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Ecotourism and Neste NEXBTL renewable diesel

Market potential of Neste NEXBTL renewable diesel in ecotourism

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Environmental concerns such as global warming, photochemical smog and eutrophication has caused a global concern about the condition of the natural environments. Increasing awareness of sustainability and environmental aspects among tourists has created a new form of tourism called ecotourism. Ecotourists are trying to minimize negative economical, social and environmental impacts of the journey.

Through several ecotourism certificate systems and general consensus among ecotourists, environmental issues are highly valued and prioritized with highest concern. One of the largest environmental impacts of tourism is air pollution, which is mainly caused by transportation of tourists. Major air pollutants produced are carbon dioxide, nitrogen oxides and particulates. When 75% of the total carbon dioxide emissions from tourism industry originate from transportation, great opportunity for companies acting in the field of ecotourism is born to cut down their transportation emissions. This can be done for example by using cleaner transportation fuels.

Neste NEXBTL renewable diesel has potential to cut down harmful emissions and contribute cleaner tourism by offering ecotour operators their product to use for tourism transportation. The aim of this thesis is to perform detailed interpretation for the concept of ecotourism and clarify the market potential of Neste NEXBTL in the ecotourism industry.

LCIA case studies, where NEXBTL was compared to conventional diesel in typical ecotours in Malaysia and South Africa was implemented. Results that global warming, eutrophication and acidification potential could be decreased in all situations were obtained. Environmental properties of NEXBTL create clear advantage to the ecotourism markets of transportation fuels. Also growing number of ecotourists supports the positive market size and rate of growth. This is a good thing for NEXBTL and its potential to reach ecotourism markets. Major challenges are profitability in locations where fuel prices are low and distribution channels may be limited.

Still, the use of NEXBTL renewable diesel as a transportation fuel could be good marketing tool for ecotour providers in order to attract environmentally conscious tourists.

Keywords	Ecotourism, NEXBTL, Renewable diesel, biofuel, LCIA

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Ilmastonmuutos, ilmanlaadun heikkeneminen ja vesistöjen rehevöityminen ovat haasteita, jotka aiheuttavat maailmanlaajuista huolta ympäristön tilasta. Kasvava ympäristöasioiden, sekä aiheeseen liittyvien ongelmien tiedostaminen on johtanut uudenlaisen turismin muodon syntymiseen, jota kutsutaan ekoturismiksi. Ekoturisti pyrkii minimoimaan aiheuttamansa negatiiviset sosiaaliset, taloudelliset sekä ympäristölliset vaikutukset, joita matka potentiaalisesti aiheuttaa.

Useat ekoturismisertifikaatit, sekä yleinen mielipide ekoturistien keskuudessa korostaa ympäristöasioiden painoarvoa vaikutusten arvioinnissa. Tämä painottaa erityisesti ilmansaasteisiin liittyviä haasteita, mitkä ovat yksi suurimmista matkailun aiheuttamista negatiivisista ympäristövaikutuksista. Yleisimmät matkailuun liittyvät päästöt ovat peräisin kulkuneuvoista, jotka aiheuttavat 75% kaikista matkailuun liittyvistä hiilidioksidipäästöistä. Muita haitallisia ilmansaasteita liittyen matkailussa käytettäviin kulkuneuvoihin ovat typen oksidit ja pienhiukkaset. Kuljetuksen merkittävä rooli ilmansaasteiden syntymisessä luo kuljetuksia tarjoaville ekoturismi –alan yrityksille hyvän mahdollisuuden parantaa liiketoimintaansa vähentämällä kulkuneuvojensa päästöjä. Tämä voidaan toteuttaa esimerkiksi käyttämällä puhtaampia uusiutuvia polttoaineita.

Nesteen NEXBTL uusiutuva diesel omaa potentiaalia vähentää yleisimpiä ilmansaasteita ja edesauttaa uusien puhtaampien ekoturismiin liittyvien kuljetusten syntymistä. Tämän insinöörityön tavoite on kartoittaa ekoturismin käsitettä, sekä arvioida Nesteen NEXBTL polttoaineen markkinapotentiaalia alalla.

Kaksi tapaustutkimusta, joissa NEXBTL polttoaineen käyttöä verrattiin perinteisen dieselin käyttöön tyypillisissä ekoturismiryhmien kuljetuksissa Malesiassa ja Etelä-Afrikassa suoritettiin, jotta suoraa vaikutusta ekoturismiympäristöön voitaisiin arvioida. Suoritettu ympäristövaikutusten arviointi osoitti, että kaikissa tapauksissa NEXBTL polttoaineen käyttö vähensi potentiaalisia vaikutuksia ilmaston lämpenemiseen, sekä vesistöjen rehevöitymiseen ja happamoitumiseen. Lisäksi kasvava ekoturistien määrä tukee Nesteen kannattavuutta lähestyä ekoturismimarkkinoita. Kilpailukyky kohdemaissa, joissa polttoaineiden hintataso on erittäin alhainen, sekä rajoittuneet jakeluverkot ja infrastruktuuri aiheuttavat haasteita, jotka on syytä ottaa huomioon.

Silti, NEXBTL polttoaineen käyttö kulkuvälineissä on hyvä markkinoinnin työkalu ekomatkoja tarjoavalle yritykselle, joka haluaa herättää ympäristötietoisten turistien mielenkiinnon.

Avainsanat	Ekoturismi, NEXBTL, biopolttoaineet, LCIA

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Abbreviations

AF	Animal Feed
ATF	Aviation Turbine Fuel
AV	Aviation gas
CESD	Center of Ecotourism and Sustainable Development
EU	European Union
GSTC	Global Sustainable Tourism Criteria
GHG	Greenhouse gases
HDO	Hydro deoxygenation
HVO	Hydrotreated Vegetable Oil
ICAO	The International Civil Aviation Organization
ISO	International Standard Organization
Ktoe	Kilotons of oil equivalent
LCIA	Life Cycle Impact Assessment
NGO	non-governmental organisations
NEP	National Ecotourism Plan
NEXBTL	Next Generation Biomass to Liquid - Renewable fuel commercialized by Neste Corporation
SAT	South African Tourism
TIES	International ecotourism society
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNEP	United Nations Environment Programme
UNWTO	the World Tourism Organization
USD	United States Dollar
WCED	World Commission on Environment and Development
WTO	World Trade Organization
WTTC	World Travel and Tourism Council

1 Introduction

Tourism has been one of the most steadily growing industries through last decades. The growth of real income, international transportation and increases in leisure time has led to the strong global demand for tourism in developed countries. Annual international tourist arrivals exceeded the one billion mark on 2012 and have been increasing steadily after that (WTO, 2014). These massive amounts of people travelling around the world are causing social, economic and environmental impacts, in particular, the negative environmental impacts such as air pollution, biodiversity loss and land degradation have given universal concern. This concern about not preserving the existing ecosystems and strive to minimize environmental impacts of tourism are factors that have contributed to the formation of the concept of *ecotourism*.

This document is going to study the concept of ecotourism: what it means in general, what the volumes are and how the future looks. Ecotourism as a phenomenon has widely spread all around the world, and this thesis gives a detailed cross-section of the case studies on ecotourism in Malaysia and South Africa.

Because one of the largest environmental impacts of tourism is air pollution caused by transportation, the key aspect where ecotourists and companies offering ecotourism-services should concentrate on is the decrease of transportation emissions. This can be done for example by using alternative low emitting renewable fuels instead of old-fashioned fossil fuels.

Neste NEXBTL is a Finnish innovation in the renewable fuel technology sector, and it offers a solution for lowering the critical air emissions produced by aviation and passenger car fuels commonly combusted today. As a critical air emission, this research considers NO_X, CO_2 and PM emissions. Background and technical details of the NEXBTL renewable diesel fuel and detailed clearance about how it could be introduced into the present day ecotourism markets are also discussed in the thesis. Both case studies include brief environmental impacts assessments on how NEXBTL could lower emission levels and decrease environmental impacts caused by the use of transportation fuels.

1.1 Goal and scope

This research was done for Neste Corporation in co-operation with Helsinki Metropolia University of Applied sciences. The objective of the research was to study the potential use of Neste NEXBTL renewable fuel in the field of ecotourism. The market potential in this field was determined, and potential customers for NEXBTL fuel acting on ecotourism industry were investigated.

Hypothetical potential of NEXBTL related lies in its use as transportation fuel for various vehicles during journey.

Positive and negative impacts of tourism are described in the thesis with the emphasis on environmental impacts, which are the most relevant considering the topic of ecotourism. Two different destination countries are chosen as case studies in order to outline different cultures and environments for NEXBTL. Malaysia and South Africa were selected because both of them have a solid popularity as a tourist attraction, but they represent totally different cultural and economic backgrounds as well as differing tourism attractions and natural environments.

The information for this qualitative research was obtained by literature review on tourism and NEXBTL renewable fuel. Environmental impacts of tourism were studied with the scope for air pollution. Air emissions that are concentrated in this thesis are carbon dioxide (CO_2), particulates (PM), nitrogen oxide (NO) and Nitrogen dioxide (NO_2). Nitrogen oxide and nitrogen dioxide is also referred together as NO_X. These pollutants were selected because they are the most relevant ones, considering environmental impacts caused by air pollution from typical means of transportation used on tourism industry. Modes of transportation focused in this thesis are light and heavy passenger cars and airplanes because those are the most relevant vehicles for NEXBTL renewable fuel.

Life cycle impact assessment (LCIA) was done in order to estimate the environmental impacts of studied emissions and the reduction potential that can be reached by switching existing fuels to NEXBTL.

For determining the market potential of NEXBTL, dimensions of market analysis by David A. Aaker (Aaker, 2014) is used as a baseline.

2 Theoretical background

2.1 Market potential

The market potential of a product or service that someone is willing to commercialize can be defined with market analysis. The fundamental objective of market analysis is to determine the attractiveness of a market, clarify its possible future opportunities and threats. Also those future opportunities and threats are evaluated by how those correspond as a strength or weakness of the company.

According to David A. Aaker (2014), comprehensive market analysis can be determined by reviewing following aspects.

Size of the market

Typical starting point for market analysis is the analysis of total sales level. Determining the size of the market gives the general overview and if the business idea strives to gain a certain share of the markets, it is important to determine the total market size. (Aaker, 2014).

Growth rate

When the total size of the market is evaluated, it is important to focus on what the market size would be in the future. Easiest approach for estimating future growth rate is to assess the data and statistics of the past and extrapolate it into the future. This method provides harsh estimates but the number one challenge is that it can't predict the important turning points of the markets. That is why in order to achieve reliable estimates for the market growth rate it is important to concentrate to the driving forces of the market sales. (Aaker, 2014)

Profitability

Different companies have different profitability levels in the same market. As guidance, the average profit potential can be used in order to get a peak about the potential of making money in the market desired. An often-used model for the industry profitability is Michael Porter's Five-Factor Model of Profitability, which considers following factors that affects profitability (Aaker, 2014):

- Competition among existing companies
- Threat of new entrants and substitute products

- Bargaining power of customers and suppliers

Every factor plays a different role explaining the basic correlations why some industries are more profitable than others.

Cost structure of the industry and key success factors

For identifying the key factors of success, the cost structure of the industry is advantageous to be evaluated. To determine where the value is added to the product can be useful for formulating strategies to develop an economical advantage (Aaker, 2014).

Channels of distribution

When analysing the distribution system of certain market it is crucial to concentrate on existing distribution channels. Existence of initial distribution channels may be alleviating factor at the beginning of new business, but also at some cases the creation of new distribution channel may also lead to competitive advantage (Aaker, 2014). Also it is worth considering trends related to existing distribution channels and possible emerging.

Trends of the market

Usually changes and rising trends are the sources of new opportunities in the markets. For existing businesses those can also be threats that are leading consumers towards competitors. It is especially important to distinguish the difference between growing and rewarding trends and not so long-lasting fads (Aaker, 2014).

2.2 Impacts of tourism

In order to understand the concept of ecotourism, it is significant to research the impacts of tourism that has later on acted as trigger for formation of this complete subcategory of tourism actions.

Tourism as an international phenomenon contains numerous positive and negative impacts. It is a complex industry and one of the largest sources of economic outcome and employment, but the same time it requires enormous amount resources, for example non-renewable natural resources such as fossil fuels in order to meet the enormous transportation fuel needs of the industry. Impacts of tourism can be socio-cultural, economical or environmental, where well-managed tourism can result in development op-

portunities for many countries and communities. It can also have opposite results that can cause very damageable impacts, such as situations where large multinational corporations are competing against local entrepreneurs in the hotel business of popular tourist destinations.

Compilation of impacts of tourism can be seen from Table 1, which merges the positive and negative impacts of all three sub-classes of economical, environmental and socio-cultural impacts.

