R.E.A. HOLDINGS PLC

CARBON FOOTPRINT REPORT FOR 2011

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Executive summary

'A carbon footprint measures the total Greenhouse Gas (GHG) emissions caused directly and indirectly by a person, organisation, event or product.'

Definition from the Carbon Trust, UK

This inaugural carbon footprint report for R.E.A. Holdings plc and its subsidiaries (together "REA" or the "group") identifies and quantifies the greenhouse gas (GHG) emissions associated with the group's core business of producing crude palm oil (CPO) and crude palm kernel oil (CPKO) in East Kalimantan, Indonesia. This carbon footprint will facilitate the design and implementation of effective strategies for reducing the group's GHG emissions and will provide a baseline against which progress in achieving GHG reductions can be monitored and reported to stakeholders.

The scope of REA's first carbon footprint calculation incorporates the two palm oil mills, Perdana Oil Mill and Cakra Oil Mill, which were operational as at 31 December 2011, together with their plantation supply base. This includes 28,175 hectares of immature and mature oil palm planted by REA, representing 76% of the area that was planted or under development as at 31 December 2011, as well as oil palm cultivated by outgrowers. REA's third palm oil mill, Satria Oil Mill, which was commissioned in the fourth quarter of 2012, will be included in the carbon footprint calculation for 2013. The GHG emissions associated with each of the more recently developed plantation estates will be included in the carbon footprint calculation as soon as the first plantings within each such estate mature and start to supply one of the group's mills.

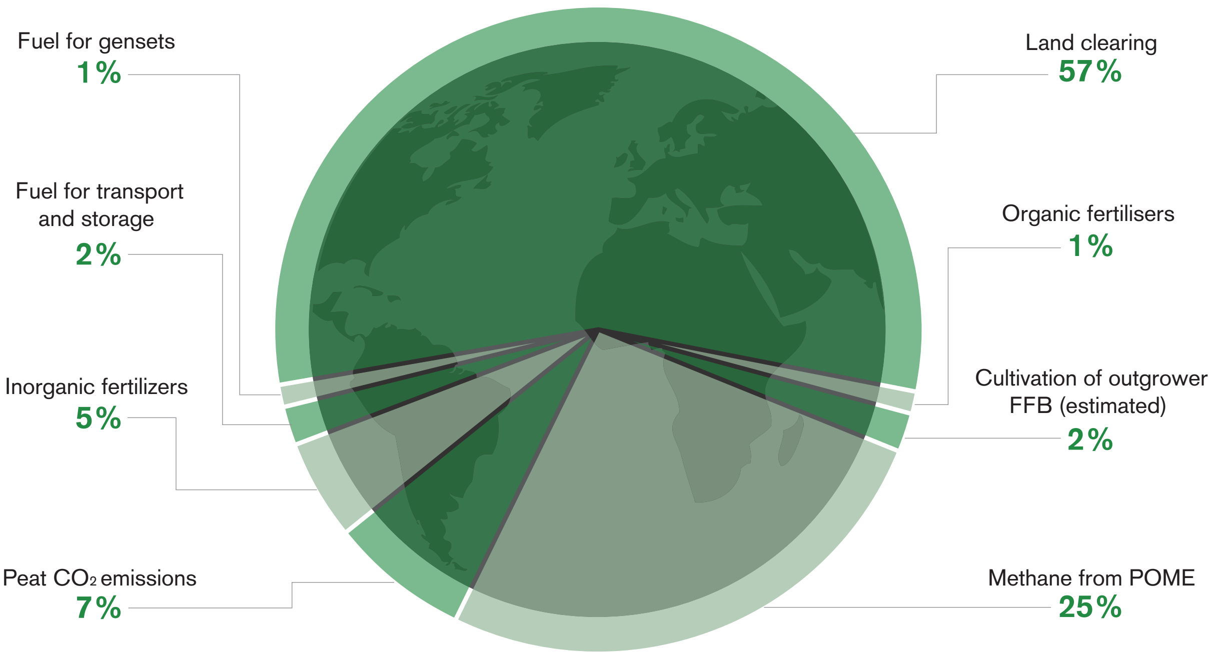
The carbon footprint calculation has been performed using the Roundtable on Sustainable Palm Oil (RSPO) 'PalmGHG' tool. This tool estimates the net GHG emissions associated with the production of palm oil at a particular mill by quantifying the major sources of emissions linked to the cultivation, processing and transport of oil palm products and offsetting these against any carbon sequestered or GHG emissions avoided. The results of the calculation are expressed as the net GHG emissions per tonne of product sold, which in REA's case is limited to CPO and CPKO as the group does not currently sell any of the palm kernel expeller (PKE) that it produces, preferring instead to use the PKE produced as a fertiliser substitute.

Net GHG emissions are also expressed per hectare of oil palm for the group's plantings that are included within the scope of the carbon footprint calculation. Since a proportion of such plantings are either immature or have yet to produce optimal yields, including such plantings in the carbon footprint means that the current carbon emissions per tonne of CPO and CPKO are higher than would be the case if all planted areas within the scope of the carbon footprint were fully mature. Net GHG emissions per hectare are therefore considered to provide a more meaningful basis for assessing changes in the intensity of GHG emissions from REA's oil palm operations than the net GHG emissions per tonne of oil palm product, given that fluctuations in the latter will reflect not only changes in management practices but also changes in the maturity profile of the plantation supply base.

REA's carbon footprint in 2011

Net GHG emissions	341,824 tCO_2eq
Per tonne CPO	2.2 tCO_2eq
Per tonne CPKO	5.6 tCO_2eq
Per planted hectare	11.6 tCO_2eq

GHG emissions by source



The major sources of GHG emissions in 2011 were land clearing (57%), methane emissions from the digestion of palm oil mill effluent (POME) (25%), planting on peat soil (7%) and the use of inorganic fertilisers (5%). Efforts to reduce these sources of GHG emissions include the production of carbon stock maps to inform future development, the introduction in 2010 of a policy to limit planting on peat and the construction of two methane capture facilities which were commissioned in 2012. The substitution of inorganic fertilisers with organic fertilisers produced from oil palm processing waste may also assist in reducing GHG emissions but this has yet to be verified. More detailed policies and targets for GHG emissions reduction will be developed over the course of 2013 as part of a continuing programme of work to manage and report on all aspects of sustainability in a more effective manner.

