

New Britain Palm Oil Ltd Carbon Footprint Report 2011

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Executive Summary

This is the first carbon report for New Britain Palm Oil Limited (NBPOL), presenting an analysis of the company's carbon footprint, mitigation strategies and projections of carbon reductions over the next 5 years.

The data and methodology presented forms the basis towards delivering on its *'zero net carbon emissions'* commitment. This commitment is an extension of NBPOL's significant efforts towards reducing its impact on climate change and global warming. Previous initiatives go back to 1969, where NBPOL adopted a "no burn policy" for new developments, and includes a 2002 commitment to reducing all emissions, including greenhouse gases, as well as a "no planting on peat" policy in 2010.

Work on this report was initiated in 2009. It is based on data from the Group's largest site in West New Britain, Papua New Guinea as well as its New Britain Oils Refinery in Liverpool, UK (New Britain Oils). The report is the first phase of NBPOL's target to account for the Group's carbon footprint in its entirety by 2013.

The total net emissions for NBPOL, West New Britain Plantations, mills and refinery and New Britain Oils, Liverpool refinery have been determined for 2010. 92% of these derive from land use conversion and palm oil mill effluent. Total net emissions are:

West New Britain	269,140	tonnes of CO2eq
Liverpool Refinery	39,256	tonnes of CO2eq

This has been broken down and apportioned to palm oil products produced on site and from the refinery in Liverpool.

The carbon cost of Crude Palm Oil (CPO), Palm Kernel Oil (PKO), Palm Kernel Expeller (PKE) and Refined Products from the West New Britain operations is

0.90	tonnes CO2eq	per tonne of CPO
0.22	tonnes CO2eq	per tonne of PKO
0.22	tonnes CO2eq	per tonne of PKE
0.92	tonnes CO2eq	per tonne of Refined Product

The transport to, and production of refined products from, Liverpool resulted in a carbon cost of Refined Deodorised and Bleached oil (RBD) and Palm Fatty Acid Distillate (PFAD) of :

1.26	tonnes CO2eq	per tonne of RBD
0.07	tonnes CO2eq	per tonne of PFAD

Emission reductions have been estimated from work on methane capture. Reductions, based on current 2010 emissions are expected to be:

2012	30% reduction, with net emissions at 188,591 t CO ₂ eq
2014	50% reduction, with net emissions at 134,708 t CO ₂ eq
2016	70% reduction, with net emissions at 80,825 t CO2 ₂ eq

In addition to enabling internal improvement, the report also ensures that NBPOL can contribute to customers' carbon accountability and reductions, which is a cornerstone in remaining the leading supplier of traceable and sustainable palm oil. NBPOL is a large scale integrated, industrial producer of sustainable palm oil in Australasia. Headquartered in Papua New Guinea (PNG) it now has over 75,000 hectares of planted oil palm plantations, a further 5,000 hectares under preparation for oil palm, over 8,000 hectares of sugar cane and a further 9,500 hectares of grazing pasture, (some of which will be converted to oil palm); twelve oil mills; two refineries, one in PNG, and one in Liverpool, UK; and a seed production and plant breeding facility. The Company is quoted on both the Main Market of the London Stock Exchange and on the Port Moresby Stock Exchange in PNG.



Sustainability at New Britain Palm Oil Ltd

NBPOL is fully vertically integrated, producing its own seed (which it also sells globally) and planting, cultivating and harvesting its own land and processing and refining palm oil, in both PNG and the UK. It also contracts directly with its end customers in the EU and arranges shipping of its products.

NBPOL has high regard for the importance of its sustainability credentials and is active in proving its performance through ISO 14001 certification and a close involvement and support of the Roundtable on Sustainable Palm Oil (RSPO) ⁽¹⁾, as well as in developing standards for both PNG ⁽²⁾ and Solomon Islands ⁽³⁾. The Company is a certified supplier of sustainable palm oil from the entire production base in West New Britain Province, at Ramu Agricultural Industries Ltd (RAIL) in PNG, and its entire Solomon Islands estate, under the RSPO guidelines. Operations in Poliamba were audited against the RSPO standard in 2011 and have been recommended for certification. Higaturu and Milne Bay Estates will be audited against the same standard in December 2012 and a rolling program will see all sites certified to ISO 14001 by 2016.

In September 2011, the World Economic Forum (WEF) together with The Boston Consulting Group ⁽⁴⁾ identified New Britain Palm Oil Ltd as one of 16 out of a study of 1,000 companies from across the developing world that best demonstrate how to grow profits while actively tackling environmental and social challenges. Describing NBPOL, the WEF report says that "the company has developed new ways to engage small farmers, who provide one-third of the company's supply. These close ties have not only helped to reduce poverty, but also enabled the company to develop one of the world's first fully traceable palm oil supply chains." In 2002, NBPOL committed to reducing all emissions, including greenhouse gases. Some elements had already been established, such as our zero burn policy for new developments which was introduced in 1969. Throughout the evolution of the RSPO, NBPOL has been active in developing and refining greenhouse gas (GHG) aspects in the standard. In 2009 NBPOL initiated carbon footprint measurements. As a result NBPOL declared a "no planting on peat" policy in 2010 and concluded the first phase of the carbon measurements in 2011 with the generation of a carbon calculator which has become "PalmGHG" the RSPO's approved methodology for calculating emissions.

NBPOL is acutely aware that the issues of climate change and reduction of GHG emissions are part of the broader definition of being a responsible palm oil producer. Operating a fully traceable supply chain, direct to customers also means sharing in their accountability for reducing carbon emissions. The first step to reducing carbon footprint is to determine what the Group's operational emissions are.