Table 1. Impacts of tourism.

Economical	Socio-Cultural	Environmental
+ Employment opportunities + Local income growth + Increase in foreign exchange + Infrastructure and facility development	+ Preservation of culture and heritage, where tourists find those interesting	+ Conservation of natural habits
- Seasonal unemployment - Seasonal under use of facilities - Tourism receipt leakage, which means when companies originated outside the destination country are benefitting instead of the local entrepreneurs.	- Increased crime rates - Dilution of local culture and heritage	- Pollution - Increased carbon footprint - Littering - Habitat destruction - Increased congestion - Depletion of natural environments

Socio cultural impacts of tourism are effects on local communities caused by either direct or indirect interactions with the industry. Examples for the positive impacts are development of local infrastructure and encouragement of the preservation of the traditional customs, handicrafts and festivals (Table 1.) Visitor behaviour, crowding and possible increased crime levels can cause undesired outcomes. In addition, in some situations tourism can also violate human rights, when locals can be displaced from their land in order to establish a new hotel or beach.

Economies of some developing countries are even dependent on the tourism industry, and these countries promote themselves as a good place to visit hoping economic improvement. Some small countries such as Vanuatu, Bahamas and Maldives are almost entirely relying on tourism and over 40% of their Gross domestic product (GDP) is gained from tourism (WTTC, 2015).

A good example of the importance of tourism is Croatia, where 28.3% of the GDP in 2014 was accounted for by tourism. The total spending of the leisure tourists in Croatia in the same year of 2014 was 12.4 billion USD and the total contribution for the employment was estimated to be over 300 000 jobs created directly or indirectly by the travel and tourism sector (WTTC, 2015). The development of the effects of tourism on the economy of Croatia can be seen in more detail in Appendix A.

When talking about ecotourism, the third column of Table 1 is the most relevant impact for this thesis. Ecotourism aims at the minimization of the environmental impacts caused by travelling.

2.3 Environmental impacts

The condition of both man-made and natural environment is essential for tourism. An ecotourist strives to be active on the environmental sector and attempts to raise awareness of environmental values and to understand the impacts caused by travelling. The potential of positive environmental impacts caused by tourism lies in the influence on environmental protection and conservation of the destination. This can be contributed to by the tourist or by the locals. One force that drives the locals to preserve their environment is that it is one of the most effective ways to sustain the attractiveness of the tourist destination.

Still, tourism involves several activities that can cause negative environmental impacts and majority of those are connected to actions such as construction processes and transportation. Negative impacts directly from tourists usually occur when the environment's ability to handle the changes caused by visitors is exceeded. According to United Nations Environment Programme (UNEP, 1997) these impacts can be divided into three major groups: depletion of natural resources, physical impacts and pollution.

2.3.1 Depletion of natural resources

Increasing tourism development is creating pressure on the natural resources. This usually occurs in areas where resources are already in short supply. Fresh water is one of the most critical resources affected by tourism and the industry commonly overuses water for golf courses, hotels, swimming pools etc. This increases the local volume of wastewater and can lead into shortages and degradation of water supplies. Also increased amounts of wastewater are increasing the wastewater treatment load, which can lead into eutrophication or toxic algal blooms if not carried out properly.

Also local resources such as energy, food and other raw materials, which may be already scarce can be affected. The seasonal nature of tourism creates high demands for these resources during the high seasons creating pressure for local distribution systems and infrastructure. Tourism also affects to the demand of important land resources such as minerals, forests, fossil fuels and wildlife. Increased construction projects and new recreational facilities are increasing the pressure on these resources.

2.3.2 Physical impacts

Attractive and popular natural areas for tourists such as lakes, riversides, beaches, and mountaintops are usually also transitional zones and bio diverse ecosystems. The most typical physical impacts from tourism are the degradation of the ecosystem of these areas. This kind of physical impacts starts with the land clearing and construction and continues along the tourist activities and causes long-term changes in local economies and ecologies. (Sunlu U, 2003)

Developing infrastructure and emerging construction actions such as accommodation, water supplies and recreation facilities usually involves sand mining that can lead into beach and soil erosion, which can cause degradation of scenery and wildlife. Construction processes of tourism resorts and infrastructure can also cause negative physical impacts, where unsustainable use of land can lead to deforestation or drained coastal wetlands. (Sunlu U, 2003)

2.3.3 Pollution

Tourism produces pollutions as any other major industry. Pollution can occur in different forms; solid waste, littering, oil and chemical emissions, sewage and air emission.

Also noise can be considered as a pollution, not to mention visual pollution caused by poorly planned architecture.

Littering is a problem in areas with high concentrations of tourists and improper disposal of solid wastes can spoil natural environments. According to UNEP (1997) littering degrades physical appearance of shoreline and water and can cause death to marine animals. Increased number of hotels and other recreational facilities has also lead to greater sewage pollution. Poorly treated wastewater pollutes seas and lakes surrounding tourist attractions causing damage to natural environment, which will eventually affect negatively to the tourism industry, when people do not find the places attractive anymore.

As this thesis is determining the potential of NEXBTL renewable fuel in ecotourism sector, the most relevant factor considering the topic is the air pollution caused by tourism because one of the most significant variables in the production of air emissions is the fuel used in transportation vehicles.

2.3.4 Air Pollution

When possible human caused contribution of climate change and deterioration of air quality in large cities is a hot topic, air pollution is fairly topical issue considering the environmental impact of tourism. The most relevant air emissions caused by the aviation and car transportation are greenhouse gases (GHG), nitrogen oxides and particulates, which all are also the pollutants handled on this thesis. Greenhouse gases are gases that absorb and emit radiation in the infrared wavelength range emitted by Earth, which causes the greenhouse effect.

The most abundant greenhouse gases related to tourism transportation are water vapour (H_2O) and carbon dioxide (CO_2).

Air pollution emissions of tourism are directly connected to the transportation. As an example of one pollutant, tourism accounts for 5% of the global carbon dioxide emissions and 4% is attributed directly from the transportation (UNWTO, 2008). The distribution of the carbon dioxide emission sources and emissions caused by the tourism industry can be observed from Figure 1.

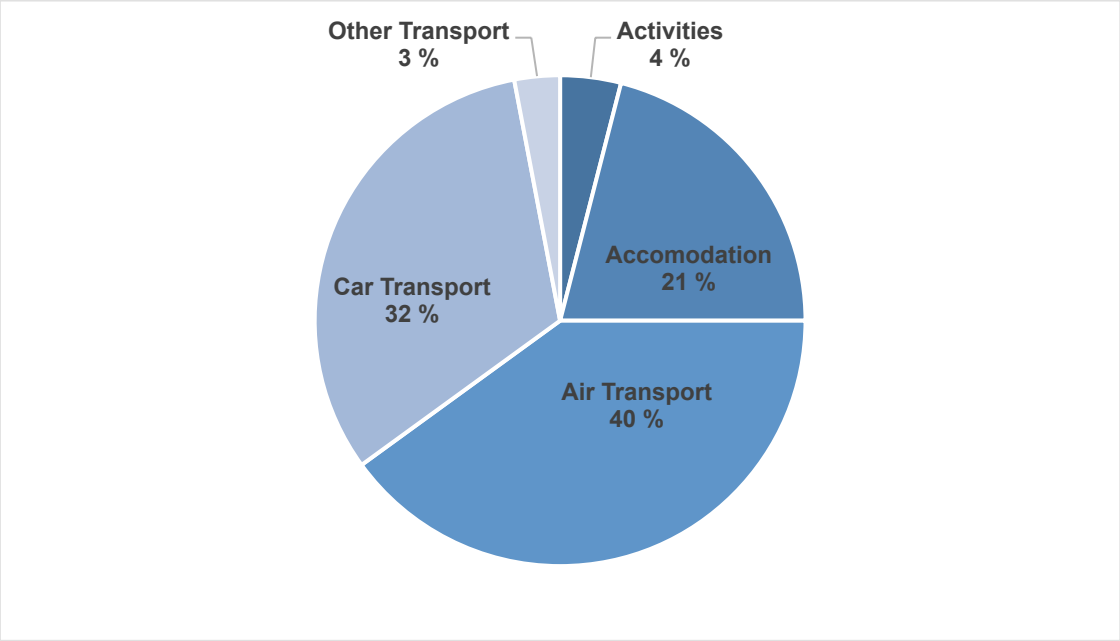

Figure 1. Carbon dioxide emissions of tourism industry (UNWTO/UNEP, Climate Change and Tourism, 2008).

Figure 1 shows that transportation plays a major role (75%) of the total CO_2 emitted. This creates a great opportunity for companies acting on the field of ecotourism to cut down their emissions and decrease the environmental effects of transportation by using cleaner transportation fuels and renewable energy sources.

When the amount of tourists is all the time increasing it leads straight to the increase of the most critical air emissions from the engines of the common vehicles used. Statistics of the World Bank are stating that the number of international tourist arrivals worldwide rose from 837 million on 2005 to over 1.1 billion in 2013 and are increasing still (World Bank, 2015). When according to The International Civil Aviation Organization (ICAO, 2011) publication, 45 percent of all tourists worldwide arrive by air; the airborne traffic is responsible for large share of the common air pollutants from aviation and emissions from transportation can be linked to various environmentally harmful effects. From Table 2, the major effects that can be considered as environmentally harmful caused by greenhouse gases, nitrogen oxides and particulates can be seen. Basically all popular forms of tourism transportation (airplanes, cars, trains and ferries) are emitting these air pollutants.

Table 2. Environmental impacts of emissions considered (C. Cooper, 2011).

Greenhouse Gases	NO and NO_2	Particulates
Greenhouse gases such as water vapour and carbon dioxide acts in atmosphere by trapping infrared radiation, causing greenhouse effect where thermal radiation back into space is partially impeded. This has a potential to cause climate change.	NO and NO_2 are usually referred as NO_X. Together with volatile organic compounds NO_X produce photochemical smog in the atmosphere, which is considered as a major problem in large cities across the world. Smog can cause several health effects to humans, especially breathing problems. Also NO_X can form nitric acid in the atmosphere and cause acid rain.	Particle pollution consists of a various components, including acids (nitrates and sulfates), organic chemicals, metals and soil or dust particles. PM pollutants can affect to heart and lungs by causing health effects when inhaled. They can also effect to vegetation by blocking stomata openings and interfere photosynthesis.

The awareness of these negative impacts of tourism has enlarged the popularity of more sustainable tourism and has created a completely own form of tourism called ecotourism. Ecotourist strives to minimize environmental impacts of the journey and instead tries to leave positive impact to the destination country. In most cases this means that people who want to travel more ecologically are required to pay something extra compared to regular tours.

2.4 Ecotourism

2.4.1 History

Environmental impacts of tourism have been acknowledged for a long time. This basically goes all the way back to the 1950s, when mass tourism started to commence as a side effect of economic growth of the middle class and operation of the first commercial aeroplanes.

One of the first generally noticed reports that touched on the theme of ecotourism was Our Common Future on 1987, published by Brundtland Commisison or World Commission on Environment and Development (WCED). It targeted the interdependence and multilateralism of the nations in order to promote sustainable development. Report de-

fined the term of sustainable development for the first time considering social and economic needs of the people with interaction of environmental carrying capacity (UN, 1987). The report did not directly include tourism, but the general idea of sustainability is the very same that is the foundation of concept of ecotourism.

When the public awareness of environmental concerns increased the researchers and non-governmental organisations started to demand the introduction of principles of sustainable development into the field of tourism. The first international organisation representing ecotourism was International Ecotourism Society (TIES), which was founded in 1990 and has spread information and promoted on sustainable tourism since. Today there are hundreds of organisations and companies pushing the sustainable tourism forward and creating opportunities for people to travel ecologically and sustainably.

2.4.2 Concept

Currently, environmental awareness is rising rapidly in the context of tourism and concepts such as new tourism, ecotourism and sustainable tourism have emerged. Term ecotourism has caused confusion in the tourism industry, because it is unclear context. For example expressions such as nature tourism, environmentally friendly tourism and sustainable tourism are used as a synonym, although their exact meaning might be different (Tuohino, A. and Hynönen A. 2001). It can be stated that ecotourism is a subsector of tourism including nature-loving, ecologically and socially conscious people.

The International Ecotourism Society defines the ecotourism as “Responsible travel to natural areas that conserves the environment and improves the welfare of local people” (TIES, 2015). That is the most used and well-known description for the term. There can be various different definitions for ecotourism, but the bottom line is that it means tourism that attempts to have positive impact on local communities and natural areas.