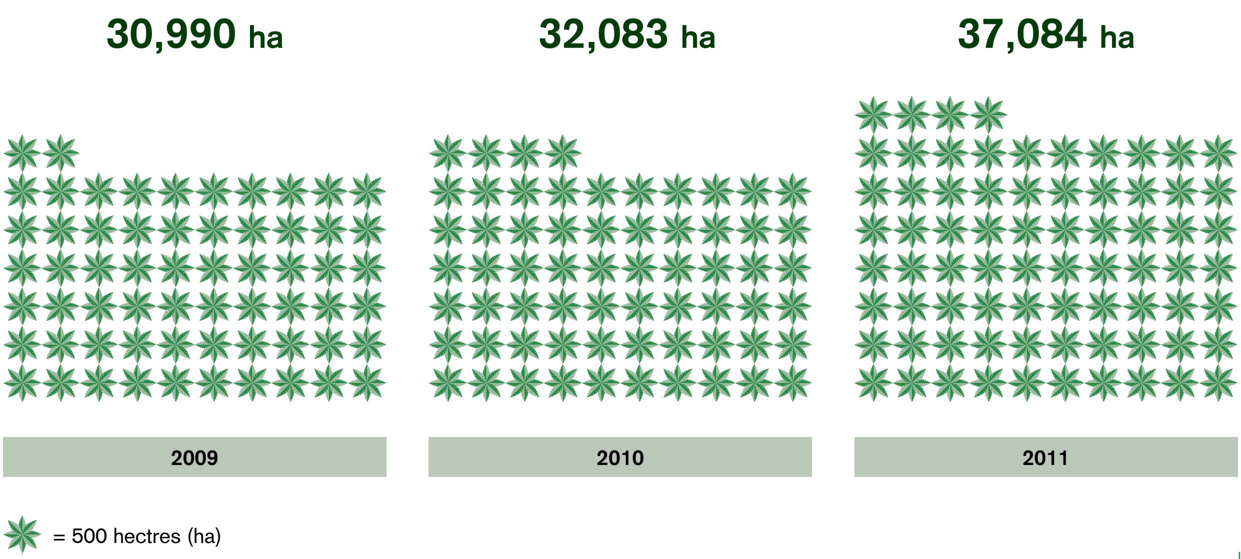
1 REA: GROWING RESPONSIBLY

1.1 Overview of operations

R.E.A. Holdings plc is a UK public listed company, traded on the main market of the London Stock Exchange. The group has been involved in the cultivation of oil palm in East Kalimantan in Indonesia since 1991, when it acquired its first concession in that province. The group has since expanded its oil palm operations in the province through the acquisition of additional concessions for extension planting of oil palm, the construction of three palm oil mills and the development of a bulking terminal close to Samarinda, the provincial capital. As at 31 December 2011, the group held land allocations of 97,698 hectares, of which 37,084 were planted or under development with oil palm. All of the group's oil palm concessions are currently in their first planting cycle.

In addition to the oil palm fresh fruit bunches (FFB) harvested from the group's own estates, FFB produced by scheme smallholders, independent smallholders and local companies are also processed in the group's palm oil mills. Production from the two palm oil mills operated by the group in 2011 (the third mill was commissioned in the fourth quarter of 2012) amounted to approximately 147,500 tonnes of CPO, 10,800 tonnes of CPKO and 15,600 tonnes of PKE.

Figure 1 Oil palm expansion by REA



REA: Growing responsibly

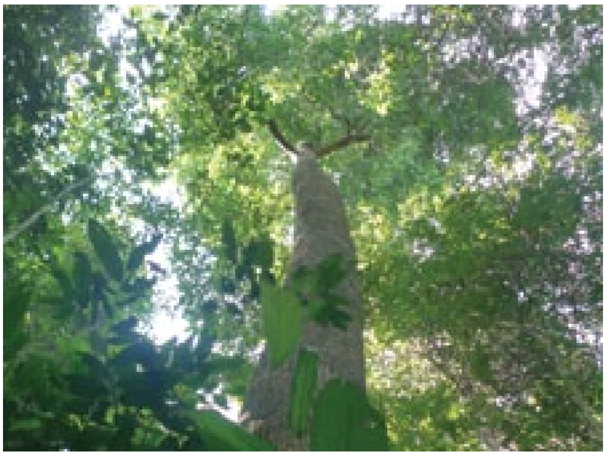
In addition to REA's oil palm operations, which generate the large majority of the group's revenue (Table 1), in 2008 and 2009 the group acquired the rights to three coal mining concessions in East Kalimantan, which together cover an area of 7,500 hectares. To date, the volume of coal extracted by REA has been limited, with the majority of the revenue generated by the group's coal activities deriving from trading coal supplied by third parties. Of the 355,000 tonnes of coal that has been sold by REA to date, only 9% of this was also mined by the group. It is the intention that REA's involvement in the coal industry will remain insignificant in comparison to its oil palm operations.

Table 1 Proportion of REA's revenue generated by oil palm and coal related activities

	2009		2010		2011	
	US $	%	US $	%	US $	%
Oil palm revenue	78,885,000	100	114,039,000	96	147,758,000	88
Coal revenue	1,000	0	4,171,000	4	18,216,000	12

1.2 Sustainability

REA is committed to creating the environmental, social and economic conditions necessary to produce oil palm products in a responsible manner for the foreseeable future. Implementation of the ISO14001 and RSPO voluntary standards is the foundation for achieving this goal and, to date, these internationally recognised accreditations have been obtained for the two palm oil mills operated by the group as at 31 December as well as for the majority of the supply base for these two mills. RSPO Supply Chain Certification and International Sustainability and Carbon Certification (ISCC) accreditation were also obtained in 2012 by PT REA Kaltim Plantations, the group's principal and longest established subsidiary company and owner of the two palm oil mills and of the group's oil transport and bulking terminal facilities. REA is currently in the process of compiling its first standalone sustainability report, which is due to be published in 2013. It is intended that this report will establish a baseline against which both internal and external stakeholders can monitor the group's sustainability performance.



2 ABOUT THIS REPORT

About this report

This report outlines the methodology used to estimate REA's carbon footprint for 2011, summarises the results calculated by applying this methodology and provides an insight into the strategies that are being adopted by the group in an effort to reduce its GHG emissions.

2.1 Purpose

REA recognises that a wide range of stakeholders are increasingly interested in and placing growing pressure on the private sector to take action to reduce GHG emissions. A pertinent example is the recent action by the UK government to amend existing legislation so that from April 2013 it will be mandatory for all companies listed on the main market of the London Stock Exchange to report their GHG emissions in the annual report. More stringent requirements to monitor and report on GHG emissions are also proposed for inclusion in the revisions which are currently being made to the RSPO Principles & Criteria. By producing an estimate for 2011 of the net GHG emissions associated with the majority of its oil palm operations the group is well prepared to respond to these new reporting requirements. Furthermore, the results of the carbon footprint calculation will assist REA to understand better and to quantify the key sources of GHG emissions and sequestration associated with its oil palm operations and, therefore, to identify opportunities for reducing the group's carbon footprint more effectively. Repeating the carbon footprint calculation on an annual basis will enable both the company's management and external stakeholders to monitor the impact of actions taken by the group in an effort to reduce its GHG emissions in a quantitative manner.

2.2 Scope

REA's Carbon Footprint for 2011 estimates the direct and the majority of the indirect[1] GHG emissions associated with the process of producing CPO and CPKO at the group's established oil palm operations in East Kalimantan. These comprise two palm oil mills (Cakra and Perdana) and their supply base. It is the intention that all of the GHG emissions associated with oil palm cultivation in each of the more recently developed plantation estates will be included within the scope of the carbon footprint calculation as soon as the first plantings within each estate mature and are supplying fruit to the REA mills. Similarly, REA's third palm oil mill, which was commissioned in the fourth quarter of 2012, will be included in the calculation of the group's carbon footprint for 2013. Due to the limited and uncertain nature of REA's involvement in coal mining these activities have not been included within the group's carbon footprint at this stage. However, it is recognised that the GHG emissions associated with coal mining are significant and that these would need to be included in the group's carbon footprint in the unlikely event that coal mining ever became a material component of the group's business. At this stage no attempt has been made to calculate the GHG emissions associated with REA's offices in Samarinda, Jakarta or London, nor business related domestic and international travel. Including these emissions is likely to have an insignificant impact on the estimate of the group's current net carbon footprint.

Unless otherwise stated, all of the data and discussion in the sections that follow refer only to the oil palm operations included within the scope of REA's carbon footprint calculation for 2011, as described above.

