# CHINA IN THE LIGHT OF THE GREEN ECONOMY:

## How does the 12th Five-Year Plan address the environment and energy?

**DISSERTATION**

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## Abstract

This dissertation explores the controversial concept of the green economy and the rapidly increasing environmental concerns associated to the heavy energy industry. The main objective of this paper is to investigate how China's 12th Five-Year Plan responds to the green economy paradigm. Hence, it examines the Chinese government's commitments in greening the energy sector and analyses whether or not these commitments are congruent with the attempts to mitigate climate change.

The 2008 financial and economic crisis has brought new attention to the prevailing business as usual, as it has continuously implied high costs on nature. While nation states struggle to revive the global economy, many are cogitating on the broad concept of the green economy. The green economy calls for governments and business leaders to actively invest in green strategies, if they are to prevent the world of undergoing unprecedented environmental catastrophes. Greening the energy sector will be among the former major drivers of the green economy. Energy generation is the foremost prompter of greenhouse gas emissions, notably owed to the perpetual dependency on fossil fuel sources across nations. As such, the green economy encourages economies to prioritise the expansion of renewable energy and the advancement of energy efficiency, since these are pivotal alternatives for empowering the tackling of climate change. During the research, it became clear that China is a country of much discussion, as it has the second largest economy in the world and a very polluting energy sector. Thus, the underlying focus of this paper lies on analysing China's 12th Five-Year Plan, which evidences attempts in tackling the environmental implications caused by its unsustainable energy industry.

In order to explore the green economy paradigm and its central ideas, a qualitative approach was employed by intensive desk and documentary research. This approach was applied to maintain unbiased reflections on the examined subject. Also, the research is sustained by the most recent data available, since the focus is on the present. Detailed analyses were performed on the green economy and energy sector, consistent with reports afforded by the United Nations Environment Programme. Further, China's commitments were assessed by set of policy documents, consolidated by NGO publications and online newspapers. Ultimately, the gathered in-depth knowledge was applied to discuss the situation in China.

The research shows that China's 12th Five-Year Plan discloses a set of tactics aimed at greening its energy-intensive industries, essentially at enlarging non-fossil fuel sources and enhancing energy efficiency, through energy and carbon intensity reduction targets. Yet, the dissertation concludes that, given China's heavy reliance on coal and unbridled economic growth, the proposed green strategies are likely to have marginal impact on the country's *total* greenhouse gas emissions and energy demand, reflecting, therefore, the government's inability to mitigate climate change.

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## List of Abbreviations

| | |
|---|---|
| **AGECC** | Advisory Group on Energy and Climate Change |
| **BAU** | Business as usual |
| **CIA** | Central Intelligence Agency |
| **CO2** | Carbon dioxide |
| **EEB** | European Environmental Bureau |
| **EIA** | Energy Information Administration |
| **FYP** | Five-Year Plan |
| **GDP** | Gross domestic product |
| **GEI** | Green Economy Initiative |
| **GER** | Green Economy Report |
| **GGND** | Global Green New Deal |
| **GHG** | Greenhouse gas |
| **IEA** | International Energy Agency |
| **IPCC** | Intergovernmental Panel on Climate Change |
| **NDRC** | National Development and Reform Commission |
| **OECD** | Organisation for Economic Co-operation and Development |
| **R&D** | Research and Development |
| **UN** | United Nations |
| **UNCSD** | United Nations Conference on Sustainable Development |
| **UNEP** | United Nations Environment Programme |
| **UNFCCC** | United Nations Framework Convention on Climate Change |
| **WECD** | World Commission on Environment and Development |
| **WEO** | World Energy Outlook |
| **WHO** | World Health Organisation |
| **WRI** | World Resources Institution |

# 1. Introduction

## 1.1 Background

Over the past decade, the world has been facing numerous simultaneous crises; crises that are arousing controversy and demanding mindfulness from environmentalists, politicians, academia and society. It is widely known that the world's ecosystems have been suffering from dramatic development and substantial transformations, and these are currently revealed in a "global interlocking crisis" (Brundtland, 1987, ¶ 11), a crisis encompassing the environment, energy and development.

The 2008 financial and economic crisis reflected the urgency to shift the prevailing business as usual to a new global pattern of economic growth, which affords long-term commitments instead of short-term attainments; values the environment instead of externalising it; focus on human well-being instead of unbridled GDP growth; and which considers future generations instead of neglecting that predominant practices will not affect their ability to thrive. As the Organisation for Economic Co-operation and Development accentuates it:

> With a population of 7 billion, the world in 2012 faces highly complex economic and social challenges. While protecting the environment and conserving natural resources remain key policy priorities, many countries are also struggling with slow economic growth, stretched public finances and high levels of unemployment. Tackling these pressing challenges requires a deep cultural shift towards "greener" and more innovative sources of growth, and more sustainable consumption patterns. (2012, p.3)

Given the struggle to revive the global economy, much consideration has been given to the broad concept of the green economy. Primarily introduced in the work of David Pearce, Anil Markandya and Edward Barbier, *Blueprint for a green economy*, in 1989, and presently advanced by the United Nations Environment Programme (UNEP), the green economy is now widely acknowledged as a potential alternative to business as usual. In response to the rapidly increasing environmental concerns related to business as usual, several countries have demonstrated commitments in pursuing green growth strategies. During the documentary research of the reports and papers surrounding the green economy paradigm, China evidenced as having a special role in the international system with regards to climate change and to *greening* growth.

China is known for its environmental crisis, particularly owed to the country's unbridled economic growth. The country's heavy reliance on coal awakens much criticism due to the ever increasing energy demand. Coal is the biggest carbon dioxide emitter among other fossil fuel sources (UNEP,

Climate Change Mitigation, ¶ 4), notwithstanding, coal amounted 70 per cent of China's total energy demand in 2009 (Xinhua, 2010, ¶ 1). The recently announced 12th Five-Year Plan discloses an entire chapter to *greening* growth, which is a fundamental and necessary commitment to achieving a more sustainable economy.

