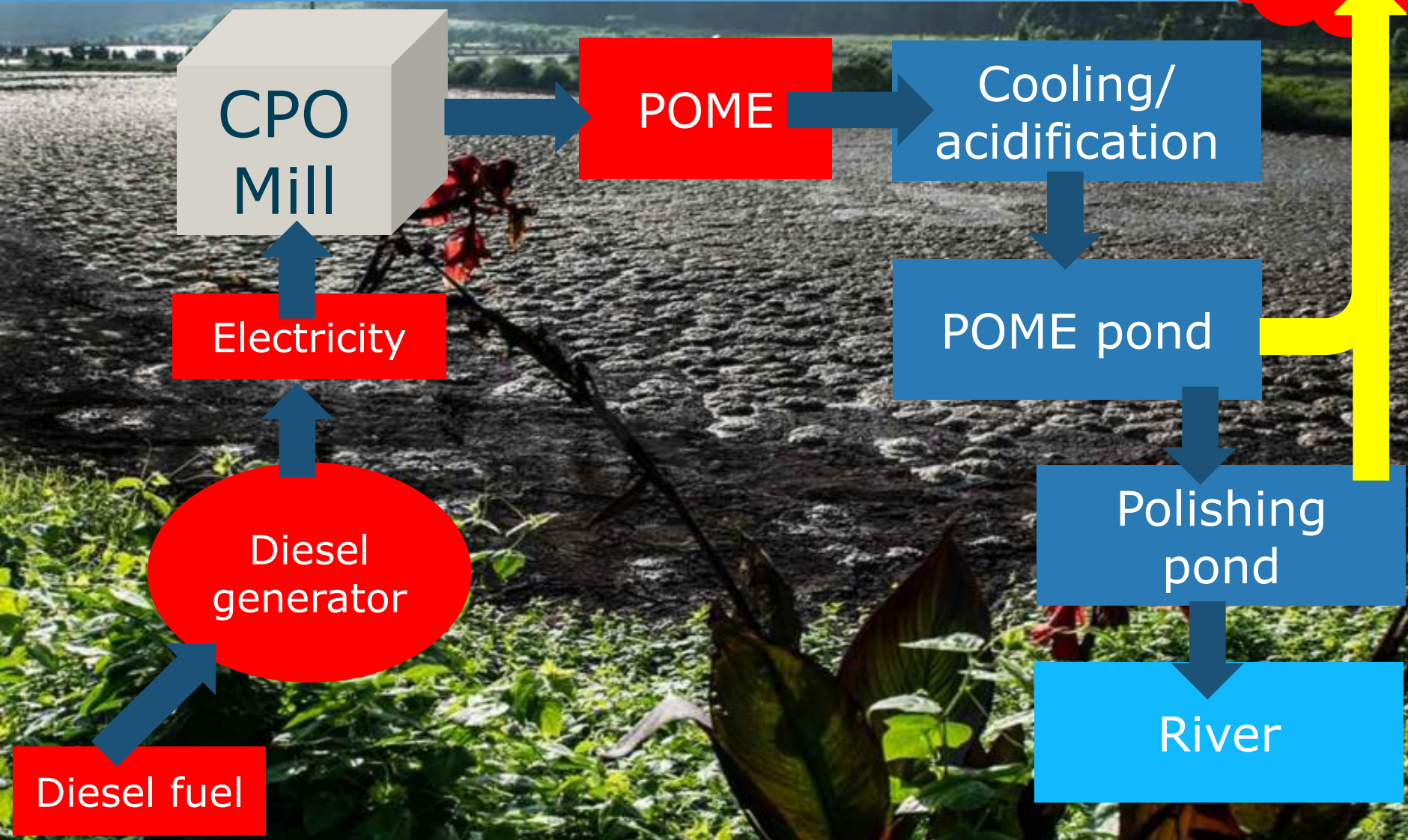


ALTERRA

WAGENINGEN UR

Baseline Situation: Open POME Pond

CH₄



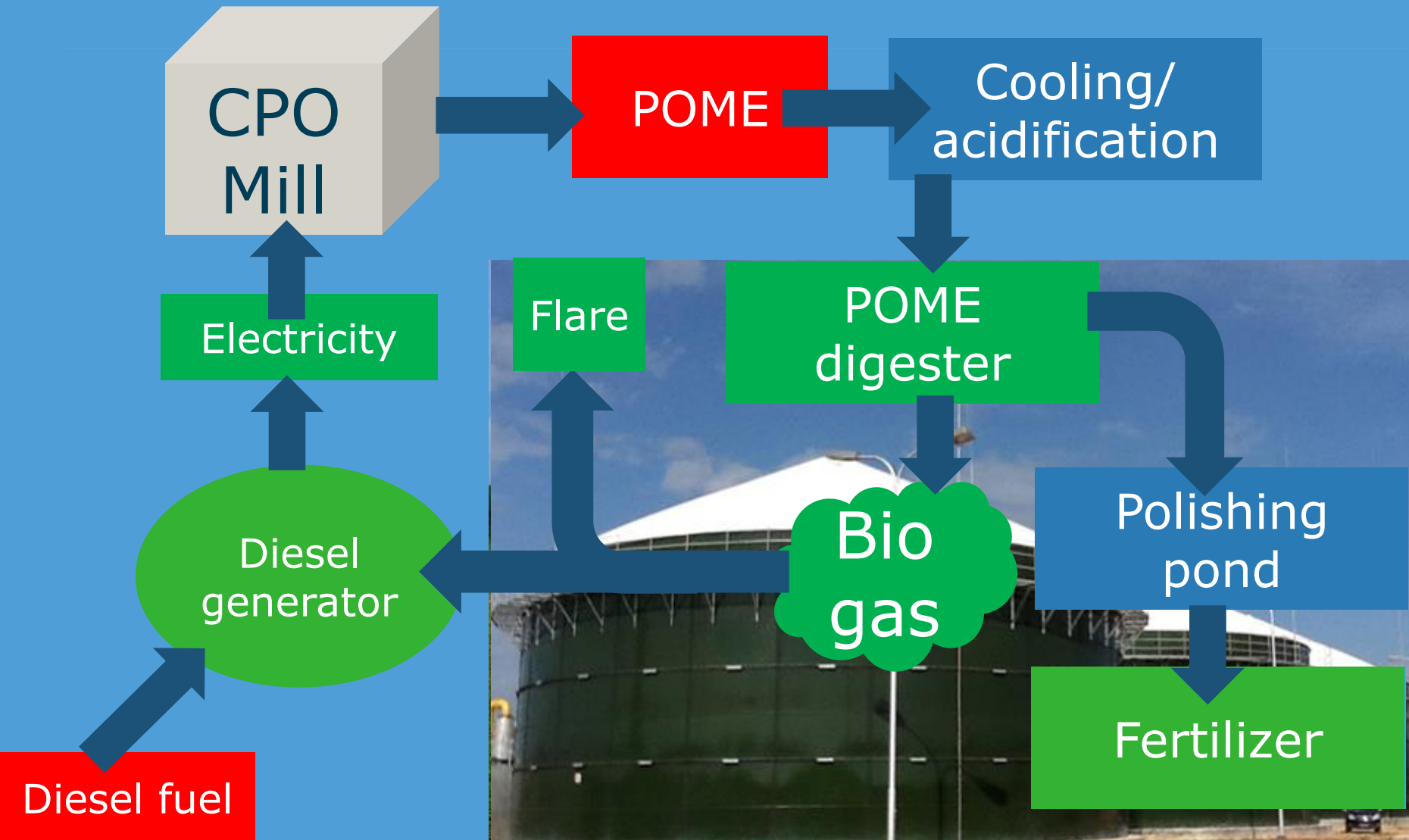
Project Situation: POME Methane Capture



ALTERRA

WAGENINGENUR

Project Situation: POME Methane Capture

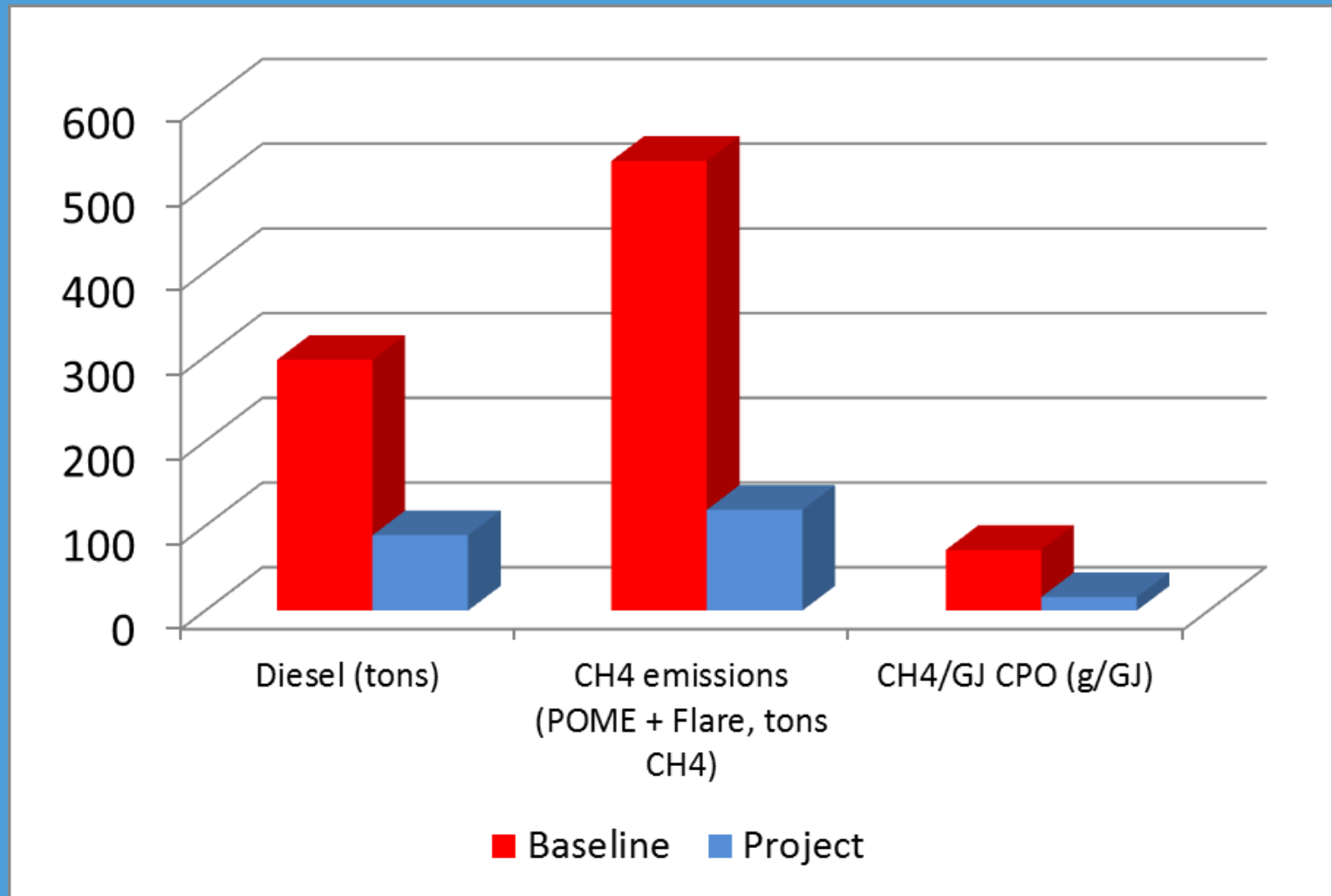


Summary Baseline & Project situation

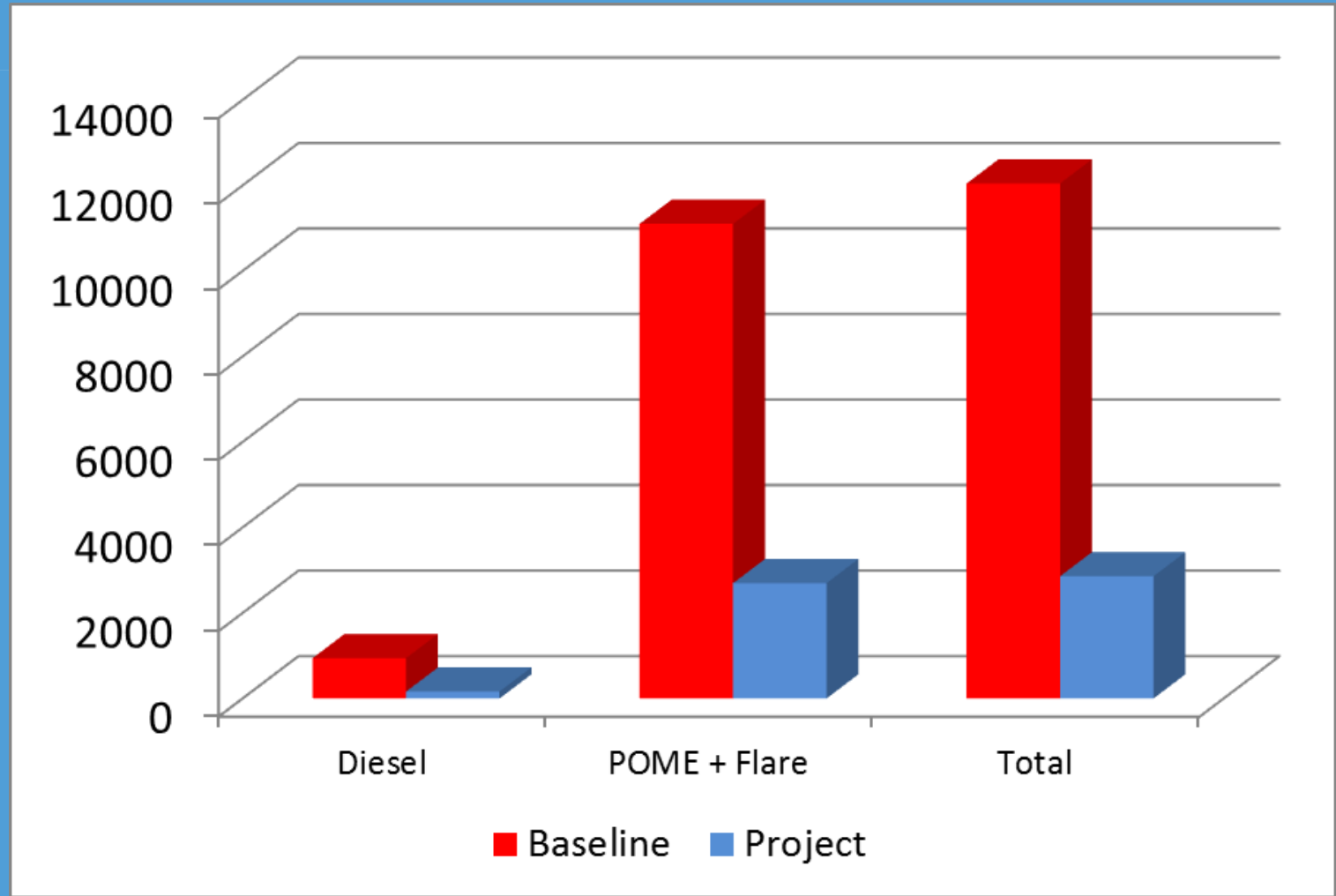
	Baseline	Project
