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The external impact of the Green Economy: An analysis of the environmental implications of the Green Economy

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Abstract: The *Green Economy* has increased its popularity among international organizations and OECD countries, as the solution to the current economic and ecological crisis. This strategy consists of a transition to a *low-carbon economy* and the achievement of *resource efficiency*, whose assumptions are grounded in *environmental economics*. Despite its international recognition, *Green Economy* indicators reveal an uneven distribution of the benefits of its implementation reflected by the externalization of the environmental damage. What is more, empirical studies enlighten its physical boundaries in terms of environmental damage through the extraction of the required raw materials and their future scarcity problems. This evidence is in line with the *theory of unequal ecological exchange,* which posits that environmental cost is displaced from *core* countries to the *periphery* countries. Additionally, the *Green Economy* can be framed within the concept of *environmental fix,* in that it lies on the marketization of the environmental problem to solve it.

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1. Introduction

Over the past decades one can perceive an increasing preoccupation with the environment in political programmes. This increase originates in the messages that nature sends us, which reveal that the current production and consumption patterns are not sustainable and that fossil fuels may not be available indefinitely. The level of carbon dioxide (CO_2) emissions, which are driven by the combustion of fossil fuels, is one of the most common indicators of such fact and one of the main causes of *global warming*, which threatens the life on Earth as we know it. Indeed, the concentration of this toxic greenhouse gas in the atmosphere has dramatically increased and currently reached 401.30 ppm in June 2014. This implies a yearly growth rate of 1 % since 1958 (CO_2 Now, 2014). Furthermore, the current CO_2 emissions level is well above the upper safety limit estimated at 350 ppm, which was already reached in 1988. This phenomenon known as the ecological crisis does not occur in isolation. In addition, the world is suffering from the consequences of the financial and economic crisis that started after the bailout of Lehman Brothers in 2008; the so-called *Great Recession*, which is characterized by high unemployment levels, the credit crunch and falls in Gross Domestic Product (GDP) levels.

In such a constellation, international organisations and governments face the challenge of overcoming these overlapping problems. They perceive the *Green Economy* as a solution to them. This ambitious strategy of international recognition has been adopted by many developed countries and has recently started to be implemented in developing countries. Its main purpose is to manage an energetic transition with a focus on renewable energies, to create jobs and to eradicate poverty (UNEP, 2011a).

Despite its popularity in political agendas, there is a growing preoccupation on the environmental consequences that result from the extraction of the raw materials required for the build-up of a *Green Economy*, endangering its feasibility. Sun, water, biomass and wind among other alternative energies in difference to fossil fuels are renewable, whereas the raw materials for the establishment of a renewable energy society are not. This thesis will study to what extent the *Green Economy* is dependent on an *external sphere* for its implementation. Inspired, on the one hand, by the work of Blume et al. (2011) which presented that environmental damage occurred in countries that exported these raw materials and on the other hand by the idea of Rosa Luxemburg of the capitalist system being always dependent on an *external sphere* or non-capitalist setting.

2. Methodology

This thesis is mainly based on primary and secondary literature, as well as on empirical studies.

The first part of the thesis will describe the origins, the underlying assumptions, the economic paradigm and the empirical critique of the *Green Economy*. To present the roots and the main goals of the strategy this thesis will be mainly based on the official documents presented by international organizations, such as the United Nations Environment Programme (UNEP), the Organization for Economic Co-operation and Development (OECD) and the European Union (EU), as well as on academic papers. During the description of the goals, the strategy will be conceptualized within the *environmental economics* approach. The empirical critique will be two-fold. Firstly, it will focus on the problems and shortcomings of the indicators used to monitor the *Green Economy*. A series of empirical studies from the UNEP and the Fakultät für Interdisziplinäre Forschung und Fortbildung der Universität Klagenfurt (IFF) in Vienna and data available at Eurostat and at the OECD Database will reflect these problems. Secondly, the environmental problems arising from the extraction process of raw materials that are crucial for the renewable energy transition will be presented. The literature selected to that end comes from environmental journals, online newspaper articles, the Institut Français des Relations Internationales (IFRI) and the previously mentioned work from Blume et al. (2011).

The second part of the thesis will tackle the issue of the dependence of the *Green Economy* on an external sphere from a theoretical perspective. This theoretical work will build on academic papers on the issue through the presentation of two approaches. Firstly, the tendency of the *Green Economy* to externalize its environmental impacts will be framed within the theory of ecological unequal exchange. An ecological economic approach on how to measure this unequal exchange will also be introduced. Secondly, the link between the expansionary tendency of capitalism and the *Green Economy* will be confronted. To that end, the *Green Economy* will be conceptualized within the main characteristics of the capitalist system, paying attention to its inherent tendency to expand and to its inner contradictions. After describing such characteristics, this thesis will discuss the different fixes present in capitalism that manage to overcome those contradictions. These will be based on the work of Harvey (2001a; 2001b; 2004)*;* Jessop (2008) and Castree (2008) on spatial fixes and environmental fixes.

3. The *Green Economy*

"*In its simplest expression, a green economy is low-carbon, resource efficient, and socially inclusive. In a green economy, growth in income and employment are driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services."*(UNEP, 2011a p. 16)

The aforementioned definition of what constitutes a *Green Economy* reveals its challenges, namely to sustain economic growth levels and prevent the environment from further harm (Morgera and Savaresi, 2013; Brand, 2012; UNEP, 2011a; OECD, 2011a; Babonea and Joia, 2012). This definition also makes reference to the concept of *decoupling* that will be developed later. One can also perceive from this definition that the main claim of the *Green Economy* is the possibility of a *win-win* situation (Wissen, 2014).

Even though the *Green Economy* has made its way onto political agendas and growth strategies in both national and international organizations as well as right-wing and left-wing discourses (Wissen, 2014), [1] there is a need to properly define and unfold the underlying assumptions relating toits implementation.

3.1. Historical background and main goals

The participants of the UNEP Conference on Sustainable Development in 2012 which took place in Rio de Janeiro from the 20th to the 22nd of June made clear their commitment in supporting the transition to a *Green Economy* as a way to attain sustainable development and poverty eradication (UNEP, 2012a). Nevertheless, they did not agree upon a clear definition of the term and left the door open for each country or region to adopt its own transition process. It was argued that each country had different starting points, and hence, the specification of a determined strategy could not apply to all members (Morgera and Savaresi, 2013). In that sense, the conference limited itself to the encouragement of each country to adopt *Green Economy* policies.

The term *Green Economy* was first used in 1989 in a report from Pearce et al. whose theoretical approach expands on that of on *environmental economics* (Morgera and Savaresi, 2013). This strand of the literature understands the environment as a subsystem

[1] *Green Growth* is the second main pillar of the Europe 2020 Strategy, which was approved in 2010 and which pleads for a *smart, sustainable and inclusive growth* (Babonea and Joia, 2012).*Green Growth* is also implemented, for instance, in countries such as the Republic of Korea (Morgera and Savaresi, 2013) and Barbados (Moore et al., 2014).

within the economic system and sees the valuation of nature as a key element towards sustainable development, building mainly on microeconomic foundations (Aguilera and Alcántara, 1994). It is suggested that in order to account for and reduce environmental impacts – externalities – an adequate taxation system or creation of a market provides for a solution (ibid.).[2] As Morgera and Savaresi (2013) pointed out, economic valuation has become a crucial element in multilateral environmental negotiations, particularly after the *Stern Review on the Economics of Climate Change* in 2006.

With the current international pressure on *global warming* and after the bailout of Lehman Brothers and the consequent onset of the financial and economic crisis; the *Green Economy* or *Green growth* appears to be the only possibility to tackle future crises and ensure new growth and progress paths that will maintain the living standards attained in the past fifty years (OECD, 2011a). [3]

Despite the fact that the *Green Economy* is not a *one-size-fits-all* strategy due to differences in policy and institutional settings, development levels, resource endowments and national environmental pressures, the OECD insists on creating a series of common goals (ibid.). These are the following: a *low-carbon economy*, *resource efficiency*, *green* jobs, technological improvements, poverty eradication and social inclusion (Brand, 2012). The preconditions that should enable the transition to a *Green Economy* include national policies, market regulations via incentives, subsidies and taxation and the creation of an international market and legal infrastructure (UNEP, 2011a).

For the implementation of a *Green Growth* strategy, the OECD (2011b) suggests two sets of policies. The first set deals with the required conditions to reinforce economic growth and preserve *natural capital*.[4] It consists of fiscal and regulatory measures that allow for the correct allocation of resources. This set of rules is to be accompanied by a promotion of innovation to tackle natural resource scarcity and increase resource efficiency. The second set of policies aims at boosting the efficient use of natural resources and rendering pollution more expensive. The OECD (2011b) offers a guideline for policymakers attempting to implement a green growth strategy.