### 1.2 Problem definition and research questions

This dissertation explores the controversial concept of the green economy and the rapidly increasing environmental concerns associated to the heavy energy industry. The purpose of this study is to investigate how China's 12th Five-Year Plan responds to the green economy paradigm, and therefore the following research question was formulated:

*"How does China's 12th Five-Year Plan address the environment and energy?"*

The dissertation examines the Chinese government's commitments in greening the energy sector and analyses whether or not these commitments are congruent with the attempts to mitigate climate change. In order to support the resolution of the central question and to provide guidance in writing of this study, the following sub-questions were elaborated upon:

- What is understood about the green economy concept?
- How does green economy approach sustainable development?
- What are the main sectors of concern in a green economy?
- What are the main international concerns associated to climate change?
- How does energy generation aggravate climate change?
- How does the green economy respond to energy-intensive industries?
- What is China's current environmental position?
- What has China done in order to *green* its energy sector?
- How does China's 12th Five-Year Plan address the energy sector?
- Are these strategies in line with the green economy paradigm?
- How does China manage the country's continuous reliance on coal?

### 1.3 Structure

This research is basically divided into four major chapters, which aims at providing a clear and concise understanding of the analysed content to the reader.

Firstly, given the relatively new and extensive concept of green economy, this paper provides an introductory chapter aimed at enlightening one's comprehension of the green economy. The *Green Economy* chapter details the concept of the green economy, while describing a set of green initiatives and policies developed by the United Nations Environment Programme. Further, the chapter raises global environmental concerns, accentuating climate change; and exposes the risks of a misconception of the green economy. Considering that much of the green economy initiatives were profoundly encouraged by the UNEP, the first chapter is highly consistent with the work of such. Nevertheless, in order to invigorate the reasoning, other central reports are mentioned, such as the OECD and IEA.

Secondly, the paper deepens the focus on the single most crucial sector that hampers the run towards a green economy and the mitigation of climate change: the energy industry. The *Towards a low-carbon energy sector* chapter affords a broad overview of the distinct dimensions embodying the energy sector, so as to not lose track on the association of green economy and sustainable development, yet, it sticks to the environmental pillar of such. Moreover, the chapter stresses the importance of *greening* the energy industry and reports on two potential strategies for *greening* growth: the expansion of renewable energy and the advancement of energy efficiency.

Thirdly, the chapter *China in the light of the Green Economy* explores the country's 12$^{th}$ Five-Year Plan, so as to analyse its current attempts in *greening* the energy sector, while tackling climate change. First of all, the chapter provides a snapshot of China's current economic and environmental circumstances, attempting to awake the reader's attention towards the country's reliance on coal. Next, it examines China's 12$^{th}$ Five-Year Plan, whilst emphasising the government's emissions reduction objectives and its implications on climate change. Moreover, it gives a closer look on the presupposed justification for lowering the current carbon intensity target. Furthermore, the chapter describes the country's renewable energy and energy efficiency strategies. Then, it analyses the collected data while highlighting key findings. Finally, it dedicates a sub-chapter to China's continued dependency on coal. Given the limited access to the government's documents and reports, most sources were collected from Chinese non-governmental organisations and news websites, such as the Xinhua News Agency, China Dialogue and China Daily.

Ultimately, the conclusion summarises the whole document, while underlining key passages according to the author's senses. Remarkably, the central subject of this dissertation is very current and extensive, being rather challenging to investigate. Hence, much of the dissertation is, as well, consolidated by web publications and online newspapers.

## 2. Methodology

### 2.1 Methodological approach

In order to frame the methodological approach of this dissertation, an epistemological position was taken on. Blaikie defines an epistemology as "a theory or science of the method or ground of knowledge" (2007, p.18), which assists researchers in maintaining a clear and accurate reasoning of the collected data by a prior methodological approach position. Given the controversial scope of this paper, *interpretivist* assumptions were deemed to be the most suitable epistemological approach for the study, since "the stress is on the understanding of the social world through an examination of the interpretation of that world by its participants" (Bryman & Bell, 2007, p.402).

### 2.2 Secondary research

This dissertation is sustained by intensive desk and documentary research, and is embodied with recent available information. The research comprises a set of policy documents, academic articles, journals and statistical data. Further, constant referencing to research reports provided by the UNEP, OECD and IEA was performed throughout the paper, as these are pivotal for one's comprehension of the complexity encompassing the green economy paradigm. Also, considering the much limited access to China's documents, web-publications afforded by non-governmental organisations and online newspapers were fundamental so as to reinforce the validity of this study. In general, the research was mainly conducted online, owed to the recentness of the explored subject.

In order to analyse the collected qualitative data, an inductive approach was applied. This analytical approach demonstrated appropriateness because "in inductive reasoning, we begin with specific observation and measures, begin to detect patterns and regularities, formulate some tentative hypotheses that we can explore, and finally end up developing some general conclusions or theories", (Smith, 2004, ¶ 6). Additionally, an inductive reasoning is "more exploratory and open-ended" (Smith, 2004, ¶ 9) in contrast to deductive reasoning, which is "is narrower in nature and focuses on testing or confirming hypotheses" (Smith, 2004, ¶ 10).

### 2.3 Research limitations

Although the research has achieved its aims, it is important to stress a few limiting aspects, particularly trade-offs. This study was mainly consolidated by research reports provided from international organisations, yet it misses the robust representation of governmental sources. However, given the limited extent of this research, trade-offs were anticipated. This dissertation is primarily

concerned with the exploration of a relatively new alternative to economic growth. Hence, the topic is better represented by neutral organisations that have sole focus on a sustainable future. Moreover, on several occasions it occurred that various recent sources were not openly accessible, notably Chinese sources. Also, a few of them could be only bought in exchange for a high price. Thus, the paper could contain slightly outdated sources in different areas.

# 3. The Green Economy

## 3.1 Defining the Green Economy concept

The green economy concept is not yet commonly understood worldwide. As the Brazilian ambassador for the Rio+20, André Aranha Corrêa do Lago, humorously asserts it "Some people say that the green economy has such a colour because it reflects the dollar" (Bulcão, 2012, ¶ 1). Some people may still tolerate such mockery, once one of the central themes of the United Nations Conference on Sustainable Development (UNCSD), the green economy, lacks accuracy in its definition. However, aside from the evident reference to environmental concerns, the "green", in this context, represents what is not "brown", widely known as the model that rules current economic activities, in which the progress of businesses and governments implies a high cost on nature and on human well-being.