Scope and methodology

This report outlines NBPOL's strategy to measure and reduce emissions across the entire Group. It presents Phase one in this strategy which is the determination of the carbon foot print for its palm oil production operations in West New Britain and the UK refinery. It calculates emissions from palm tree to refinery products based on currently available science and data.

- It models and predicts reduction in these emissions as a result of operational changes.
- It outlines NBPOL's no net loss of carbon strategy for expansion.

By providing accurate data on the emissions resulting in the production and processing of palm oil this report provides transparency and accountability to NBPOL's stakeholders. NBPOL welcomes comments and suggestions to improve this report.

The report is a first attempt at identifying, enumerating and reporting on actual emissions in an oil palm agricultural environment. It is part of NBPOL's commitments to ISO 14000 and the RSPO Principles and Criteria under its sustainability continuous improvement programs. It is an evolving work which will be added to and reported on as the emission calculations for other operating sites are determined. It is to be read in conjunction with the 2007/8 and 2009 NBPOL Sustainability report (to be published in 2012).

At the heart of the report is the "Carbon Calculator" which was developed by Laurence Chase and Dr. Ian Henson using a variety of publications and scientific research (Appendix 1). Working for Global Sustainability Associates (the consulting wing of NBPOL) and together with Dr. Simon Lord, Director of Sustainability for NBPOL the calculator has been revised and updated from the authors original concept (7) which itself drew on 35 separate publications (Appendix 2). The calculator has been adopted by the RSPO and is now called "PalmGHG", the RSPO Greenhouse Gas Calculator. The modelling of sensitivities in response to historic and current operational changes is the sole work of NBPOL. This report acknowledges the management and staff of West New Britain, particularly the scientists at NBPOL's Dami Oil Palm Research Station, who have contributed their time and efforts to ensure accurate and complete data sets.

The methodology employed is consistent with a Life Cycle Assessment (LCA) calculating emissions from "cradle to gate" and beyond, into refined palm products. Whilst it does not satisfy a complete "cradle to grave " approach it does capture and account for some 95% of all gross emissions. As yet the report has not been independently verified and hence does not meet the requirements of the ISO 14064 or the reporting standards of The Carbon Trust ^(B) although elements of each are incorporated.

The data present is relevant only to NBPOL operations and to New Britain Oil products. Application of this data and the derived calculations to palm oils from other sources would be misleading.

The data is based on best available science for the area of operations. Some aspects such as carbon stocks of vegetation prior to conversion and emissions from peat are still areas of debate. No account of the positive effect of sequestration from set aside land (High Conservation Value, riparian and wildlife reserves) has been included. Other uncertainties, such as the actual reduction in emissions due to Methane Capture of the palm oil mill effluent, will remain as predictions until commissioning of the plants determine the absolute values.

The Carbon Calculator

The calculator estimates major sources of GHGs and balances this against carbon sequestration in the oil palm crop and in the mill products and by products. It converts all of these to carbon dioxide equivalents (CO_2eq) over the 21 year life span of the crop and expresses the results in CO_2eq per tonne of Crude Palm Oil (CPO).

The production of CPO results in the release of carbon from Land Use Conversion (LUC) and of greenhouse gases namely, carbon dioxide (CO₂), methane (CH₄) and Nitrous Oxide (N₂O) from production and processing of the crop into oil and transport of the oil to market. Balancing this is the ability of oil palm to sequester carbon during growth (Figure 1).



Figure 1: Diagram showing approximate mass flows for the production of one tonne CPO and the main sources of GHGs – redrawn from Henson and Chase 🕅

Boundaries

The methodology includes calculated emission and sequestration from both directly managed lands and smallholders. The report is based on data from 2008 to 2010. The unit of reporting is the West New Britain site which comprises one refinery, four mills, ("Waraston" mill was commissioned post data collection), 55,976 hectares and over 8000 smallholders. All gross emissions are allocated to the individual mills and then aggregated to give final figures for crop products.

The calculator does not include sequestration from carbon offset areas such as riparian reserves, set aside high conservation value forests and conservation value areas, slopes and fragile soil areas or afforestation and reforestation projects. In West New Britain, 14% of the total concession is held in these reserves. In addition, sequestration in palm products is not included as this is short lived.

Size, change and materiality thresholds are calculated to the actual value and presented to two decimal places or 0.1% of total emission contribution.

The calculator determines and models direct net emission scope 1 and 2 ^(B) resulting from generation of heat, steam and electricity for processing, transportation of inputs to the field and crop from the field. It excludes transportation of employees and fugitive emissions (personal and business transport, emissions resulting from housing, such as lighting and septic, refrigerants, and fire extinguishers). All energy which is consumed in company-owned or controlled equipment or operations is derived from company controlled sources. The calculator also accounts for indirect emission (scope 3) with the exception of non-processing waste and procurement.

With the calculator it is now possible to go beyond these simple approaches and determine the potential success of adopting mitigation strategies and to apply these across the Group to reduce the net carbon footprint.

Work continues to input data for all operations into the calculator. Once completed, it will be possible to view The NBPOL Group's entire emissions on a net basis. The project will be completed by June 2013. Phase one (West New Britain) will be completed with the publication of this report and the remaining program is as follows:

Operation	Phase	Hectares (Estate)	Cumulative % of Group	Target Completion	Status
West New Britain	1	35,427	45.5	Dec 2011	complete
Guadalcanal *	2	6,316	53.6	June 2012	on target
Ramu Agri-Industries	2	10,206	66.7	June 2012	on target
Poliamba	3	5,668	74.0	Dec 2012	yet to start
Milne Bay	3	11,305	88.5	Dec 2012	yet to start
Higaturu	4	8,892	100.0	June 2013	yet to start

* Solomon Islands, all other operations in PNG

The data is derived from the specific PNG and Solomon Islands vegetation carbon data, NBPOL processing, transport, yields and oil palm growth data and is therefore only applicable to NBPOL operations and New Britain Oil products.