[2] Two approaches on how to internalize these externalities will be clarified later.
[3] Some authors refer to *Green Economy* while addressing developing countries and to *Green Growth* while addressing developed countries whereas other do not establish any significant difference between the terms. For the goal of this paper, the terms will be used indifferently.
[4] *Natural capital* comprises the stock of non-renewable and renewable resources, semi-natural and natural areas, the ecological factors and land used (Hediger, 2000).

The political strategies can be summarized as follows (Brand, 2012):

- Adjustment of prices so that they internalize external costs, encouragement via opening a market or through public procurement of *sustainable consumption* and promotion of *green* business and markets.[5]
- Instauration of a tax reform in favour of environmentally and socially friendly practices.
- Expansion of public endorsement for more energy-efficient infrastructure to enhance and preserve natural capital.
- Promotion of research and development programmes with a special focus on *green* technologies.
- Destination of public investment towards agreements to promote ecologically and socially sustainable economic development.
- Harmonization of future economic policies with social goals.

Going back to the main goals mentioned in the first paragraph, the following sections will deal with the two of them which are directly related to the environment – *low carbon economy* and *resource efficiency* – and the concept of *decoupling*.

3.1.1. *Low-carbon economy*

As observed in the preceding sections, the *low-carbon economy* is one of the main aims of the *Green Economy*. Advocates of a *low-carbon economy* transition bet on the following three main policies to achieve it: control over the price of carbon, boost of alternative energies via increases in investments and a strong regulatory framework.

The first policy regarding carbon price control can be approached either by the creation of a market for the emissions based on the work by Coase (1960), by the implementation of an environmental tax based on the work by Pigou (1948) or by a combination of both (Edenhofer et al., 2009).

Experts on the determinants of the carbon price define the following factors affecting its future fluctuation: supply capacity of renewable energies, innovation and technological level of those energies, state engagement on providing certainty to alternative energy markets and conditions of the emission trade agreement (ibid.). Since CO_2 emissions are one of the main causes of *global warming* and its level in the atmosphere has reached unprecedented levels, environmental economists suggest that a

[5] *Sustainable consumption*, as will be later explained, is a central element to achieving *resource efficiency*.

higher price of carbon would reflect the negative repercussions of CO_2 emissions and consequently reduce them (Aguilera and Alcántara, 1994).

As previously anticipated, the Pigouvian approach consists of the establishment of an environmental tax, whose goal is the discouragement of consumption and production practices that entail CO_2 emissions (Edenhofer et al., 2009). Coase's approach is based on the definition of carbon emissions property rights and the creation of a global trade emissions market. These two conditions along with the introduction of a CO_2 emission limit are supposed to adjust the carbon price bearing in mind both the supply and the demand side, thus responding with a higher price to the carbon scarcity. In practice, two trading emission systems have already been developed: a credit schemes system and a cap-and-trade system (ibid.). An example of a credit schemes system is the *European Union Emission Trade System* (EU ETS) which grants emission allowances to firms and opens up an exchange market, whereas an example of a cap-and-trade system which imposes pollution limits on countries and establishes an international exchange market is the *Kyoto Protocol* (ibid.).

To carry out the remaining two policies, the role of government becomes crucial. First, the government acts as a guide for investments towards improvements in alternative energies through fiscal intervention in the form of subsidies and tax benefits. And second, the government introduces laws to protect the environment from the depletion of resources and further problems associated with the build-up of a *low-carbon economy* (ibid.). As explained by Edenhofer et al. (2009) and Hey (2012), new alternative energy plants risk harming the environment not only through the plundering of natural resources and more land use but also through potential negative externalities brought about during the process.

3.1.2. *Resource efficiency* and *Sustainable Consumption and Production*

> "*During the past century, aggregate consumption of raw materials has continuously increased; regular improvements in resource efficiency and pollution control technologies have not been large enough to offset the effect of the increase in the size of the global economy.*"(UN, 2011 p. 5).

> "*Europe has enjoyed many decades of growth in wealth and wellbeing, based on intensive use of resources. […] Over the 20th century, the world increased its fossil fuel use by a factor of 12, whilst extracting 34 times more material resources. Today*

in the EU, each person consumes 16 tonnes of materials annually, of which 6 tonnes are wasted, with half going to landfill. Trends show, however, that the era of plentiful and cheap resources is over."(European Commission, 2011 p.2).

The aforementioned quotes point to the fact that the consumption and production levels during the past years have reached an unsustainable stage. Such a constellation calls for a global and integrated action to achieve the second goal of the *Green Economy – resource efficiency*. According to the *ABC of Sustainable Consumption and Production* (SCP):

"*Resource efficiency is about ensuring that natural resources are produced, processed, and consumed in a more sustainable way, reducing the environmental impact from the consumption and production of products over their full life cycles. By producing more wellbeing with less material consumption, resource efficiency enhances the means to meet human needs while respecting the ecological carrying capacity of the earth*." (UNEP, 2010 p. 42)

In line with the preceding definition, the UNEP focuses on ways to reduce resource use by promoting SCP (UNEP, 2012b). SCP was first employed during the Oslo Symposium in 1994. SCP refers to:

"*[...] the production and use of goods and services that respond to basic needs and bring a better quality of life, while minimizing the use of natural resources, toxic materials and emissions of waste and pollutants over the life cycle, so as not to jeopardize the needs of future generations."*(UNEP, 2008 p. 21)

Indeed, it is highly linked to the concept of *sustainable development*. As stated by Mr. Siddhahrt Behura, sustainable consumption and production are the two preconditions to attain *sustainable development* (UNEP, 2008). On the one hand, *sustainable production* is to be accomplished via technological innovation and improvements in products and production processes applicablein all economic sectors. The principal objectives are pollution prevention, cleaner production, eco-efficiency and green productivity. On the other hand, the *sustainable consumption* goal takes into account the lifecycle of the product in order to render the use of both renewable and non-renewable energies more efficient. In practice, the basic actions to attain *sustainable consumption* include recycling, waste reduction and resource efficiency measures. Even though the terms are explained separately, they are intertwined in that *sustainable consumption* is present during the whole production process and in that *sustainable production* can influence the consumption of certain goods and services through market mechanisms (ibid.). It is hence addressed to all members of society; government, retailers, producers and consumers.

In line with the definition of the concept and the recognition of consumption/production patterns as a far-reaching global problem, the UNEP and the United Nations Department of Economics and Social Affairs (UNDESA) have assumed the task of tailoring the basic national guidelines to accomplish SCP (ibid.; UNDESA, 2012). This integrated approach is supposed to provide for common goals and targets for different national, regional and local strategies and is monitored through the *Marrakesh Process*.[6] Another line of action started by the UNEP and in co-operation with the United Nations Industrial Development Organization (UNIDO) is the *Resource Efficient and Cleaner Production joint programme.* This programme focuses on increasing production efficiency by optimizing the use of natural resources at all phases of the production cycle, on minimizing environmental impacts driven by industrial production and on helping development of people and communities.

A good example of the proposed measures to foster *resource efficiency* is found in the *Roadmap to a Resource Efficient Europe* by the European Commission (2011). The main policies are the following:

- Detecting fiscal policies that do not reflect the environmental costs of resource use and proceed with a phase-out of the so-called environmentally harmful subsidies as well as with the imposition of higher taxes on polluting activities, both on the consumption and the production side.
- Increasing knowledge on how natural capital reacts to production and consumption processes via research and innovation programmes.
- Promoting long-term investments and a long-term innovative thinking in business.
- Seeking consensus in the international sphere so that more partners adopt similar policies.

[6] The *Marrakech Process* is a multi-stakeholder platform that works on the implementation of SCP through the elaboration of a 10-Year Programme. It was launched as a response to the third chapter of the *Johannesburg Plan of Implementation* in 2003 (Marrakech Process Secretariat, 2010).

- Boosting the demand of *green* goods and long-term efficient production, whilst reducing the rebound-effect.[7]
- Transforming waste into a resource, thus generating a circular economy.

3.1.3. *Decoupling*

"*The decoupling of economic growth rates from resource use is [...] the next big opportunity for green economic growth, innovation and sustainable development at large*" (UNEP, 2014 p. 14).

As previously announced, the term *decoupling* requires further explanation in order to fully comprehend its significance and plausible applications. This recently introduced concept implies using fewer resources in production and consumption processes, hence reducing the environmental impact associated with them (UNEP, 2011b).

It is thus seen as a key element of a *Green Economy*, in that it deals with its main objective; the achievement of growth without environmental degradation, i.e.*resource efficiency*. To be more specific, the term *decoupling* can be interpreted differently depending on the spheres in which it is making reference; use of natural resources or environmental impact. On the one hand, *resource decoupling* relates to a process of dematerialization of economic activity (UNEP, 2011b). To put it differently, the concern of *decoupling* is the reduction of natural resource use per unit of output (ibid.). On the other hand, *impact decoupling* focuses on negative environmental externalities driven by production increases. Nevertheless, the concepts are highly interrelated since the depletion of natural resources provokes environmental degradation.