In spite of the questionable definition of the green economy, the Secretary-General's Report to the Second Preparatory Committee of the UNCSD conceptualizes the green economy as an economy that "focuses primarily on the intersection between environment and economy" (United Nations, 2010, ¶ 3), or, as an economy that reacts to the "growing recognition that achieving sustainability rest almost entirely on getting the economy right" (UNEP, 2011, p.7). Hence, the notion of a green economy accentuates the economic and environmental dimension of sustainable development.

In order to respond to the raising concerns of what a green economy truly is and to what extent it embraces the intergenerational equity of sustainable development – one that "meets the need of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987, ¶ 49) - and three pillars of sustainable development – economic, social and environmental – the UNEP determined the green economy as "an economy that not only improves human well-being and lessens inequality, but also reduces environmental risks and ecological scarcities" (UNEP, 2010)

The green economy is, therefore, an economy that is "low-carbon, resource efficient and socially inclusive" (UNEP, 2011, p. 16 ). Also, so as to respond to concerns, the forthcoming UNCSD focuses one of its major themes on the "green economy in the context of sustainable development and poverty eradication" (UNCSD, 2012), thus, emphasizing the articulation of the green economy with sustainable development. To this, a green economy consolidates efforts towards sustainable production and consumption, and resource efficiency, while mitigating environmental challenges and contributing to poverty alleviation.

### 3.2 The Green Economy Initiative

Relatively distinct initiatives, under various names, are taking place all over the world and have disclosed the importance and the rapid development of alternative thinking. "Green Economy", "Green New Deal", "Green Growth", "Environmental Tax Reform", "Green Job", *inter alia*, are examples of initiatives that have involved numerous governments, business leaders, UN agencies, other international organisations, such as the World Bank and OECD, and that have awoken public consciousness.

The *Green Economy Initiative* (GEI) was launched by the UNEP exactly at the heart of the financial crisis outbreak, during the second half of 2008. It exposed a substantial appeal to transform the prevailing business as usual conditions of economic growth, which is focused on increasing GDP above all other purposes. According to the UN General Secretary Ban Ki-Moon, the obstinacy to maintain business as usual will lead to "a global suicide pact", calling for an extensive investment of private and public funds so as to make the global economy sustainable (UN, 2011, ¶ 3). Consequently, governments and business leaders were convened by the UNEP to mobilize and re-focus the global economy towards investments in clean technologies and "natural" infrastructure, considering that it is the greatest opportunity for absolute growth, the tackling of climate change and employment boom (UNEP, 2008, ¶ 1).

The GEI was initiated to motivate and enable governments to invest in green economies (Bouvier, 2010, p. 8). Primarily, the GEI is sustained by three pillars: putting a price on nature; generating green jobs through the implementation of appropriate green policies; and assuring that these policies are further promoted and regulated, national and internationally, in order to foster the transition to a green economy. To this, the GEI encompasses a set of reports, which are directed at affording detailed analysis, policy support and perspectives of a green economy in short, medium and long-term scenarios for governments and business leaders, who aspire to distort current environmental unfriendly economic activities through investments in green sectors.

Within the framework of GEI, the *Global Green New Deal* (GGND), which was inspired by the Franklin D. Roosevelt's New Deal (The Green New Deal Group, 2008, ¶ 5), was the first report developed in partnership consultation with UN organisations and other intergovernmental organisations, released in 2009 (Berger & Sedlacko, 2010, pp.12-13). The GGND embodies recommendations to encourage the inclusion of green technologies in strategies of economic recovery as to mitigate the adverse effect of the global financial crisis, which was initiated in the United States in late 2008. These recommendations are translated into two central significant reforms: "major

structural changes to national and international financial systems, including taxation" and "sustained investment in energy conservation and renewable energy generation" (The Green New Deal Group, 2008, ¶ 5).

The objective of the GGND also deepens in other relevant areas, such as ensuring sustainable and inclusive growth and the achievement of the Millennium Development Goals (MDGs), particularly of the poverty reduction targets. After all, the GGND is supported by the notion that it will "contribute to reviving the world economy, saving and creating jobs, and protecting vulnerable groups" (Bouvier, 2010, p.11).

The second report is the *Green Economy Report*, one of the leading contributions of UNEP to Rio+20, launched in 2011. Under the title *Towards Green Economy: Pathways to Sustainable Development and Poverty Eradication*, the report presents a compact version of various work from specialists aimed at policy makers, concluding that a green economy would lead to superior GDP global growth rate and higher levels of employment in medium and long term scenarios, compared to the prevailing business as usual. With the purpose of sustaining this proposition, the UNEP calls for an annual investment of 2 per cent of global GDP, $1.3 trillion, in the following key sectors: renewable energy, energy efficiency, low-carbon transport, clean technologies, energy-efficient buildings, sustainable agriculture and forest management, improved freshwater provision, and sustainable fisheries (UNEP, 2011, p.24). As reported by the UNEP, national and international policies, and market infrastructure advancement should be the engine for such investments (UNEP, 2011, pp.22-23).

### 3.3 Green Growth policies to enable the Green Economy

Enabling the transition to a green economy will require a mix of policy and institutional adjustments. Most importantly, the transition will differ from country to country, once it highly relies upon the level of development and the local environmental pressure of an individual country. According to the OECD, "advanced, emerging and developing countries will face different challenges and opportunities, as will countries with differing economic political circumstances" (OECD, 2011, ¶ 4). Nevertheless, good economic policies are ordinary considerations that all countries must address in order to shift the prevailing paradigm of business as usual to green growth (OECD, 2011, ¶ 5).

The conditions to empower the progress towards a green economy embraces reconfigurations in national and international policies, regulations, subsidies and stimulus, international market and legal infrastructure, trade and technical cooperation (UNEP, 2011, pp.22-23). Further, the transition characterises pricing carbon, securing property right regimes and protecting low-income water users

(UNEP, 2011, pp.64-66). To this, policies for *greening* growth must ensure that natural resources are significantly integrated in decision making processes that push economic growth; it must constantly promote and evolve economic payoffs that sufficiently demonstrate the importance of natural resources in economic activities; and it should mutually reinforce economic and environmental policies.

The development and promotion of economic payoffs embrace the reduction or complete elimination of subsidies that have perverse economic and environmental outcomes; pricing pollution and the over-exploitation of scarce natural resource through environmentally-related taxation, i.e. border carbon adjustment, levies and tradable permit systems; and certifying that regulatory standards focus on outcomes (OECD, 2011, p.12).