POME treatment	Open pond	Methane capture
Electricity	100% diesel	70% biogas / 30 % diesel
Flare	Absent	Present



Results: Diesel use and Methane emission



Results: GHG emissions (tons CO₂ annually)



UNFCCC vs BIOGRACE



ALTERRA

WAGENINGEN **UR**

UNFCCC vs BIOGRACE

	UNFCCC	BIOGRACE
	Tons of CO2 - emitted	
Baseline	11,150	21,300
Project	1,850	4,700
Reduction	9,300	16,600



Parameter values

Parameter value	UNFCCC	BIOGRACE	Unit
CO2 eq CH4	21	25	g CO2/g CH4
CO2 eq diesel	74.1	87.64	g CO2 / MJ
CH4 / CPO	0.7115	1.32	g / MJ
CH4 / CPO (if captured)	0.1178	0	g / MJ
CPO / FFB	0.2015	0.344	kg/kg
CPO LHV	37	37	MJ / kg
Diesel LHV	43	43.1	MJ / kg
Steam from CHP	0.0156	0.0156	MJ / MJ CPO
Steam from CHP (if captured)	0.0047	0.0047	MJ / MJ CPO
Oil yield	0.2811	0.53	MJ / MJ FFB



Parameter values

Parameter value	UNFCCC	BIOGRACE	Unit
CO2 eq CH4	21	25	g CO2/g CH4
CO2 eq diesel	74.1	87.64	g CO2 / MJ
CH4 / CPO	0.7115	1.32	g / MJ
CH4 / CPO (if captured)	0.1178	0	g / MJ
CPO / FFB	0.2015	0.344	kg/kg
CPO LHV	37	37	MJ / kg
Diesel LHV	43	43.1	MJ / kg
Steam from CHP	0.0156	0.0156	MJ / MJ CPO
Steam from CHP (if captured)	0.0047	0.0047	MJ / MJ CPO
Oil yield	0.2811	0.53	MJ / MJ FFB

