RIPAEX

Crypto Asset Marketplace

WHITEPAPER

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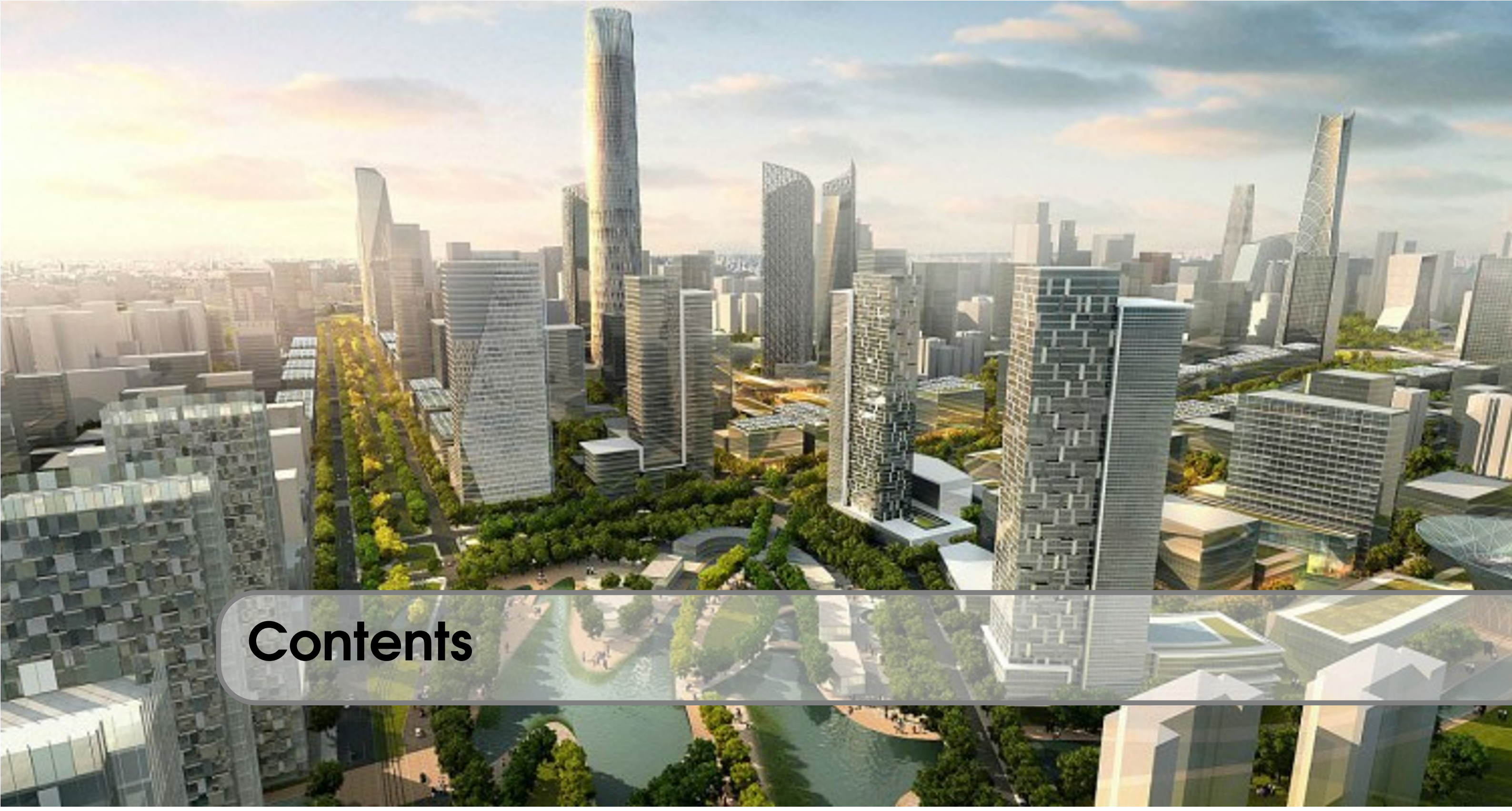
0.1 Abstract

The World is faced with a formidable challenge. The hope of the Kyoto Protocol was that industrialised nations would cut their collective emissions of greenhouse gases by 5.2% in 2012 compared to the year 1990. However, that World governments was not capable of achieving even this token first-step. And this at a time when all manner of climate-induced disasters are gathering force, and polar ice caps melting at a rate that even the worst-case scenario computer models did not anticipate.