Another relevant categorization of *decoupling* is the one resulting from its measurement, which can be calculated with the ratio between the growth rate of GDP and the natural resource use rate or the environmental impact rate (ibid.). The denominator varies depending on the *decoupling* type in question. When the ratio is smaller than unity, one can talk about a *relative decoupling*. If the ratio tends to infinity because the denominator tends to zero, it is possible to talk about *absolute decoupling*, since economic growth has not implied a danger to the ecosystem. In case the rate is higher than one, there is no evidence that *decoupling* has taken place.

[7] The rebound effect occurs when cost savings driven by technological improvements lead to more consumption and the demand effect is so high that savings are offset (European Commission, 2011).

The key instruments to attain both types of *decoupling* are advances in technology which render natural resources more efficient, to investigate renewable resources' potential and to make use of alternative indicators that correctly evaluate the progress made and that account for nature(Panayotou, 2003; UNEP, 2011b).

3.2. Empirical critique

The main goals of the *Green Economy*, which have been previously explained, insist on the possibility of achieving a growth path that is both socially and ecologically respectful. Nevertheless, there is evidence that sheds some doubts on the *win-win* flagship of the *Green Economy*. Trade-offs, earth limits and further environmental damages are among those problems that might come about while *greening* the society and constitute the observable proof of the *Green Economy´*s need for an *external sphere*.[8] The first subsection will deal with the problems associated with the indicators of the *Green Economy*, which in some cases are distorted because of environmental protection being implemented in consumption countries and not in production countries. The second subsection will expose the environmental impacts driven by the goal of a *low carbon economy* which will be proven to be resource intensive.

3.2.1. *Green Economy* indicators and shortcomings

As previously clarified, the concept of *decoupling* manages the interaction of environmentally negative externalities and economic growth. In order to account for and monitor the improvements in the *low-carbon economy* transition and the *resource efficiency* fields towards a *Green Economy*, international organizations made use of a series of indicators.

For instance, the EU monitors four different indicators to evaluate national and communitarian progress towards a *green* and sustainable growth. These indicators are the level of greenhouse gases (GHG) emissions, the renewable energy share in gross final energy consumption, the level of *primary energy consumption* and the level of *final energy consumption* (Eurostat, 2014). [9];[10]

The calculated indicators to supervise the transition towards a *low-carbon economy* are the level of GHG emissions and the share of renewable energies in energy

[8] This concept will be explained later.
[9]*Primary Energy Consumption* refers to the Gross Inland Consumption excluding all non-energy use of energy carriers (e.g. natural gas used not for combustion, but for producing chemicals) (Eurostat, 2014).
[10]*Final Energy Consumption* is energy supplied to industry, transport, households, services and agriculture (it excludes deliveries to the energy transformation sector and the energy industries themselves) (ibid.).

consumption. The data streaming from Eurostat shows optimistic results for some EU members (See Appendix Table 1). Eight out of the 28 current members of the EU have reduced their levels of GHG in 2012 compared to those in 2000. Data from the OECD suggest that countries like Canada, Finland, Japan, Switzerland and the United States have also decreased their GHG levels in 2011 in relation to 2000 (See Appendix Table 2). These positive results do not reflect the global evolution of GHG emissions of the last ten years. On a global scale, GHG emissions were estimated to have grown between 2000 and 2008 at a yearly rate of 3.4% (Davis and Caldeira, 2010). Nonetheless, the break-out of the financial crisis in 2008 signalled a turning point in that global emissions have decelerated along with the fall in world GDP (ibid.).

One of the risks, while measuring production-based GHG emissions, is that it does not manage to account for possible *carbon leakages*. The concept of *carbon leakage* makes reference to the externalization of GHG emissions to other countries which do not have a strong environmental framework, thus truncating the positive results streaming from Eurostat and the OECD. This concept is based on the *Pollution Haven Hypothesis* (PHH) (Hermele, 2010). According to this theory, the introduction of stringent environmental policies in developed countries provokes the displacement of polluting industries to developing countries where environmental regulation is rather loose (Cole, 2004), thus explaining the inverted U-shape of the *Kuznets curve.*[11] This process is also known as *environmental load displacement*. *Carbon leakage* can be categorized into two types: strong and weak leakages. The former is related to the GHG driven by carbon-intensive industries displaced through FDI to developing countries whereas the latter refers to the increase in GHG emissions driven by the industrial expansion of those countries themselves (Davis and Caldeira, 2010).

An alternative way to monitor GHG emissions would be to account for the consumption-based emissions. This topic has recently received more attention, and a couple of studies have engaged in their accounting (ibid.; Muradian et al., 2002). The data for 2004 reflects that almost a quarter of global CO_2 emissions was traded across borders, mainly from China and other emerging economies to consumers in developed countries (Davis and Caldeira, 2010). What is more, the share of global emissions driven from the production of goods traded internationally has been growing for the past ten years (Peters

[11] The environmental *Kuznets curve* depicts the relationship between a country's income level and pollution. It is normally argued that up to a certain income level pollution decreases as income increases; nevertheless many studies suggest that this occurs through the externalization of pollution (Cole 2004; Panayotou, 2003; UNEP, 2011b).

et al., 2011). Even though this could simply be a repercussion of an increase in international trade, it could also be provoked by climate change mitigation policies, eased by the existent distance between the country of production and the country of consumption. Supported by the results of a regression with OECD and non-OECD countries, Peters et al. (2011) find that the increase in global emissions driven by consumption in many developed countries originates in developing countries. Yet, it is hard to determine whether these increases are caused by mitigation policies themselves or socioeconomic structures (ibid.).

With respect to the renewable energy share in final energy consumption, all EU members have increased their share of renewable energy use (See Appendix Table 3). Nevertheless, this indicator does not inform about the environmental problems that can derive from the raw materials' extraction which the construction of renewable energy plants requires.

To account for *resource efficiency*, the EU and the UNEP use the GDP to Domestic Material Consumption (DMC) ratio. The United Nations defines the DMC as the total amount of materials that a country employs. Hence, it is supposed to provide enough information on the *resource efficiency* and *decoupling* improvements of a country.

When taking a look into this indicator during the past decade, one could suggest that most members of the EU and some OECD countries have experienced relative and in some cases absolute *decoupling* (See Appendix Table 4). Nevertheless, the upper definition of the DMC reveals its weakness when it comes to recording the material use embodied in exchanged goods. A study by (Wiedmann et al., 2013) indicates that the use of the Material Footprint (MF) as an indicator to monitor for gains in *resource efficiency* yields opposite results. The MF is an indicator that records the global extracted raw materials that provide for the demand of an economy (ibid.). The study warns that the use of the DMC, since it has a blind eye on the material use embedded in international trade, might lead to inconvenient *resource efficiency* policies by shifting resource use and ecological problems to third countries (ibid.). Through a regression of 186 countries, the study suggests that countries' use of raw materials in third countries exceeded almost threefold the physical quantity of the goods traded and points out the need to use alternative indicators that capture these resource use shifts.

Further critiques on the conventional indicators to measure the improvements in the direction of the *Green Economy* suggest that the current indicators are too narrow to account and control for the transition. As Steen-Olsen et al. (2012) point out; the challenges when facing climate change necessitate the use of further indicators that capture its complexity. Considering the premise that environmental problems are ultimately driven by consumption of goods and services, these authors analyze the *Footprint Family* of the EU. The *Footprint Family* collects the three most important footprints; these are the carbon footprint, the ecological footprint and the water footprint. The carbon footprint is the level of GHG emissions associated with consumption; the ecological footprint calculates the biological resource used in terms of land and the water footprint quantifies both direct and indirect water requirements (ibid.). Based on data of 2004, the study concludes that through international trade, the EU was able to shift all of the above-mentioned kinds of environmental pressure resulting from their consumption levels to the rest of the world, as well as among them.

An underlying assumption of the previous critiques is the fact that environmental problems are driven by consumption in some countries and the polluting mode of production to provide for it. Weinzettel et al. (2013) stress that palliative climate change measures, such as the promotion of bioenergy and biomaterials, increases competition for biologically productive land. The appropriation of land to satisfy the needs of developed countries takes in recent times the form of *land grabbing.*[12] This phenomenon takes place when local communities lose the right to use the land they were previously using (GLOBAL 2000 et al., 2013).

This study from Weinzettel et al. (2013) reveals that a country's affluence drives global land use displacement since high-income countries require more biologically productive land to supply their demand.[13] Through a multivariate regression, the authors state that the affluence has a positive and significant effect on the land footprint associated with consumption and imports, whereas biocapacity has a positive effect and significant on the land footprint driven by production and exports (ibid). More evidence in line with the statement that land use and the problems caused by it originate in high-income countries is presented by Global 2000 et al. (2013). Their study estimated that 60% of the

[12] This concept will be further developed in the theoretical part.
[13] Affluence is GDP per capita in purchasing power capacity (Weinzettel et al., 2013)

land required to supply the European demand is domestic, whereas the remaining 40% is embodied in their imports.