As mentioned, an ecotourist is a person who wants to minimize his/her own negative impact when travelling. These negative impacts can be for example emissions caused by the transportation, biodiversity losses and erosion of the trails, roads, buildings, etc. that can be sensitive for continuous movement of tourists. It can be argued that there is no ecological way to travel, because it is always better to stay home and do not contribute any carbon dioxide emissions caused by aircrafts or damage the nature by erosion and load down the local waste treatment systems. This can’t be denied, but still,

as long as people have a passion to discover, relax and search for new experiences, it is important to understand the consequences and try to find more sustainable ways to do it.

Ecotourism tries to minimize the effects of transportation, accommodation, trails and other infrastructure used during the trip. This can be done by using renewable sources of energy, proper recycling and disposal of waste and supporting local housing. Accommodation should also favour environmentally and culturally sensitive architectural design (TIES, 2015).

Educational agenda is also present; ecotourism can act as an interactive learning experience between the tourists and residents of the local communities. Travellers attempt to study beforehand the local natural and cultural history, ethical principles, communication practises and using this attempt to minimize the negative impacts while visiting sensitive environments (Honey M. 2008).

2.4.3 Certification

Travel operators, accommodation provider or any other kind of business operating on the field of tourism can apply for an eco-certification for their business. Certification program can be used as an important tool for companies that want to stand out distinguishing themselves as a genuinely responsible company, separated from those that are merely using words such as “sustainable” or “eco” as a marketing tool. Certification program assures consumers that the certificated company they are supporting is complying sustainable practises and quality nature-based tourism experiences.

There are many different types of certification systems and so-called “ecolabels” on tourism industry. All Ecotourism-related certificates share common core of a matter including the triple bottom line of sustainability: taking into consideration environmental, social and cultural aspects. Many of these programs are also designed to work in parallel with governmental health and safety regulations (CESD, 2013). According to World Trade Organization (WTO, 2002) there was over 60 identified ecotourism or sustainable tourism certification programs on 2002. Today, due the increased popularity of sustainable tourism, nearly every highly tourist-orientated country has own corresponding certification programs.

One example for global sustainable tourism certification programme is Green Globe certification established on late 1994. Green Globe program is one of the oldest tourism certification programme applying the Agenda 21 sustainable development principles originated from 1992 United Nations Rio de Janeiro Earth Summit. Programme pursues to achieve improvements on the field of environment, social economic, cultural heritage and sustainable management (Figure 2.)

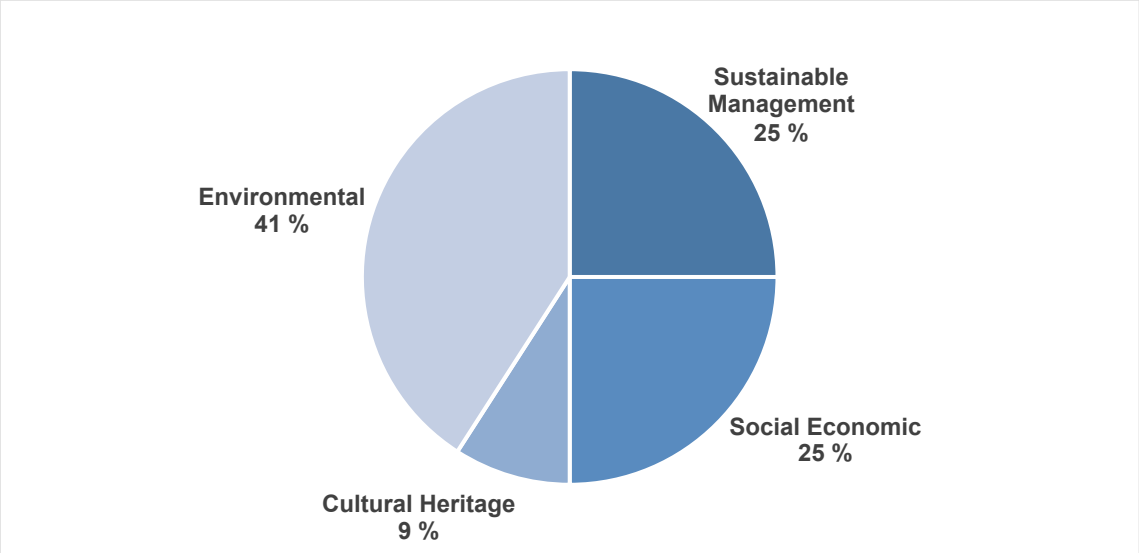

Figure 2. Green Globe standard focus distribution (Green Globe, 2015).

From Figure 2 the distribution of different areas of interest related to Green Globe certification can be observed. The largest are of interest (40.9%) is environmental aspects which keeps inside targets in minimizing greenhouse gas emissions and strive to sustainable energy consumption, these aspects could be met with the use of clean transportation fuel.

The Green Globe standard is mostly based on following commonly recognized international standards and regulations on the sustainability:

- Global Sustainable Tourism Criteria (GSTC)
- Global Partnership for Sustainable Tourism Criteria (STC Partnership)
- Baseline Criteria of the Sustainable Tourism Certification Network, Americas
- Agenda 21 and principles for Sustainable Development endorsed by 182 Governments at the United Nations Rio de Janeiro Earth Summit in 1992
- ISO 9001 / 14001 / 19011 (International Standard Organization)

2.4.4 Volumes

Because of the complex categorization of ecotourists, and lack of statistical data where different tourists are separated, it is hard to give accurate estimation on the real volume of ecotourists. Still, some estimation on the international volume of ecotourists can be accessed via the data available of tourists overall.

Total amount of annual tourist arrivals has been generally increasing in past decades. In 2013, tourist arrivals grew by 5% and reached 1.123 billion, which is 51 million more compared to the previous year. Regardless of the economic challenges around the world, tourism industry seems to be mostly unaffected and United Nations World Tourism Organization is forecasting steady increase rate of 3.3% a year between 2010 and 2030 (UNWTO, 2015). With this linear growth, total amount of annual tourism arrivals could reach 1.95 billion in 2030 (Figure 4).

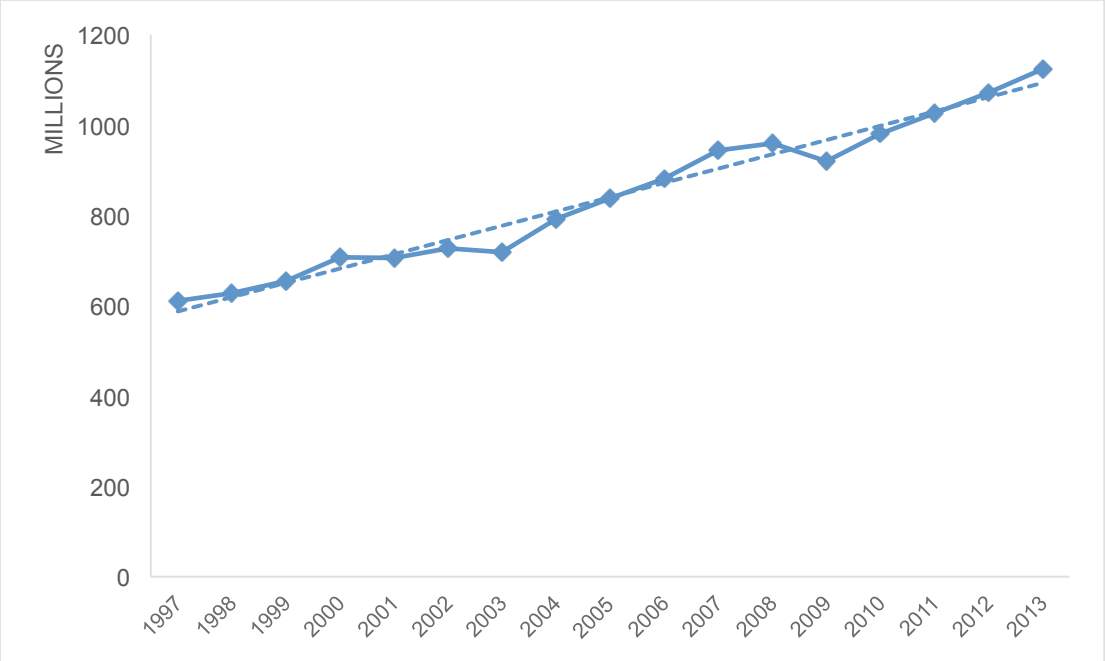

Figure 3. Amount of international tourist arrivals (World Bank. International tourism, number of arrivals, 2015).

As we can conclude from Figure 3 tourism numbers are steadily increasing, excluding the drop in the year of 2009. Decrease in the tourist arrivals on 2009 can be explained with the global financial crisis of 2007-08 that affected heavily to the world's economy.

From these statistics UNWTO recalled that 53% of all international tourist arrivals were for holidays and recreation, 14% travelled for business purposes and 27% for occasional reasons such as visiting friends and relatives. Remaining 6% of the travels were not specified. (UNWTO, 2015)

According to Lindberg K. (1997), rough estimation of the ecotourism share of tourists is 7% of the total international tourism arrivals. Also it was stated that in 2004, ecotourism was growing globally three times faster than tourism industry (TIES, 2006). With these figures it can be estimated that total number of ecotourists in 2013 could be around 83 million. This estimation was calculated by using share of 7% of all tourists in 1997 and 10% steady annual increase between 1997 and 2013.

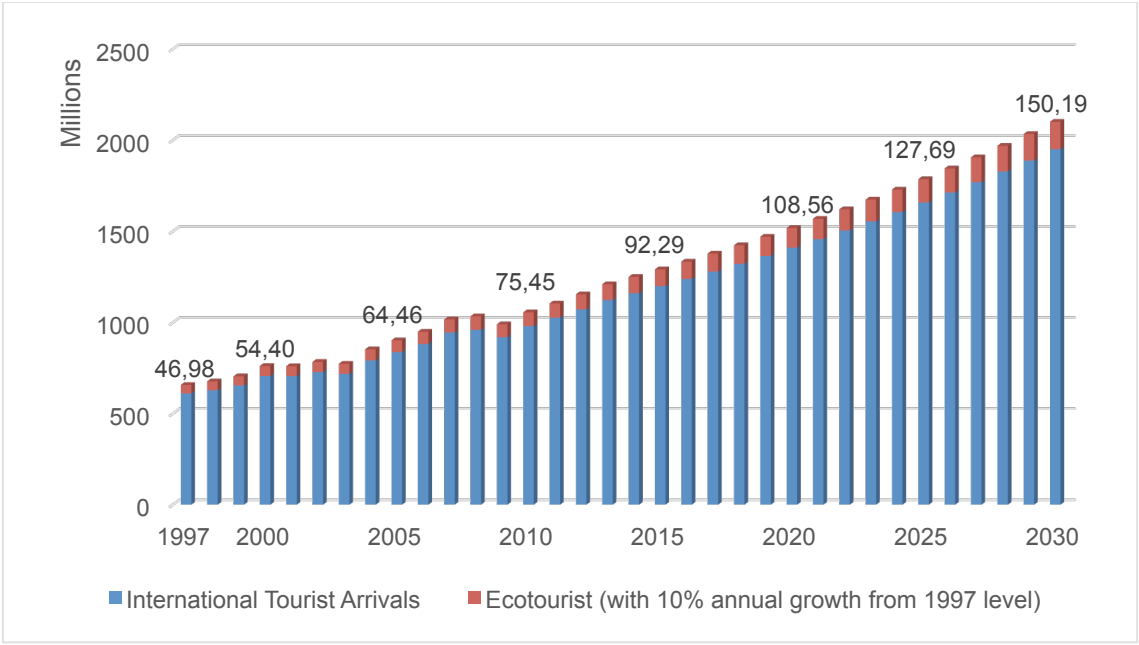

Figure 4. Estimated growth of ecotourists from 1997 to 2030 (World Bank. International tourism, number of arrivals, 2015).

There is also common increasing recognition of the importance of responsible and sustainable travel among the consumers and professionals. For example according to world's largest travel website Trip Advisor; 71% of the survey respondents said they plan to make more eco-friendly choices, such as eco-certified hotel, cleaner transportation and more sustainable food decisions in the next year (Trip Advisor, 2012). Also survey carried out by The Nielsen Company, covering over 28 000 respondents stated that 66% of consumers around the world prefer to purchase services and products from companies that have implemented programs to give back to society (Nielsen Wire, 2012)

2.4.5 Ecotourist Market Profile

The International Ecotourism Society has collected data on ecotourists based on survey concluded by HLA and ARA consulting companies (TIES, 2000). People participated in the questionnaire were all from North America, still when North Americans represents one of the largest segment of nationalities participating nature- or ecotourism holidays, this target group can be considered as a valid source of sampling.