West New Britain

In 2010, The West New Britain (WNB) site processed 1.29 million tonnes of fruit, had average yields of 25.8 and 19.0 tonnes of fruit per hectare for plantations and smallholders respectively. From this fruit production 290,830 tonnes of Crude Palm Oil was produced, of which the refinery at West New Britain processed 69,726 of Crude Palm Oil with the balance exported to Europe.

The WNB operations (including smallholders) have been certified to the RSPO sustainability standard (certificate SPO 537355) and have been independently audited since 2008 ⁽⁶⁾.

For all vegetation and sequestering calculations only aboveground carbon was measured. NBPOL does not have the capacity to measure below ground carbon except to determine soil type.

The following components are included in all calculations

- Land use conversion (change)
- Land preparation

- Planting and upkeep of immature crop including fertilisers and transport
- Mature crop upkeep, fertilizer use and transport
- Harvesting and fruit collection
- Smallholders
- Yields
- Crop carbon sequestration
- Crop processing and carbon sequestration in mill products and by-products
- Mill waste product emission
- Transport

New Britain Oils refinery

CPO oil is shipped to destinations in Europe as fully segregated on contracted ships. A total of 221,104 tonnes of CPO was shipped from West New Britain. Of this, 29,642 tonnes were processed by NBPOL's New Britain Oils Liverpool refinery.

The fully traceable supply chain from WNB to Liverpool is independently audited to the RSPO supply chain standard for segregated Crude Palm Oil, certificate BMT-RSPO-000001 ⁽⁹⁾.



CPO arriving at New Britain Oils in Liverpool, UK

Emissions

Total net emissions from the West New Britain operations for 2010 were calculated at 269,416.71 t CO_2eq . The production of mill products from WNB resulted in the following emissions per tonne of product:

2010 GHG

Product ex Kimbe	t CO₂eq/t
CPO	0.90
РКО	0.22
PKE	0.22
Refinery products	0.92

The transport to and production of refined products from the UK, Liverpool refinery resulted in net emissions of 39,256.72 t of CO₂eq and the production of refined products resulted in the following emissions per tonne of Refined Bleached Deodorized (RBD) and Palm Fatty Acid Distillate (PFAD) products:

2010 GHG

Product ex Liverpool	t CO₂eq/t
RBD	1.26
PFAD	0.07

Sources of emissions

There were six major sources of gross emissions from NBPOL operations in West New Britain. In order of importance these are: Land clearing; palm oil mill effluent (POME); nitrogenous fertilisers; fertiliser transport; fuel in other transport and mill diesel usage. Of these land use conversion and palm oil mill effluent accounts for 92% of all gross emissions(Figure 2). The remaining 8% is split between fertilizers and transport. These six sources are believed to capture 95% of all emissions in the LCA. This report will deal with each.



Land Use Conversion (LUC)

Clearing and conversion of land prior to planting oil palm comprises 66% of all emission. This is the most significant contributor. In West New Britain the previous land types were a mixture of heavily logged-over forest, coconut plantations, gardens and earlier plantings of oil palm. Previous land use was determined from records which date back prior to 1985. Values of above-ground carbon were derived from specific research ⁽⁷⁾ and from published scientific papers (Appendix 1 and 2). Determination of carbon sequestration of oil palm was based on research data from NBPOL's Dami Oil Palm Research Station.

Land clearing assumptions	C t / ha	t CO₂eq/t
Heavily logged Forest	90.20	330.7
Coconut	75.00	275.0
Gardens / slash and burn	8.50	31.2
Peat	-	54.6
Oil Palms	80.31	294.5

Conversion of carbon in the standing biomass was based on a factor of C to CO₂ of 3.666. The carbon figure for logged-over forest is based on the work by Fox etal (10). Carbon per hectare was estimated to be 50% of the dry biomass and is based on the various wood densities for different species and their derived estimate for Above Ground Biomass took into account living biomass, coarse woody debris, non-living biomass and fallen trees. Although Fox etal did sample forests on New Britain Island in PNG, there were only 4 observations which were close to NBPOL's operations and therefore the figure (90.2 tonnes) derived from 114 samples across PNG for selectively harvested lowland tropical forest was used to represent standing carbon levels. The figure of 90.2 tonnes of carbon per hectare still has a standard deviation of 25.6 (giving rise to an data range of between 64 and 115 tonnes) and may therefore still be an over or under estimate.

Selectively harvested lowland forest accounts for 49.5% of all previous land use, replanted oil palm for 34.5%, slash and burn gardens 11.8%, and replants on coconut 4.2%.

Carbon footprint

Peat

Emissions from land use conversion are also affected by soil type. Peat is dealt with separate from land use, as clearing peat soils results in annual and not "one off" clearance emission. A figure of 54.6 t of CO₂eq per hectare is used to determine peat emissions. The National Interpretation guidelines of the RSPO standard in PNG defines "extensive" peat as being greater than three metres in depth and occurring in a contiguous area of over 150 hectares ⁽²⁾. NBPOL originally used a precautionary approach in assigning areas as peat, labelling entire fields even if only a small fraction contained peat soils of any depth. NBPOL's sustainability 2008 and 2009 reports ^(5, 6) stated that the area planted on peat in West New Britain was 400 hectares of non-contiguous fragments. As part of the research for this report the areas of peat were re-examined in detail.