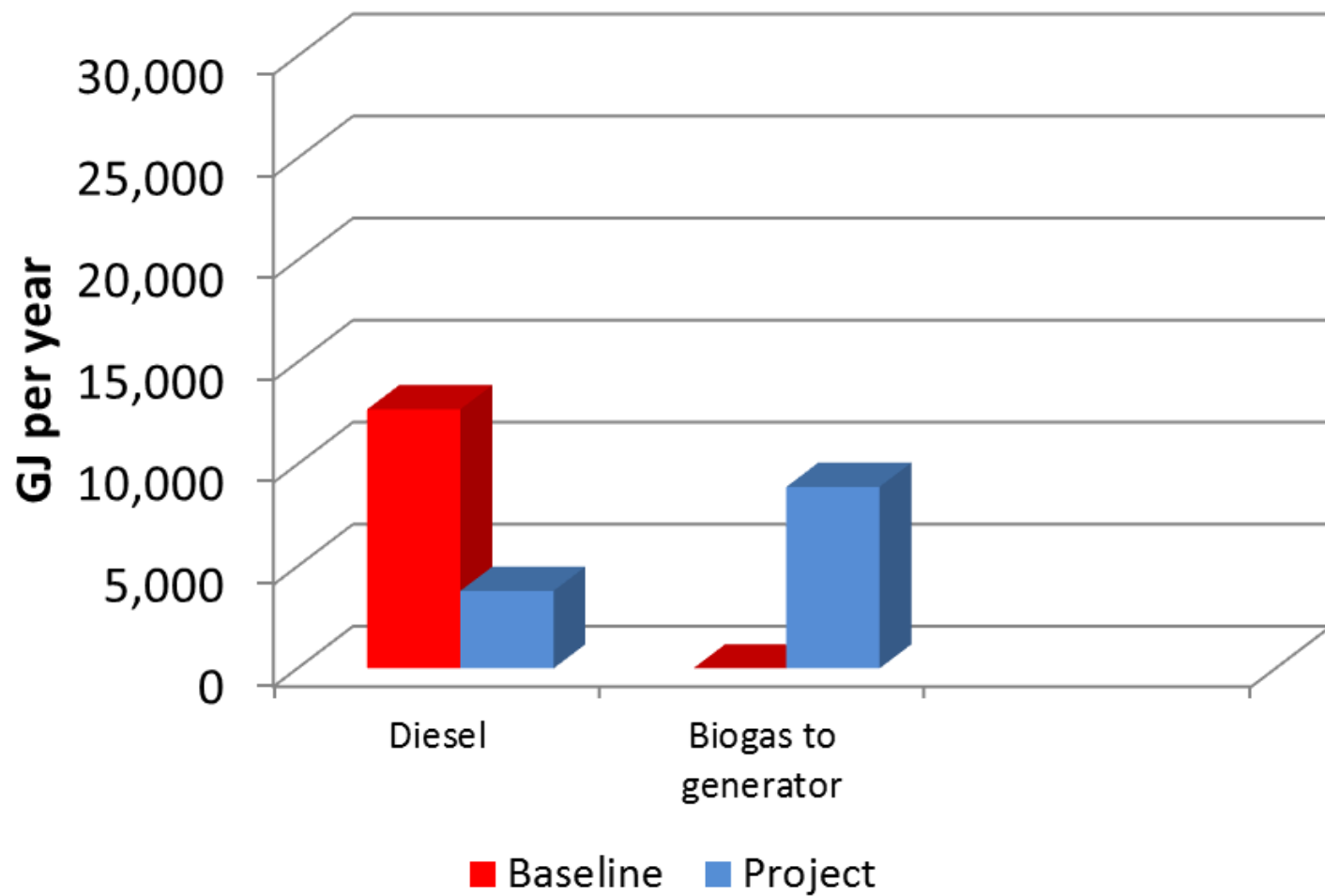


IF UNFCCC = BIOGRACE parameters

	UNFCCC	BIOGRACE
	Tons of CO2 - emitted	
Baseline	16,300	19,800
Project	3,150	3,500
Reduction	13,150	16,500

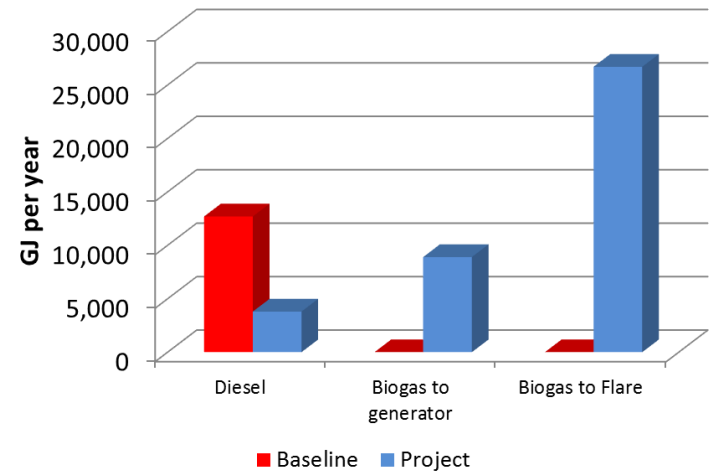


Further improvements?