3.2.2. Environmental impact of the extraction of raw materials and their physical limits

The preceding subsection has picked up the fact that environmental problems can come about while extracting the raw materials to build up renewable energy plants (Haberl et al., 2014). This subsection will present the main raw materials needed to build up a renewable energy grid as well as the problems associated with their extraction and their future scarcity.

Advocates of the *Green Economy* focus on the share of renewable energy consumption in the gross final consumption. For instance, the EU sets its goal for 2020 at 20% of this share, whereas the *Energiewende* has established the amount of 80% of the share in 2050 (Bundesministerium für Bildung und Forschung, 2014). Briefly described, the *Energiewende* makes reference to the decision made in Germany in the aftermath of the tsunami in Fukushima that implied the shutdown of nuclear power plants by 2022 (ibid.). However, the term is rooted in the environmental movement of the 70's, engaged in the search for alternative energy sources (Öko-Institut e.V., 2014). Its main instrument is the *Erneuerbare-Energien-Gesetz,* which stands for *Law of Renewable Energies* and was passed in April 2000. Its principal objectives are the regulation of the energy supply and the prevention of further energetic costs increments. Since its implementation, this law has experienced different changes. In its current form, which is effective from the 1st of August 2014 onwards, it has five main aims: to reduce the use of fossil fuel energies, to decrease the dependence on international oil and gas imports, to dismantle the national nuclear energy, to develop new technologies and to create a new growth path that leads to more employment, to protect the environment and finally to expand their energy strategy worldwide (ibid.). Many of these aims correlate with those of the *Green Economy*.

The infrastructure to support renewable energies requires raw materials whose extraction involves ever more energy, which initially comes from fossil fuels (Vidal et al., 2013). What is more, these materials cannot be recycled immediately. In such a constellation, there is no wonder that different studies foresee the replacement of fossil fuels dependency with another non-renewable source like minerals and metals (ibid; Riva Palacio, 2012). Materials involved in the build-up of the *Green Economy* are, among others, silicon for solar cells, steel and copper for wind energy and cobalt, rare earths and lithium for electric cars (Blume et al., 2011). A *Report on Critical Raw Materials for the EU* (European Commission, 2014) has categorized some of these materials as *critical* according to their economic relevance and their supply risk, yet neglecting their environmental impact; these are silicon, cobalt and rare earths. The increase in global energetic demand and the transition to a *low carbon economy* promoted, for instance, by the targets of the *Green Economy* and the *Energiewende*; increases the demand for these materials, therefore inducing environmental problems in the countries where the extraction takes place (ibid., Vidal et al., 2013). Because of their environmental repercussions, the materials selected in this thesis to depict the external environmental impact of the *Green Economy* are silicon, copper, lithium and rare earths.

Currently, the majority of solar cells are made out of silicon, which is obtained from sand. Even though this material is 100% renewable, it cannot be employed in the construction of solar cells. Through its transformation into pure silicon, it becomes suitable for the capture of solar energy. Yet, this transformation process is highly costly and energy intensive. Moreover, it entails the formation of toxic chemicals that may lead to health problems (Blume et al., 2011). Global supply of silicon concentrates in China; where in 2012 over 65% of the production took place, followed by Russia, which accounted only for 8% of the global production (US Geological Survey, 2013). Despite the legal framework (ISO 14001) introduced to monitor the health problems induced by the transformation of silicon into pure silicon in the solar power firms, silicon tetrachloride was spread over nine months in 2008 in a Chinese region in the surroundings of a children's playground and a cornfield,[14] thereby endangering the health of the inhabitants of the area (Blume et al., 2011). Had the legal framework been extended to the pure silicon suppliers, this tragedy would have been avoided (ibid.). Solar cells do not depend exclusively on pure silicon; combinations of cadmium-telluride, copper-indium-diselenide and copper-indium-gallium-disulphide are also present in the production of thin solar panels. Although the incorporation of these materials into solar cells does not require the equivalent levels of energy as silicon, it has been estimated that their demand will reach its peak by 2030 (Blume et al., 2011). Additionally, gallium has fewer chances

[14] Silicon tetrachloride is a substance that appears during pure silicon’s transformation process and whose inhalation causes irritation. In the long run it causes ulceration of the throat, lungs and nose (Cameo Chemicals, 2014)

to be utilized in the EU due to the European Commission's decision to limit its use because of its challenging recycling requirements.

With regard to wind energy, data suggests that the global consumption of copper and steel will increase to almost five billion tonnes for steel and almost 50 million tonnes for copper by 2050 (Vidal et al., 2013). When focusing on copper, one realizes that the German supply of copper relies almost exclusively on imports (Blume et al., 2011). In 2008, 34.4% of the imports came from Chile, 24.7% from Peru, 13.2% from Argentina, 11.4% from Canada and 8.8% from Brazil, pointing to the dependence of the *Energiewende* on external suppliers. Because of the low level of copper in minerals, the separation of the metal from the rock requires considerable amounts of water, energy and chemicals which ultimately leads to the formation of contaminated sludge. Not only is the separation process energy intensive, it also entails the destruction of landscapes and the creation of mine dumps where radioactive materials and acid sulphur accumulate (ibid.). Future global supply of copper is also a challenge of the *Green Economy*; between 1930 and 2011 550 million tonnes of copper were extracted which leaves a reserve of 530 million tonnes of exploitable copper (Exner et al., 2014).

Thanks to its energy transmitting and energy storing properties, lithium has become one of the key elements in the evolution of electric cars. Of course, this material has been demanded for quite some time since it is also crucial for antidepressants, glass and ceramics among other things (Riva Palacio, 2012; Blume et al., 2011; Ober, 2001). Additionally, it suffers from a new source of pressure due to its characteristic as the lightest metal in the periodic table (Gallardo, 2011; Blume et al., 2011). With an expected electric car market share of 20% in 2020, the pressure on lithium's use is undoubtedly expected to increase (Gallardo, 2011). Also known as *white gold*, this material is mostly extracted from what has been called the *Lithium Triangle* or the *Saudi Arabia of Lithium* which is located in Bolivia, Chile and Argentina (Riva Palacio, 2012; Koerner, 2008); specifically between the shafts of the salt fields of *Uyuni* (Bolivia), *Atacama* (Chile) and *Hombre Muerto* (Argentina). It is estimated that 75% of the global reserves concentrate in this area. The environmental impact of lithium extraction does not differ significantly from that of other minerals: use and pollution of water, landscape distortions and chemical residuals. As Gallardo (2011) points out for the case of *Hombre Muerto* in Argentina, brine extraction in order to obtain lithium generates a decrease in groundwater that in turn reduces sweet water levels and consequently leads to the disappearance of lakes and water meadows. This kind of exploitation affects the ecosystem, the fauna, bird migrations and the population itself, in that it demolishes the ethnic particularities of the communities (Gallardo, 2011; Burdiles Perucci, 2012).

In spite of their name, rare earths elements are not at all rare. These elements can be categorized into light and heavy, depending on their atomic number and are a crucial element in the high-tech and *Green Economy* society (Seaman, 2010; International Energy Agency, 2012). Electric automobiles and wind plants are the two main sectors that increase the demand of rare earths due to their ability to generate strong permanent magnets. Moreover, they are also present in the production of batteries, magnetic refrigeration and are a good candidate to transport and store hydrogen (Seaman, 2010). Although rare earth deposits are located all around the world, the country where most of the extraction takes place is China, accounting for 97% of the global production in 2010 (ibid.). Despite Chinese attempts to limit its rare earths exports for industrial protection and environmental reasons, its share in the global market remains at 90%. Rare earths refining procedures releases radioactive thorium and uranium, and their separation processes require a series of acid baths, which include ammonium bicarbonate and oxalic acid. Apart from the emergence of these toxic elements, the lack of appropriate environmental regulation in China has given rise to waterways pollution and farmlands destruction which in turn threatens the health of the mine workers and those living in the mine surroundings (ibid., Blume et al., 2011). The level of pollution in the atmosphere is such that the inhabitants rarely see the sun and are hence more likely to suffer from cancer (Blume et al., 2011).

4. Theoretical explanation of the externalization of environmental problems

Once the underlying assumptions of the *Green Economy* have been explained andempirical evidence has revealed the inconsistencies regarding its monitoring and the impossibility to assure its environmental protection goal since it externalizes or displaces the environmental load to third countries, one can now turn the attention focus to analysing this incapacity from a theoretical perspective. In other words, how can the dependence of a *Green Economy* on an *external sphere* be understood in theoretical terms? To answer this question the approach will be twofold. First, the discussion will deal with the influences and the measurements of the *ecologically unequal exchange theory*. And second, the section will dig into the contradictions of capitalism and its inherent expansionary drive.