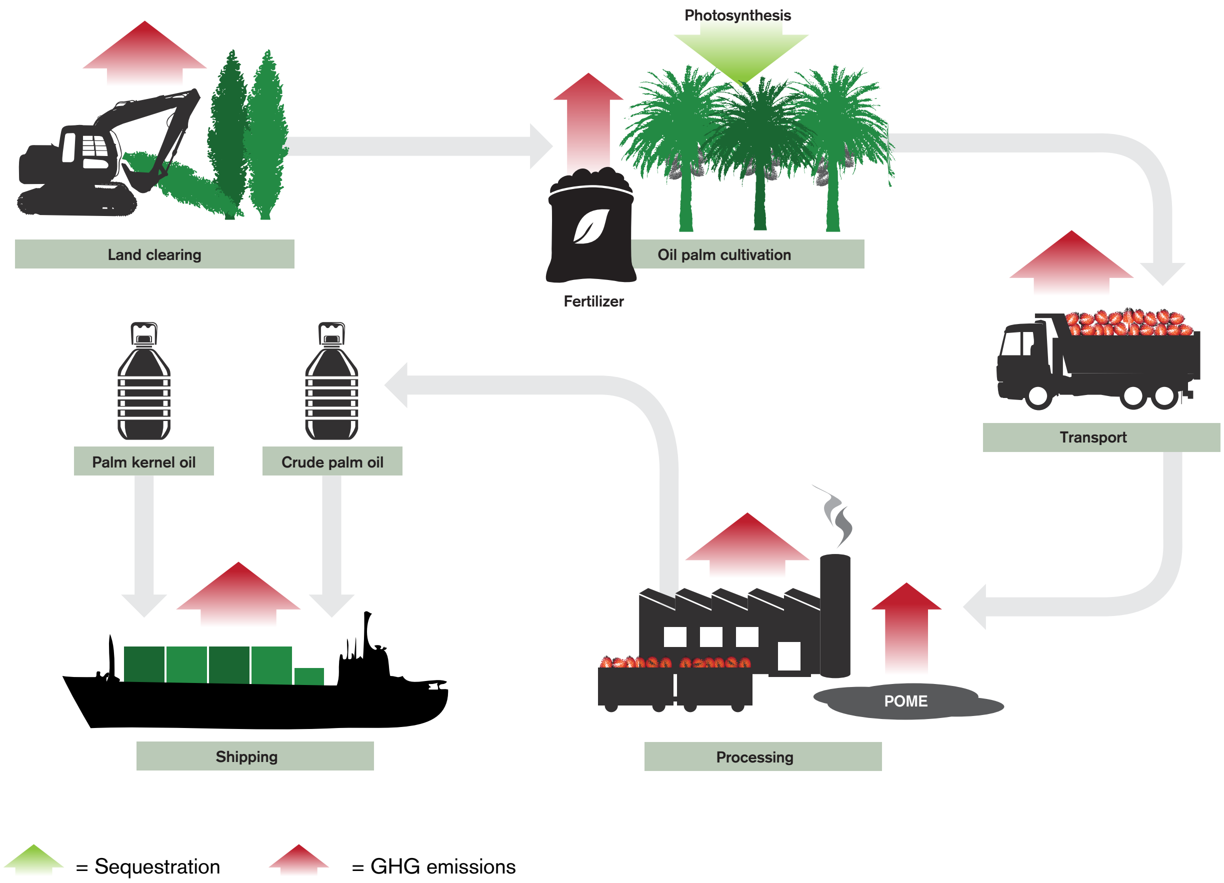
1 The Greenhouse Gas Protocol defines direct GHG emissions as emissions from sources that are owned or controlled by the reporting entity. These are categorised as Scope 1 emissions. The GHG Protocol defines indirect GHG emissions as emissions that are a consequence of the activities of the reporting entity, but occur at sources owned or controlled by another entity. Indirect GHG emissions are further categorised into Scope 2 (indirect GHG emissions from the consumption of purchased electricity, heat and steam) and Scope 3 emissions (all other indirect GHG emissions, such as the extraction and production of purchased materials and fuel and transport in vehicles not owned or controlled by the reporting entity). PalmGHG takes into account all Scope 2 emissions and some Scope 3 GHG emissions. (www.GHGprotocol.org).

2.3 Methodology

The net GHG emissions linked to REA's mature oil palm operations have been calculated using PalmGHG (Chase et al, 2012), a GHG accounting tool that was developed by Laurence Chase and Ian Henson in collaboration with the RSPO GHG Working Group in 2011. REA participated in the pilot study of the PalmGHG tool and, with considerable support from Laurence Chase, has since adapted it slightly so as to reflect better the intricacies of the group's operations. This should help to ensure that the PalmGHG tool provides the information necessary to design and monitor management interventions to reduce GHG emissions effectively.

As recommended by the Intergovernmental Panel on Climate Change (IPCC) guidelines (2006), PalmGHG takes into consideration emissions of the three major GHGs: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). In order to aid comparison, all GHG emissions are expressed in tonnes of carbon dioxide equivalent (tCO_2eq) by converting emissions of methane and nitrous oxide to tCO_2eq based on their global warming potential (GWP). The GWP of each GHG is determined by the ability of each gas to trap heat in the atmosphere over a 100 year period in comparison to carbon dioxide, which is assigned a GWP of 1. Methane, which has a GWP of 22.25, and nitrous oxide, which has a GWP of 298, are more powerful GHGs than carbon dioxide.

Figure 2 Sources of GHG emissions and sequestration included by the PalmGHG tool



About this report

PalmGHG is designed to calculate the carbon footprint of a palm oil mill and its supply base. The tool uses a life cycle assessment (LCA) approach, taking into account the sources of emissions, sequestration and emissions avoidance that are directly and indirectly linked to the production unit being assessed (Figure 2). The processes taken into account are the preparation of land for planting, oil palm cultivation, processing of FFB, the treatment of associated waste products, and all transport up to the point that the output (namely CPO and CPKO) from the assessed unit is sold by REA from its bulking facilities in Samarinda, East Kalimantan. Aspects of the production process that are not included are the production of oil palm seedlings, the application of pesticides, fuel used for land clearing, emissions associated with infrastructure and machinery and the sequestration of carbon in oil palm products and by-products. These items are generally minor whereas those aspects of the production process which are encompassed by the calculator are considered to account for the majority of GHG exchanges (Chase and Henson, 2010).

Subject to two exceptions and to the extent that data was available, GHG emissions were estimated using values averaged over three years (the year of reporting and the two years preceding it) so as to reduce the effect of annual variation on the net carbon footprint. The first exception to this was land clearing, for which the emissions, which only occur prior to planting, are amortised over the life cycle of each oil palm planting. Since REA has yet to start re-planting this was assumed to be 25 years, which is the default value specified by the RSPO GHG Working Group. The second exception was a decision to use only data for the year of reporting to calculate emissions from POME. This is to allow the GHG emissions savings achieved as a result of installing methane capture facilities at both of REA's mills to be reflected in the carbon footprint calculation on a real time basis, rather than the less realistic and more gradual decrease that would be seen if a three year rolling average was used.