### 3.4 What will the Green Economy look like?

A green economy is grounded in identifying cleaner sources of growth and orientating the associated structural modifications, while boosting opportunities to develop new green industries, technologies and jobs (OECD, 2011, p.22). A green economy is an economy that heavily invests in natural capital and people; in *greening* high impact sectors and services, which moves investment and financial flows; and advances governance and measurement (Green Economy Coalition, 2012).

One may have already noticed that the word "investment" is greatly used on the road to a green economy. Indeed, the successful transition to *greening* the economy depends highly on financial inputs and the crucial moment we are currently living in – the global financial crisis –, may retard the advancement of a green economy. Yet, UNEP stresses the significance of *greening* actions in energy, water, transport, buildings, cities, waste and fisheries.

Previously mentioned, UNEP calls for stimulus packages, which amount a global investment of $3 trillion, in *greening* five major areas: i) renewable energies, including wind, solar, geothermal and biomass; ii) raising energy efficiency of old and new buildings; iii) sustainable transport, including hybrid vehicles; iv) high speed rail and bus rapid transit systems; the planet's ecological infrastructure, including freshwaters, forests, soils and coral reefs; and v) sustainable agriculture, including organic production[1].

[1]UNEP. (2009, March 9). *Delivering Tomorrow's Economy and Job Market Today. From Renewable Energy to Freshwaters: Five Sectors Key to Sustainable Recovery* [Press release]. Retrieved from: htpp://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=573&ArticleID=103&1=en

The enforcement of the above guidelines within these five areas, accompanied by another set of measures, is fundamental if the global economy is to resuscitate. It is fundamental because it will simply propel employment, consequently contributing to poverty alleviation, and will reinforce the fighting against climate change and environmental degradation. In other words, it does not only contribute to *greening* growth, but to achieving sustainable development.

The transition to a green economy will be time consuming, as results are based in a long-term approach. Notwithstanding, once the set of green policies tools are accordingly implemented, the green economy should be seen as one that generates greener jobs, lower-energy and resource-intensive production, substantially reduces greenhouse gas emissions, waste and pollution, and, ultimately, leads to the desired GDP growth.

### 3.5 Why the Green Growth path?

It is unquestionable that development is not yet sustainable and has, therefore, been affecting Earth's ecosystems. Raising awareness about business as usual and its consequences on not only climate change, biodiversity loss and environmental degradation, but on inequality, shows that action is needed. Yet, some fear that such consciousness may have aroused "too little, too late" (Elkington, 2012). In the 2012 Global Compact Conference, Arnhem, John Elkington asserted that we are currently implementing policies at a time where transformation should have been already showing its outcomes.

A study developed by a team of scientists led by Professor Johan Rockström, from the Stockholm Resilience Centre, has identified a framework of nine *planetary boundaries*, known as safety zones, which humanity and biosphere depend on. The research reveals that three of these boundaries – biodiversity loss, nitrogen cycle and atmospheric concentration of $CO_2$ – may already have been breached (Rockstrom *et al*., 2009, pp. 20-23). The breaching of *planetary boundaries* leads to a risk of "irreversible and abrupt environmental change", alerts the scientists (Rockstrom *et al*., 2009, p. 2). This reality demonstrates how audacious human activities have been and how urgent tackling biodiversity loss, climate change and the environmental degradation is.

The OECD's Environmental Outlook to 2050, *The Consequences of Inaction* (hereinafter mentioned as *Outlook*), is an important wake-up call report to the world's governments and business leaders to relevantly reinforce their efforts to safeguard the environment. The *Outlook* examines the most significant risks to the environment now, strongly connected to the prevailing business as usual, and

the risks to come about in four decades. Not surprisingly, the conclusions, if no adequate actions are taken, are rather frightening

The *Outlook* addresses implications in four key areas of aggregated concerns: climate change, biodiversity, water and the health impact of environmental pollution. The *Outlook* forecasts the global economy to be four times larger than of today, at which point fossil fuels will supply nearly 85 per cent of energy demand in 2050, due to a projected energy use of approximately 80 per cent higher than current levels. This could massively imply a 50 per cent raise in greenhouse gas (GHG) emissions and deteriorate air pollution (OECD, 2012, p. 74). The implications of such are disastrous. In 2050, urban air pollution is to be considered the major environmental cause of premature deaths, expected to double from current levels to 3.6 million each year (OECD, 2012, p. 276). Further, the *Outlook* predicts a global 55 per cent augmentation in water demand and a further 10 per cent decay of biodiversity (OECD, 2012, pp. 22-24).

Without strong and more aspiring policies, so as to reinforce the commitment to fighting against unsustainable practices, we are to anticipate accelerated climate alterations as a result of, as mentioned above, a 70 per cent increase in $CO_2$ emissions from energy use, translating to a 50 per cent growth in GHG emissions (OECD, 2012, p.74). The *Outlook* further emphasizes that "climate change is projected to become the fastest growing driver of biodiversity loss to 2050", (OECD, 2012, p.24). To this, we are, as well, to anticipate continuous decline in biodiversity, exceptionally in Asia, South Africa and Europe (OECD, 2012, p.158).

Moreover, the *Outlook* foresees water-stressed areas to be 40 per cent denser than recently, compromising, therefore, the accessibility of freshwater in regions such as South and Central Asia, and North and South Africa. The *Outlook* advances by underlying the severe health impacts associated with urban air pollution, ahead of lack of sanitation and dirty water. Ultimately, the *Outlook* accentuates the relation between hazardous chemicals and serious diseases.

The damage of postponing action is extensive and the consequences will be experienced in economic, environmental and social dimensions. Governments and business leaders should commit themselves into prioritising and fostering improved policies now so as to not undergo vulnerability in a later stage. As Jeremy Wates states "We have been talking for years about decoupling economic growth from negative environmental impacts. Now we really have to do it, or admit that indefinite growth under the current model is not an option on a finite planet", (Abrahams, 2012, ¶ 4). Hence, in order to tackle environmental challenges, minimize social inequalities, boost economic growth and place, once again,

Earth in balance, a fundamental "cultural shift towards greener and more innovative sources of growth and more sustainable consumption patterns" (OECD, 2012, p. 3), is needed.