The actual area of peat soils has been determined at 88.3 hectares of which the largest contiguous area is only 66.5 hectares. Despite peat plantings accounting for only 0.15% of the total planted area in West New Britain they contribute 0.39% of all gross emissions.

Once oil palm is planted there is little that can be done to reduce emissions from previous vegetation types and the carbon cost in emissions must be borne through the entire life cycle of the palm. Although management of peat soils can minimize emissions such practices are not practical on the small areas of peat soils found within West New Britain.

Sequestration

Oil palm sequesters carbon from the environment and locks it up in the biomass of trunk, fruit bunches and fronds. This carbon sequestering (or sink) takes into account trunk, roots, pruned and shed fronds and their bases, male flowers and ground vegetation associated with oil palm cultivations ⁽⁷⁾. In addition the amount of carbon sequestered in processed products from the mill is also accounted for. Total standing carbon contained in palm trees in West New Britain is calculated to be 80.31 tonnes of carbon per hectare at 21 years. On average, oil palms in West New Britain add 4.06 tonnes of carbon per hectare per year producing a time averaged sequestration rate of 14.89 t CO₂eq/ha/year.

Mill Operations

The contribution of methane from mill effluent digestion to overall emissions is 25.97% and represents the second most significant source of emission.

Methane evolves from the lagoons used to treat the mill effluent produced from processing oil palm fruits. This effluent (there are no chemical additions) has a high organic content and this is reflected in the amount of oxygen required for microbial break down of the waste. Palm oil mill effluent (POME) is traditionally treated in a series of open lagoons (both anaerobic and aerobic) in order to reduce the organic burden before release. The capturing of methane and its use as a fuel represents a significant opportunity to reduce overall emissions and to offset diesel fuel used to generate electricity heat and steam at the processing mills. This is discussed in the mitigation and reduced emission strategies of this report.

An oil mill is largely self sufficient in energy due to the use of palm biomass as fuel with diesel used only for start up and transport. Diesel usage accounted for only 0.59% of total gross emissions and was the smallest contributor.



Traditional method of POME treatment in open lagoons

Carbon footprint

Fertilisers

The application of nitrogen fertiliser releases nitrous oxide (N_2O) and accounts for 2.95% of all gross emissions whilst the manufacture and transporting of the fertilisers, from source to site, adds a further 2.90%. Together these two components are the third largest source of gross emissions at 5.85%.

Mature upkeep of oil palm plantations involves pruning of aging fronds which are recycled in the field. A leguminous cover crop is also grown amongst the palms. Empty fruit bunches and POME are both used as organic fertiliser in addition to inorganic applications of Nitrogen, Potassium and Phosphate. All are precision-applied in a mechanized process. Urea is not used as a source of N fertiliser in West New Britain.

In the calculator the various rates of Nitrogen and Potassium, applied as fertiliser, are derived across the entire age of the palms both for plantations and smallholders. The calculator then sums the amount immobilized in the biomass, that which is removed in the harvested crop, and then subtracts nutrient inputs in rainfall and adjusts the final figure for fertiliser uptake efficiency which currently has a low default value of 60%. Fertilizer uptake efficiency will affect emissions and research at the PNG Oil Palm Research Association may result in this figure being amended. No account of emissions from recycled fronds or from the cover crops is included. Further research may assist in putting a value to these.

Nitrogen fertiliser can be applied in a number of different compounds and the calculator accepts these and estimate the amount of N_2O evolved. The application of empty fruit bunches and POME also results in the formation of N_2O and the calculator models projected denitrification in the soil and indirect denitrification through runoff, leaching and volatilization.

Transport

The calculator adds together the fuel used for transporting of crop from the field, the fuel used by tractors on the estates in all aspects of operations, the fuel used by road trucks for transporting crop products and the fuel used in the bulking station to pump the oil products on board the ships.

The transportation of all crop and crop products (up until the point of embarkation) as well as diesel usage from mechanization contributes only 1.14% of total gross emissions in West New Britain.



CPO being loaded to ship from West New Britain

Data modelling and predictions

Historically, and in the absence of data, NBPOL's approach had been to adopt avoidance strategies, as in the case of avoiding land containing peat and primary forest. With the advent of the calculator, NBPOL can now move forward to a more proactive stance. The calculator uses the best available scientific data to accurately calculate current emissions (Appendix 1 – references 1-18). Using the data set it is possible to model various scenarios and predict future emission. The modelling also allows performance evaluation of previous strategies in terms of emission reduction as well as determining their ongoing usefulness. Once vegetation is removed prior to planting oil palm, most of the carbon is lost. NBPOL has a zero burn policy and all vegetation is left *in situ* to return to the soil as organic matter. However calculations as to what fraction of the carbon is sequestered in the soil and what is emitted are incomplete therefore only mitigated by sequestration of the crop is considered in the model. If the vegetation removed is of a higher carbon stock than the oil palm can sequester, the result is net emissions. For palms already planted, these emissions will occur year on year throughout the life span of the palms until they are replanted, which in NBPOL's case is 21 years.