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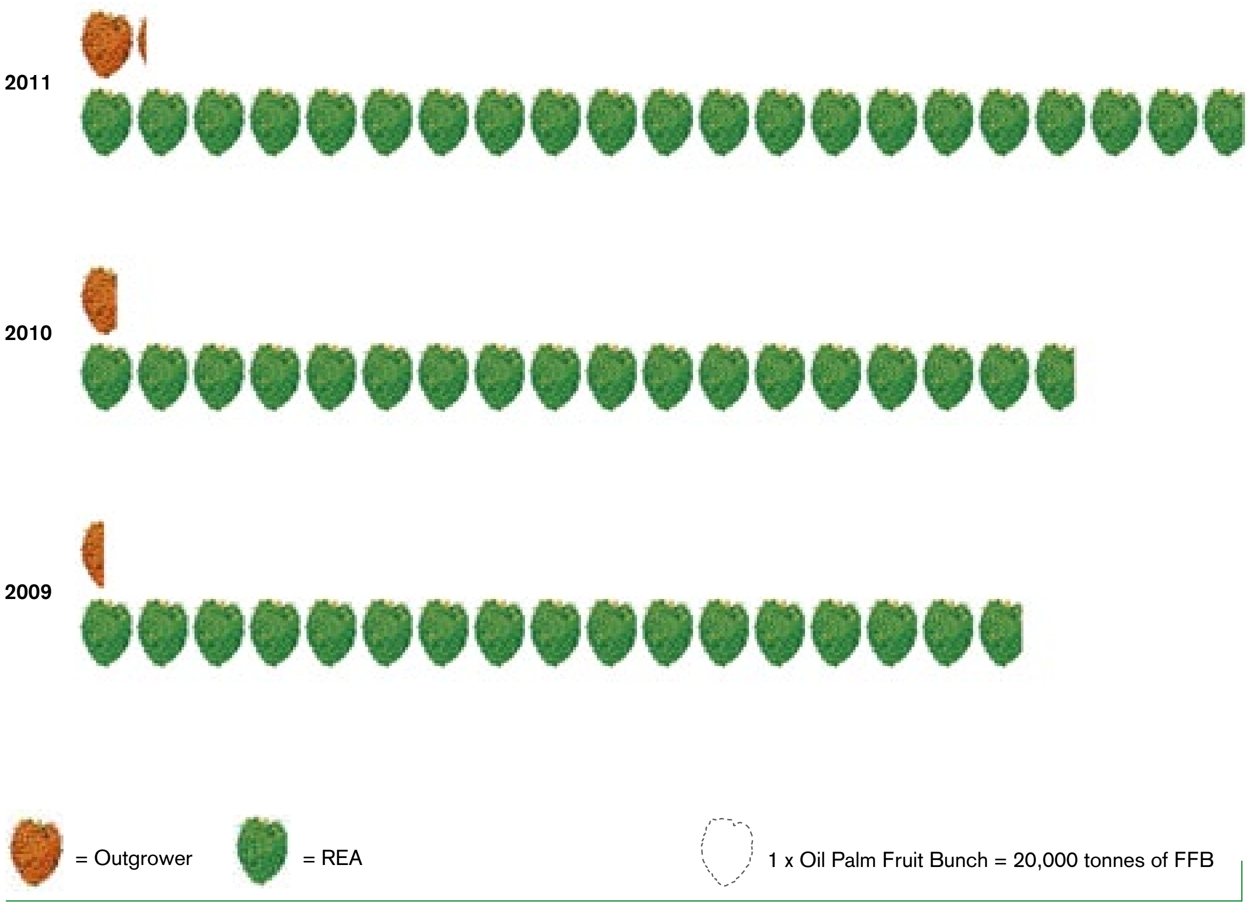
The net GHG emissions for each mill are calculated by balancing the GHG emissions at each stage of the production process against the carbon which is fixed and any emissions that are avoided as a result of the production process. To facilitate comparison between oil palm operations of different sizes the net GHG emissions are expressed per tonne of CPO and CPKO produced. The net GHG emissions have also been expressed per planted hectare (immature and mature) because this provides a more informative basis for comparison between different oil palm operations with plantings at different stages of maturity. REA was not able to calculate the net GHG emissions per planted hectare for the whole supply base because the total area cultivated by the outgrowers that supply FFB to REA's mills was unknown. However, it was possible to estimate the net GHG emissions per planted hectare of REA's own oil palm plantings by apportioning to those plantings the net GHG emissions associated with the processing and transport of oil palm products based on the proportion of the FFB throughput at the mill that is supplied by the relevant group plantings as opposed to outgrowers.

2.4 Data limitations

In 2011 the supply base for the two REA mills which form the units for the carbon footprint calculation included FFB cultivated not only by REA but also semi-independent smallholders (PPMD scheme), independent smallholders and local companies without their own processing facilities. Between 2009 and 2011 these sources accounted for between 3% and 5% of the FFB processed by REA's two mills (Figure 3). Due to the lack of complete and accurate data regarding the fertiliser and diesel used by the outgrowers, it was necessary to estimate the GHG emissions associated with the cultivation of the outgrowers' FFB based on the average value obtained for the FFB cultivated by REA. Lack of data regarding the fuel consumption by vehicles operated by external contractors and used to transport FFB from the field to the mill, CPO and CPKO from the mill to the point of sale, and other materials such as fertilisers from the suppliers to the point of application, meant that it was necessary to estimate this usage.

The assumptions and methodology used to produce estimates are outlined in Annex 2.

Figure 3 Proportion of the FFB processed in REA's mills that is cultivated by outgrowers.

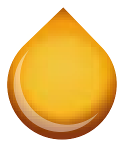


3 REA'S CARBON FOOTPRINT IN 2011

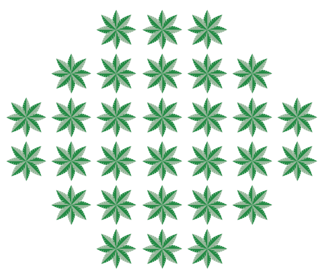
Between 2009 and 2011 the average net GHG emissions resulting from the average annual production of 131,200 tonnes of CPO and 10,200 tonnes of CPKO by REA's Perdana and Cakra Oil Mills are estimated to be 341,824 tCO_2eq. This is equivalent to 2.2 tCO_2eq per tonne of CPO produced, 5.6 tCO_2eq per tonne of CPKO produced and 11.6 tCO_2eq per planted hectare. The GHG emissions per tonne of product would be lower if a portion of the net GHG emissions were allocated to the production of PKE, a product typically sold to the animal feed market. However, REA's remote location has meant that, to date, using PKE as a fertiliser substitute has produced higher economic returns than selling it into the animal feed market. Based on the guidelines provided by the RSPO GHG Working Group, because REA does not sell the PKE that it produces such PKE is classified as a waste product, meaning that GHG emissions should not be allocated to it.

The sources of GHG emissions, carbon sequestration and GHG emissions avoided, as well as their respective contributions to the carbon footprint, are summarised in Table 2 and Figure 4 and described in detail below.