Action is needed and action is needed now. Road transport contributes about 20% of the EU27 carbon dioxide emissions, and must play a fundamental role in greenhouse gas emissions reductions if we are to stave off catastrophic impacts on our living planet. Despite the desperate urgency of the situation, alternative fuel producers and environmental technologies are constantly facing resistance, criticism and hostility, which, if the same strict criteria were applied to the present generation of energy technologies, it would make a mockery of them. Biodiesel has not escaped such harsh and ill-informed attacks, particularly in the last year.

It is the aim of this project to give in-depth information to prospective biodiesel producers, or project managers, to enable correct decision-making and to ensure success for their proposed projects. It seeks to analyse the real potential in the EU27 for biodiesel production from Used Cooking Oil (UCO), and its place in the market.



Contents

1. Introduction

Biodiesel is an alternative road fuel made from transesterfied fatty acids. The most common form is made from straight vegetable oil, whether that be rapeseed oil, soya oil or others. It can however, also be produced from used cooking oil (UCO) or animal fat such as tallow, and if processed correctly will produce high quality fuel. Although certain diesel engines can run on straight vegetable oil, if transformed into biodiesel it can be used in almost all diesel engines, most importantly in modern high-performance direct injection engines. Despite the knowledge of the possibilities for running diesel engines on vegetable oil having been overlooked for a large part of the last century, Dr Rudolf Diesel first developed the Diesel engine in 1895 with the full intention of running it on a variety of fuels, including vegetable oil. The concept is neither revolutionary nor fanciful. Recent developments at European Union level are transforming both the disposal method of Used Cooking Oil (UCO) and the way in which the EU fuels its road transport vehicles. These combined developments have made the use and production of biodiesel from UCO an increasingly favourable prospect. In May 2003, the European Parliament and the Council adopted the 'Directive on the promotion of the use of biofuels or other renewable fuels for transport'. This Directive requires that Member States in 2005 to replace 2% of their diesel and petrol with biofuels, and replacing 5,75 % by 2010. The EU Animal by-product Regulation 1774/2002 sets restrictions on the use of Used Cooking Oil originating in restaurants, catering facilities and kitchens. The effect is that, except for in special cases, UCO from catering premises can no longer be used as an ingredient in animal feed, which historically was its main disposal route. In parallel, the Landfill Directive 99/31EC requires each Member State to set out a pollution control regime which prohibits the acceptance of certain types of wastes at landfills, including liquid wastes 4 such as UCO. Furthermore, recent statistics show a huge increase in volume of production of UCO in the last few decades and the number of catering establishments in European countries is on the increase. With a growing amount of UCO in the EU, the disposal problems UCO generators now face, and the concern to remove the UCO from the food chain, the production of biodiesel offers an ideal solution. The waste management exigency and sustainable transport strategy can both be addressed by the production of biodiesel. This is a real opportunity.

1.1 Key Terminology

UCO : Used Cooking Oil. Also referred to throughout the literature as WVO (waste vegetable oil) and UVO (used vegetable oil), RVO (recycled vegetable oil) and RCO (Recycled Cooking Oil). UCO has been chosen as the standard for this document.

FAME : Fatty Acid Methyl Ester. The technical acronym for biodiesel.

UCOME : Used Cooking Oil Methyl Ester. FAME coming from UCO.

B30 : The use of B followed by a number such as B30 and B100 is used in this document where appropriate, to identify the various percentages of biodiesel blends. Although historically mainly used in America, the terminology is well understood and it is starting to be used across Europe now too, hence was deemed appropriate.

Billion : The Anglo-Saxon use of billion has been chosen. That is to say for the purposes of this document, it represents one thousand million, and not a million million, which is referred to as a trillion.