Age of a typical ecotourist varies between 35 and 55 years old, although age varied with factors such as costs and types of activities. Clear variation for gender did not occur and approximately 50% were male and 50% female, although slight gender variation occurred when types of activities performed during the trip were compared. 82% of the people questioned were college graduates and it could be concluded that people with high-level education prefer ecotours. Still, in general highly educated people have more money to spent and better preconditions for travelling. Survey also stated that 60% majority of the ecotourists preferred to travel as a couple, when 15% prefer travel with family and 13% enjoyed travelling alone. Largest group of the respondents (21%) were ready to spend around 1000-1500 USD during the trip and most of the "experienced ecotourists" who had been on ecotours more than once were willing to pay even more. (TIES, 2000)

Also according to survey published by Statista (2014), 86% of the respondents said that they were willing to pay more for staying in an eco-friendly accommodation during the holiday.

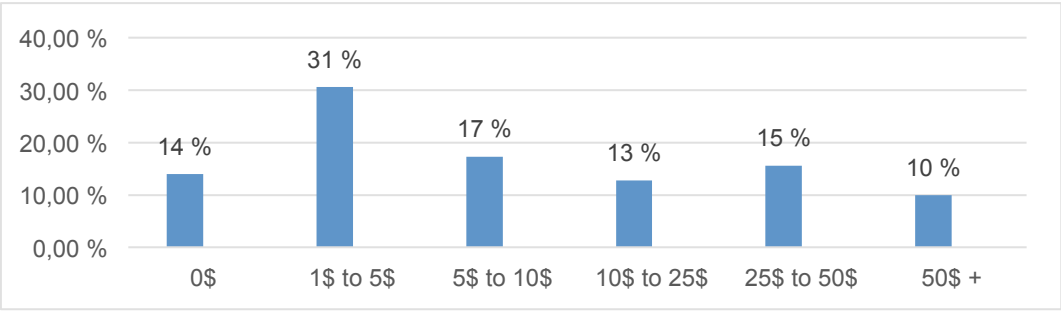

Figure 5. Additional price per night travelers were willing to pay for environmentally-friendly hotels worldwide as of March 2014 (Statista, 2014).

Majority of the respondents (31%) said that they were ready to spend 1-5 USD more for environmentally friendly accommodation, this gives brief guidance that same customers might have interest to pay more for more sustainable and clean transportation.

2.5 NEXBTL

When a company, considering themselves as ecotour provider is trying to minimise all the environmental impacts caused by their actions, one obvious way is to cut down the harmful emissions caused by the transportation vehicles used during the tours. Examples for these kinds of situations where different vehicles are used during the ecotourism activities can be trucks used in African wildlife safaris or light aircrafts taking passengers to the rural natural park areas in the rainforests of Amazonas or Southeast Asia.

In 2007, Finnish oil and refining company Neste Oil started renewable diesel fuel production with their new NEXBTL fuel production process. The development process of NEXBTL, which comes from the words Next Generation Biomass to Liquid, started during the mid-1990's together with VTT (Technical Research Centre of Finland) and several Finnish universities (Stade and Siitonen, 2006). Unblended diesel product meets the criteria set by European Committee for Standardization CEN TS 15940. Also blended NEXBTL complies the requirements for European diesel fuel standard EN 590.

There are currently four NEXBTL production sites. First two sites with annual capacity of 190 000 tons were commissioned to Porvoo and Naantali, Finland on 2007 and 2009. On 2010 Neste invested for new refinery to build in Singapore with annual capacity of 800 000 tons. Latest production site was completed on 2011 to Rotterdam, Netherlands with capacity of 800 000 tons.

As a raw material for the fuel Neste uses mainly vegetable oil and waste animal fats that are currently available on large quantities. Fuel quality of the NEXBTL equals to the synthetic Fischer-Tropsch BTL and GTL diesel fuels and the quality of the product is independent of the feedstock used (Turpeinen, 2009). As a vegetable oil feedstock Neste uses mainly palm oil and rapeseed oil. Palm oil used is originated in Malaysia and transported to towards refineries usually by ships. For Kilpilahti site, rapeseeds are originated in the area of European Union and rapeseed oil is processed in Finnish rapeseed oil plant. Animal fats used are transported by truck from Finnish rendering plants (Nikander S. 2008). Animal fats for the Singapore plant are originated from rendering facilities in Australia and New Zealand. In 2015, over 70% of the total feedstock used for NEXBTL production was from wastes and residues.

2.5.1 Production process

Neste's proprietary NEXBTL technology allows flexible use of any vegetable and waste oil for the production of premium quality renewable diesel and renewable aviation fuel, which are currently under production. The NEXBTL biofuel production process consists of two main process steps that are pre-treatment of raw materials and hydrotreatment process.

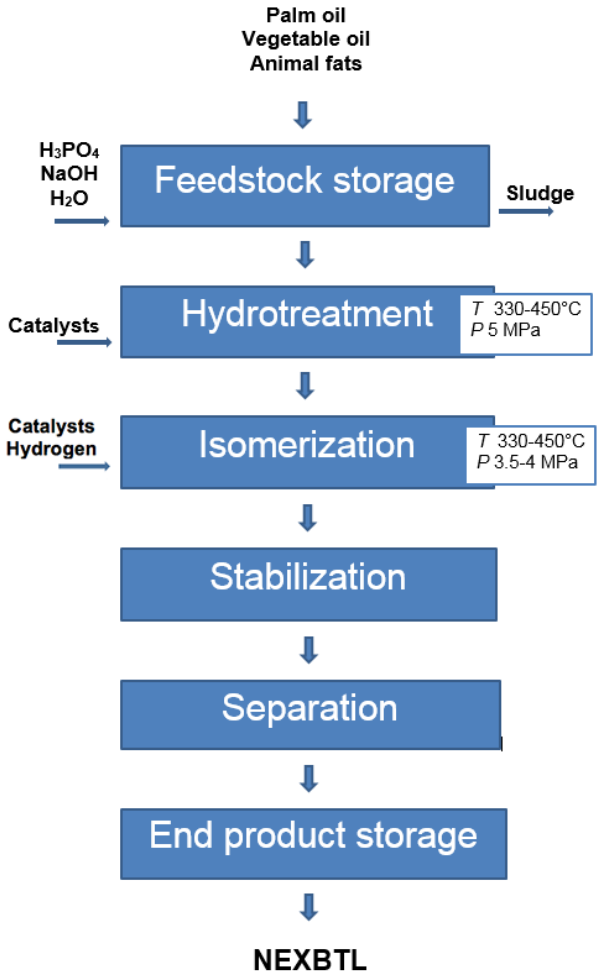

Figure 6. NEXBTL Process Diagram (Stade and Siitonen, 2006).

At the start of the production process, the raw materials are stored in storage units, until they are transferred into pre-treatment unit, where they are purified. Water, steam and washing chemicals are used in the pre-treatment phase in order to purify the raw material and prepare it to the next stage. Chemicals used in washing are mainly phosphoric acid and sodium hydroxide (Stade and Siitonen, 2006). Amount of washing chemicals used in the process is approximately 0.2% of the raw material used (Nikander S. 2008). Small amounts of solid waste formed mainly during the separation

and pre-filtration is dried and sent for further treatment. Wastewater formed in washing and drying is sewered and pumped towards proper water treatment.

After the pretreatment, the raw material is pumped towards the hydro treating section. This part starts with hydro deoxygenation (HDO) process, where triglycerides of animal fats and vegetable oils are converted to saturated straight-chain hydrocarbons and treated with middle distillate desulfurization catalysts (Aalto, Piirainen, Kiiski, 1997).

In order of improved cold properties, the fuel goes through isomerization, where the molecular structure of *n*-paraffin of the hydrocarbon is processed with appropriate catalyst, which creates methyl branches to the structure.

After the isomerization the product is stabilized. Stabilization is carried out by stripping with low pressure stream that is causing the separation of light hydrocarbons. Before storage of the end product, NEXBTL-components need to be separated from the gases and other components formed in the process. Removal occurs at first by absorption or washing with aqueous amine solution and followed by amine regeneration that separates the individual gases. (Aalto, Piirainen, Kiiski, 1997).

2.5.2 Environmental properties

Compared to conventional diesel and gasoline fuels, which are regulating common standards such as EN 590 and retailed over the world, NEXBTL has clear environmental advantages related to exhaust gas emissions produced by the combustion of the fuel. The tailpipe emission reductions are directly correlated to the blending volume of NEXBTL fuel into conventional fuel. Tests carried out with 100% blend of NEXBTL renewable diesel have met for example 33% lower emission values in fine particulates (PM) and 9% reduction against nitrogen oxides (NO_X) (Neste, 2015). These average reduction percentages are based on NEXBTL and Hydrotreated Vegetable Oil (HVO) related tests with different vehicles and compared to conventional EN 590 diesel.

Greenhouse gases are one of the most discussed emissions related to transportation industry and one major pollutant from typical vehicles. When the total life cycle of the fuel is taken into consideration, raw material of the NEXBTL is one of the key factor that effects to the total greenhouse gas emissions of the fuel. According to research made by Joint Research Centre of the European Commission some raw materials for

NEXBTL fuels can reach significantly low greenhouse gas emissions when compared from “Well-to-Wheel” (Figure 7). This “Well-to-Wheel” considers the emissions from fuel production and vehicle use and do not include emissions involved in building the vehicles and facilities or the end life aspects.

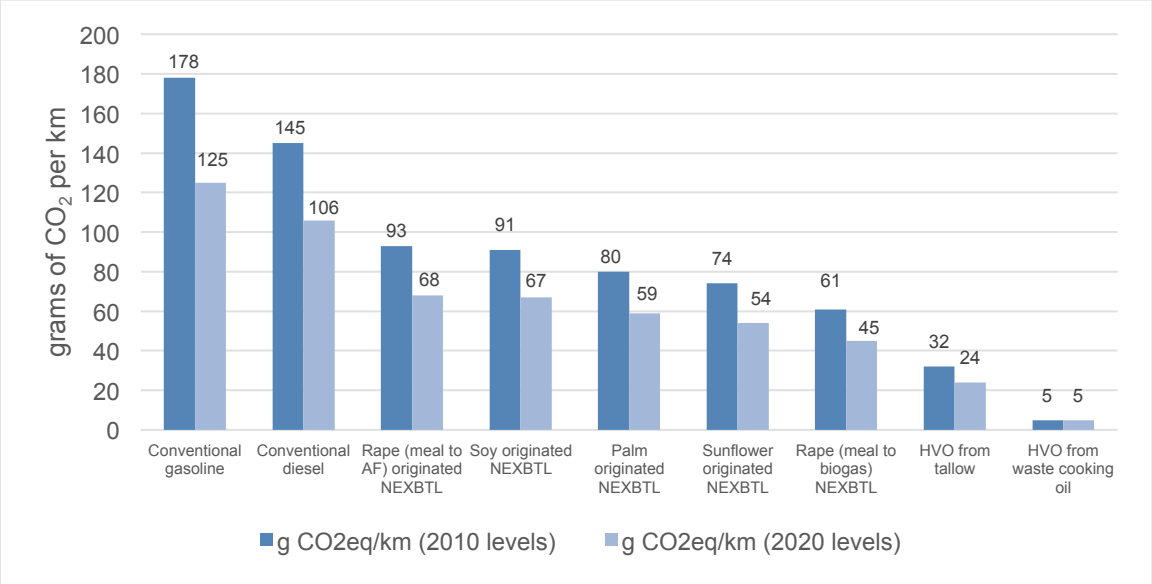

Figure 7. CO_2 emissions of NEXBTL from different fuel sources (European Commission, 2014).

As we can see from Figure 7, carbon dioxide emissions from NEXBTL fuel are lower compared to conventional diesel and gasoline. Regardless of the raw material used NEXBTL is open to reach greater than 30% reductions in CO_2 emissions. Renewable fuel manufactured from rape with meal to biogas treatment and HVO from waste cooking oil reached both over 50% reductions (Rape -58%, Cooking oil -97%) (Appendix B).

Values used for diesel emissions are all modelled by using direct injection compression ignited engine (DICI) and for the conventional gasoline emissions Direct Injection Spark Ignited engine (DISI). 2020 levels are obtained by using the guidance of upcoming legislative restrictions and technological development.

Use of renewable and clean transportation fuel can offer advantage for ecotourism companies marketing advantage when consumers are more and more conscious on environmental aspects. Also when for example greenhouse gas emission reductions can be significant (up to 40-90% compared to fossil fuels) use of NEXBTL could give valuable proof for environmental awareness during certification processes, where carbon footprint and air pollution impacts are reviewed.

3 Case study 1: Ecotourism in Malaysia

3.1 Ecotourism in Malaysia

Malaysia is one of the top biologically diverse countries on earth, combining variety of different ecosystems such as rainforests, mangroves, swamps, mountains and coral reefs. It has been estimated that 20% of the world's animal species can be found encountered on the geographical area of Malaysia (Alexander, 2006). Country with great quantities of wildlife species and strong history as a travel attraction holds a huge potential as an interesting ecotourism destination.