Avoidance of primary forest

Estimates of carbon stock values for lowland primary forest in PNG is provided by Fox *etal*, 2010 ⁽¹⁰⁾, and is stated to be between 98.3 – 143.3 with a mean of 120.8 t C / ha. The lower productivity of PNG forests compared with the highly productive *dipterocarp* forests of S.E. Asia is thought to be as a result of El Niño –Southern Oscillations which has cyclically induced drought in 1972, 1982, 1988 and 1998 and caused serious fires. NBPOL does not plant on primary forest and by strictly following the RSPO sustainability standard, NBPOL has reduced potential emission from forest conversion significantly. Modelling what emissions would have been had WNB replaced primary forests with oil palm over the last 23 years (Table 1) a potential reduction of between 42% and 82% has been achieved.

Table 1: Modelled Changes in Net Emissions with increasing oil palm planting on primary forest.

Primary Forest	Total Net Emissions t CO₂eq	CPO t CO₂eq/t	RBD t CO₂eq/t	Increase in Net Emissions over base scenario of zero primary forest
(%)		Ex Kimbe	Ex Liverpool	
0*	269,140	0.90	1.26	0
49.5**	383,024	1.29	1.63	42%
65.5***	490,536	1.63	1.95	82%

* West New Britain current emissions.

** West New Britain - assuming all planted forest was primary (excludes areas of replanting, coconuts and gardens)

*** West New Britain - assuming all plantings were on primary forests (excludes areas of replanting)



Primary rainforest in West New Britain

By followed a policy of no planting on primary forests, WNB has decreased its net emissions by 82% and this carbon saving is carried on up through the supply chain to NBPOL's customers and is reflected in the lower CPO and RBD product emissions (Table 1).

Clearly planting on primary forest or any forest with a high carbon stock carries with it a heavy GHG emission burden. Had NBPOL not followed RSPO sustainability guidelines, and had its operations been located in Southeast Asia where the carbon stock of forests is higher (Fox *etal*,⁽¹⁰⁾ cite 243, 256 and 260 t C / ha in East Kalimantan, Sabah and Sarawak respectively) the net emission increase would have been at least 300%.

Avoidance of planting on peat

Estimates of the total peat area in PNG, range from 500,000 to 2,894,200 hectares (Page, 2010, ⁽¹¹⁾). NBPOL is committed to not planting on peat. Currently peat plantings are only 88.1 hectares, which is 0.15% of the total planted area of NBPOL operations in West New Britain. The model allows the current situation in West New Britain to be compared with an ideal situation where peat is completely excluded and to look at what emissions would arise if peat planting increased. Table 2 summarizes this data. The calculated increase in total net emission from this 88.1 ha planting is 1.24%.

Had NBPOL not followed a policy of not planting on peat, the models predicts that emissions would have risen, and the carbon cost of this carried on up through the supply chain to NBPOL's customers (Table 2).

By further modelling, the data allowed predictions on the emissions generated by increased plantings on peat. For every 1% increase in the land planted on peat the emissions increase by approximately 5%. Peat rapidly becomes the single largest source of emissions.

High GHG emissions are associated with planting on peat. The very low incidence of peat plantings within NBPOL operations in West New Britain reduces the group's exposure to emissions. NBPOL remains committed to its no planting on peat policy.

Peat area	Total Net Emissions t CO₂eq	CPO t CO₂eq/t	RBD t CO₂eq/t	Increase in Net Emissions over base scenario of zero primary forest
(%)		Ex Kimbe	Ex Liverpool	
0	266,119	0.89	1.25	0
0.15*	269,140	0.90	1.26	1%
1	279,717	0.93	1.29	5%
10	402,094	1.37	1.70	51%
50	945,994	3.29	3.53	256%
100	1,625,868	5.69	5.81	511%

Table 2: Changes in Net Emissions with increasing oil palm planting on peat.

* West New Britain current emissions.

Replanting implications

At replant oil palm replaces oil palm. The average economic life span of palms in West New Britain is 21 years. Currently replanted oil palm accounts for 35.4% of all previous land use. As replanting progresses (at an average of 1.5% per year), this percentage will increase and as oil palm has a lower carbon stock than selectively harvested lowland forest, gross emissions from the estates will decrease over time. As food gardens and coconut plantations make up only 16% of the previous land use their combined low carbon stock values do not significantly affect the reduction in emissions from estates.

Offsetting this reduction is the 28% of the land that was previously cleared for horticulture by smallholders. The previous carbon value of this land was low (8.5 t C per hectare). Replanting this large area is sufficient to alter net emissions. Gradually replanting both estates and smallholders over the next 25 years will cause net emissions to increase by 8%. However, the increases in yield will have the reverse effect. Current yields are rising on average 1.15% per year. Smallholders have lower yields than estates but also show increases and have the greatest potential improvement. Modelling modest increase of three tonnes of fruit per hectare over the same period for both estates and smallholders will produce a reduction in emissions of 10% and hence a reduction of 2% in total gross emissions within the next ten years. Additional fuel costs associated with higher yields will increase emissions. The likely net effect of replanting on net emissions is neutral.

Methane capture

West New Britain has two methane capture projects nearing completion and a further two at the preliminary stages. The two plants in commissioning are CDM registered and in the process of complying with the WWF Gold Standard and be commissioned by March 2012. Using in-ground anaerobic digester the captured biogas will be used as fuel to generate electricity in three biogas engines at each site. Flares will be installed to combust any excess biogas that cannot be utilised in the biogas engines.

Total capacity installed for the first site (Mosa) will be 2,859 KWe. The new biogas renewable energy will completely displace the existing diesel fired electricity and the electricity generated by the project will be used to meet NBPOL's own energy demand and will also be sold to the grid. Annual average emissions savings over the crediting period are estimated to be 59,785 tonnes of CO₂eq / year.