### 3.6 Risks of misuse of the Green Economy concept

Besides undergoing complexity on its definition, the green economy concept also encounters another set of regards. Within the policy framework of the United Nations Environment Programme (UNEP), the green economy is defined as the engine that will advance efforts towards sustainable development. The green economy will do so by involving a technological revolution, which will in turn have fundamental impacts on production structures and on consumption patterns (Ocampo, 2011, p.5). That said, one may wonder whether the green economy accounts developing and least developing countries' economic, environmental and social disparities. It is more than evident that these countries will encounter numerous challenges while entering this race to the green economy, after all, a "technological revolution" sounds unreasonable for countries with alarming levels of hunger and poverty.

Developing and least developed countries are unease by the implications the green economy concept may impose on them. Apart from the economic development pressure, these countries are concerned that the green economy concept may be used to reinforce protectionism, complicate the conditionality of international financial cooperation, and aggravate international inequalities (Ocampo, 2011, p. 3). Moreover, the inappropriate comprehension of the green economy concept may cause unpleasant effects.

The concept of the green economy may risk being accounted and operationalized in one-dimensional approach, as solely environmental (Khor, 2011, p.72). If the green economy concept is to approach only environmental related issues, it may mislay its controversial association to sustainable development and, consequently, undermine the prospering of such. Further, the "one size fits all" approach is considered to be another risk related to the green economy concept (Khor, 2011, p.72). If all countries are to be treated in the same manner in the green economy, one may already anticipate development and environmental deficiency. The transition to the green economy should fully respect the differentiated stages of development of individual countries.

*Green protectionism* is another major concern of developing countries. According to Khor, there is a risk of using the environment for trade protection and developed countries may use this purpose to vindicate unilateral trade measures, i.e. carbon tariff or border adjustment tax, against goods of developing countries (Khor, 2011, pp. 72-74). Trade measures can disadvantage developing countries

that do not yet have access to low-emission technologies, neither the financial resources to progress in *greening* growth, infringing, therefore, the principle of common but differentiated responsibilities, framed in the Rio Declaration, 1992.

The removal of trade barriers to green products and services also preoccupies developing countries, although trade negotiations to lower or remove barriers to environmental goods and services are an on-going mandate under the Doha Round of World Trade Organisation (WTO) (Cosbey, 2011, p.42). Developing countries fear that the green economy concept could be used by (developed) countries as a way to gain market access. Nevertheless, the impacts of trade liberalization in green goods and services would be rather positive for foreign producers, once exports will be more feasible in the implementing country (Cosbey, 2011, pp. 42-44).

Another relevant concern is that of the subsidies and competitiveness. The funding for research and development (R&D) in clean technologies are invested primarily in developed countries, which have the financial resources to do so. Unlikely is the situation for developing countries, in which the circumstances are substantially disadvantageous. Yet, the ultimate objective for subsidising innovation is to nourish domestic competitiveness in individual areas of the green economy (Cosbey, 2011, p.55).

Environmental standards and regulations for goods are other potential trade obstacles for developing countries. Unable to meet the criteria, these countries will encounter significant export decline. Domestically, though, the impacts are very limited (Cosbey, 2011, p.31). In order to reverse the predicted scenario, developed countries should support developing countries through the provision of resources and technology transfer (Khor, 2011, pp.4-5), fostering, therefore, win-win situations.

Finally, the green economy may risk a new sort of conditional support on developing countries (Khor, 2011, p.75-76). Support measures include loan, aid, and debt rescheduling and/or debt relief. Conditioning support to developing countries may overshadow their approaches towards sustainable development, as these may attempt to prioritize *greening* growth so as to be granted cooperation.

In short, there are certainly relevant risks associated to the green economy concept and without proper policy framework and the harmonisation of such, developing countries may face a great deal of challenges. As Cosbey asserts it, “developing and least developed countries are clearly more vulnerable as a group, saddled as they are with a lack of export diversity and a relative lack of resources to adapt to the changing demand of a greening global market” (Cosbey, 2011, p.31).

## 4. Towards a Low-Carbon Energy Sector

> Energy is at the forefront of the global agenda. It is central to the issues of development, global security, environmental protection and achieving the Millennium Development Goals. (Kandeh K. Yumkella, 2010, p.3)

### 4.1 The distinct dimensions of the energy sector

Energy is an imperative input to human progress and economic development. Energy affords accessibility to the production of food and provision of clean water – consequently ameliorating health performances; it affords access to education and entrepreneurial activity; and provides mobility to trade. Energy is what makes the motion of people, services and ideas possible, being, therefore, the root of globalisation. Presently, we cannot imagine our lives without communication and information technologies and the emergence of such owes to the ever increasing use of energy. Also, the advance in economic, political, social and environmental horizons is inextricably connected to modern energy services. That said, energy manages the quality of the everyday life and is a crucial determinant for economic competitiveness and employment.

Sadly, access to energy is not for everyone. The *World Energy Outlook 2010* (WEO) stresses that stresses that 1.4 billion people do not have access to electricity, either due to limitations or affordability, and 2.7 billion people still depend on biomass for cooking and heating (IEA, 2010, p. 56). The concentration accounts for 95 per cent in sub-Saharan Africa, India or in developing Asia and 84 per cent in rural areas (IEA, 2010, p.56). The WEO warns that another 1.4 billion people could lack energy services by 2030, supposing that no action is to be taken (IEA, 2010, p.237). Meanwhile, Fatih Birol emphasizes that "lacking access to electricity affects health, well-being and income" (Walsh, 2011, ¶ 3). Addressing energy services disparities is substantially urgent if countries, under the above mentioned circumstances, are to prosper and fulfil the UN Millennium Development Goals by 2015.

Our dependence on the supply of modern energy – oil, natural gas, coal, nuclear power and hydroelectricity – in order to sustain our progresses has unfolded crucial implications on the environment. The use of fossil fuels, although beneficial to development, has increasingly harmed local and regional ecosystems; it has aggravated climate change and has continuously stimulated consumerism in developed nations. Yet, as the OECD anticipates it, fossil fuels are to supply 85 per cent of energy demand in 2050, suggesting a 50 per cent increase of GHG emissions from current levels (OECD, 2012, p.20). The predicted GHG emissions raise is associated to the economic boom in

emerging countries, whose growth in energy use surpasses progress in energy efficiency (IEA, 2010, ¶ 2).

Apart from the implications on developmental (known as *energy poverty*, IEA) and environmental dimensions, energy encounters as well growing concerns on a global extent, such as energy security - the uninterrupted availability of energy sources at an affordable price (IEA) - and geopolitics.