2.2 tonnes CO_2eq per tonne CPO



5.6 tonnes CO_2eq per tonne CPKO



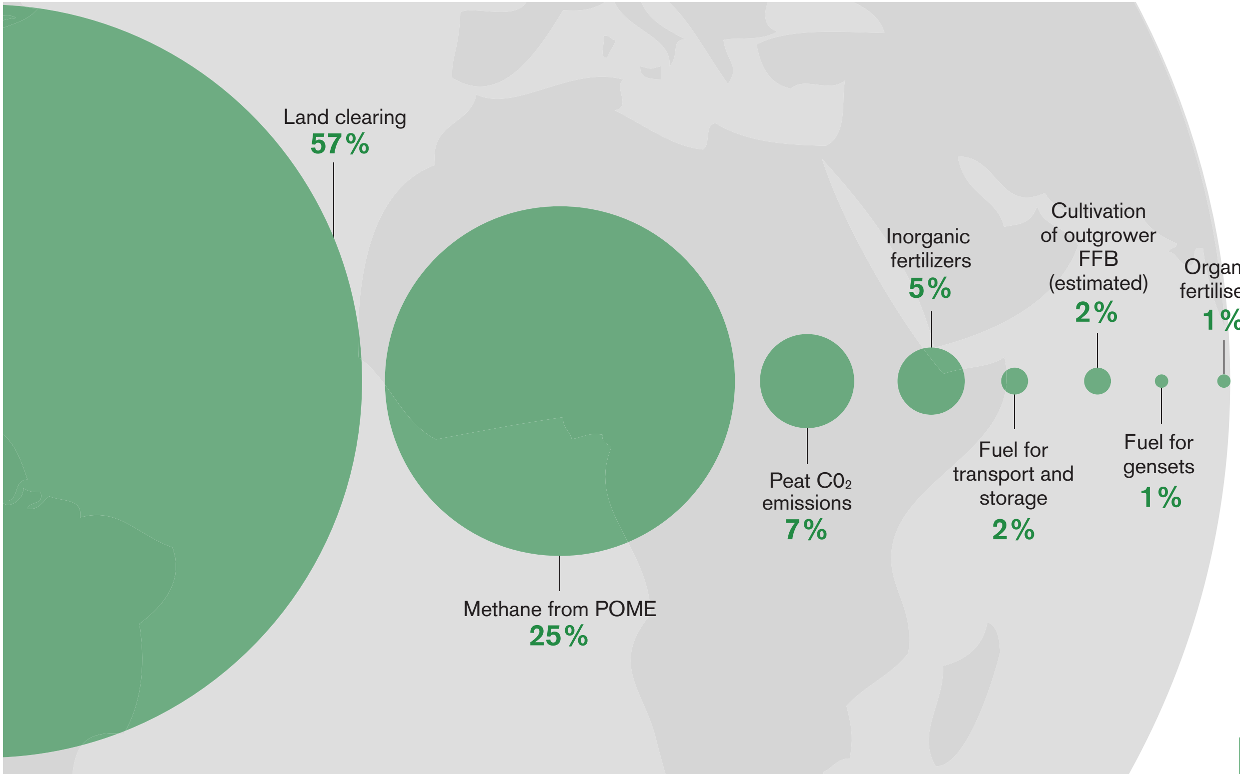
11.6 tonnes CO_2eq per planted hectare

Table 2 Summary of REA's carbon footprint for 2011

	Sequestration		Emissions	
	tCO_2eq	%	tCO_2eq	%
Land clearing			345,865	57
Methane from POME			156,077	25
Peat CO_2 emissions			43,702	7
Inorganic fertillisers			33,253	5
Fuel for transport and storage			12,854	2
Cultivation of outgrower (estimated)			9,482	2
Organic fertilisers			5,730	1
Fuel for gensets			3,942	1
Crop sequestration	269,081	100		
Total	269,081		610,905	
Net emissions	341,824			

REA's carbon footprint in 2011

Figure 4 Contribution of each source of GHG emissions to REA's carbon footprint in 2011



3.1 Land clearing

The biggest component of REA's carbon footprint (57%) is the GHG emissions that result from the clearance of land in order to plant oil palm. These emissions are due to the assumed release of carbon stored in the biomass removed from above ground (trees, climbers, shrubs etc) and below ground (roots, detritus etc) when the land is cleared and prepared for planting. These GHG emissions will be offset to an extent by the carbon that will be absorbed (fixed) from the atmosphere by the oil palm seedlings that are planted. This is further explained in the section on carbon sequestration below. However, in many cases the carbon contained in the biomass removed when land is developed exceeds the amount that can be sequestered over a single life cycle of the oil palms that replace it. The result is a net emission of carbon dioxide.

REA engaged the remote sensing experts 'SarVision' (www.sarvision.nl), a company associated with Wageningen University in the Netherlands, to provide an independent assessment of the loss of above ground biomass as a result of the clearance and degradation of vegetation within the group's concessions.

The amount of above ground biomass is determined by the type and quality of vegetation that is removed when an area of land is developed. Before working with SarVision, REA's data regarding the vegetation present prior to the initiation of land clearing by the group in 1993 was limited to records made by estate managers. Furthermore, the satellite imagery (LandSat) available from this period is of poor quality, particularly for East Kalimantan which suffers from semi-persistent cloud cover. Faced with these challenges, SarVision's starting point was a map of the above ground biomass for the entire island of Borneo in 2008, which was created using high spatial resolution (30-50m) images from satellites which use both radar and lidar remote sensing techniques (ALOS PALSAR and ICESat-GLAS lidar) (Quinones and Hoekman, in prep). From these images, it was possible to identify approximately 200 different categories of land cover based on the structural characteristics of the vegetation and then calculate the median height for each using the lidar derived height. A published allometric equation (Woodhouse, 2006) was then used to estimate biomass from the median height for each category of vegetation. The accuracy of the map was verified by cross referencing values provided by the map with biomass data obtained from field research conducted at different locations in Borneo, including studies within REA's conservation areas conducted by students from Utrecht University.

Since the advanced satellite imagery used to generate the 2008 biomass map of Borneo is not available for years prior to 2007, the same technique could not be used directly to estimate the biomass lost within the concessions that were developed during the 1990s. However, LandSat imagery has been available since the inception of the group's development in East Kalimantan. SarVision therefore obtained LandSat imagery from 2008 and identified a relationship between the range of spectral values present in the LandSat map and the range of biomass values contained in the map produced using the radar and lidar satellite data. This was based on a comparison of the spectral and biomass values at 75 points, which covered all of the major land cover categories present within the region in which REA's concessions are located. This relationship was then applied to LandSat images available from between 1990 and 2012 to produce a consistent time series of estimated above ground biomass maps. Figure 5 shows an example of one of the maps produced.

To overcome the impact of haze and cloud cover on the quality of the LandSat images, SarVision produced a 'jigsaw puzzle' (composite image) of the highest quality pixels available for each section of the LandSat scene for each year. If more than one image of sufficient quality was available for a particular area, that showing the least vegetation cover was selected to ensure that

all biomass loss was accounted for in the assessment. For the 1990s, only one or two images were available for each year, while no images were available for 1992, 1993 & 1995. Due to the poor quality of the cloudy images available it was therefore necessary to combine images from 1990 and 1991, as well as from 1996 and 1997, in order to create composite images of sufficient quality. From 1999 onwards there were often more than 10 images available for each year, significantly improving the quality of the composite images.

Due to the limited imagery available for the 1990s, the composite image from 1990 and 1991 was used as the baseline for the assessment of biomass loss for all the estates that REA started to develop during the 1990s. For estates where development began after 1999, imagery from the year prior to the initiation of land clearing by the group was used as the baseline for the assessment. The biomass removed within each estate during each time period (1990–1999, then annually from 2000 onwards) was estimated by calculating the cumulative number of pixels cleared over time and the total of the biomass values (tonnes biomass/ha) assigned before clearing to each of these pixels on the map. It is generally accepted that carbon stock is equivalent to 50% of the biomass of vegetation, so this is the basis on which the GHG emissions associated with the removal of above ground biomass present prior to land clearing have been derived.