Also Malaysia has steady economy and according to World Bank (2015), solid growth of 5.5% after The Asian financial crisis of 1997-1998 lasted until the Global Financial Crisis in 2009. Malaysia recovered rapidly from the worldwide crisis and has posted averaging growth rates of 5.7% since 2010. Exporting of electronic appliances, electronic parts, palm oil and natural gas are the key components of Malaysian economy. Malaysia has fought well against poverty during last decades and with inclusive economic growth the share of households living below national poverty line has decreased from 1960s level of 50% to less than 1% at present. Steady national economy allows also local entrepreneurs into ecotourism markets, which is widely present in Malaysia.

Malaysia is generally considered as one of the leading countries on the field of ecotourism with various internationally competitive local ecotourism companies. For ecotourists, a wide range of activities is offered, for example: hiking, caving, rafting, diving, jungle trekking and bird watching. Also different kinds of events are annually arranged that highlight awareness on conservation of country's natural and cultural assets. As an example for this kind of events are; Tabin Wildlife Conservation Conquest in town on Sabah and Taman Negara Eco-Challenge held in Taman Negara national park. Malaysia also has various UNESCO's World Heritage Sites including Lagkawi Island, Kinabalu National Park in Sabah and Mulu National Park in Sarawak. The Government of Malaysia has also awakened for the potential of sustainable tourism and the Malaysian Ministry of Tourism has adopted the National Ecotourism Plan (NEP), which provides guidance for improving national awareness and course of actions towards eco- and sustainable tourism. (Tourism Malaysia, 2008)

According to National Ecotourism Plan of Malaysia (2011) there are about 2000 registered tour and travel agencies in Malaysia and it is estimated that 800 from those are linked to bookings for nature related destinations. Out of these 800 companies, 30 are registered as a specialized company for nature and ecotourism business. Ministry of Culture and Business of Malaysia is estimated that from 7% to 10% of all overseas tourists are visiting ecotourists, which corresponds of 1.9 to 2.7 million ecotourists in Malaysia during the 2014 using tourist arrival statistics from 2014 (Ministry of Tourism and Culture Malaysia, 2014).

Transportation fuel trends of Malaysia are dominated by conventional petrol and diesel fuel, as would be expected. For example on 2008 over half of the energy use by transportation sector in Malaysia is consumed by using petrol fuel (54%) (Onga, 2011).

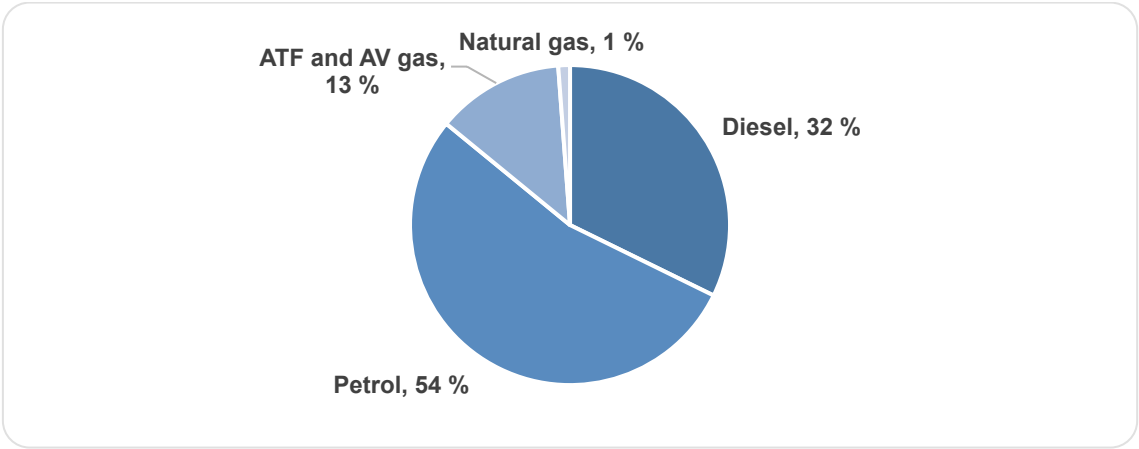

Figure 8. Energy use by transportation sector in Malaysia 2008 (Onga, 2011).

ATF and AV are fuels used in aviation, where ATF gas is jet fuel and AV gas aviation gas. Respectively, diesel fuels took 32% of the overall energy used by transportation in Malaysia 2008. This equals 5 283 000 tons of oil equivalent of energy. Share of diesel as a transportation fuel in Malaysia has been slowly growing over the last 15 years, when back in the 1998 petrol accounted over 60% of the energy use in transportation. Trend of amount of diesel used has also been increasing over the past years (Figure 9).

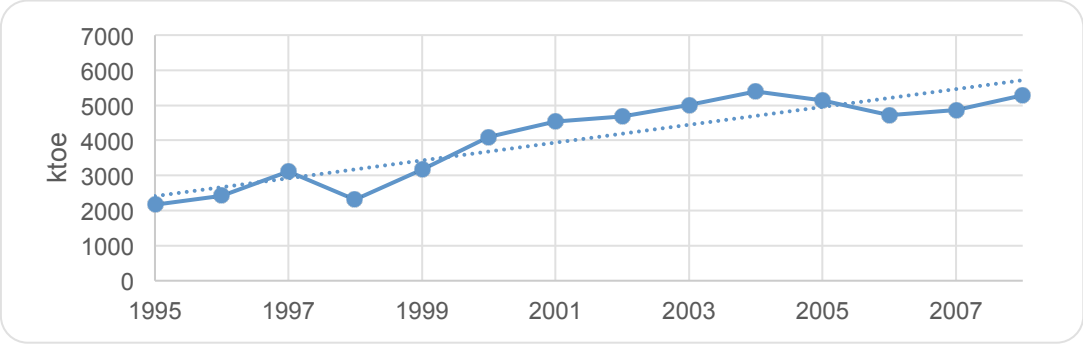

Figure 9. Energy use by diesel in transportation, Malaysia 1994-2008 (Onga, 2011).

Energy use in Malaysia during 1994-2008 is illustrated in Figure 9 with unit of ktoe, which means kilotons of oil equivalent.

3.2 NEXBTL in Malaysia

Because of the geography of an island state and extent of rainforest areas the most typical way of transportation to ecotourism areas is with light aircrafts. Especially the largest tropical rainforest areas in Borneo, which are the most popular destination for one of the largest ecotourism company in Malaysia Borneo Eco Tours, are mostly reachable by air. It is typical that national parks have their own small airfields and light vehicles are not needed at all. Anyhow this creates markets for NEXBTL renewable aviation fuel.

Still, some popular ecotourism destinations are also available by light vehicles and one example is the largest national park in Malaysia, Taman Negara. Taman Negara National Park is located approximately 250 km away from Kuala Lumpur, which is at the most cases the starting point of an ecotour. Usually ecotourists are taking international long distance to Kuala Lumpur, where company offering the ecotour starts operation. When ecotourism groups are attempted to keep small, it is common for ecotour entrepreneur to transport the group back and forth using light vehicles or minibuses.

In order to obtain data for emission reductions and local environmental impacts caused by transportation from Kuala Lumpur to Taman Negara National Park, life cycle impact assessment (LCIA) was made. Goal of this LCIA is to access environmental impacts and their variations between conventional diesel and NEXBTL renewable fuel. Following assessment uses same Well-to-Wheel emission rates that were considered in chapter 2.5.2 and by this does not consider emissions involved in building the vehicles, fuel production facilities or end life aspects. Following figures are showing the direct

emissions caused by the vehicle during the trip and variation between the two different fuels studied. All values used in the calculations can be obtained from Appendix C

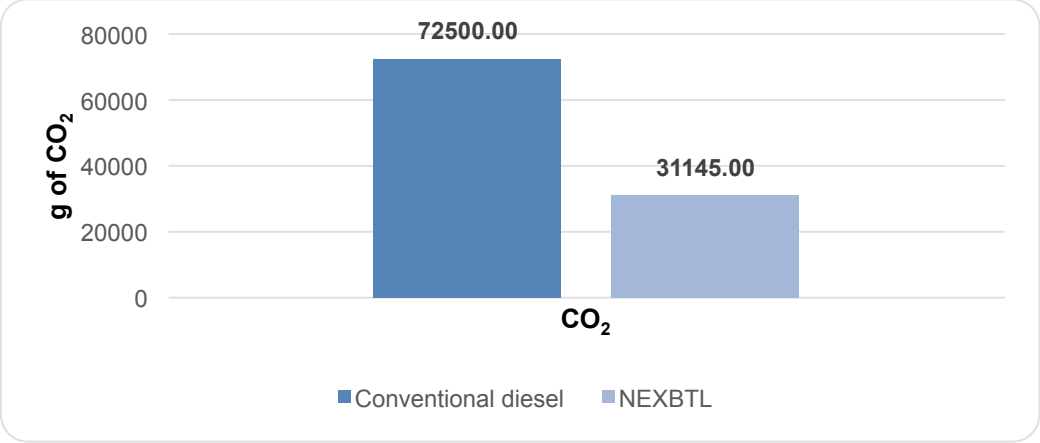

Figure 10. CO_2 emission reduction for round trip to Taman Negara National Park (500 km drive).

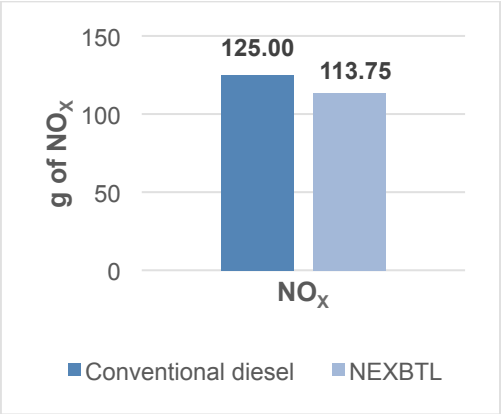

Figure 11. Particulate emission reduction.

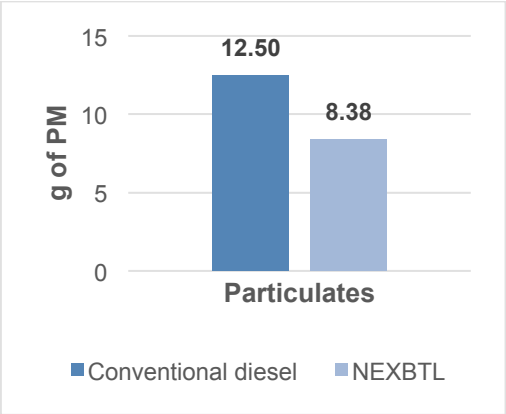

Figure 12. NO_X emission reduction.

We can see from Figure 10 that by using NEXBTL renewable fuel, carbon dioxide emissions generated by the round trip from Kuala Lumpur to Taman Negara National Park could be reduced by 57%. As well as particulate and NO_X emissions were also decreased (Figure 11 and 12).

In order to clarify environmental impacts caused by these emissions, data were characterized and normalized using CML-IA factor database, created by Institute of Environmental Sciences in Leiden (CML-IA, 2013). Characterization was made to emphasize different consequences of certain pollutants. Characterization factors are estimates for different scenarios and in this thesis; scenario for 20 year with the geographical environment of the World is used. Because characterized results are all in different units

(CO_2 eq., NO_X eq., PM eq.) normalization is required. By normalization, the data are transformed into comparable format within different impacts. In order to follow calculations that has led to results shown in Figure 13, example calculations can be seen from Appendix C.

Following results show doesn't show the quantity or significance of environmental impacts, just the lessening compared to current levels and usage of conventional fuels.