“,” or “.” : The Anglo-Saxon use of decimal points and commas to represent numbers has been chosen for the purposes of this document (except in the accompanying excel spreadsheets, and the occasional figure or table derived from excel, where continental numeration has been used). That is to say that a “.” represents a decimal point, and a “,” distinguishes between multiples of thousands, millions and billions. [References]: Where sources have not been given, the information has come directly from OilEx consortium partners.

1.2 Background

OilEx project is a project to facilitate the uptake of used cooking oil to produce biodiesel. The objective of OilEx is the promotion of localised biodiesel production for transportation purposes, by means of the active involvement of key local actors the European and Extra-European countries that want to participate.

The promotion will be enforced by the creation of a UCO exchange marketplace powered by Blockchain Technology and by the creation of a OCF (OilEx Community Fund) to promote such initiatives.

There are essentially four phases to the OilEx project:

Information gathering and synthesis (WP2) This phase recognises the existence of multiple sources of information and experience from across Europe concerning the supply chain of biodiesel UCOME. It aims to make the first comprehensive analysis of this state of the art to form the basis of the later project phases.

The development of tools and resources (WP3) The second phase takes the results of the first and develops from them a set of tools and resources which provide concise and comprehensible guidance to market actors in any Member State. With this guidance new biodiesel production facilities can be initiated and vehicle fleets converted to biodiesel.

The set up of demonstration activities (WP 4-6) Using the tools and resources developed in WP3, Work packages 4-6 focus on bringing collected knowledge and tools into practice. The three work packages reflect three major focal points (and target groups) within the supply chain for establishing successful biodiesel demonstrations on local scale: production of local biodiesel plants (WP4), distribution facilities for biodiesel (WP5), and demand development for fleets (WP6). The demonstration phase forms the heart of the OilEx action; WP 2 and 3 are focused on providing deliverables (e.g. tools) that enable successful and efficient demonstration activities.

Dissemination (WP 7/8) and Project Coordination (WP1) During the full duration of the project, dissemination activities (WP 7/8) are carried out in which results from the individual work packages are disseminated to relevant target groups including project partners, OilEx supporters, EC delegates as well as relevant target groups. This phase covers a wide range of dissemination techniques, from printed and electronic handbooks to workshops and training sessions, ongoing networks, all having the ultimate goal of increasing the uptake of biodiesel among public and private transport fleets across the EU. An overarching work package is concerned with the management of the project from start to finish, ensuring proper coordination, quality assurance and budgetary control (WP1).

1.3 Summary

1. OilEx project is a project to facilitate the uptake of used cooking oil to produce biodiesel. The objective of OilEx is the promotion of localised biodiesel production for transportation purposes: It is the aim of this reference document to give in-depth information to prospective biodiesel producers, or project managers, to enable correct decision-making and to ensure success for their proposed projects. It seeks to analyse the real potential in the EU27 for biodiesel production from Used Cooking Oil (UCO), and its place in the market.
2. Biodiesel is an alternative road fuel made from transesterfied fatty acids. Although certain diesel engines can run on straight vegetable oil, if transformed into biodiesel it can be used in almost all diesel engines, most importantly in modern high-performance direct injection engines.
3. Recent developments at European Union level are transforming both the disposal method of Used Cooking Oil (UCO) and the way in which the EU fuels its road transport vehicles. These combined developments have made the use and production of biodiesel from UCO an increasingly favourable prospect. In May 2003, the European Parliament and the Council adopted the Biofuels Directive requires that Member States in 2005 to replace 2% of their diesel and petrol with biofuels, and replacing 5.75 % by 2010. The EU Animal by-product Regulation 1774/2002 sets restrictions on the use of Used Cooking Oil originating in restaurants, catering facilities and kitchens. The waste management exigency and sustainable transport strategy can both be addressed by the production of biodiesel.
4. There is still very little data available on UCO. Combining total collected with total dumped in the 10 BioDieNet countries gives a figure of 1.92 billion litres this would equate to 1.4 % of their total diesel consumption. Therefore, the potential for UCOME substituting 1 or 3 % of EU diesel consumption is quite possible.
5. The results indicate that restaurants represent the primary UCO source for most of the BioDieNet countries, although the domestic sector and food processing industry are also of importance. Most of the Western European BioDieNet countries have well established collection systems for UCO, but this is not the situation in Bulgaria, Romania and Hungary. Conservative estimates for average litres of recoverable UCO per capita are 8 l/cap and 6.26 l/cap.
6. Total FAME production in the EU-25 in 2005 has been estimated to 3.2 million tonnes. It can thus be concluded that the UCOME production in the ten BioDieNet countries constitutes about 13 % of the FAME produced in EU-25.
7. Local authorities are best placed to operate UCO collection services for catering establishments, but there is no core funding available for this service. Core funding may be available for domestic collection but the logistics make this a difficult endeavour. The food industry, is likely to already have found its solution to UCO waste. However, if a biodiesel producer is able to get hold of this material at the right price, then it could provide a very valuable, high-quality source of UCO. However, the most likely and reliable UCO source for a small-scale biodiesel producer will be from catering establishements.
8. The average cost of 23.4 was estimated for the cost of UCO collection. Costs for a collection will very much depend on UCO generator ie domestic or catering or industry, and the