While all dimensions are fundamentally important for one's comprehension of energy related issues, the primary focus of this chapter is on the environmental dimension of the energy sector. It exposes the current and potential strategies used so as to *green* the energy sector, as well as the implications they may have and, consequently, foster the paths towards the green economy.

### 4.2 Energy generation aggravating climate change

Energy generation is the foremost prompter of GHG emission, essentially because power generation implies an elevated use of fossil fuels such as gas, oil and, particularly coal, being the biggest $CO_2$ emitter among fossil fuel sources (UNEP, Climate Change Mitigation, ¶ 4). According to the *OECD Environmental Outlook to 2050*, GHG emissions are likely to raise by nearly 50 per cent, given that fossil fuels are to supply approximately 85 per cent of energy demand in 2050 (OECD, 2012, p.20). That said, energy generation is central in tackling climate change and air pollution and deserves, therefore, much mindfulness.

In the year of 2007, the *Intergovernmental Panel on Climate Change 4$^{th}$ Assessment Report* (AR4) alerted that atmospheric concentrations of GHG should not surpass 450 parts per million (ppm) $CO_2$-equivalents if we are to have a roughly 50 per cent fortune of stabilising the global average temperature rise at 2 degree Celsius (2 $^0$C) (IPCC, 2007, p.826). As such, the AR4 called developed countries to reduce their emissions to 25-40 per cent from 1990 levels by 2020, and 80-95 per cent from 1990 levels by 2050 (IPCC, 2007, p. 776).

The *Outlook* underlines that, without more ambitious policies, the global average temperature is unlikely to stabilise at 2$^0$C. Under the predicted scenario, global temperature is to increase approximately 3$^0$C to 6$^0$C by the end of the century (OECD, 2012, p.73). The European Environment Agency anticipates that surpassing the global average temperature of 2$^0$C is likely to awake the

crossing of the *tipping points*[2]. Also disturbing is the Outlook's conclusion that no "Green light"[3] aspects are recognized with regards to climate change (OECD, 2012, p.22)

### 4.3 Stressing the importance for *greening* the energy sector

> Governments need to introduce stronger measures to drive investment in efficient and low-carbon technologies. The Fukushima nuclear accident, the turmoil in parts of the Middle East and North Africa and a sharp rebound in energy demand in 2010 which pushed CO2 emissions to a record high, highlight the urgency and the scale of the challenge. (Maria van der Hoeven, 2011, ¶ 2)

*Greening* the energy sector is crucial if the world is to reduce GHG emissions and urban air pollution, while contributing to the tackling of climate change. The energy sector is still heavily dependent on fossil fuels and the combustion of these amounted 84 per cent of the global GHG emissions in 2009 (OECD, 2011, ¶ 1). More aggravating were the $CO_2$ emissions from the power sector in 2010, which jumped to a record of 30.6 gigatons, up five per cent higher from 2008's level of 29.3 gigatons (IEA, 2011, ¶ 2). The data shows that the combustion of coal and oil amounted 44 and 36 per cent of the $CO_2$ emissions, respectively, and 20 per cent was emitted from natural gas (IEA, 2011). Contributors to this brand new record are China and the US, the world's foremost GHG emitters (Harvey, 2011, ¶ 22).

*Greening* the energy sector will be among the former major drivers of the green economy, exceptionally due to the rapidly increasing population and economic growth in emerging countries, whose energy demand will account 90 per cent of the total energy demand growth (OECD, 2011, ¶ 1). Investments and improvements in renewable energy and energy efficiency are fundamental to foster efforts towards a low-carbon energy sector. As such, renewable energy and energy efficiency must be regarded as "twin pillars" in sustainable energy strategies (Prindle, Eldridge, Eckhardt, & Frederick, 2007, p. 7).

### 4.4 Expanding renewable energy

Nowadays, renewable sources of energy are one of the major controversial subjects in sustainable development discussions and have been the driver in the global *greening* energy sector since 2000 (IEA, 2012, ¶ 1). For one to understand what renewable energy is, it is necessary to expose the difference between the two approaches of electricity generation. The first approach employs non-

[2] The term *tipping point* refers to a critical threshold at which a tiny perturbation can qualitatively alter the state or development of a system (Lenton *et al.*, 2008).
[3] OECD Environmental Outlook to 2050, *The Consequences of Inaction*. "Traffic light" system: Green light = environmental issues which are being well managed, or for which there have been significant improvements in management in recent years but for which countries should remain vigilant.

renewable sources such as fossil fuels (coal, oil, natural gas, uranium, etc.), and the second employs renewable sources such as water, sun, biomass, wind, etc. Renewable energy is that originated from natural sources that are capable of renewal, thus, not limited. Examples of renewable energy are solar, wind, hydropower, biofuels, biomass (organic matter), geothermal (earth's internal heat) and tidal (seas and ocean's waves).

Unlike non-renewable energy generation, renewables have lower environmental impacts, i.e. pollution and deforestation, and provide lower GHG emissions. For these reasons, renewables are excellent alternatives to the conventional energy technologies, essentially in providing energy services in a sustainable way and tackling climate change. Currently, renewables amount 17 per cent in the share of the total emissions GHG and urban air pollution reduction (OECD, 2011, p. 29).

### 4.4.1 The current global renewable energy sector

Although renewable energy is an excellent alternative to *greening* the energy sector, considerable commitment to renewables is still needed. The *Renewable Energy Sources and Climate Mitigation Report* underlines that 85 per cent of the global energy mix is heavily made up by fossil fuels, these being responsible for approximately 57 per cent of GHG emissions derived from human activities (IPCC, 2011).

Renewable electricity generation expanded to an average of only 2.8 per cent per year since 1990 and miserably fell from a global electricity share of 19.5 to 19.3 per cent in 2009 (IEA, 2012, ¶ 3). With accordance to the International Energy Agency, achieving the objective of decreasing 50 per cent of GHG emissions by 2050 will require twice as the current levels of renewable generation by 2020.

Notwithstanding, according to the *Global Trends in Renewable Energy Investment Report*, global investment in renewable energy fostered and amounted a record of $211 billion, as a result of wind farm development in China and small-scale solar PV positioning on rooftops in Europe in 2010 (United Nations Environment Programme and Bloomberg New Energy Finance, 2011, p.11). Particularly, China invested $48.9 billion in renewable energy in 2010, being, therefore, the world's leading new investor in renewable technologies (United Nations Environment Programme and Bloomberg New Energy Finance, 2011, p.12). These instances show a remarkable progress of developing countries, whereby the shift in the world's renewables market is being conducted by developing economies.