At the second site (Kumbango), the renewable electricity from biogas will also displace electricity from a separate diesel based mini-grid system supplying power to the refinery and fractionation plant. The electricity generated by the project will be used to meet NBPOL's own energy demand at the facilities associated with and adjacent to the Kumbango oil mill and will also be sold to the grid. Total capacity installed will be 2,859 KWe with an annual average emissions saving over the crediting period of 62,790 tonnes of CO_2eq / year.

Both projects will help to increase the amount of environmentally safe, renewable electricity generated in Papua New Guinea. The project will also help promote the Clean Development Mechanism (CDM) in Papua New Guinea. The projects' contributions to sustainable development are transparently reported in accordance with the Gold Standard best practice guidelines.

The model also predicts emission reduction from methane capture strategies and renewable energy initiatives it predicts the following reductions in WNB as a result of the methane capture CDM projects are shown in Table 3.

CDM Projects	Total Net Emissions t CO₂eq	CPO t CO₂eq/t	RBD t CO₂eq/t	RBD t CO₂eq/t	Decrease in Net Emissions
		Ex Kimbe	Ex Kimbe	Ex Liverpool	(%)
0*	269,416	0.90	0.92	1.26	0
1	217,994	0.70	0.83	1.07	19
2**	168,253	0.63	0.63	1.00	38
3***	110,542	0.40	0.30	0.79	59
4****	49,112	0.15	0.22	0.55	88

Table 3: Changes in Net Emissions as a result of implementing methane capture CDM projects

* West New Britain current emissions.

** West New Britain Emissions in 2012 as a result of 2 CDM projects.

*** West new Britain Emissions in 2014 as a result of 3 CDM projects

**** West New Britain Emissions in 2016 as a result of 4 CDM projects

Emission reduction strategies

Independent calculation based on the methodology to determine CDM output show the following emission reductions as a result of the Mosa and Kumbango CDM projects (Table 4).

Table 4: Projected annual percentage reductions in Net Emissions as a result of implementing methane capture CDM projects at Mosa and Kumbango mills

Year Reductions	Gross Emission Reductions	Gross Emission Reductions	Combined	Calculated Reduction based on the 2010 emissions of 269,416.71 t CO₂eq
	Mosa	Kumbango		
2012	49,700	54,367	104,067	39%
2013	58,388	55,276	113,664	42%
2014	59,745	63,847	123,592	46%
2015	59,859	63,951	123,810	46%
2016	62,134	66,024	128,158	49%
2017	64,214	67,910	132,124	49%
2018	64,458	68,141	132,599	49%
Average	59,785	62,788	122,573	45.6%

For 2012 the calculations predict a 37.6% reduction in net emissions whilst the CDM methodology suggest a 38.7% reduction in gross emissions. Over the seven year crediting period the average emission reduction from the CDM calculations was 45.6%. The figures in the two tables differ slightly and possibly due to variance in the two methodologies and their derived calculations, e.g. net versus gross calculations. Until actual measurements are taken they both remain estimates.



Figure 3: Projected reductions in Net Emissions (2012-2018) as a result of implementing methane capture CDM projects at Mosa and Kumbango mills.

Emission reduction strategies

NBPOL intends to pursue methane capture projects at all sites. The current projects will have the following timeline:

Warastone (WNB)	2013	estimated reduction of 54,986 t CO ₂ eq per year
Sangara (Higaturu)	2014	no estimate – base calculations not done
Kapiura (WNB)	2014	estimated reduction of 64,150 t CO ₂ eq per year
Hagita (MineBay)	2015	no estimate – base calculations not done
Numundo (WNB)	2016	estimated reduction of 54,986 t CO ₂ eq per year

The remaining four sites will be phased in after 2016. Warastone mill has yet to be built and is not included in the base calculation for 2011. From the two methods the estimated emission reduction as a result of commissioning CDM projects in West New Britain will be between 37% and 45% in 2012 and 88% in 2016. It can therefore be conservatively stated that methane capture in West New Britain will result in the following net emission reductions:

2012	30% reduction, with net emissions at	188,591.69	t CO2eq
2014	50% reduction, with net emissions at	134,708.35	t CO2eq
2016	70% reduction, with net emissions at	80,825.01	t CO ₂ eq



Kumbango mill methane capture

Grassland in reduction strategies

Grasslands are variable in their carbon stock. Assuming a figure of 5 t C / ha $^{(12)}$ the model estimates that if all operations in WNB were planted on grass (excluding replants) then the GHG reduction would be 114% and if planting on grass replaced secondary forests the GHG reduction would be 108% (Table 5). Planting on such low-carbon stock vegetation dramatically reduces emission. However areas of grassland within PNG are fragmented. In Solomon Islands, where GPPOL operates, the area is almost entirely grassland. Work continues on determining the net emissions from these operations but suggest that a figure of $0.31 \text{ t } \text{CO}_2\text{eq/t}$ CPO at the Point Cruz Port Terminal is the likely outcome.

Table 5: Modelled reductions in Net Emissions as a result of increased plantings on grassland

Grassland	Total Net Emissions t CO₂eq	CPO t CO₂eq/t	RBD t CO₂eq/t	Reductions in Net Emissions
(%)		Ex Kimbe	Ex Liverpool	
0*	269,416.71	0.90	1.26	0
49.5**	-22,769.63	-0.10	0.31	108%
65.5***	-39,539.30	-0.16	0.26	114%

* West New Britain current emissions.