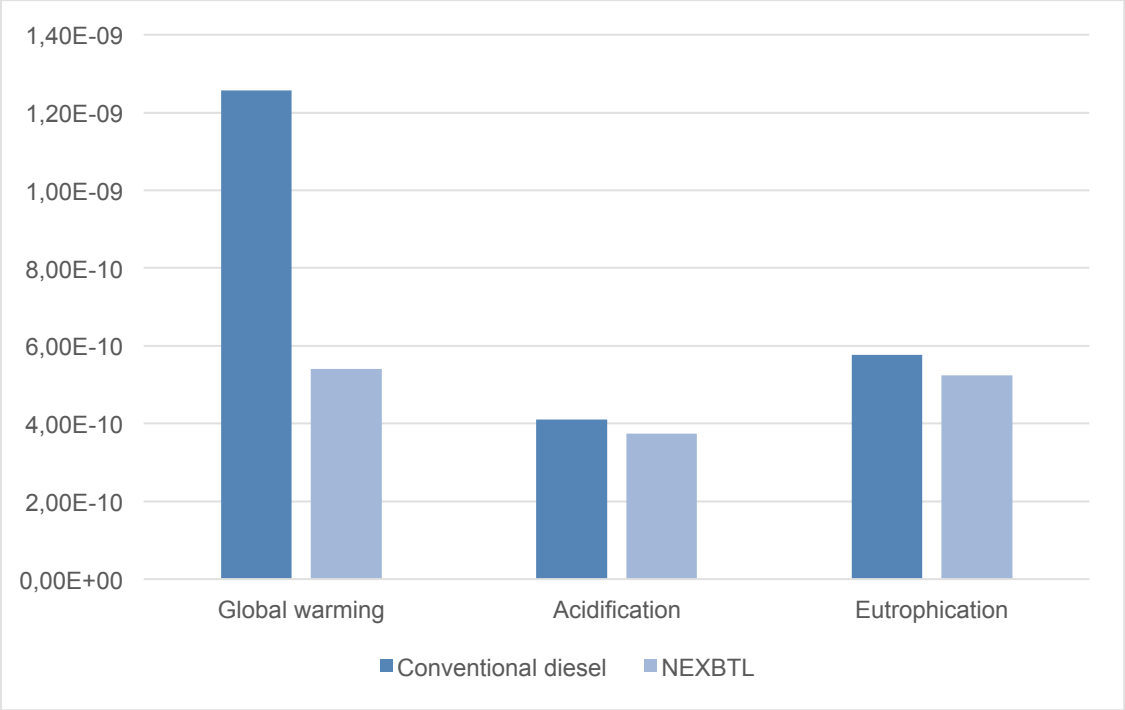

Figure 13. Normalized environmental impacts of transportation to National Park for World 20 Years.

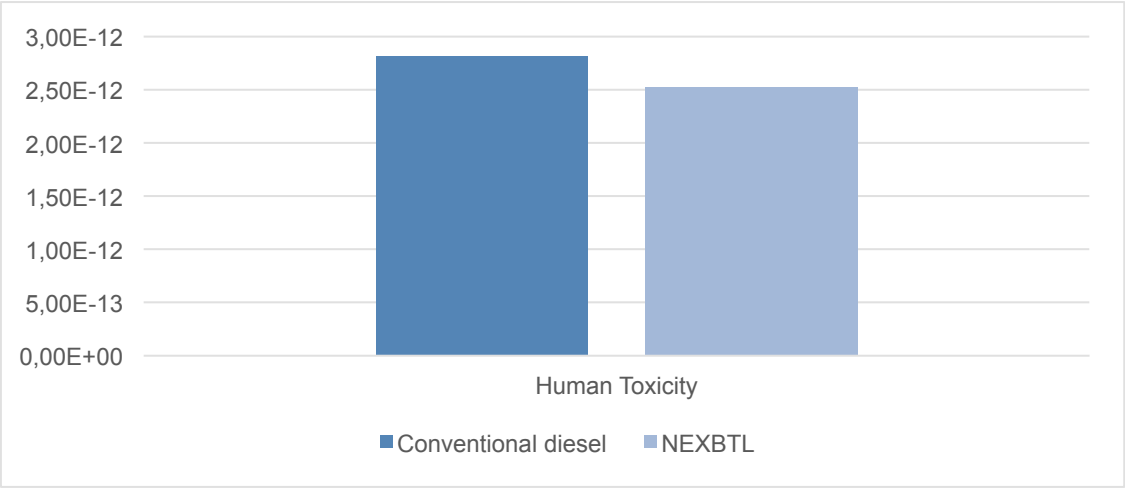

Figure 14. Normalized results for Human Toxicity of transportation to National Park for World 20 Years.

Figures 13 and 14 shows that all key environmental impacts could be decreased by introducing NEXBTL for transportation fuel, especially global warming. Also human toxicity caused by the PM and NO_X emissions could be decreased by over 9% (Figure 14). Reduction in the global warming potential is relatively large, when this case study considers only fairly short distance (500 km round trip) the impact is not significant, but if for example multiple cars are driving this same route couple times a week, decrease for global warming potential would be fairly large. Considering the effects on natural environments; acidification and eutrophication are relevant impacts on this case area, switch from conventional diesel to NEXBTL will cause small positive improvements. Effect on human toxicity is fairly small and especially in rural areas the effect is not significant.

These estimations for emission reductions and environmental impacts changes were calculated using test results of 100% blend NEXBTL compared to conventional diesel. Emission values for carbon dioxide are obtained from Well-to-Wheel research (European Commission, 2014). Particulate and NO_X emission levels for NEXBTL were estimated by calculating percentage reductions reported by Neste (2015) towards EURO-4, emission standard limits for vehicle pollution. EURO-4 emission limits are the prevalent emission in Malaysia since 2013 (CAI-Asia Center, n.d) Presumably the car pool of Malaysia is notably older than cars with EURO 4 emission limits, which considers cars manufactured for European markets in 2005-2009, so the emission reductions might be even larger in the most real life scenarios. Also is needed to keep in mind that calculations were made by using one round-trip from Kuala Lumpur to Taman Negara National Park, if it is estimated that ecotour provider offers 1-2 trips per week, annual emission levels are multiple.

All in all, clear improvements for emissions that cause global warming creates a good potential to market NEXBTL for travel providers that value sustainable and ecological values or works within the ecotourism field.

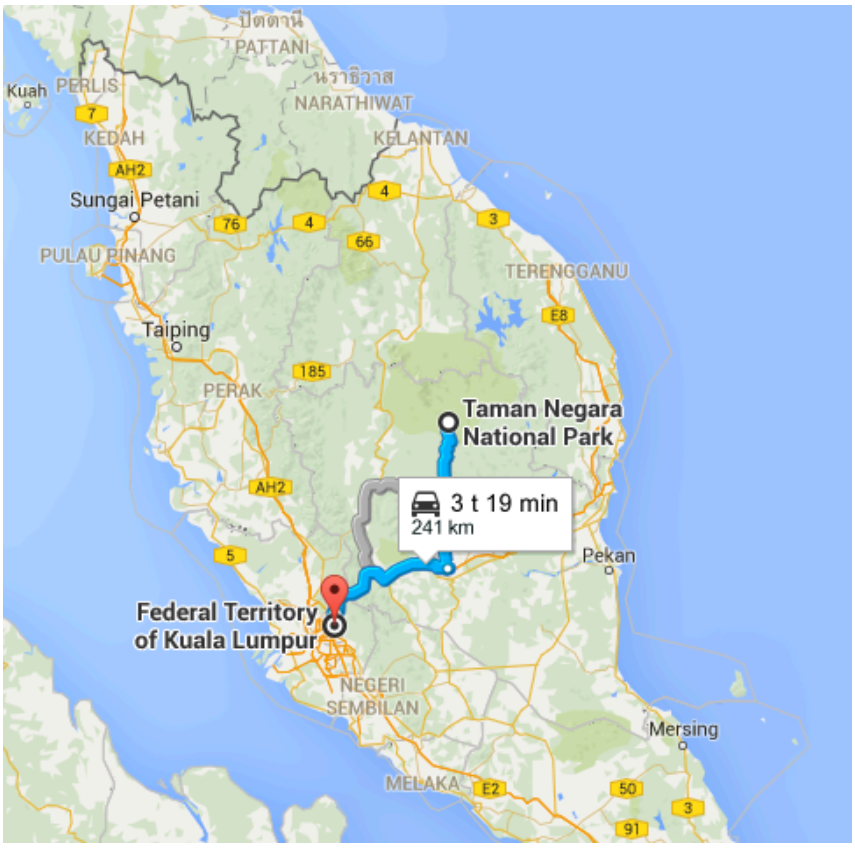

Figure 15. Route from Kuala Lumpur to Taman Negara National Park (Google Maps. Map of Malaysia. 2° 30' N and 112° 30' E. 2015).

4 Case Study 2: Ecotourism in South Africa

4.1 Ecotourism in South Africa

South Africa is a huge country with a wide variety of climatic conditions and topography variations. The combination of climate and topography gives rise to wide-range of vegetation zones with their own plants and species. Diverse nature and wildlife gives foothold for ecotourism, when a large share of tourists visiting in South Africa is seeking nature experiences. As well as Malaysia, South Africa is defined as one of the seventeen “megadiverse country” on the planet. Megadiverse country means an area that holds the majority of Earth’s species and hence considered as exceptionally biodiverse. When ecotourism strives to the conservation of fragile natural areas, it is common that common destinations for ecotourism activities are these particular megadiverse countries.

Tourism arrivals in South Africa have increased with steady annual rate of 5% during the last years. The annual tourism arrivals at present is close to 10 million, with the last

official data from 2013 stated that the amount of tourist arrivals in 2013 were 9.616 million (SAT 2014). As mentioned, seek of the natural experiences are a popular reason for travelling to South Africa and according to South African Tourism Departure Surveys (2013), 58.8 % of the holiday and leisure tourists listed “visiting natural attractions” for their purpose of the visit. Also 40% holiday tourists visited during 2013 stated that one of their attractions of South Africa was wildlife (SAT 2014). The most popular activities for ecotourism in South Africa are focused around the wildlife safaris, which are one of the most common activities when visiting the country, together with winery tours and nature park camping.

When the tourism is the fastest growing industry in South Africa, there have been high hopes especially for ecotourism in order to have positive outcomes for tackling the national issue of poverty in the country. More than half of the population in South Africa does not reach the boundary for international established poverty line. For ecotourism it is important that local indigenous people are included and supported as much as possible, it creates a potential to alleviate poverty through the creation of local jobs and bringing money directly to the local businesses. For example ecotourism operators in South Africa attempts to hire local people as guides and it have been estimated that ecotourism industry creates over 5000 jobs for local area people in South Africa (Pinsof and Sanhaji 2009). This will also give governmental pressure to assist ecotourism industry in South Africa

In South Africa diesel as transportation fuel has been in significantly increasing in the past twenty years. Following figures are presenting the road sector fuel consumption in South Africa during past decades.

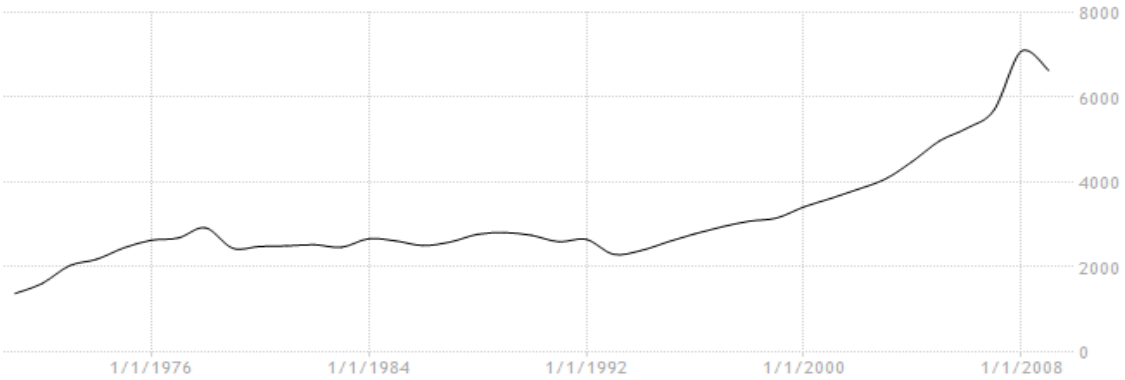

Figure 16. Road sector diesel fuel consumption (ktoe) in South Africa (Trading Economics, 2015).

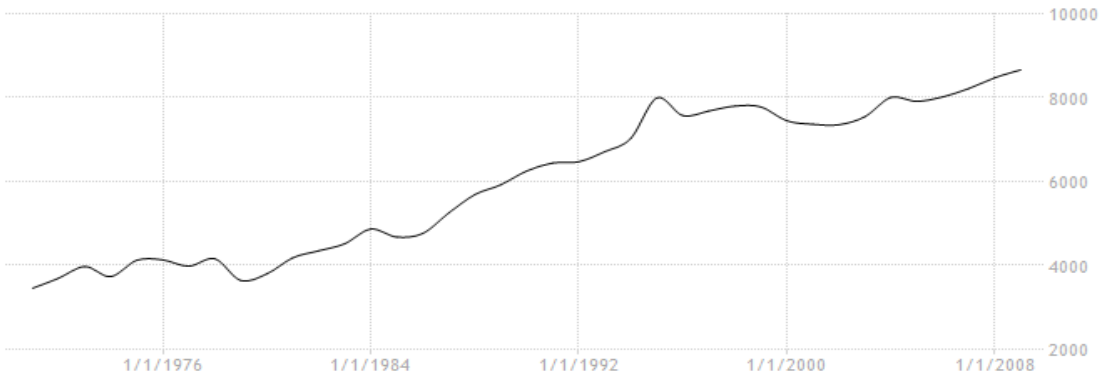

Figure 17. Road sector gasoline fuel consumption (ktoe) in South Africa (Trading Economics, 2015).