### 4.4.2 Environmental implications of renewable energy

Despite the positive implications renewables have on the environment such as lowering GHG emissions and pollution, not all renewable technologies are environmentally or socially benign. An extraordinary example in these regards is the Three Gorges Dam, China, the world's largest hydropower and a model of disaster. The massive hydraulic power project displaced more than 1.2 million people, flooded 13 cities, 140 towns and 1.350 villages and deteriorated more than 600 kilometres of biodiversity (International Rivers, n.d., ¶ 1).

The case of the biofuel industry is another well-known example of a renewable energy source with significant negative implications. The suddenly increase in demand for crops, as a source of biofuels, is causing rural depopulation and deforestation worldwide (Global Forest Coalition *et al*., 2006, ¶ 2) and the converting of cereal to biofuels production has continuously unbalanced food prices worldwide (Mitchell, 2008, p.2).

### 4.5 Energy efficiency

Energy efficiency is defined by the International Energy Agency as "a way of managing and restraining the growth in energy consumption" (IEA, 2012, ¶ 1). In a very simple way, energy efficiency is the ability to do more with less. "Improved energy efficiency is an indispensable component of any policy mix", says the executive director of the IEA, "and it is available immediately" (Mandil, 2006, ¶ 4).

Presently, energy efficiency holds the biggest share of the total GHG emissions and local pollution reduction, amounting 38 per cent (OECD, 2011, p.29). In 2050, energy efficiency alone could be able to reduce global energy demand by nearly 50 per cent from current energy consumption levels (IEA, 2006, ¶ 4). Yet, advancements in energy efficiency are formerly needed. Energy efficiency is, thus, vital to mitigate increasing energy demand and $CO_2$ emissions, and to advance the run towards the green economy.

Sustaining improvements in energy efficiency is substantial to *greening* the energy sector. Energy efficiency offers solutions across a variety of challenges such as climate change, economic development, energy security[4], industrial competitiveness and human welfare (AGECC, 2010, p.18). Also, energy efficiency can significantly moderate investments in energy infrastructure (IEA, 2012, ¶ 2), being, therefore, one of the few policies that do not demand aggressive investments so as to contribute to a greener world.

[4] According to the International Energy Agency, improved energy efficiency can be profitable to energy security since it reduces dependency on imported fossil fuels (IEA).

Energy efficiency currently proposes the greatest alternative in *greening* the energy sector, not only because it is significantly cheaper, but because it offers a vast scope for performances. Energy efficiency investments in industry, buildings and transport create win-win situations for all stakeholders, as it is cost-effective and usually has short pay-back periods (OECD, 2011, p.36).

Manufacturing is responsible for over 20 per cent of $CO_2$ emissions, nearly 35 per cent of the global electricity consumption and over a quarter of primary resource extraction (UNEP, 2011, p.246). Furthermore, manufacturing implies approximately 17 per cent of air pollution (UNEP, 2011, p.246), which causes significant health implications such as respiratory infections, lung cancer and heart disease (WHO). Despite the negative implications on the environment, the industry sector is still greatly important in developing countries, whereas 22 per cent of global GDP and 23 per cent of the current global employment is owed to manufacturing (UNEP, 2011, pp.246-247).

The UNEP's *Green Economy Report* (GER) foresees win-win opportunities for the industry sector if it is to encourage life-cycle approaches and improvements in resource efficiency and productivity (UNEP, 2011, p.273). In order to do so, manufacturing should encompass supply and demand-side approaches, while fostering the re-design of products and/or business models, the introduction of new and cleaner technologies and closed-loop manufacturing[5] (UNEP, 2011, p.248). Industries will, as they moderate necessities for raw material and waste, reduce costs and become more competitive, while reducing environmental impacts of its manufacturing.

The greatest potential sector for energy efficiency improvements is buildings. Buildings are currently responsible for the consumption of 30 per cent of all natural sources, representing 40 per cent of the global energy demand, 25 per cent of water, and 12 per cent of land use, while being also responsible for generating 25 per cent of solid waste and for emitting approximately 30 per cent of GHG (UNEP, 201, pp.336-337). For these reasons, buildings are central to mitigating urban air pollution and climate change and must be a key focus in reducing emissions via clean technologies and existent knowledge.

Energy efficiency advancements are substantial for the building sector. The renovation of existent buildings and the construction of new green ones do not only lead to significant savings, but to fundamental decrease in GHG emissions and employment creation (UNEP, 2011, p.336). Yet, enhancing energy efficiency in builds will not be as smooth as one may imagine, as it requires strong

[5] Closed-cycle manufacturing, or closed-loop production, refers to the system in which some or all of its output is used as its input. Business Dictionary, http://www.businessdictionary.com/definition/closed-loop-system.html

architecture, design, and construction and material systems, relying notably in innovative technologies.

In developed countries, energy efficiency should be prioritised in existing buildings, under which measures and incentives should be placed so as to provide the means for large-scale investments in retrofitting programmes (UNEP, 2011, p.369). In developing countries, essentially in emerging countries, energy efficiency should be prioritised in new buildings, preferably on the construction of new green buildings, by investing in adequate available design and technologies alternatives (UNEP, 2011, p.369).

Presently, the transport sector amounts for approximately a quarter of the global energy $CO_2$ emissions; is responsible for over 80 per cent of urban air pollution in developing countries; and it demands more than 50 per cent of the global liquid fossil fuels (UNEP, 2011, p.380). The transport sector is also responsible for an annual 1.27 million traffic accidents and for perpetual traffic congestions in numerous cities (UNEP, 2011, p.380). Additionally, if the world is not to see any shit in the business as usual (BAU) path, we are to anticipate three times more vehicles from current amounts, surpassing 2 billion cars by 2050 (UNEP, 2011, p.380).

The pathway towards a low-carbon transportation sector will depend on several factors. The GER stresses the need to transform the investment standards – referring to BAU – so as to encourage access rather than mobility; alter the current mode of transportation towards less harmful ones; and foster the development of low carbon automobiles (UNEP, 2011, p.407). In other words, investments should prioritize the development of more environmentally efficient types of transportation, the advancement of infrastructure and public transportation, and the substitution of petroleum with sustainably produced biofuels, electric drive and fuel cells. The latter is essential to the fighting of urban air pollution and GHG emissions.