** West New Britain – assuming all planted area was grassland (excludes areas of replanting, coconuts and gardens)

*** West New Britain - assuming all planted area was grassland (excludes areas of replanting)



Grassland and pasture available for planting in the Ramu Valley

Emission reduction strategies



Overview of No Net Carbon Loss

Towards No Net Carbon Loss on expansion

Since little can be done to reduce emissions once the previous vegetation is cleared, the key to reducing emissions on expansion is the selection of low carbon areas. By balancing expansion on grassland with logged-over forest, it is possible to expand with no net carbon loss. In addition, actively planting trees on previously un-forested areas positively adds carbon into this simple balance.

This strategy is a mixture of avoidance and proactive mitigation through land selection. It uses the modelling calculation to avoid peat and forests whilst actively selecting low carbon areas and has *additionality* through the creation of carbon stocks. The development concept is in three phases.

Phase 1 The development of a carbon dioxide emission calculator and model, for existing operations, which will account for sequestration and emission along the entire supply chain and for all operations. The model will incorporate changes in practices as a result of the upcoming methane capture work (CDM) and grassland planting. The model will be used to determine sensitivities and allow NBPOL to focus on elements which have the greatest impact. This will allow targets for emission reduction to be calculated which are realistic, achievable and time bound. The outcome from the model will be used to report on our carbon footprint to the market place.

Phase 2 Acquisition of sub metre resolution satellite maps which, when coupled with radar imaging, will allow land use to be determined. False colour will be used to produce colour coded maps of likely carbon stock for a given area. The work will be correlated with key expansion areas and will be part of the High Conservation Value Assessments.

On the ground, evaluation of the carbon stock will occur at reference sites to link the colour with a calculated carbon value. The process will be similar to painting by numbers but in reverse. A colour will have a carbon number affixed and then all subsequent areas of the same colour will possess the same carbon number.

Phase 3 The "no net loss" balance sheet will be applied to ensure that all expansions are carbon neutral. Accounts will be made of secondary forests, grassland and re-afforested areas as well as potential carbon reserve sites.

The calculator and model are complete for West New Britain. Work has begun on acquiring satellite imagery and developing the techniques to determine carbon through remote sensing. The project is expected to be completed by 2013.

Implications for supply chains

A global survey of almost 250 supply chain executives by Accenture found that the majority of companies are now committed to reducing greenhouse gas emissions from their supply chains, but that only one in ten has accurate data on the carbon footprint of different components of their supply chain ⁽¹³⁾. To date, there has been little published information on the carbon footprint of oil palm from plantation to mill. In addition the complexity of the palm oil supply chain has meant that European consumers were unable to trace the origins of the oil used. Historically it has not been possible for many companies to accurately determine the impact of this ingredient in their own carbon accounting. This carbon report allows NBPOL customers to trace and account for the carbon contained within the oils they purchase from New Britain Oil.

Certification of NBPOL's production base, to both the ISO 14001 and RSPO standards provides assurance to customers of the social and environment credentials of the oil procured. Each of these standard demands yearly continuous improvement to be evident. Continuing re-certification therefore, not only demonstrates NBPOL's commitment to this improvement cycle but also the robustness of the management system. Carbon accounting has now been added to these credentials.

The construction of the New Britain Oils refinery in Liverpool not only anchored a palm oil supply chain that extends from PNG to the EU but also cemented the vertical integration of NBPOL's business (Figure 4). This same certified, fully traceable supply chain now allows carbon accountability along with the physical oil to flow downstream to NBPOL customers in Europe and to benefit from NBPOL's future emission reduction strategies.

NBPOL seeks to be a responsible and ethical producer of food ingredients delivering fully traceable palm oil direct to its UK customers. With this report, NBPOL establishes accounting and reporting of carbon as a key performance indicator in its drive for continuous improvement and its commitment to open and transparent communications.



Figure 4: NBPOL's fully certified and traceable supply chain from PNG to UK. Source: Worrell A. New Britain Oils

The atmosphere

The Earth is surrounded by an envelope of gas. The gases include Nitrogen (78.1%) Oxygen (20.9%) and other trace gases such as Argon and Helium. Some of the gases present affect the average weather (climate) occurring under this envelope. These gases cause changes to the mean and variability of relevant measures such as temperature, precipitation and wind.

Climate change

The International Panel on Climate Change (IPCC) refers to the changes in the relevant measures that persist for decades or longer as climate change ⁽¹⁴⁾. It includes any change whether due to natural variability or as a result of human activity.

Intergovernmental Panel on Climate Change (IPCC)

The international scientific body established by the World Meteorological Organization and the U.N. Environment Programme in 1988 to provide an objective and neutral source of information on climate change. The IPCC releases periodic assessment reports that are reviewed and approved by experts and governments ⁽¹⁵⁾.

United Nations Framework Convention on Climate Change (UNFCCC)

Adopted on 9 May 1992 and signed at the Rio de Janeiro Earth Summit, the convention established general principles to stabilize greenhouse gas concentrations and prevent dangerous human-caused interference with the climate system. The treaty includes requirements such as preparing national inventories of GHG emissions and a commitment to reduce emissions to 1990 levels. The convention has nearly universal membership, with more than 190 signatory countries ⁽¹⁵⁾.

The United Nations Framework Convention on Climate Change (UNFCCC) is more specific, defining climate change as being due to anthropogenic (man-made) causes. It defines climate change as "a change of climate which is attributable directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climatic variability observed over comparable time periods" ⁽¹⁵⁾.

Global warming

Changes in the global surface temperature are a relevant measure of warming in the atmosphere. Figure 5 is a time series showing the combined global land and marine surface temperature records from 1850 to 2010 1. The years 1998, 2003 and 2010 were the hottest on record ⁽¹⁶⁾.