4.1. *Theory of the ecological unequal exchange*

> "*Ecologically unequal exchange theory posits that the vertical flow of exports is a structural mechanism allowing for more-developed countries to partially externalize their consumption-based environmental impacts to lesser-developed countries. It is argued that these structural relationships contribute to environmental degradation in the latter while directly suppressing resource consumption opportunities for domestic populations; often well below globally sustainable thresholds."*(Jorgenson et al., 2009 p. 263)

The abovementioned definition of the *theory of ecological unequal exchange*, also known as *ecologically unequal exchange theory*, seems to describe pretty accurately the phenomena previously explained, namely how the demand of raw materials in countries who adopt *Green Economy* policies gives rise to environmental degradation in countries that extract them. To properly understand the background of this theory, a review of its influences and main ideas will be presented.

4.1.1. Roots and influences of the theory

Ecologically unequal exchange theory has much of its influences in the theories of the classical trade dependence, *unequal exchange* and world-system (Jorgenson et al., 2009; Jorgenson, 2009). One of the main pillars of the *theory of ecological unequal exchange* is the role of trade as a means to displace ecological impacts. According to David Ricardo and his theory of *comparative advantage*, two countries will profit from trade since they specialize in the product which they can produce comparatively more efficiently (Foster and Holleman, 2014). His analysis however was rather narrow-sighted in that he only considered two countries, two goods and the means of production – capital and labour – in both countries were fixed and perfectly interchangeable within their borders. Another weakness of his analysis was the neglect of the natural capital involved in the exchange process.

Another source of the *ecologically unequal exchange theory* in the trade field is the *Prebisch-Singer Hypothesis* (Hermele, 2010). Contrary to Ricardo's argument that the opening of the international markets results in a *win-win* situation for the countries involved and based on a UN study published by Hans Singer, Raúl Prebisch demonstrated that the implementation of export-oriented policies in developing countries hindered their development (ibid.). The data presented by Singer reflected a long-run downward trend in the prices of raw materials, which translated into a decline in raw material exporting countries' terms of trade from 1876 to 1947. The authors argued that this fall was motivated by the differences in technology and productivity improvements among developed and developing countries.

Another factor explaining this price fall is the low price and income elasticities of raw materials. As opposed to manufacturing, changes in prices and income hardly modify raw materials' demand thus reducing the purchasing power of manufacturers in developing countries (ibid.). As Prebisch (quoted in Hermele 2010) explained, the reason productivity gains occurred in the manufacturing sector but did not expand to the raw materials sector lies in the power relations factor. He argued that since workers in the *core* are better organized than in the *periphery* and entrepreneurs have to compete against each other,[15] the gains from trade can be translated into profit and wage increases. This redistribution of the gains from trade cannot occur in the *periphery* due to its lack of organization (ibid.).

The next two interconnected pillars of the *theory of ecological unequal exchange* derive from the trade theories previously exposed. Firstly, the idea of *unequal exchange* which comes about when considering, as Marx noted, *"[...] three days of labour can be exchanged against one of another country"* (quoted in Foster and Holleman, 2014 p.203) meaning that *"[...] the privileged country receives more labour in exchange for less [...]"* (ibid.). And secondly, the influence of the world-system theory on how countries in a more advantageous position in the global economy benefit from better terms of trade and ensure their position.

The idea of *unequal exchange* directly contradicts the *win-win* constellation proposed by David Ricardo. Originally, the *unequal exchange theory* arose from the Marxian insight in the specific use value of the commodity labour power, namely its ability to produce a higher value than it has. Thus, although bought at its exchange value on the market, once introduced in the production process labour power does not only produce an equivalent to its own value but a surplus value which is appropriated by the capitalist. (Marx 1980).

With respect to trade between countries, *unequal exchange* occurs when the products traded do not embody the same amount of labour (Foster and Holleman, 2014). Even though the rate of profit might equalize on a global scale, Rice (2007a; 2007b)

[15] The notions of *core* and *periphery* will be developed later.

suggested that this might happen under different wages and rates of exploitation between the countries. The reason rates of profit tend to equalize as opposed to wages and rates of exploitation is that capital can move more freely acrossborders, whereas labour is more fixed within a space. This fact impedes the equalization of wages and rates of exploitation among rich and poor countries. The author also argued that cultural and social factors play a role when it comes to the flexibility of the labour market and hence on wage fluctuations. International wage disparities are thus the cause rather than the consequence of different economic developments and commodity prices (Rice, 2007a), and capitalism is understood as a system of exploitation through exchange within the world system (Brewer, 2001). This analysis focuses more on the production conditions and social relations rather than on the commodities themselves since the former ultimately depict the *unequal exchange* (Communist Working Group, 1986).

The main author that discussed the issue of world-system theory is Wallerstein. His definition of what the world system constitutes is:

> *"[...] a multicultural territorial division of labour in which the production and exchange of basic goods and raw materials is necessary for the everyday life of its inhabitants"* (Wallerstein, 1974 p. 347).

According to their power and wealth levels, countries can be categorized into *core* states and *periphery* states. The former, which own comparatively more wealth and whose power degrees are higher, tend to specialize in *core* production that is capital-intensive, whereas the latter, with less wealth and a weaker degree of power, specialize in labour-intensive production (Wallerstein, 2004; Chirot and Hall, 1982). As previously anticipated, the trade between those countries results in what has already been defined as *unequal exchange*, since surplus value flows from *periphery* to *core* countries as the position of the latter is more powerful. This *unequal exchange* leads to a continuous process of impoverishment and exploitation in the *periphery* countries (Chase-Dunn and Grimes, 1995). Nevertheless, a third category must be added which is *semi-periphery* states. They present a mix of capital-intensive and labour-intensive economies. Another relevant contribution of Wallerstein (2004) is the definition of the modern world system as a capitalist system whose priority is the creation of mechanisms that allow for its expansion and accumulation of capital.

4.1.2. Considering nature in the analysis

It was not until the work from Bunker (1984) on how the extractive industries in the Brazilian Amazon region from 1600 to 1980 were provoking devastating ecological losses that environmental and human costs, in the sense of health problems, started to be considered in both theoretical and empirical analyses (Jorgenson, 2009).[16]

Starting with the premise that industrial production is dependent on natural resources as opposed to what many development theories defended, Bunker (1984) positioned energy and matter instead of labour and capital as the key elements of production. Even though each country dedicates part of its economic activity to extraction and part to industry, Bunker's analysis divided economies into *extractive* and *productive* (Bunker, 1984). The former present a unique class structure since their economic activity is focused on unique natural resources export, i.e. they are natural resource export-oriented. The latter are characterized by a higher level of division of labour and by the spatial organization of firms that can benefit from technological improvements, thus following a value-added production strategy (Rice, 2007b; Bunker 1984).

Consequently, extractive economies should not solely measure the value extracted from nature in terms of labour (Bunker, 1984), but also in terms of energy flows and matter from the *periphery* to the *core* country, thus providing a better measure of the *unequal exchange*. Bunker (1984) argued that in order to account for *unequal exchange*, both the appropriation of labour and capital and the appropriation of nature are equally relevant.

In his analysis, the continuous growth of production systems, which relies on extractive economies, contributes to accentuate the interdependencies of the economies as well as to increase the competition for natural resources (ibid.).

The extraction of natural resources in one region destined to be consumed in another induces a loss of value in the extractive economy and an opposite effect in the consumption economy (ibid.). In this sense, the consumption economy is appropriating nature from the *extractive* economy, thus deteriorating the environment of the latter. In order to name the systemic connections in *extractive* economies driven by this

[16] For a more recent contribution on the role that nature plays in the process of industrialization and development, see Moore (2003).

appropriation of nature and its ecological implications, the author coined the term *modes of extraction*.[17]

This appropriation process entails the following consequences in *extractive* economies. Since the labour and capital to value ratios are normally low in these economies they are prone to produce fluctuations in income, rendering them unstable. In addition, due to decreasing returns to scale, the unit cost of the extracted good increases while the good itself becomes scarce (Bunker, 1984). *Extractive* economies also display demographic dislocations as a result of the rapid exhaustion of the natural resources and due to the location of the enterprises next to the extraction sites, which precludes the advantages from shared locations (ibid.). Empirical evidence from Bunker's work sheds light on the fact that whereas indigenous societies were exploiting nature at rates that permitted their regeneration, colonial extraction propelled by international demand occurred beyond natural regeneration capacities which consequently led to an environmental aggravation (ibid.; Martínez-Alier, 2000).

4.2. The dependency of the *Green Economy* on an *external sphere*

The *ecologically unequal exchange theory* does not explain the dependence of the *Green Economy* on an *external sphere*; hence this section will be devoted to clarifying this dependency. The term *external sphere* refers not only to the value extracted out of nature in countries that provide the natural resources for the build-up of the renewable energy grid, but also to the countries themselves where the environmental impact is externalized.