particulars of your locality. Some research suggests that the actual operating costs could be as low as 8 to collect UCO from catering establishments if collection is kept “in-house”. The viability of a biodiesel plant will depend very heavily on the price for which it can obtain its raw material. The ideal scenario would be to be able to operate a free collection service.

9. The main problems encountered in UCO collection schemes were: Pouring of mineral oil in public containers; Low temperatures creating handling problems; Overcooking of oil which increase Free Fatty Acids (FFAs); Too much saturated fats; Illegal collections.
10. Classic industrial steps to biodiesel production are: 1. Oil pre-treatment 2. Free Fatty Acids elimination 3. Drying 4. Transesterification in reactors 5. Separation phase 6. Washing 7. Drying. Glycerine purification 8. Additive injection.
11. Choice of the fats or oils to be used in producing biodiesel is both a process chemistry decision and an economic decision. With respect to process chemistry, the greatest difference among the choices of fats and oils is the amount of FFAs.
12. Options for raw material are: Primary biomass (energy crops); secondary biomass and organic waste. Process catalyst options are: Alkaline catalysis; Acid catalysts; Heterogeneous catalysis; Enzymatic catalysis; No catalysts (Biox Co-Solvent Process & supercritical process). Process options are: Batch or Continuous. Batch processing is most common in small plants of less than 4 million litres/year.
13. For setting-up a biodiesel plant a project must take into account the following leglislation: Health & Safety; Oil Storage; Fire prevention and control; Integrated Pollution Prevention and Control (IPPC); Planning; Taxation. By far the biggest and most arduous task with regards to legitimising the biodiesel plant is obtaining an Integrated Pollution Prevention and Control (IPPC) licence. The IPPC follows Council Directive 96/61/EC and is applied in each country via its own national laws. Costs of an IPPC licence can vary between 3000 and 35,000, depending on the size of operation.
14. The nature of the business under consideration by the BioDieNet project (small scale, localised biodiesel production), means that each enterprise likely to have 3 or 4 staff. The turnover of such an enterprise however, because of the high value of the end product, is likely to be more than 350,000 a year and could be several times higher. A business of this scale lends itself to the following possible company structures: A simple partnership; A limited company; A non-profit company or social enterprise; A worker co-operative. Energy Agencies are potential key actors, but the type of business they can set up will depend on their legal status which does vary from country to country.
15. Potential sources of funds for a small-scale biodiesel projects are: Bank Loans; Low Interest Loan Schemes; Commercial Credit; Equity financing; Business Angels venture capital. Having a robust Business Plan and financial guarantees are essential elements for securing funding. The European Investment Fund (EIF) of the EIB, offers support in the form of guarantees for SMEs.
16. The arguments for biodiesel are principally for Energy Security and Climate Change. There are other benefits, well documented, such as improvements in most local emissions, its reduced environmental impacts in case of spillage, job creation etc. But above all, biofuels are the only direct substitute for oil in transport that is currently available on a significant scale.
17. There is consensus in the literature that the use of biodiesel in place of petroleum diesel will result in significant GHG savings, with the potential for up to 80% from oil crops. The GHG savings potential of a scheme recycling UCO into biodiesel could be near on 100%.
18. Statistical analyses show a reduction of the local emissions of CO, HC, and PM10 by an average of 27%,36%,24% respectively for neat biodiesel relative to petroleum diesel. It is also predicted that up to around 30% that biodiesel will be NOx neutral although after that

will increase. Hence any responsible environmental strategy would include a NOx mitigation policy. There is agreement that the use of biodiesel results in both a decrease in emissions of PAH, and in mutagenic activity.