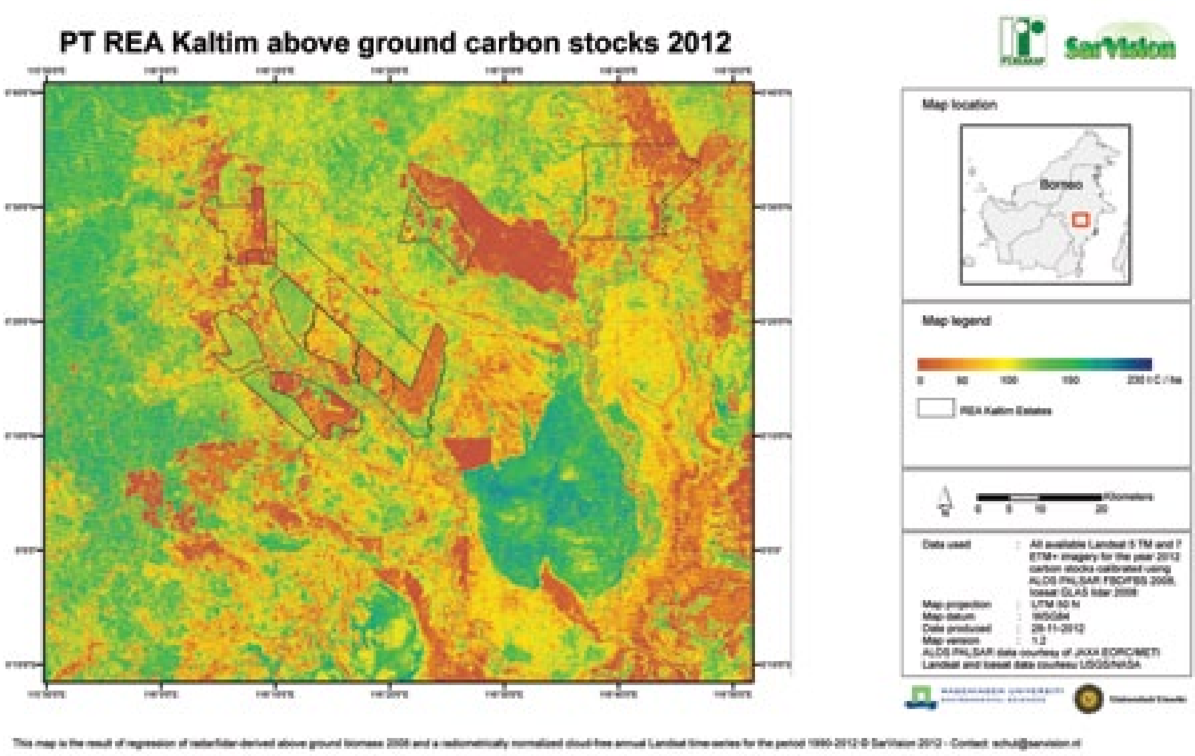
REA's carbon footprint in 2011

It should be noted that, by using this approach, REA has taken into account biomass lost anywhere within the boundary of the estates included within the carbon footprint calculation, including any degradation of the conservation areas which may have occurred as a result of encroachment or logging by local communities. Such loss of biomass would not be taken into account by the methodology specified by the RSPO GHG Working Group for estimating the GHG emissions from land use change. The RSPO methodology involves using company records to determine the area of each category of vegetation cleared (e.g. logged tropical lowland forest, peat forest, oil palm) and then assigning default carbon stock values for each land use category identified from scientific publications by the RSPO GHG Working Group. In REA's opinion, the comprehensive and site specific nature of the SarVision assessment should mean that it provides a more accurate estimate of the above ground biomass lost than the RSPO methodology.

Since the approach used by SarVision has not taken into account the loss of below ground biomass, a published default value for the ratio of shoot to root biomass (Mokany et al, 2006) was assigned to the above ground biomass estimates produced by SarVision in order to estimate such below ground biomass. This is the default value for estimating root biomass that was identified from the scientific literature by the RSPO GHG Working Group.

The total GHG emissions that result from land use change are amortised over the lifecycle of the oil palm, which is assumed to be 25 years. Accordingly, the group's carbon footprint for 2011 includes one twenty-fifth of the estimated total GHG emissions from land use change applicable to the assessed operating units. When the group's estates enter their second planting cycle, the GHG emissions caused by clearing the first crop of oil palm should be equal to the carbon that will be sequestered over the lifecycle of the second crop of oil palm, resulting in zero net GHG emissions from land use change.

Figure 5 Example of the carbon stock maps produced by SarVision



3.2 Palm Oil Mill Effluent

The second largest source of GHG emissions in REA's carbon footprint is the treatment of the POME that is produced when FFB is processed. The conventional method for treating POME, which was still adopted by REA in 2011, is to pass it through a series of open settlement ponds over a period of several months. This allows time for micro-organisms which are naturally present in the environment to digest a large proportion of the organic matter contained in the POME. Although this reduces the biological oxygen demand (BOD) of the POME and therefore the damage it would cause if it were to enter a natural water course, the anaerobic digestion performed by these micro-organisms produces large volumes of methane. As a consequence of the high GWP of methane, which is 22.25 times greater than that of carbon dioxide, the emission of methane from the POME treatment ponds at the two palm oil mills accounted for 25% of REA's gross GHG emissions in 2011.

The volume of methane emitted was calculated based on estimates of the volume of POME produced and the chemical oxygen demand (COD) of this liquid. These estimates were derived using the results of a 10 day baseline test which was carried out at each of REA's mills in 2010 as part of the process involved in developing clean development mechanism (CDM) projects for the methane capture facilities that were subsequently installed. However, continuing to use this data to estimate the amount of POME produced would prevent any reductions in the actual amount of POME produced per tonne of FFB processed that may result from improving management practices from being reflected as a reduction in GHG emissions. It is therefore intended that flow meters will be installed in all of REA's mills in 2013 to allow the accurate recording of the total volume of POME produced.

3.3 Planting on peat soil

The oxidation of peat soil in areas that have been planted with oil palm has been estimated to cause 7% of REA's total GHG emissions. Peat soil is defined as soil with 50cm or more of organic materials at the soil surface. When peat soil areas are drained in order to plant oil palm, the organic matter becomes exposed to the air and gradually starts to oxidise, releasing carbon dioxide.

The annual emissions of carbon dioxide per hectare of oil palm planted on peat soil are determined by estimating the depth of the water table in the affected areas after they have been drained and then multiplying by a default value of 0.91 tCO_2/cm/year, a factor identified from the scientific literature by the RSPO GHG Working Group (Hooijer, A et al, 2010). In the peat areas that REA has planted with oil palm, the average depth of the water table has been estimated to be 45cm.

Based on soil surveys carried out by independent experts, 1,067 hectares of the oil palm has been planted on peat soil ranging from 50cm to 3m in depth within the REA plantations included in the scope of the carbon footprint calculation. No areas of peat greater than 3m in depth have been planted. The estates containing the areas of peat soil were developed prior to 2010, when REA introduced a policy to limit planting on peat to non-homogenous areas less than 1m deep.

In order to improve the accuracy of the estimate of the GHG emissions associated with the oxidation of peat soils in future iterations of REA's carbon footprint calculation the group intends to undertake further field work to obtain more accurate measurements of the depth of the water table in the peat soil areas that have been planted with oil palm since the current value was based on a very limited number of samples.

3.4 Fertilisers

The use of inorganic and organic fertilisers accounted for 5% and 1% respectively of REA's gross GHG emissions in 2011. This includes emissions associated with the manufacture of inorganic fertilisers, their transport to the plantation and the direct and indirect release of nitrous oxide when the inorganic and organic fertilisers containing nitrogen are applied. This is due to direct reactions with the soil, as well as leaching, run-off and volatilisation.

GHG emissions associated with the manufacture of inorganic fertilisers are calculated by determining the amount of each of the active ingredients (nitrogen, potassium, phosphate and magnesium oxide) applied each year and then multiplying these by 'emission factors' identified by the RSPO GHG Working Group from the scientific literature (Jensson and Kongshaug, 2003). The GHG emissions associated with the transport of these fertilisers from the manufacturer to the plantation were calculated by first estimating the fuel required for the journey, based on the distance these materials were transported and the estimated fuel consumption per km of each mode of transport used, and then applying a standard GHG emission factor for diesel (3.12kg CO_2eq/litre). The direct and indirect emissions of nitrous oxide, which has a GWP 298 times greater than that of carbon dioxide, have been calculated using the IPCC default values.