4.2.1. Capitalism and its contradictions

To discuss the issue of the dependence of the *Green Economy* on an *external sphere*, one needs to frame this strategy within the characteristics of the capitalist system and stress its implications in the world as the fossil fuel era ends.

The key element to achieving growth under capitalism is the accumulation of capital (Harvey, 2001a). Hence, accumulation is the impellor promoting growth within the capitalist mode of production. This characteristic makes the capitalist system dynamic and expansionary; thus constantly reshaping and modifying the world. However, the growth process contains internal contradictions that erupt in the form of crises (ibid.). For accumulation to take place, the following conditions need to be fulfilled: the existence of

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[17]The author employs the term *modes of extraction* as opposed to the notion *modes of production* typical in Marxist readings. A *mode of production* entails the productive forces and the relations of production (Easterling, 2003).

a surplus of labour, which can be increased through different mechanisms, i.e. population growth policies, promotion of migration and as Harvey (2001a, p.238) put it by "*drawing 'latent elements' -labor power employed in non-capitalist situations, women and children, and the like - into the workforce"*; the existence of a marketplace with enough means of production so that production can expand along with the reinvestment of capital, and lastly a market in charge of absorbing the ever bigger quantity of commodities produced (ibid.). In the eyes of Marx, growth can hardly be stable since the preceding conditions are almost unreachable during a long period. Hence, stable growth occurs out of fortuity, and the capitalist system is likely to go through a variety of crises (ibid.).

Expanding on these arguments, James O'Connor (1998) described capitalism as both crises-ridden and crises-dependent, making it its own gravedigger (Spence, 2000; Jorgenson, 2006). This author introduced what he called the two *contradictions of capitalism*. The *first contradiction* deals with the relations between the means of production and labour. The introduction of better technologies deskills workers and leads to wage cuts, thus generating overproduction or underconsumption crises (Harvey, 2001b; Jorgenson, 2006). Overproduction can in turn lead to high unemployment levels and finally to decreases in the rate of profit (Jorgenson, 2006). The *second contradiction of capitalism* initially built on how capitalist agriculture destructed potential productive soil. It points to the underlying drive of capitalism to hinder further accumulation of capital through the exhaustion of the natural and material conditions which are essential for its steady expansion (ibid.). This destruction of the means of production occurs because companies transfer the ecological costs from production processes to society and the environment. Hence, without the implementation of environmental regulation capitalist societies are prone to suffer ecological crises (Castree, 2008). In other words, the exploitation process of the capitalist mode of production destroys the socio-ecological requirements on which the work process is based (Wissen, 2014). It can be hence deduced that for O'Connor (1998), nature played a crucial role in capitalist production, firstly by enabling it to occur and secondly by imposing limits on it.

These contradictions seem to be overcome through the externalization of the destruction processes to the non-capitalist milieu (Wissen, 2014). Section 4.2.2. will discuss the different ways in which capitalism overcomes or at least postpones these contradictions both temporally and geographically.

The reason an energetic transition is of high relevance in our current context does not rely solely on its function as a solution to the ecological and economic crisis. It also relies on the scarcity of fossil fuels on Earth and on the need to search for substitute energy sources that can perpetuate the functioning of the system as it is (Altvater, 2006). The period characterized by the use of fossil fuels as a central energy source is known as *fossil capitalism* or *fossilism* (ibid.). Despite the environmental damages associated with their production and their consumption, fossil fuels enabled a surprising capitalist expansion with high growth rates from the industrial revolution on, making yearly growth rates jump from 0.2% to 2% by the end of the last century. So fossil fuels and especially oil, are seen as a crucial element in recent capitalist expansion (ibid.). Even though, the Energy Return on Investment (EROI) of fossil fuels is not the highest among energy sources, their following properties can explain the preference of fossil fuels to other energies. [18] Fossil energy made the location of energy sources no longer a determinant for a country's development since it could be transported all over the world thus allowing for the instauration of capitalism in pre-capitalist regions (ibid.). Another advantage is its constant availability as opposed to solar energy, which enabled a production organization independent from social and natural rhythms. And lastly, its flexibility in all production, consumption and transportation processes, which rendered accumulation and economic growth independent from land use and its limitations (ibid.). Indeed, the use of fossil fuels promoted a shift from underproduction to overproduction.

4.2.2. Fixes to the contradictions of capitalism

Relevant for the discussion on how capitalism manages to overcome its inner contradictions are the concepts of *spatial fix* and *environmental fixes* (Harvey, 2004; Jessop, 2000; Castree, 2008).

The notion of the *spatial fix* by Harvey (2001b) was the result of different attempts at reconstructing the theory of Marx on the geography of capitalist accumulation.[19] This interest in the spatial dimension of capitalism is motivated by his knowledge as a geographer and his long-standing focus on land-use patterns and dynamics (Jessop, 2008). Due to his background as a geographer, for Harvey (2001b) the modification and reconfiguration of space are crucial when understanding the dynamics of capitalism.

[18]The EROI is the ratio that compares how much energy is gained when producing it, with the energy that is required to generate it (Murphy and Hall, 2010).

[19] Harvey's first work on the spatial fix was based on Hegel, von Thünen and Marx (Harvey, 2001a).

Globalization is hence the current stage of capitalism characterized by its constant search for fixes to deal with its crisis-prone nature (ibid.).

This *spatial fix* refers to the different forms by which accumulation crises are solved through spatial reconfiguration and geographical expansion (Jessop, 2008). Consequently, the need of a *spatial fix* originates in the inherent drive of capitalism to solve its inner contradictions via geographical expansion (ibid.). Harvey (2001b) aimed at proving three aspects. First, that the survival of capitalism is dependent on geographical expansion; second, that innovations in the transport and communication fields are central to that expansion and third that the way in which geographical expansion takes place varies according to the reason behind it; i.e. search for new markets, for new labour powers, for new materials or new investment opportunities (ibid.).

The term fix is used with both of its meanings. On the one hand, in that it provides a solution for a particular problem. And, on the other hand, in that it secures or fixes capital in some physical form in a determined place (Harvey, 2001b, 2004; Arrighi, 2004). The first meaning of fix has indeed a time dimension; because the solution, as in the case of a drug addict, only temporarily palliates the symptoms (contradictions) (Harvey, 2001b).[20] The concept also reflects the dialectic between fixity and mobility of capital (Jessop, 2008). It requires immobile capital, represented by the landscapes and the infrastructure as well as circulating capital, i.e. raw materials, semi-finished and finished goods and money that moves from one area to another (Jessop, 2008; Harvey, 2001b). In other words, long-term investments in immobile capital, such as highways, aircrafts and airports, enable the mobility of other capital (Jessop, 2008).

Another kind of fix to mention within this debate is the notion of *environmental fix* introduced by Castree (2008). The aforementioned fix does not deal specifically with environmental problems arising from capitalist production, but rather represents solutions to accumulation crises in general. Castree (2008) offers a categorization of four *environmental fixes* that take place within the current expression of capitalism; *neoliberalism.*[21]

[20] The process by which the contradictions arise again will be developed later.
[21]In short, the main characteristics of *neoliberalism* are privatisation, marketization, through a process of assignment of prices; deregulation, that is to say, reducing state intervention; reregulation, through the implementation of mechanisms that facilitate the first two characteristics; letting state-firms act according to efficient and competitive principles and promoting the creation of non-state groups that takeover the interventionist role of the state (Castree, 2008).

The *environmental fix* type one suggests that through the incorporation of the environmental problem and nature into the market and thus into the mechanism of capital accumulation, the previously mentioned *second contradiction of capitalism* from O'Connor (1998) can be overcome (Castree, 2008). This set of measures is known as *free market environmentalism*. The *environmental fix* type two describes the ownership transfer from the state to a private firm of a natural environmental aspect for its introduction into the market. The *environmental fix* type three is the opposite of the first one, that is to say the continuation of environmentally unfriendly practices. The logic behind it is that the degradation of protected nature is economically beneficial, even though it is harmful. The *environmental fix* type four regards the intervention of the state, which in the belief that markets can solve the environmental problem, can either displace the environmental responsibility to the private sector or to non-state groups by the creation of new markets or by directly assuming a minimal intervention strategy (ibid.).

5. Summary of the main findings

Once the goals, policy implications and problems of the *Green Economy* have been described and the theoretical explanations on how environmental problems can be externalized within capitalism have been discussed, one can now turn to summarize the main findings of this thesis.

In the current context of financial and ecological crises, the *Green Economy* has been gaining in popularity counting largely on the support of international organizations and OECD countries. This strategy has managed to push the *Green Economy* onto political agendas on all five continents by promising that a *win-win* situation for all countries and members of society is possible. Its main goals regarding the environment are the transition to a *low-carbon economy* and the achievement of *resource efficiency*. Both are grounded on the assumption that the valuation of nature and its inclusion into the market are crucial to handle and successfully reduce environmental damages and CO_2 emissions. It is hence deduced that the *Green Economy* is based primarily on *environmental economics*.