19. Heated fuel lines are recommended for cold weather as B100 has higher cloud point than fossil diesel. Rubber components should be replace with biodiesel resistant parts and similarly biodiesel should not be brought into contact with brass, bronze, copper, lead, tin, and zinc as this may accelerate oxidation. Normally if warranty is approved for 100biodiesel this will be provided that the standard engine oil change interval is halved, and similarly the oil and fuel filter change interval is halved.
20. The two cricitcal factors affecting the biodiesel market are taxation and the warranty approval for the vehicles. Although a harmonisation throughout Europe would be beneficial to development of the industry both in terms of taxation and warranty approvals, this is currently not the case. Each country has its specific legislation and tax regime for all fuels, including biofuels, and vehicle manufacturers vary their warranty approval between countries.
21. Germany, has been the leader in the field of biodiesel for over 10 years, with a proactive approach and favourable tax regime. At the end of 2006, total sales of biofuels were 3.1 million tonnes (all biofuels). But Volkswagen Group (VW, Audi, SEAT, Skoda) has stopped issuing warranty approval since the introduction of the EURO 4 engines and selfregenerating particle filters. This could seriously damage the market and reverse the trend.
22. Any assessment of your local market should include: Number of diesel vehicles in your region; Quantity of diesel consumed in your region; Quantity of biodiesel already consumed in your region; Local government fleets composition and fuel usage; Local public transport fleets composition and fuel usage; Number of independent filling stations in your region.
23. There are a number of options for dealing with Warranty issues: Creating consumer pressure by making clear to the manufacturers that providing warranties for biodiesel will be an important factor in decision-making for purchase of new vehicles; Undertaking a liability transfer where the risk is shifted onto the local authority or other public body; Development of your own warranty; Or simply promoting biodiesel for the vehicle pool that is out of warranty.
24. Favourable warranties are found with the following: Mercedes Benz, DaimlerChrysler, MAN and IVECO who have given approvals for EURO-4 and EURO-5 truck engines in commercial vehicles; Almost all agricultural vehicle manufacturers; The French manufacturers PSA Peugeot Citroën and Renault approve warranties for their vehicles up to B30 under certain conditions. This offers sales prospects of at least 10 years. The public sector, whether it be bus fleets or waste collection vehicles is likely to be “path of least resistance” for biodiesel sales.
25. Recommendations: Local Authority and Energy Agency to participate in biodiesel projects; Closing of the loop by uniting the supply chain; Development of a UCO policy to make catering waste the responsibility of local authorities; In-depth EU-wide studies on UCO availability undertaken by official bodies; A fast-track system for IPPC applications for biodiesel plants; Widening of the scope of potential feedstocks in the quality standard EN14214; Development of an EU-wide quality assurance scheme; Making it compulsory that all EC Euro emissions standards be met using biofuels as well as fossil diesel; Promote biodiesel-friendly manufacturers such as PSA group.

2. In-text Elements

2.1 Theorems

This is an example of theorems.

2.1.1 Several equations

This is a theorem consisting of several equations.

Theorem 2.1.1 — Name of the theorem. In $E = \mathbb{R}^n$ all norms are equivalent. It has the properties:

$$\big| ||\mathbf{x}|| - ||\mathbf{y}|| \big| \leq ||\mathbf{x} - \mathbf{y}|| \tag{2.1}$$

$$||\sum_{i=1}^{n} \mathbf{x}_i|| \leq \sum_{i=1}^{n} ||\mathbf{x}_i|| \quad \text{where } n \text{ is a finite integer} \tag{2.2}$$

2.1.2 Single Line

This is a theorem consisting of just one line.

Theorem 2.1.2 A set $\mathscr{D}(G)$ in dense in $L^2(G)$, $|\cdot|_0$.

2.2 Definitions

This is an example of a definition. A definition could be mathematical or it could define a concept.