Further improvements?

- Capture and utilize flared gas
- Removal of H₂S and water
- Compression
- Local cooking, Transport.....



Indonesian national context, potential production

Indonesia

CPO production	28.5	million tons
POME production	99.8	million tons
Potential Methane production	1.0	million tons
Potential Electricity production	14.1	billion kWh
Representing	7.7%	of total Indonesian electricity production

Malaysian national context, potential annual production

Malaysia

CPO production	18.9	million tons
POME production	66.2	million tons
Potential Methane production	0.68	million tons
Potential Electricity production	9.4	billion kWh
Representing	8.9%	of total Malaysian Electricity production



Future: Power to Biogas?

- Doubling the methane concentration in biogas
- How?



Power to Biogas

Doubling the biogas production

Concept

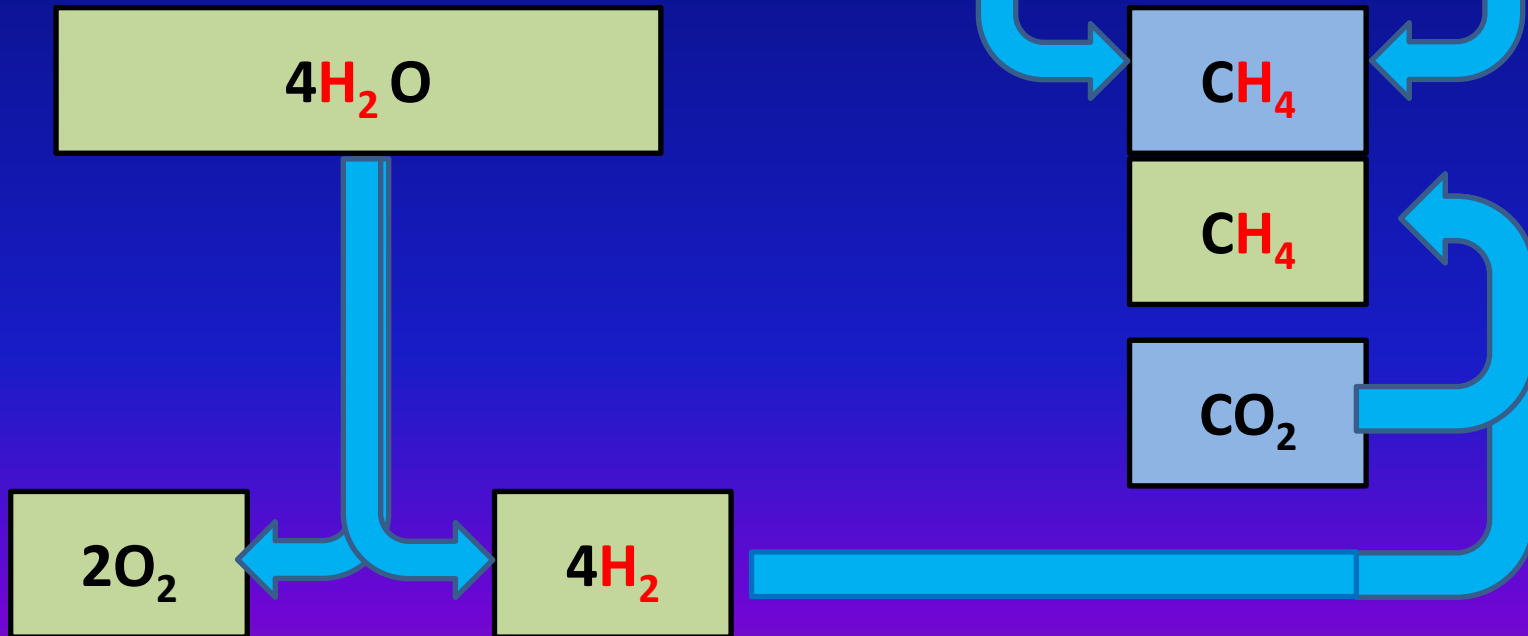
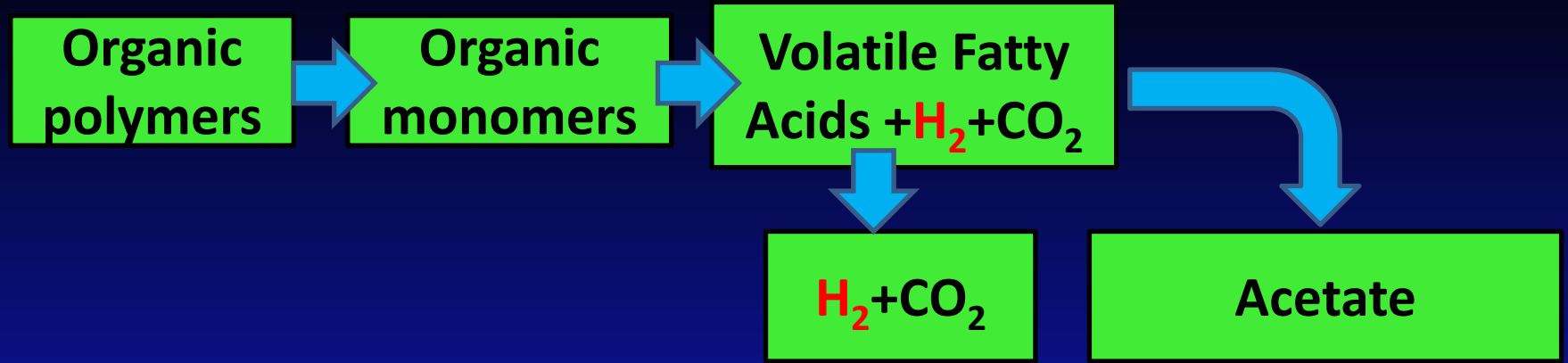
Biogas process