3.5 Fuel consumption

3% of REA's gross GHG emissions are estimated to have resulted from the consumption of diesel and petrol for transport and electricity generation. Approximately 65% of these emissions resulted from fuel used for transport by road and river (on average approximately 4.8 million litres/year between 2009 and 2011). This included transport of people and general materials to and around the plantation, road transfer of the crop from the field to the mills, road transfer of oil palm products from the mill to river jetties, as well as the river transport of CPO and CPKO to the point of sale. The fuel used for the operation of the bulking station has also been included under transport. As noted in the section on 'Data Limitations', fuel consumption by vehicles operated by external contractors was estimated in the absence of actual data.

Since REA's plantations are too remote to be supplied with electricity from the national grid, generating sets are used to power the start-up of mills and provide power to estate buildings and employee housing and facilities. The remaining 35% or 2.6 million litres/year of the fuel consumed was used to run these generating sets. Since it could be argued that the GHG emissions that result from providing electricity to employee housing and amenities are not 'additional' to the GHG emissions that would be generated if these employees were not resident on REA's estates and, instead, lived in housing beyond the boundaries of the plantation, the RSPO GHG Working Group has decided that such emissions should not be included in the calculation of an oil palm grower's carbon footprint. Furthermore, growers may include a credit for renewable energy that is generated as a result of their operations and exported to domestic housing, for example electricity generated by a mill's steam turbines.

At present, the electricity meters within the group's operations are not sufficient to determine the total power supplied to the domestic buildings within REA's estates or the proportion of this power that is supplied by the mill steam turbines as opposed to diesel powered generating sets. Therefore, in order to exclude the GHG emissions associated with providing electricity to domestic buildings the amount of fuel that would be required to provide these buildings with electricity using diesel generating sets has been estimated. This has been done by calculating the average diesel consumption per domestic building in estate villages where the vast majority of the buildings are domestic and all of the power demand is supplied by diesel generating sets, and then extrapolating this to the total number of domestic buildings in each estate. On this basis, it has been estimated that approximately 1.3 million litres of diesel would be required to generate electricity for the domestic buildings. It is recognised that this is likely to be higher than the actual amount of diesel used to power the domestic buildings due to the fact that the buildings close to the mill will be powered by electricity generated by steam turbines when the mill is in operation. In order to compensate for this, no credit has been included for the renewable energy exported to domestic buildings from the mill steam turbines.

3.6 Carbon sequestration by the oil palm and conservation areas

The loss of biomass as a result of clearing land in order to plant oil palm is balanced to some extent by the ability of the oil palm to absorb (fix) carbon dioxide from the atmosphere as it grows, through the process of photosynthesis. The amount of carbon that the oil palm crop sequesters in this manner was estimated using a published growth model (Henson, 2005), the assumptions for which have been compared with the limited growth data available from the group's plantings and appear to be representative. The total amount of carbon sequestered each year will vary depending on the age profile and the standard of cultivation of the oil palm that supplies each mill. In 2011, the total amount of carbon sequestered by the oil palms included within the scope of the carbon footprint calculation was estimated to be 269,081 tCO_2eq. This is equivalent to approximately 78% of the emissions from land clearing that have been allocated to 2011.

Natural vegetation also fixes carbon dioxide through photosynthesis. The RSPO GHG Working Group therefore decided that oil palm growers should take into account carbon sequestered by areas of natural vegetation that they conserve other than the areas that they are prohibited from planting with oil palm by law. REA has invested considerable resources in maintaining a network of conservation reserves throughout its estates with the aim of conserving the natural biodiversity and ecosystem functions of the landscape. Given that REA's conservation reserves extend beyond the areas that the group is obliged to set-aside by Indonesian regulations (50m–100m wide buffer zones along rivers, peat areas deeper than 3m and land with a gradient greater than 40%), the amount of carbon sequestered by these areas could be substantial.

Research conducted in Sabah, Malaysia (which borders East Kalimantan), suggests that the rate at which disturbed forest sequesters carbon decreases as the regeneration process progresses, with results showing that recently logged forest sequesters 1.4 tC/ha./yr in comparison to undisturbed natural forest which sequesters 0.3 tC/ha/yr (Berry et al, 2010). In addition to the level of disturbance, the type of vegetation, soil and climate will also affect the rate at which carbon is sequestered. Due to the site and habitat specific nature of the rate at which natural vegetation sequesters carbon, the RSPO GHG Working Group decided not to provide a default value for this.

At the present time, REA does not have the empirical data necessary to determine the rate at which the natural vegetation conserved within the REA concessions is sequestering carbon. Therefore, no credit for such sequestered carbon has been included in this initial assessment of the group's carbon footprint. Since the amount to be credited could be significant, efforts will be made to use field measurements and satellite imagery to estimate this for inclusion in future estimates of REA's carbon footprint.

4 OPPORTUNITIES FOR ACHIEVING GHG EMISSIONS REDUCTION

One of the main reasons for calculating REA's carbon footprint is to inform the development of effective strategies for reducing the group's net GHG emissions. The key opportunities identified to date are outlined below. This is the starting point for the development of more detailed policies and quantitative time-bound targets for achieving GHG emissions reduction. REA will be working to achieve this as part of a wider effort to manage and report on all aspects of sustainability in a more systematic and transparent manner.

4.1 Minimising GHG emissions associated with land use change

The GHG emissions associated with land use change are the biggest component of the carbon footprint for REA's established oil palm operations. Since 1993, when the development of the oil palm plantations included within the scope of the carbon footprint calculation began, REA's policies and practices for developing land have become more rigorous. In 2008, the company established a dedicated conservation department, known as REA KON. For concessions developed from 2008 onwards, REA KON and a variety of external experts have provided recommendations regarding the areas which should be designated as conservation reserves in order to maintain the natural biodiversity and ecosystem functions of the landscape. These areas should, to a large extent, have encompassed the most intact, and therefore the highest carbon stock, vegetation that remains within these concessions and this should have resulted in a reduction in the emissions from land use change. Such emissions should be further reduced for areas developed after 2010 by the introduction of a policy to limit planting on peat to non-homogenous areas less than 1m deep.

The production of a series of detailed carbon stock maps by SarVision for all of the concessions for which REA currently holds location permits will enable the group to identify better and avoid clearance of high carbon stock areas in concessions which it has yet to develop with oil palm. As the carbon stock maps were only completed in November 2012, REA has not yet defined a procedure for taking the information contained in these maps into account in the process of planning new developments. However, REA will be working to develop such policies and procedures during 2013.

4.2 Reducing methane emissions from POME

The second largest source of GHG emissions associated with REA's oil palm operations in 2011 was the methane produced from the digestion of POME in open settlement ponds. To address this, in 2012, REA installed facilities at each of its established mills which are capable of capturing the methane produced when the POME is digested. The captured methane is then either used to generate electricity or is flared off, resulting, in both cases, in its conversion to carbon dioxide. Since carbon dioxide has a lower GWP than methane this will help to reduce REA's total GHG emissions. In addition to this, the electricity produced will largely remove the need to use diesel generating sets to power the group's mills, offices and housing, which between 2009 and 2011 consumed an average of 2.6 million litres of diesel per year. This will both contribute to reducing the GHG emissions associated with REA's fuel consumption, and result in a substantial cost saving. Since the first of the methane capture facilities was commissioned in April 2012 and the second in October 2012, the impact of these facilities on REA's carbon footprint will only start to be seen in the calculation for 2012. Both of these methane capture projects have been verified as small scale projects under the United Nations Framework Convention on Climate Change (UNFCCC) Clean Development Mechanism (CDM), which allows REA to sell Certified Emission Reduction credits (CER's) for the GHG emissions reductions achieved.