When we compare Figures 16 and 17, we can see that the consumption of diesel fuel has almost doubled after the year of 2000, when the gasoline consumption has been relatively unchanged.

4.2 NEXBTL in South African Safaris

The most popular form of natural tourism in South Africa is the visiting national parks and attending safari tours. For example, one of the largest and most popular national park of the country, Kruger National Park accounted 1.4 million guests during the year of 2013. When the Kruger National Park, as well as majority of others, is only accessible by car because of the safety reasons, it makes the annual kilometer driven by safari vehicles very large. For businesses valuing environmental aspects including ecotourism companies, use of a clean fuel in vehicles gives an opportunity to cut down emissions produced.

Using the same LCIA method that was applied in chapter 3.1, estimations for emission reduction and environmental impact changes was calculated. If we estimate that typical daily safari-tour that businesses operating in Kruger National Park area lasts 6-8 hours and the distance driven is approximately 150 km, we can account following tailpipe emissions to be caused.

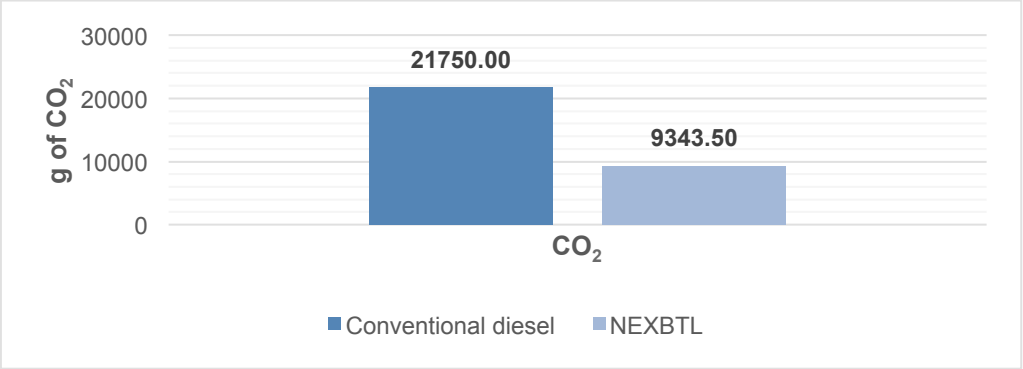

Figure 18. CO_2 emission reduction for 150 km Safari trip.

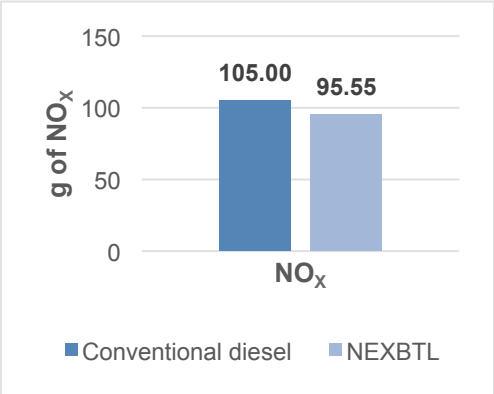

Figure 19. NO_X emission reduction (150 km).

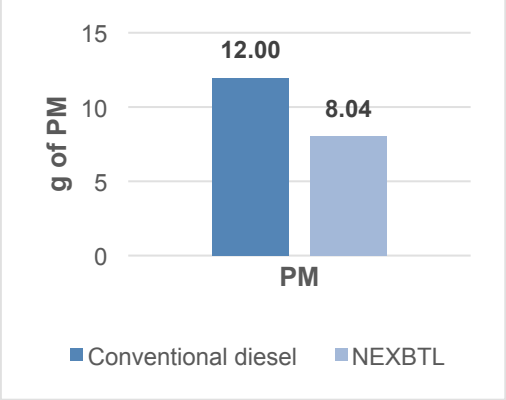

Figure 20. Particulate emission reduction (150 km).

Direct emissions from the transportation vehicles used could be clearly reduced by using NEXBTL renewable fuel. Major environmental impact is carbon dioxide emissions, which could be reduced by 12 407 grams per one 150 km safari tour.

By characterizing these results according to World 20 Years characterization factors and normalizing result into a comparable form (CML-IA, 2013) environmental impacts can be assessed.

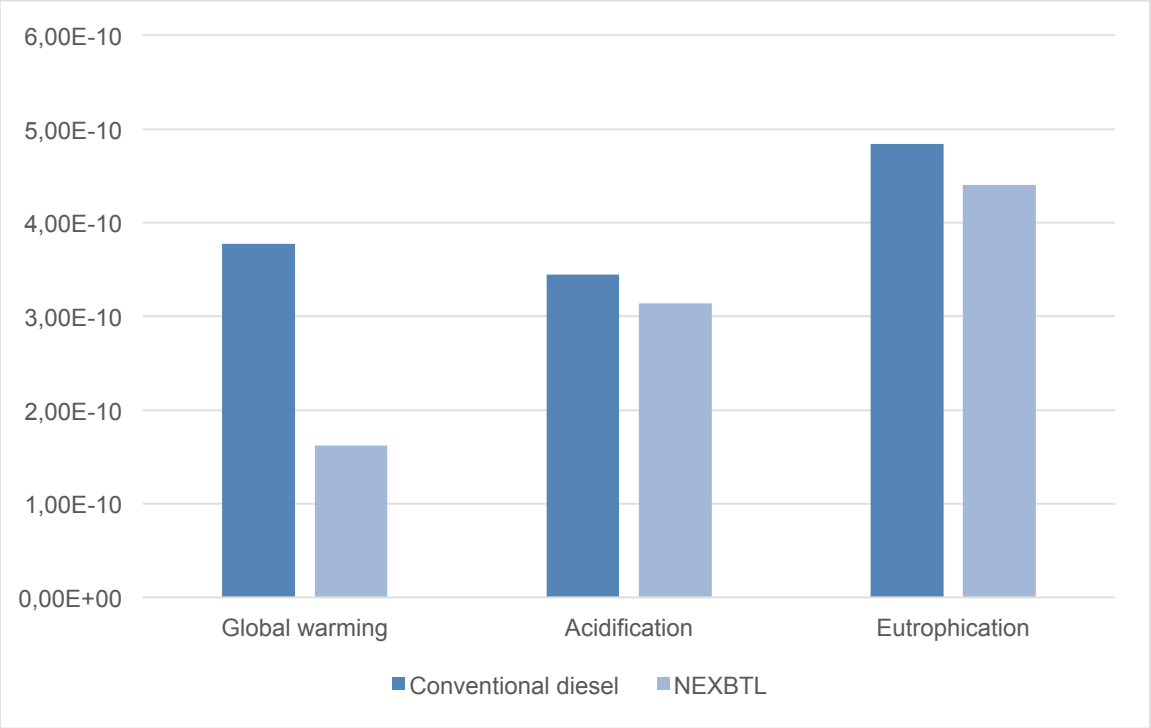

Figure 21. Normalized environmental impacts of 150 km safari tour for World 20 Years.

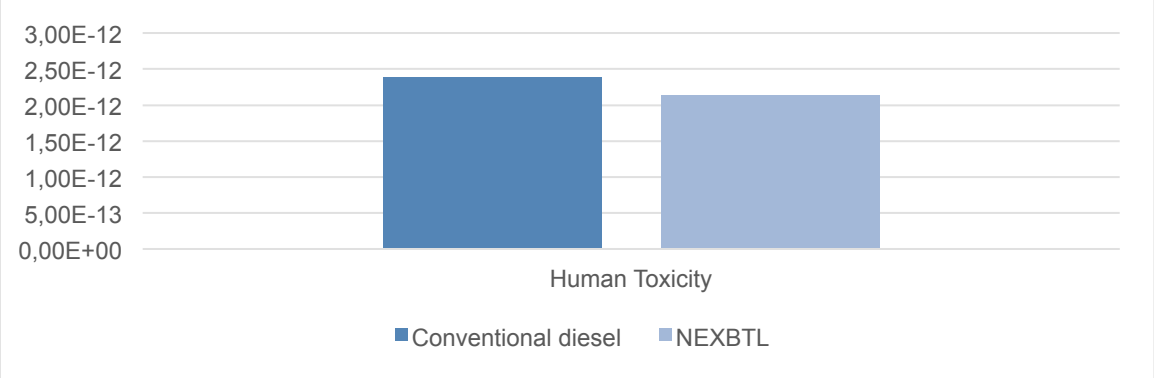

Figure 22. Normalized results for Human Toxicity of 150 km safari tour for World 20 Years.

Again, use of NEXBTL results major decrease on greenhouse gases and reduces potential of global warming. Safaris are fragile environments and positive results for decreasing of eutrophication can help to sustain dynamic living conditions for all natural habitants of national parks and because of this should be minimized. Also in this case human toxicity (Figure 22) impacts are fairly small.

Compared to previous case study in Malaysia, overall environmental impacts here are larger, because South Africa has set the emission limits for light vehicles to implement only EURO-2 emission limits, which are relatively moderate compared to EURO-4 and

5 limits (Delphi 2015). This is why these estimations for emission reductions and environmental impacts changes were calculated using test results of 100% blend NEXBTL and values for carbon dioxide emissions were obtained from Well-to-Wheel research (European Commission, 2014). Particulate and NO_X emission levels for NEXBTL were estimated by calculating percentage reductions reported by Neste (2015) towards EURO-2 emission standard for passenger cars using diesel fuel.

South African Natural Parks are irreplaceable part of national pride and heritage. At the same time these environments are fragile for pollution and preservation of these areas is taken seriously at national level. Usage of cleaner and renewable fuels national parks will contribute the preservation and could arouse interest in environmentally conscious entrepreneurs as well as ecologically thinking tourists in the future.

5 Market potential of NEXBTL on Ecotourism Industry

By covering following aspects market analysis, and the clarification of market potential of NEXBTL can be carried out:

- Market size
- Rate of growth
- Profitability
- Key success factors
- Cost structure
- Distribution channels
- Market trends

5.1 Market size and growth rate

Market group for NEXBTL in ecotourism is the ecotourism operators that are using diesel as a transportation fuel for various purposes. Typical examples for these kinds of situations are situations discussed on case studies in Malaysia and South Africa.

International tourist amounts are constantly increasing, and many large questionnaires such as Trip Advisor, 2012 and Nielsen Wire, 2012 has stood, tourists are more and more interested on sustainability and impacts of their visit to the local environments. This creates an environment that is suitable for new ecotourism companies to arise. If we look at the cumulative growth of new registered members of The International Eco-

tourism Society (Figure 23) we can clearly conclude that the extent members have increased enormously between 2008 and 2015.

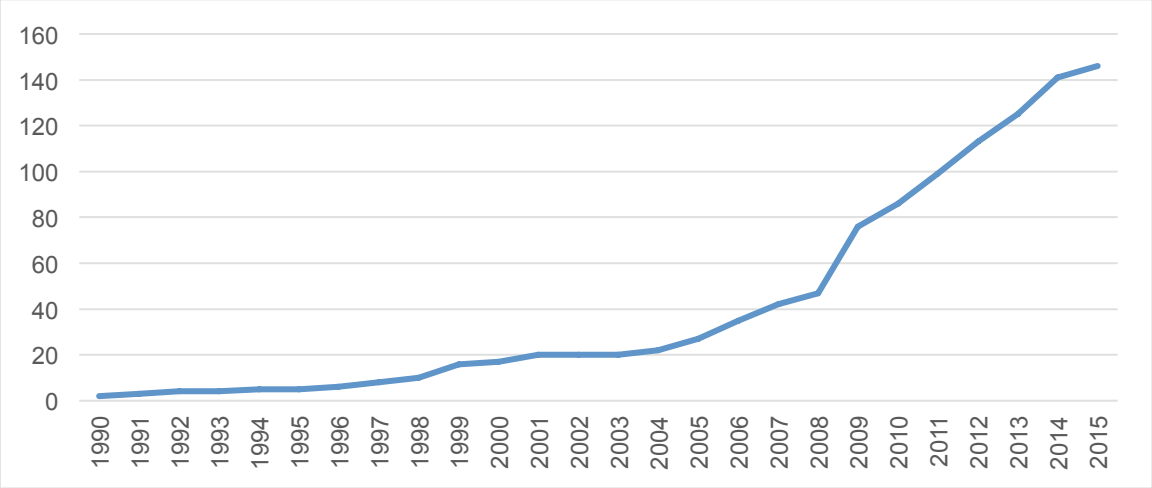

Figure 23. Members of the International Ecotourism Society 1990-2015 (Source: TIES, 2015).