The transition to a *low-carbon economy* is to be accomplished via a higher taxation of polluting activities, the creation of emission trading markets, such as the *Kyoto Protocol* and the EU ETS and via fiscal and legal intervention from the state to encourage the use of clean energies and the protection the environment. *Resource efficiency* is to be achieved through technological improvements boosted by public and private investments as well as by the implementation of the so-called *Sustainable Consumption and Production*, which ensures that production and consumption require as little resource use as possible. All in all, the most ambitious challenge of this strategy is the accomplishment of securing constant economic growth without further environmental damages; this is known as *decoupling*.

When taking a look at the data from Eurostat and the OECD it is possible to infer that not all countries benefit from *Green Economy* policies equitably. Whereas some countries see their GHG emissions decrease and their resource efficiency indicator increase others see the opposite effect. It is found that *Green Economy* indicators that account for both the transition to a *low-carbon economy* and *resource efficiency* are prone to provide biased results. They measure only the environmental impact resulting from production within a territory and do not approach the issue from a global perspective. As the studies from the UNEP and IFF point out, high-income countries can attain better results when it comes to *Green Economy* standards because they externalize the environmental consequences that come about through production processes to low-income countries, leading to cases of *land grabbing*. These displacements of production and the use of land from low-income countries are mainly motivated by their loose environmental regulation and the affluence and consumption patterns of high-income countries. It is also suggested that the indicators of the *Green Economy* are not enough when it comes to measuring all different environmental consequences in the transition; water use, land use, biodiversity losses among others should also be included.

The physical limits of the *Green Economy* have been illustrated with the case studies on the extraction of silicon, lithium, copper and rare earths. These studies have not only provided qualitative empirical evidence on environmental problems resulting from the extraction of these raw materials, they have also pointed to the fact that the extraction takes place in countries that do not present the aforementioned positive results according to the *Green Economy* standards. The main countries which provide for the selected raw materials are China, Latin American countries such as Chile and Argentina. Furthermore, the case studies have alluded to the future scarcity problems of these raw materials, pointing to the limits on the possibility to employ them in the long run.

The theoretical explanation on how some countries are able to partially externalize their consumption-based environmental problems is mainly grounded on the *theory of ecological/unequal exchange*. This theory, which builds on the theories of trade dependence, *unequal exchange* and world-systems, suggests that trade allows for the displacement of consumption-based environmental costs from *core* to *periphery* countries. As opposed to the advocates of free trade, this theory suggests that in the exchange process more environmental cost from the *periphery* countries is exchanged for less environmental cost from the *core* countries. *Ecologically unequal exchange* does not arise only from the exchange action itself, but also from different social, economic and structural characteristics of the countries involved. The externalization of production-based environmental problems is known as *environmental load displacement*. In this case, the displacement is facilitated through FDI so that firms transfer their polluting industries to countries where the regulation is less stringent.

The theoretical explanation for the dependence of the *Green Economy* on an *external sphere* is principally based on the inherent tendency of capitalism to grow and on the foreseeable change in the world as a consequence of the end of fossil fuels as the main source of energy, implying a shift to other energy sources. This *external sphere* does not only consist of living labour in a non-capitalist milieu, but also on nature and materials that are yet to be extracted and incorporated into the market. Yet, this constant need of an *external sphere* lies on the unlikelihood of the conditions for accumulation of capital to occur simultaneously. This low probability of the conditions for accumulation of capital explains the dynamic characteristic of the capitalist system and its constant modification. This instability leads to different crises, so that it can be said that capitalism is crisis-prone. Moreover, the *second contradiction of capitalism* announced by O'Connor (1998), describes how the capitalist production system destroys the conditions of production, thus building its own grave. For many years, the use of fossil fuel energies allowed capitalism to expand faster than ever before. This is mainly due to the availability of this source, its flexibility and the possibility to easily transport it. This expansion also prompted high consumption and high production levels, which are now in danger.

Despite the various crises and contradictions that the capitalist system can suffer, these have been overcome or deferred both geographically and temporally through the so-called fixes. The discussion on the fixes has helped to conceptualize that one of them applies in our current situation; that is to say, which kind of fix the *Green Economy* is. On the one hand, the *spatial fix* depicts how accumulation crises can be resolved by the transfer of either capital, labour or both to a different geographical area, thus palliating the accumulation problems in the countries where they were taking place. This process entails the reproduction of the characteristics of capitalism in the receiving area. The *spatial fix* is inevitably temporal, because by adopting the characteristics of capitalism, it necessitates the conditions for accumulation of capital and is consequently prone to suffer from crises. On the other hand, the *environmental fixes* show how the current form of capitalism – neoliberalism – tackles environmental problems. Apart from suggesting the roll back of the state and the involvement of the private sector as ground measures in all four kinds of fix, the *environmental fix* type 1 confronts the *second contradiction of capitalism* of O'Connor (1998) under the premise that valuation and marketization of nature permits the reduction of the environmental problem. These ideas have already been found in the description of the *Green Economy* and its influences from *environmental economics*.

6. Conclusion

In spite of the promises made by the advocates of the *Green Economy*, this thesis has proven that this strategy is not free from environmental degradation and further limitations. It could be that through an improved monitoring of the *Green Economy*, that is to say, accounting for all possible negative externalities driven by the implementation of the strategy, nature does not suffer from environmental harm on a global scale. Nevertheless, following the conditions of accumulation of capital on which capitalism is based, this cannot be expected in our current economic system due to it crisis-prone and crisis-dependent nature.

The dependency of the *Green Economy* on an *external spher*e can be explained at different levels. First, the *Green Economy* is highly dependent on raw materials that are being currently extracted in countries that suffer from the correspondent environmental problems. And second, the *Green Economy* is dependent on an *external sphere* that is to say, on a non-capitalist milieu where labour and nature value are yet to be extracted, as happens with any other fix to a crisis in the capitalist system.

The external impact of the *Green Economy* is thus not only the environmental problems arising from its thirst for raw materials, but also the reduction of the quantity of nature and probably of living labour that currently do not belong to the capitalist system. Trying to frame the *Green Economy* within the aforementioned fixes is no easy task, since it takes place in a situation dominated by the idea that the valuation of nature and the creation of markets are the solutions to the environmental problems as well as to an economic and ecological crisis. As explained in section 4.2.2. of this thesis, the notions of *spatial fix* by Harvey (2001, 2004) and Jessop (2008) and of *environmental fix* by

Castree (2008) present some similarities. Namely in the existence of a crisis or a contradiction and the need for the creation of a new market and the introduction of idle resources – in this case, nature – into the capitalist production process. Thereupon the *Green Economy*, in that it is based on *environmental economics*, constitutes the *environmental fix* type 1 within Castree's (2008) categorization.

The focus of this thesis on the environment problems driven by the implementation of the *Green Economy* does not imply a neglect of the socioeconomic impacts of the strategy. Further investigation on the empirical side could focus on those impacts as well as on searching more current data on vertical flows of exports of raw materials and FDI for high-income countries and low-income countries and current consumption-based indicators. This research would provide more empirical evidence on the *ecologically unequal exchange theory* and the *environmental load displacement* as well as a broader view on the problems of the strategy.

To enrich this thesis, further investigation could focus on the classification of the mentioned countries within the world system theory. That is to say, to classify countries with positive improvements with regard to *Green Economy* as well as the countries suffering from environmental degradation into *core* and *periphery* countries or into *extractive* and *productive* economies according to Bunker's (1984) categorization.

Moreover, future research could be centred on alternatives to the current economic system, by changing its essence, i.e. accumulation of capital. This investigation would thus imply a change in focus. Instead of looking for ways to increase *resource efficiency* that ultimately favours some people, the focus could be on how the available resources can be globally distributed based on fulfilling basic needs and equality principles. Such a stringent starting point would require a high contraction of the consumption and production levels in high-income countries.