REA has not yet installed methane capture facilities for its third palm oil mill, which was commissioned in the fourth quarter of 2012. However, provision has been made to enable it to do so and REA recognises that this would make a valuable contribution to further reducing the group's GHG emissions. The limiting factor at present is that the group does not have a use

for the methane or electricity that would be generated as a result of developing methane capture facilities at this mill. REA is therefore actively exploring options to overcome this, including the use of compressed methane to run plantation vehicles or the extension of the national electricity grid to permit REA to feed methane generated electricity into the grid and thus provide the villages bordering the group's estates with access to electricity.

4.3 Reducing consumption of inorganic fertilisers

GHG emissions resulting from the transport, manufacture and application of inorganic fertilisers were the fourth biggest component of REA's carbon footprint in 2011. In 2010 the company started to produce compost from the empty fruit bunches (EFB) and POME produced from the mills. The use of this organic fertiliser has allowed REA to reduce the amount of inorganic fertiliser applied. It is expected that the GHG emissions associated with the manufacture and transport of organic fertilisers should be lower than if the same nutrients are supplied by inorganic fertilisers. This is on the basis that the compost is produced on site and it is manufactured from mill waste products, whereas the manufacture of inorganic fertilisers is GHG emissions intensive and many of them are shipped long distances to reach the plantation. However, in order to confirm that the substitution of inorganic fertilisers with organic fertiliser would reduce the group's GHG emissions it will be necessary to produce a comprehensive GHG analysis of the process of producing and distributing organic compost.

ANNEXES

Annex 1: List of definitions

BOD	**Biological Oxygen Demand** This is the amount of dissolved oxygen that would be needed by micro-organisms to break down all of the organic matter present in a sample of water at a certain temperature over a specific time period. It is frequently used as an indicator of water quality.
Carbon Footprint	A carbon footprint measures the total greenhouse gas emissions caused directly and indirectly by a person, organisation, event or product.
CDM	**The Clean Development Mechanism** This enables industrialised countries that have made commitments to reduce their GHG emissions under the Kyoto Protocol to meet these commitments by investing in projects in developing countries that are designed to reduce GHG emissions.
CER	**Certified Emission Reduction** These are the saleable credits, which are frequently referred to as carbon credits, are generated by CDM projects (see above). Each CER represents a GHG emissions saving equivalent to one tonne of CO_2.
CH_4	**Methane gas** One of the six major greenhouse gases recognised by the Kyoto Protocol. It has a global warming potential of 22.25.
COD	**Chemical Oxygen Demand** This is the amount of dissolved oxygen that would be required to allow chemicals to react with and break down organic and inorganic contaminants that are present in a sample of water. In conjunction with BOD it is frequently used as an indicator of water quality.
CO_2	**Carbon dioxide gas** One of the six major greenhouse gases recognised by the Kyoto protocol. It has a global warming potential of 1.
CPO	**Crude Palm Oil**
CPKO	**Crude Palm Kernel Oil**
EFB	**Empty Fruit Bunch**
EU RED	**The European Union's Renewable Energy Directive** This directive, which was introduced in 2009, provides the regulatory framework needed to promote the use of renewable energy by EU member states in order to assist the EU to meet its targets for renewable energy consumption. It also lays out a set of sustainability criteria for the production of biofuels, which must be complied with in order for the consumption of biofuels to contribute towards targets for the use of renewable energy.
FFB	**Fresh Fruit Bunch**
GHG	**Greenhouse Gas** A gas which traps the sun's energy in the earth's atmosphere. Scientific research suggests that increasing levels of GHGs are causing the climate to change in a variety of ways, including increases in global temperature, sea level rise and changing patterns of drought and flooding events.

GWP	**Global Warming Potential** This is an indication of the ability of a particular gas to trap heat in the atmosphere over a 100 year period in comparison to carbon dioxide, which has a GWP of 1. For example, nitrous oxide has a GWP of 298 because releasing methane gas into the atmosphere will trap 298 times more heat than an equivalent mass of carbon dioxide.
IPCC	**Intergovernmental Panel on Climate Change** This is an international scientific body which was established in 1988 by the United Nations Environment Programme (UNEP) and the World Metereorological Organisation (WMO) and given the task of reviewing the scientific research and socio-economic information available in order to improve understanding of climate change and its potential environmental and socio-economic impacts (www.ipcc.ch).
ISCC	**International Sustainability & Carbon Certification** (www.iscc-system.org)
ISO 14001	**One of the International Organisation for Standardisation family of Environmental Management Systems standards** (www.iso.org)
N_2O	**Nitrous Oxide gas** One of the six major greenhouse gases recognised by the Kyoto protocol. It has a global warming potential of 298.
PKE	**Palm Kernel Expeller**
POME	**Palm Oil Mill Effluent**
RSPO	**The Roundtable on Sustainable Palm Oil** (www.rspo.org)
tCO_2eq	**Tonnes of carbon dioxide equivalent** Emissions of GHGs other than carbon dioxide are converted to tonnes of carbon dioxide equivalent by estimating the amount of gas emitted and multiplying it by its global warming potential. This allows the potential impact on global warming of the GHG emissions associated with a person, organisation or product to be compared even when they comprise different GHGs.
UNFCCC	**United Nations Framework Convention on Climate Change** This international convention, which was adopted in 1992 at the Rio Earth Summit, sets out a framework for intergovernmental efforts to address climate change and its potential environmental and socio-economic impacts. It has been ratified by 195 countries and came into force in 1994.

Annex 2: Assumptions and estimations

Data	Estimation/assumption
POME	
Mass of POME produced	0.88 tonnes and 0.99 tonnes of POME/tonne FFB processed for Cakra and Perdana Oil Mill respectively; based on CDM Baseline Test for each mill by KPSR Construction Ltd in 2010
Fuel	
Electricity demand of kernel crushing plant (KCP)	Estimated to consume 5% of the electricity produced by the diesel generating sets supplying the mill and the KCP
Electricity demand of domestic housing	Estimated by dividing the diesel consumed by generating sets by the number of domestic buildings for three estate villages that have no operational buildings or alternative sources of power. The average diesel consumed per house for these three estate villages was multiplied by the total number of domestic buildings within the estates included in the carbon footprint calculation in order to estimate the total amount of diesel that would be required to supply all of these domestic buildings with electricity
Fuel consumption of river barges used to transport CPO and CPKO	Each return trip by a 2,000 tonne barge (approximately 300km each way) is assumed to require 5,500 litres of diesel
Fuel consumption for road transport by contractors	The 8 tonne trucks used by contractors to transport palm kernel are assumed to consume 0.5 litres of diesel/km. The 6 tonne trucks used to transport FFB and compost are assumed to consume 0.25 litres of diesel/km
Emission factor for diesel	3.12kg CO_2eq/litre
Land clearing	
Root biomass	The root: shoot ratio for tropical moist forest with an above ground carbon stock < 125 tonnes of carbon per hectare is estimated to be 0.205 by Mokany et al (2006). The above ground carbon lost in each estate is therefore multiplied by 0.205 in order to estimate the root carbon lost
Oil palm planted on peat	
Annual CO_2 emissions from the oxidation of peat	This is estimated to be 41 tonnes of carbon per hectare per year, based on an estimation that the water table is maintained at 45cm below the soil surface in the peat areas that have been planted with oil palm

Annex 3: References

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