Definition 2.2.1 — Definition name. Given a vector space E, a norm on E is an application, denoted $||\cdot||$, E in $\mathbb{R}^+ = [0, +\infty[$ such that:

$$||\mathbf{x}|| = 0 \Rightarrow \mathbf{x} = \mathbf{0} \tag{2.3}$$

$$||\lambda \mathbf{x}|| = |\lambda| \cdot ||\mathbf{x}|| \tag{2.4}$$

$$||\mathbf{x} + \mathbf{y}|| \leq ||\mathbf{x}|| + ||\mathbf{y}|| \tag{2.5}$$

2.3 Notations

Notation 2.1. *Given an open subset G of $\mathbb{R}^n$, the set of functions φ are:*

1. *Bounded support G;*
2. *Infinitely differentiable;*

a vector space is denoted by $\mathscr{D}(G)$.

2.4 Remarks

This is an example of a remark.

R The concepts presented here are now in conventional employment in mathematics. Vector spaces are taken over the field $\mathbb{K} = \mathbb{R}$, however, established properties are easily extended to $\mathbb{K} = \mathbb{C}$.

2.5 Corollaries

This is an example of a corollary.

Corollary 2.5.1 — Corollary name. The concepts presented here are now in conventional employment in mathematics. Vector spaces are taken over the field $\mathbb{K} = \mathbb{R}$, however, established properties are easily extended to $\mathbb{K} = \mathbb{C}$.

2.6 Propositions

This is an example of propositions.

2.6.1 Several equations

Proposition 2.6.1 — **Proposition name.** It has the properties:

$$\left| ||\mathbf{x}|| - ||\mathbf{y}|| \right| \leq ||\mathbf{x} - \mathbf{y}|| \tag{2.6}$$

$$|| \sum_{i=1}^{n} \mathbf{x}_i || \leq \sum_{i=1}^{n} ||\mathbf{x}_i|| \quad \text{where } n \text{ is a finite integer} \tag{2.7}$$

2.6.2 Single Line

Proposition 2.6.2 Let $f, g \in L^2(G)$; if $\forall \varphi \in \mathscr{D}(G)$, $(f, \varphi)_0 = (g, \varphi)_0$ then $f = g$.

2.7 Examples

This is an example of examples.

2.7.1 Equation and Text

■ **Example 2.1** Let $G = \{x \in \mathbb{R}^2 : |x| < 3\}$ and denoted by: $x^0 = (1, 1)$; consider the function:

$$f(x) = \begin{cases} e^{|x|} & \text{si } |x - x^0| \leq 1/2 \\ 0 & \text{si } |x - x^0| > 1/2 \end{cases} \tag{2.8}$$

The function f has bounded support, we can take $A = \{x \in \mathbb{R}^2 : |x - x^0| \leq 1/2 + \varepsilon\}$ for all $\varepsilon \in]0; 5/2 - \sqrt{2}[$. ■

2.7.2 Paragraph of Text

■ **Example 2.2 — Example name.** Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris. ■

2.8 Exercises

This is an example of an exercise.

> Exercise 2.1 This is a good place to ask a question to test learning progress or further cement ideas into students' minds. ■

2.9 Problems

Problem 2.1 What is the average airspeed velocity of an unladen swallow?

2.10 Vocabulary

Define a word to improve a students' vocabulary.
Vocabulary 2.1 — Word. Definition of word.

3. Presenting Information

3.1 Table

Treatments	**Response 1**	**Response 2**
Treatment 1	0.0003262	0.562
Treatment 2	0.0015681	0.910
Treatment 3	0.0009271	0.296

Table 3.1: Table caption

3.2 Figure

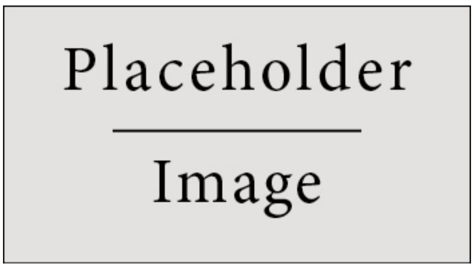


Figure 3.1: Figure caption

Bibliography

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