Biological conversion of biomass into
 CH_4 and CO_2

Hydrolysis

Acidification

Acetogenesis



Elektrolysis

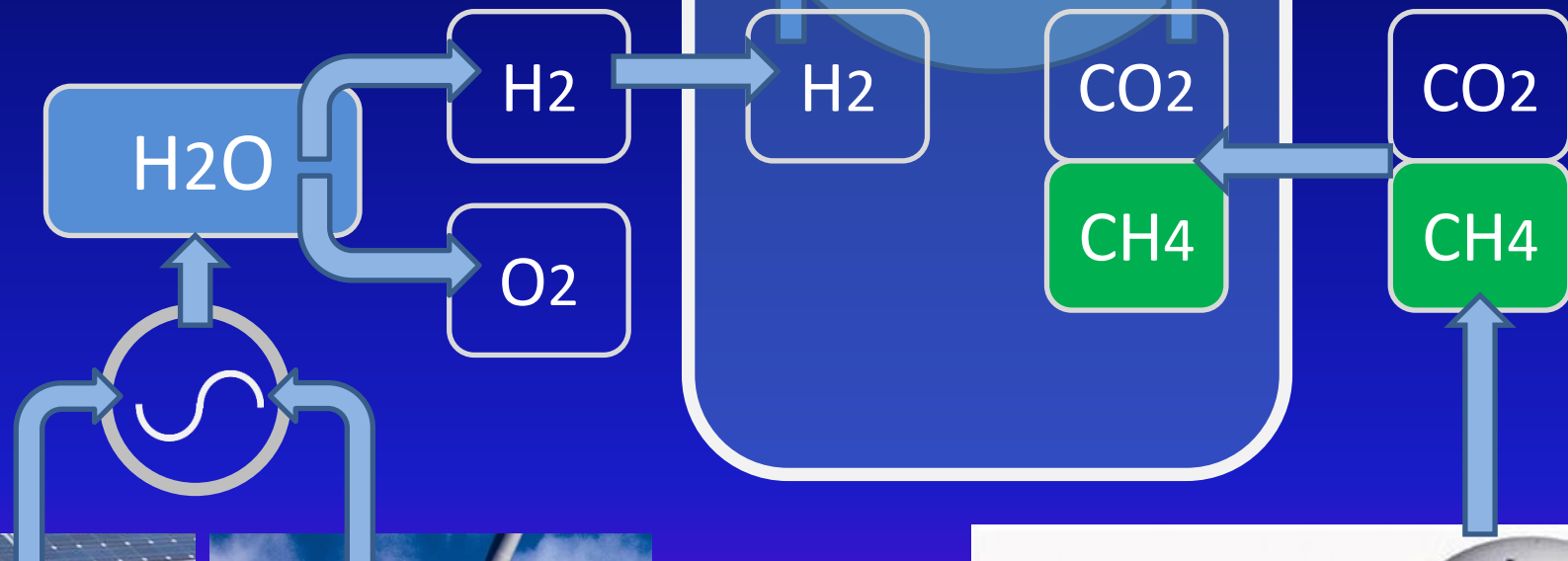
Methanogenesis

Biomass + Sun/Wind

MB



Methane + Oxygen

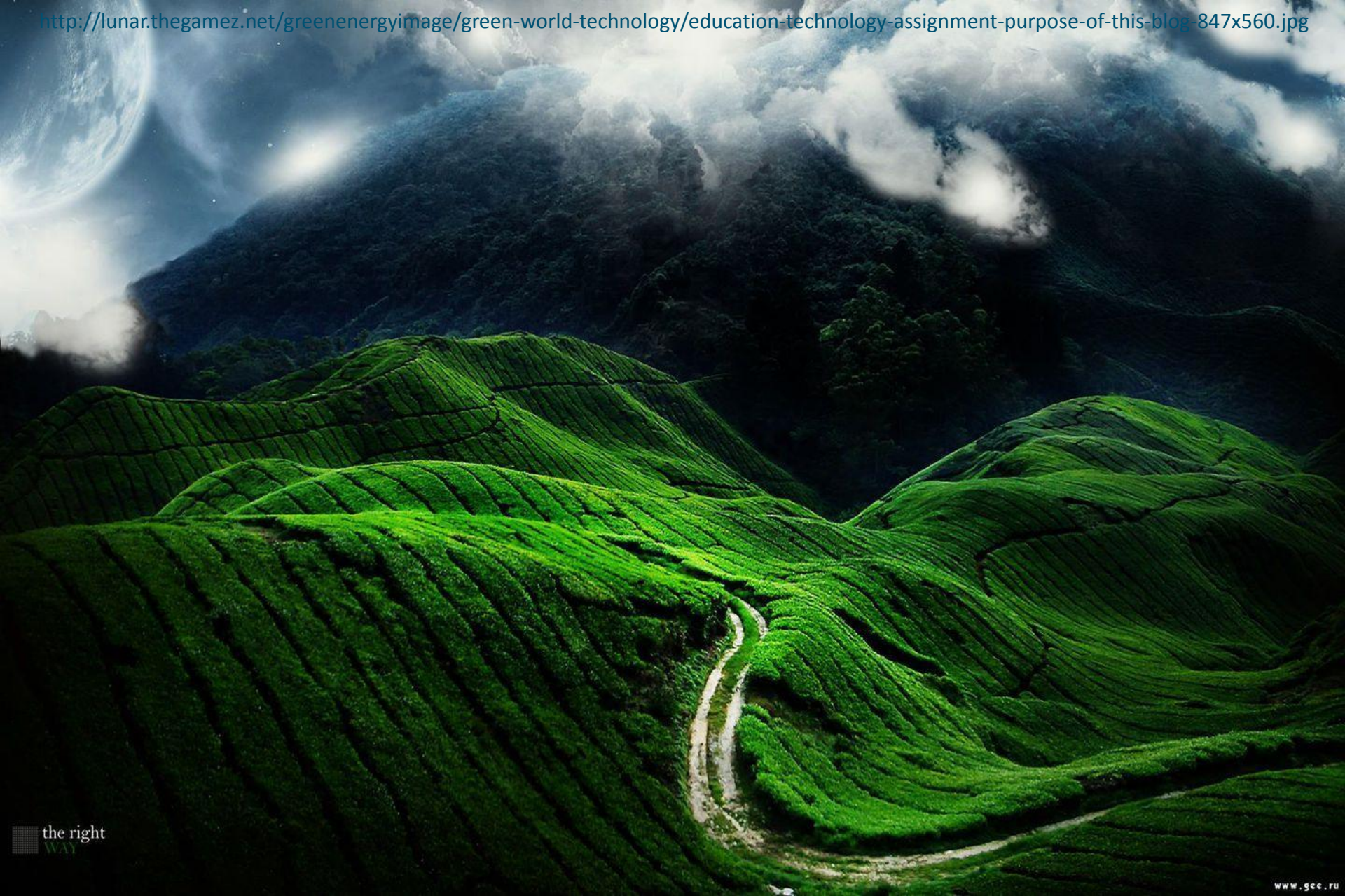


Conclusions Environmental assessment

- CPO production becomes more sustainable by
 - Capturing, utilization and flaring of POME methane through
 - Reduction fossil fuel use
 - Reduction GHG emissions by 80%
- UNFCCC and BIOGRACE give similar outcomes, if the same parameter values are applied

Conclusions Environmental assessment

- Further GHG reduction is possible
 - if excess gas is used too instead of being flared
- Methane concentration in biogas can potentially be increased to 100% by using Power to Biogas



www.gee.ru



WAGENINGENUR

For quality of life