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Table 1: GHG emissions in the EU

GEO/TIME	2000	2007	2008	2009	2010	2011	2012	Total GHG Reduction
EU 28	5.121.652	5.118.667	5.006.492	4.642.442	4.751.060	4.603.245	4.544.224	yes
Belgium	145.857	133.440	135.823	123.209	130.611	120.146	116.520	yes
Bulgaria	59.471	68.423	66.843	57.725	60.272	65.996	61.046	no
Czech Republic	146.330	147.246	142.185	134.206	137.008	135.277	131.466	yes
Denmark	68.549	67.382	63.905	61.068	61.402	56.518	51.637	yes
Germany	1.040.367	976.584	979.803	912.606	946.388	928.695	939.083	yes
Estonia	17.157	20.949	19.546	16.189	19.892	20.484	19.188	no
Ireland	68.216	68.371	68.020	62.312	61.895	57.750	58.531	yes
Greece	126.579	134.637	130.758	124.110	117.878	114.728	110.985	yes
Spain	380.004	432.112	398.444	359.659	347.181	345.887	340.809	yes
France	560.526	537.662	532.853	509.248	516.447	490.010	490.125	yes
Croatia	26.626	32.744	31.401	29.390	28.893	28.542	26.419	yes
Italy	551.237	555.078	540.620	490.113	499.359	486.601	460.083	yes
Cyprus	8.904	10.382	10.559	10.299	9.989	9.682	9.259	no
Latvia	9.994	11.979	11.496	10.850	11.987	11.140	10.978	no
Lithuania	19.632	26.119	24.932	20.432	21.119	21.680	21.622	no
Luxembourg	9.762	12.361	12.188	11.684	12.250	12.125	11.839	no
Hungary	76.504	75.651	73.328	66.976	67.638	66.034	61.981	yes
Malta	2.551	3.091	3.057	2.993	2.994	3.027	3.140	no
Netherlands	213.023	204.199	203.314	197.787	209.286	195.064	191.669	yes
Austria	80.277	86.967	86.882	80.148	84.808	82.761	80.059	yes
Poland	396.104	415.449	406.081	387.700	407.475	405.741	399.268	no
Portugal	84.100	80.269	78.032	74.854	70.634	69.317	68.752	yes
Romania	134.074	142.804	139.812	119.917	115.799	121.514	118.764	yes
Slovenia	18.953	20.672	21.384	19.373	19.411	19.463	18.911	yes
Slovakia	48.947	48.395	49.001	44.690	45.382	44.698	42.710	yes
Finland	69.188	78.249	70.126	66.003	74.397	66.861	60.966	yes
Sweden	68.563	65.233	63.014	59.097	65.072	60.754	57.604	yes
United Kingdom	690.155	662.220	643.086	589.804	605.592	562.753	580.807	yes

Source: Eurostat, Greenhouse Gas Emissions (CO2 equivalent).

Table 2: GHG for OECD countries without EU members

Country	2000	2007	2008	2009	2010	2011	GHG Reduction
Australia	493275,881	542543,389	550349,659	549132,977	548757,988	552298,91	no
Canada	717581,109	748839,981	730915,734	689030,171	700849,285	701791,222	yes
Chile	70856,482	..	..	..	..	..	no
Israel	72438,719	76869,854	77954,465	74110,507	76924,446	78452,333	no
Japan	1342560,41	1365713,223	1282405,515	1207257,738	1257745,809	1308084,22	yes
Korea	511187	591429	605407	609167	667755	697708	no
New Zealand	69542,88	74518,471	74134,077	71506,357	71940,798	72923,483	no
Norway	54110,885	56100,677	54433,563	51860,948	54334,348	53446,374	yes
Turkey	298214,782	380947,574	367207,267	370012,055	402102,746	422415,825	no
United States	7045346,254	7225933,723	7021568,904	6566198,033	6790642,119	6665700,866	yes
Latvia	10104,882	12139,187	11630,614	10940,78	12097,065	11545,285	no
Lithuania	19647,799	26157,528	24919,434	20423,296	21122,598	21614,233	no
Russian Federation	2047050,115	2199542,901	2237437,615	2121473,922	2217286,858	2320850,662	no

Source: OECD Greenhouse gases: Total emissions excluding emissions or removals from land-use change and forestry

Table 3: Resource Efficiency in the European Union, GDP/DMC

GEO/TIME	2000	2007	2008	2009	2010	2011	2012	Decoupling
EU 27	1,22	1,3	1,32	1,43	1,49	1,46	1,56	Yes
Belgium	1,65	1,76	1,62	1,75	1,75	1,68	1,87	Yes
Bulgaria	0,14	0,15	0,14	0,17	0,17	0,16	0,16	Yes
Czech Republic	0,35	0,45	0,47	0,49	0,53	0,51	0,57	Yes
Denmark	1,32	1,35	1,39	1,58	1,72	1,6	1,56	Yes
Germany	1,42	1,7	1,73	1,72	1,79	1,71	1,8	Yes
Estonia	0,31	0,26	0,28	0,26	0,26	0,27	0,26	No
Ireland	0,58	0,63	0,74	0,85	0,94	1,12	1,24	Yes
Greece	0,9	1,04	1,1	1,21	1,24	1,24	1,16	Yes
Spain	0,91	0,85	0,99	1,17	1,32	1,49	1,85	Yes
France	1,63	1,79	1,83	1,98	2,06	2,04	2,1	Yes
Croatia	0,68	0,53	0,46	0,56	0,67	0,65	0,7	Yes
Italy	1,32	1,64	1,67	1,77	1,89	1,94	2,05	Yes
Cyprus	0,65	0,62	0,49	0,59	0,64	0,73	1	Yes
Latvia	0,24	0,31	0,36	0,38	0,33	0,31	0,36	Yes
Lithuania	0,43	0,44	0,43	0,54	0,5	0,49	0,55	Yes
Luxembourg	2,07	2,55	2,85	2,81	2,82	2,86	2,85	Yes
Hungary	0,41	0,53	0,47	0,55	0,61	0,62	0,69	yes
Malta	1,2	1,38	1,61	1,48	1,78	1,39	1,22	yes
Netherlands	2,09	2,48	2,41	2,48	2,54	2,54	2,71	yes
Austria	1,12	1,18	1,3	1,31	1,34	1,32	1,43	yes
Poland	0,33	0,38	0,39	0,42	0,42	0,36	0,42	yes
Portugal	0,67	0,63	0,6	0,66	0,71	0,69	0,81	yes
Romania	0,24	0,14	0,12	0,14	0,15	0,14	0,15	no
Slovenia	0,63	0,61	0,72	0,8	0,86	0,96	1,08	yes
Slovakia	0,41	0,47	0,43	0,46	0,49	0,49	0,57	yes
Finland	0,76	0,81	0,79	0,88	0,84	0,85	0,88	yes
Sweden	1,51	1,62	1,6	1,75	1,66	1,62	1,63	Yes
United ingdom	2,14	2,66	2,81	3	3,11	3,14	3,25	Yes

Source: Eurostat, (GDP chain-linked volumes, reference year 2000)

Table 4: Share of renewable energies in final energy consumption in the European Union

geo\time	2004	2007	2008	2009	2010	2011	2012	TARGET
EU 28	8,3	10	10,5	11,9	12,5	12,9	14,1	20
Belgium	1,9	3	3,3	4,6	5	5,2	6,8	13
Bulgaria	9,6	9,4	10,7	12,4	14,4	14,6	16,3	16
Czech Republic	5,9	7,4	7,6	8,5	9,3	9,3	11,2	13
Denmark	14,5	17,9	18,6	20,4	22,6	24	26	30
Germany	5,8	9	8,5	9,9	10,7	11,6	12,4	18
Estonia	18,4	17,1	18,9	23	24,6	25,6	25,8	25
Ireland	2,4	3,6	4	5,2	5,6	6,6	7,2	16
Greece	6,9	8,2	8	8,5	9,8	10,9	13,8	18
Spain	8,3	9,7	10,8	13	13,8	13,2	14,3	20
France	9,3	10,2	11,2	12,2	12,7	11,3	13,4	23
Croatia	13,2	12,1	12,1	13,1	14,3	15,4	16,8	20
Italy	5,7	6,5	7,4	9,3	10,6	12,3	13,5	17
Cyprus	3,1	4	5,1	5,6	6	6	6,8	13
Latvia	32,8	29,6	29,8	34,3	32,5	33,5	35,8	40
Lithuania	17,2	16,7	18	20	19,8	20,2	21,7	23
Luxembourg	0,9	2,7	2,8	2,9	2,9	2,9	3,1	11
Hungary	4,4	5,9	6,5	8	8,6	9,1	9,6	14,65
Malta	0,3	0,4	0,4	0,4	0,4	0,7	1,4	10
Netherlands	1,9	3,1	3,4	4,1	3,7	4,3	4,5	14
Austria	22,7	27,5	28,3	30,4	30,8	30,8	32,1	34
Poland	7	7	7,8	8,8	9,3	10,4	11	15
Portugal	19,2	21,9	22,9	24,5	24,2	24,5	24,6	31
Romania	16,8	18,3	20,4	22,6	23,2	21,2	22,9	24
Slovenia	16,1	15,6	15	18,9	19,2	19,4	20,2	25
Slovakia	5,3	7,3	7,5	9,3	9	10,3	10,4	14
Finland	29,2	29,8	31,3	31,2	32,4	32,7	34,3	38
Sweden	38,7	44,1	45,2	48,2	47,2	48,8	51	49
United Kingdom	1,2	1,8	2,4	3	3,3	3,8	4,2	15

Source: Eurostat

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