During the last five years, International Ecotourism Society has almost doubled their amount of registered members, although it is a small association and it seems that majority of ecotourism operators doesn't belong to any associations, it tells that new businesses are emerging into the markets all the time. This also interacts together with estimated annual increase of ecotourists, which was estimated to be 10% (TIES, 2006).

Estimated amount of ecotourists now and in the near future was calculated on chapter 2.4.4 and can be seen from Figure 4. Rough estimation was that in 2013 the number of international ecotourists was around 83 million, with same increase rate in tourists and ecotourists, levels in 2030 could reach 150 million. If steady growth in the market is met, it suggests that at least potential clients are in the markets.

5.2 Profitability and key success factor

Starting point is that NEXBTL is competing against conventional diesel fuel across the different regional markets. Diesel prices have variation across the world. Table 3 shows price variation in the near past in countries or areas that have been popular among the ecotourists or otherwise active on the ecotourism industry.

Table 3. Pump price for diesel fuel (US$ per liter) (World Bank, 2015).

	2010	2012	2014
Australia	1,23	1,57	1,28
Brazil	1,14	1,02	1,02
Costa Rica	0,97	1,36	1,21
Malaysia	**0,56**	**0,59**	**0,65**
South Africa	**1,14**	**1,42**	**1,17**
European Union	1,61	1,83	1,64
North America	0,96	1,14	1,07
Sub-Saharan Africa	1,15	1,27	1,17
East Asia and Pacific	0,93	1,20	1,02

Countries such as Malaysia and Costa Rica that are widely present at ecotourism markets, have very low price levels for fuels in general, this can be challenging for trying to integrate into the markets. Taxation is one variant that causes regional differences on diesel prices and some countries even have applied tax concession for fuels that are emitting less harmful pollutants or are made out of renewable materials. This can give NEXBTL some advantage against conventional diesel fuel, but the real key success factor in the ecotourism industry lies on environmental properties of the fuel.

In a situation where two ecotour operators are competing for customers, and other one is marketing themselves by using cleaner fuels for transportation and by this lowering their air pollution levels, it could give operator the advantage needed. Because, when ecotourist made the decision to not take regular holiday package, he/she already committed to consider environmental aspects and might even be willing to pay more for the company offering more environmental decisions.

Threat of potential new entrants and substitute products are also one factor that should be kept in mind. Considering the destinations of case studies selected for the thesis, in Malaysia B5 (5% blend) biodiesel has been introduced into the markets. Government of Malaysia implemented that B5 distribution would be nationwide in mid-2014, but this goal was not met, because of the logistic challenges especially on East Malaysia. B5 biodiesel in national markets in Malaysia is typically PME, based on palm oil as a raw material (Wahab, 2014). When environmental properties are studied, B5 in Malaysian markets does not compete with high-blended NEXBTL, because of the low blending ratio.

Government of South Africa started new biofuel strategy in 2007, new targets were that mandatory blending for diesel with biofuel should start nationwide from 1 October 2015.

This target with specification of minimum 5% blending ratio for diesel was not met and new target date is not published (Engineering News, 2015). No clear competitor or substitute product at South African national markets could be found.

Even Neste might not be able to compete with the price levels; their advantage lies with better environmental properties than majority of the fuels in the markets. There are also signs that part of the customers would be willing to pay higher price for cleaner fuel, which could attract ecotour providers to choose NEXBTL as their primary transportation fuel.

5.3 Cost structure and distribution channels

Cost structure of NEXBTL is generally formed from following steps; raw material costs, refinery costs, distribution, marketing, retail and taxes. Ecotourism and tourism in general is an industry that is spread all over the world, and often ecotourism destinations might not have proper distribution systems and logistics for fuels. This is why it is crucial that a distribution cost does not become too high, in the case Malaysia, existing distribution channels and the location of Neste Singapore refinery could be utilised for in order to meet lowest possible distribution costs. South African markets are challenging, because of the geographical location of the country and the distance between the main ecotourism destinations (National parks) and the largest harbours.

5.4 Trends of the market

Interest of preserving the environment and respecting native cultures has been showing among consumers of tourist services and products through variety of market studies in recent years. Sustainable tourism is widely acknowledged and for example the United Nations Educational, Scientific and Cultural Organisation (UNESCO) beliefs that sustainable tourism will grow from ‘alternative’ to ‘mainstream’ within a decade (UNESCO, 2015)

Ecotourists are not directly the consumers of NEXBTL, but the possible clients, ecotour operators should follow the trends happening among tourists. Various market studies touched on this thesis (Tripadvisor 2012, Nielsen Wire 2012, and Statista 2014) have shown that tourists are clearly interested in environmental aspects. Until this day, the main emphasis has been on the sustainability of accommodation and activities, but it is only matter of time when sustainable transportation is going to be the thing.

6 Conclusions

Tourism is a large industry with a huge amount of business opportunities. All the time the growing trend around the world is to make environmentally better and more sustainable decisions. Ecotourism was established to meet the demand for more sustainable travelling, tourism that strives to minimize own negative impact to destination environment and the local people.

One of the most challenging environmental impact caused by tourism is air pollution, which is mainly caused by transportation. Air pollution in general and most common air pollutants considered in this thesis; CO_2, NO_X and PM, can cause severe impacts such as global warming, photochemical smog, acid rain and health problems related to lungs and heart. Neste has a tool, which can help to partly tackle this challenge, NEXBTL renewable diesel.

The use of NEXBTL renewable diesel as fuel in various occasions related to transportation of tourists can decrease all the major air emissions. Compared to conventional diesel fuel, CO_2 emissions, which may potentially cause global warming, can be reduced dramatically from 36%-97%, depending on the raw material used for manufacturing the fuel. Also particulate and mono-nitrogen oxide emissions can be reduced in all circumstances.

Malaysia has good geographical location considering the NEXBTL refinery in Singapore; the country has a solid tourism as well as ecotourism background and a good economic baseline for businesses to succeed. South Africa has a large tourism sector and Natural Park tours of the country are based on vehicles that drive around safaris. In both scenarios, NEXBTL can offer a valuable method to preserve fragile environments that both countries presumably want to preserve in order to sustain their attractiveness for tourists in the future.

The environmental advantage of NEXBTL and the technical properties that allows the use of this renewable diesel in existing diesel engines creates a market potential, where potential customers are travel providers that are willing to decrease environmental impacts and market their business as sustainable and ecological. This may not include just only ecotourism operators, but all transportation providers in tourism industry.

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Appendix A

Tourism in Croatia

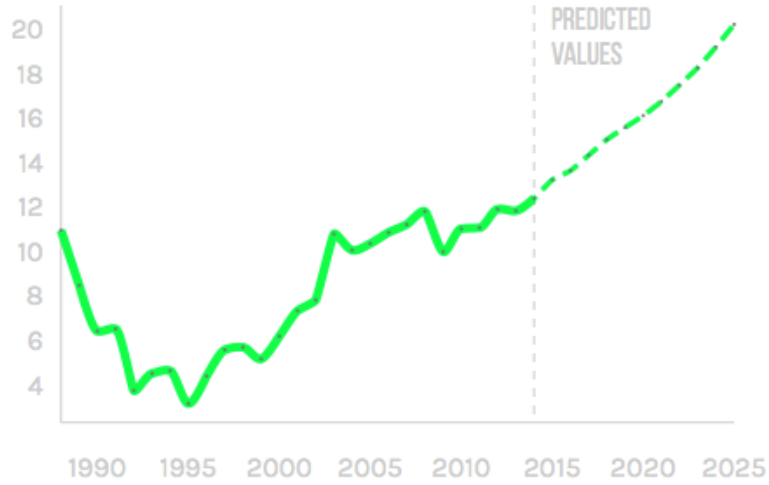

Figure A1. Leisure Tourism spending in Croatia (in billions of USD) during 1990-2025 (World Travel and Tourism Council Data Gateway, 2015).

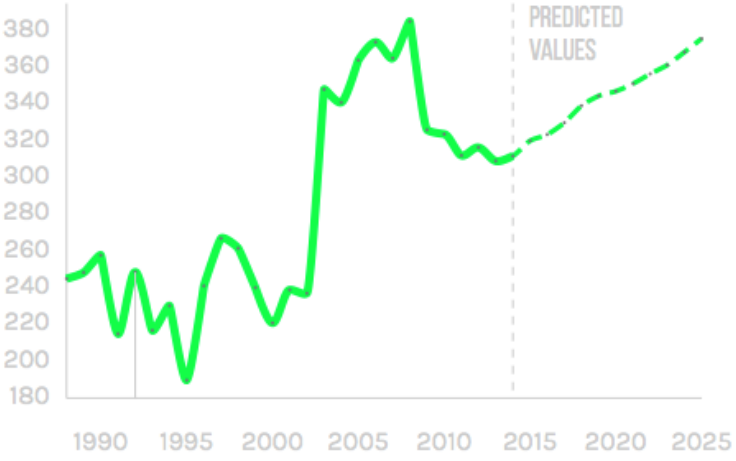

Figure A2. Total contribution to Employment by Tourism in Croatia (in thousands of jobs) during 1990-2025 (World Travel and Tourism Council Data Gateway, 2015).

Supporting chapter 2.2 for illustrating the importance of tourism for certain countries.

Appendix B

Emission properties of NEXBTL depending on source

Table B1. NEXBTL CO_2 emissions from different fuel sources.

Raw Material	g CO_2eq/km (2010 level)	g CO_2eq/km (2020 level)	CO_2eq/km Reduction from conventional diesel (2010 level)
Conventional diesel	145	106	
Rape, meal to AF NEXBTL	93	68	-36%
Soy, no till, oil to EU, NEXBTL	91	67	-37%
Palm, no CH4 rec., heat credit, NEXBTL	80	59	-45%
Sunflower, meal to AF, NEXBTL	74	54	-49%
Rape, meal to biogas NEXBTL	61	45	-58%
HVO from tallow	32	24	-78%
HVO from waste cooking oil	5	5	-97%

Appendix C
LCIA Calculations

Purpose of the LCIA study was to reach emission levels and possible emission reduction that can be achieved by using NEXBTL fuel instead of conventional diesel fuel within the limits of case studies considered.

At first the amounts of pollutants emitted was calculated using equation 1.

$$emissions = distance \times emission\ value \qquad \text{Equation 1.}$$
$$[g] = [km \times \frac{g}{km}]$$

Emission values used in case studies can be seen from Table C1 and Table C2

Table C1. Emission values for South African case study.

Emission properties	CO_2 (g/km)	NO_X (g/km)	PM (g/km)
Conventional diesel South Africa (EURO 2 for NO_X and PM)	145.0000	0.7000	0.0800
General NEXBTL 2010 level (average)	62.2900	0.6370	0.0536

Table C2. Emission values for Malaysian case study.

Emission properties	CO_2 (g/km)	NO_X (g/km)	PM (g/km)
Conventional diesel Malaysia (EURO 4 for NO_X and PM)	145.0000	0.2500	0.0250
General NEXBTL 2010 level (average)	62.2900	0.2275	0.0168

In order to reach environmental impacts caused by these emissions, data is needed to characterize. This emphases different pollutants to assist the formation of different impacts. Characterization factors used were obtained from the data bank of Institute of Environmental Sciences in Leiden (CML-IA, 2013). Factors used can be seen from Table C3 and every corresponding pollutant is multiplied with corresponding factor related to impact considered.

For example if following emissions are emitted:

- *X* grams of CO_2
- *Y* grams of NO_X
- *Z* grams of PM

Using characterization factors from Table C3 following results can be obtained:

$$Global\ Warmin = (1 \times X) + (0 \times Y) + (0 \times Z)$$
$$Human\ Toxicity = (0 \times X) + (1.2 \times Y) + (0.8 \times Z)$$
$$\text{Acidification} = (0 \times X) + (1.1 \times Y) + (0 \times Z)$$
$$\text{Eutrophication} = (0 \times X) + (1.8 \times Y) + (0 \times Z)$$

Table C3. Characterization factors used in case studies (CML-IA, 2013).

	20 years, World		
	CO_2	NO_X	PM
Global warming	1		
Human toxicity		1.2	0.8
Acidification		1.1	
Eutrophication		1.8	

Result obtained from characterization is called an impact score for certain area and period of time. Because characterized results are all in different units (CO_2 eq., NO_X eq., PMeq.) normalization is required. By normalization the data is transformed into comparable format within different impacts. Impact score from characterization is divided by corresponding annual impact score from an average person in a chosen reference year, which is also referred as normalization factor. (Equation 2)

$$Normalized\ effect\ score = \frac{Characterized\ Impact\ score}{Normalization\ factor} \qquad \text{Equation 2}$$

Table 4. Normalization factors used in case studies (CML-IA, 2013).

		World, 1995
20 years	Global warming	5.8E+13
	Human toxicity	5.7E+13
	Acidification	3.3E+11
	Eutrophication	3.9E+11