Figure 5: Global air temperature 1850 - 2010 - redrawn from (11)

In the last 100 years, this temperature has increased by about 0.8 $^{\circ}\mathrm{C}$ with about two thirds of the increase occurring over just the last three decades.

Greenhouse effect

Broecker in 1975 ⁽¹⁷⁾, used the term "Global Warming" to describe the increase in the Earth's average surface temperature as a result of rising levels of greenhouse gases. In the Greenhouse effect (Figure 6) radiation from the sun reaches the Earth, with some being absorbed by the surface and some re-emitted. Most of the re-emitted radiation passes through the atmosphere and enters space but some is absorbed by gases in the atmosphere. The gases first trap, then re-emit the radiation as energy which warms up the gas envelope which in turn warms up the surface of the Earth. The greater the quantity of gases in the envelope which have the ability to trap and remit the radiation the greater the warming effect.



Figure 6: Schematic representation of the Greenhouse effect – redrawn from The Quiet Lion (2002).

Greenhouse gases

Greenhouse gases (GHG) are an important part of the Earth's natural cycle, keeping the planet warm enough to sustain life. Human activities are upsetting the balance, increasing the concentration of GHG to the point where rising temperatures threaten livelihoods, ecosystems and economies. The major GHGs and their contribution to the greenhouse effect (rounded up) are: water vapour (60%); Carbon Dioxide (26%); Methane (5%); Ozone (4%); fluorinated gases (4%); and Nitrous Oxide (2%).

Carbon dioxide (CO₂)

Carbon Dioxide is the most widespread greenhouse gas. CO₂ is released to the atmosphere through natural and human activities, including fossil fuel and biomass burning, industrial processes, and changes to land use, among others ⁽¹⁵⁾. Carbon dioxide accounts for 76.7% of emissions with 13.5% arising from agriculture and 17.4% from forestry.



Share of Global Emissions, in Carbon Dioxide Equivalent, 2004 (15)

CO2 from deforestation, biomass decay, etc. CO2 from cement production and gas flaring

CO₂ from fossil fuel use

Emissions by Sector, in Carbon Dioxide Equivalent, 2004 (15)



The Global Warming Potential (GWP)

GWP expresses a GHG's ability to trap and re-emit heat. As carbon dioxide is a very stable molecule, it lasts longer in the atmosphere and is emitted in greater quantities. All other gases GWP are expressed relative to its value over a 100 year period. For example, Methane has a Global Warming Potential which is 25 times greater than carbon dioxide.

Greenhouse Gas	Global Warming potential
Carbon Dioxide	1
Methane	25
Nitrous oxide	298

Carbon dioxide equivalent (CO₂eq)

A unit of measurement used to compare the climate effects of all greenhouse gases to each other. CO₂eg is calculated by multiplying the quantity of a greenhouse gas by its global warming potential (15).

Carbon footprint

The standard form of labelling emissions is therefore to express them as carbon dioxide equivalents or CO₂eq. For this reason reports on the emissions from human activity are referred to as carbon reports or carbon foot prints of an operation or product.

Carbon sequestration

Vegetation captures carbon dioxide from the atmosphere through the process of photosynthesis and releases oxygen, and some carbon dioxide, through respiration. Part of the Carbon is retained in the plant as biomass. In general half of the biomass of a plant is carbon, therefore as the plant grows and adds biomass it also adds or sequesters carbon. This is a natural process but it can be enhanced, for example, planting trees on land that has not previously had trees will sequester more carbon because of the increase in biomass. The term 'sink' is used to mean any process, activity or mechanism that removes a greenhouse gas from the atmosphere.

Afforestation and reforestation

Afforestation is creating forests, establishment of trees in an area where previously there was no forest where as reforestation is the re-building of forests, re-establishment of a trees in an area where the forest has been removed or reduced in size.

Clean Development Mechanism (CDM)

A mechanism under the Kyoto Protocol that allows industrial countries to meet their emission reduction targets by investing in low- or no-emission projects in developing nations. The CDM also aims to stimulate investment in developing countries ⁽¹⁵⁾.

WWF Gold Standard

The Gold Standard is an independently audited, globally applicable best practice methodology for project development that delivers high quality carbon credits of premium value along with sustainable development co-benefits associated with the projects. Created in 2003 by a small group of nongovernmental organisations, including WWF, today the label receives worldwide recognition and is officially supported by 51 charities, NGOs and environmental and development organisations. It was created to ensure top quality projects under a Kyoto instrument, the Clean Development Mechanism (CDM). It is the most widely endorsed quality standard for designing and implementing carbon offset projects ⁽¹⁸⁾.

Life Cycle Assessments

Life-cycle assessment is decision-support tool in assessing the cradle-to-grave impacts of a product or process. The "life-cycle" or "cradle-to-grave" impacts include the extraction of raw materials; the processing, manufacturing, and fabrication of the product; the transportation or distribution of the product to the consumer; the use of the product by the consumer; and the disposal or recovery of the product after its useful life ⁽¹⁹⁾.

International Standards Organisation (ISO)

ISO 14000 series of standards seek to foster continuous improvement through better environmental management systems. The ISO 14064 standards (2006) provide governments, businesses, regions and other organisations with an integrated set of tools for programs aimed at measuring, quantifying and reducing GHG emissions. The standards specify principles and requirements at three levels: organisational for quantification and reporting of GHG emissions; project level from quantification, monitoring and reporting of activities; guidance for those conducting or managing the validation and/or verification of GHG assertions ⁽²⁰⁾. These standards allow organisations take part in emissions trading schemes using a globally recognised standard ⁽²¹⁾.

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Appendix 2

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