## 5. China in the light of the Green Economy

In response to the rapidly increasing environmental concerns related to business as usual (BAU), several countries have demonstrated great commitments in pursuing green growth strategies so as to boost the run towards a low-carbon future, while fostering economic growth, and simultaneously awakening the green economy. A good example to illustrate economies' commitments in *greening* growth is that of China. China is known for its environmental crisis, notably owned to the country's unbridled economic growth. Yet, China's 12th Five-Year Plan (FYP), a policy document that affords guidelines for the years 2011-2015, demonstrates promising attempts in tackling the implications caused by the country's unsustainable strategies.

This chapter firstly provides a snapshot of China's economic and environmental circumstances, as to evidence the urgency to shift the prevailing BAU to Green Economy. Secondly, it identifies the 12th Five-Year Plan's green strategies falling under the energy industry, accentuating initiatives in the renewable energy and energy efficiency sector. Ultimately, it explores whether the 12th Five-Year Plan positions China on the right gateway towards a low-carbon economy.

### 5.1 Why is the Green Economy a strategic choice in China?

In 2001, China's economy surpassed that of Japan and is presently the second-largest economy in the world, after the United States (CIA). China is also the world's fastest growing economy, holding an annual average growth rate of 10 per cent in the last three decades (CIA). China's rapid development once has been seen as an economic miracle and indeed it could have been one, after all, it is not every day that the world experiences steady economic growth. However, China failed to anticipate the environmental implications associated with its economic growth, and has been, therefore, undergoing severe environmental damages and increased social disparities across the whole country.

China's environmental crisis owes essentially to the energy industry, which has been highly inefficient and unclean, aggravating air and water pollution and GHG emissions. China continues to rely on coal as its primary energy source, though coal is the energy source that emits the highest GHG per energy unit (UNEP, n.d., ¶ 4). For example, the combustion of coal emits 70 per cent more $CO_2$ than gas per energy unit (UNEP, n.d., ¶ 4). Yet, China's domestic coal market triples that of the whole global coal trade (IEA, 2012, ¶ 7).

Coal consumption amounted 70 per cent of China's total energy demand (Sagawa & Koizumi, 2007, p.3) and is responsible for 68 to 94 per cent of its electricity and heat production (IEA, 2011, p.9). The

reasoning for these notable percentages lays on energy inefficiency. As Pan Yue asserts it, "To produce goods worth $10,000, for example, we need seven times more resources than Japan, nearly six times more than the United States and, perhaps most embarrassing, nearly three times more than India", (Der Spiegel, 2005, ¶ 2).

Interestingly enough is the credibility of Chinese newspapers, in which information fluctuates from an expected coal consumption decline of 7 per cent by 2015 (Xinhua, 2010, ¶ 1) to a predicted annual consumption raise of 5.2 per cent by 2015 (China Daily, 2012, ¶ 1). Here, reliability will depend upon China's commitment to *greening* its strategies and lowering its carbon emissions.

Apart from the intensive energy-related GHG emissions, it is substantial to underline the tremendous impact the combustion of coal have on air pollution. Outlined by the World Health Organisation, China has the most elevated annual rate of premature deaths caused by air pollution in the world and kills approximately 650.000 Chinese citizens every year (Platt, 2007, ¶ 2).

China's undergoing transportation boom is another major area of air pollution-related concern. China automobile market is anticipated to nearly triple in size (Reed, 2011, ¶ 1) implying growing pressure on transportation infrastructure and reflecting, not only the augmentation of urban air pollution but the continuous degradation of ecosystems. According to a study made by the Massachusetts Institute of Technology, an injection of $112 billion was necessary as attempts to minimize China's aggravating air pollution in 2005 (Lyn, 2012, ¶ 1)

Briefly, China's continued reliance on the combustion of fossil fuels as a primary source of economic growth has been undermining both the environmental and social pillars of sustainable development. Much commitment and determination are needed if China is to contribute to *greening* the economy, essentially in the nourishing of its power generation sector.

### 5.2 The 12th Five-Year Plan

China's 12th Five-Year Plan (FYP) has been a remarkable policy document for 2011-2015. The document does not only reveal the government's economic and social priorities and provide guidelines, but dedicates its environmental section to mitigating climate change, environmental issues and emphasises energy-related concerns. The 12th FYP "not only is this the first Five-Year Plan that mentions climate change, but it is mentioned at the top of the environmental section", (Bapna & Talberth, 2011, ¶ 3). China's engagement in mitigating climate change and realigning its energy sector

suggests that the country is acknowledging the urgency to tackle the implications of its unsustainable strategies, currently translated in the 12th FYP.

#### 5.2.1 Minimizing emissions while mitigating climate change

China's new environmental strategies actively respond to climate change and prioritize major adaptation measures, which will boost the country's progress towards a model of low-carbon growth. The 12th FYP underlines two major binding targets for the energy industry: 16 per cent reduction in energy intensity (energy consumed per unit of GDP) and 17 per cent reduction in carbon intensity (carbon emitted per unit of GPD) (Jiabao, 2011, p.13).

It is significant to stress a critical standpoint with regards to the reduction indicators. Notably, China's targets for energy and carbon intensity reduction are constantly given in per unit of GDP instead of absolute caps, meaning that, as the Chinese economy augmenters, so will its total energy consumption and GHG emissions. Nevertheless, the 12th FYP stated targets are consistent with China's pledge of minimizing 40 to 45 per cent of carbon intensity by 2020 from 2005 levels – a pledge made at the climate change negotiations in Copenhagen – ; and, most importantly, are crucial if China is to deliver its commitment (Xinhua, 2009, ¶ 7).

#### 5.2.2 From 20% to 16% energy intensity reduction

The 12th FYP energy-intensity reduction target is somewhat lower than of the period of 2006-2010, which was 20 per cent (Kai, 2006, ¶ 3). Although the policy document does not provide any specific explanation for lowering the current target to 16 per cent, it likely did so due to China's proven immature ability to deliver clear pathways. During the 11th FYP, the much ambitious target of lowering energy intensity by 20 per cent reflected various unintended consequences at the local level. Struggling to meet the energy intensity reduction target, some local officials drastically opted to cut electricity supply to factories, schools and even to hospitals (Jie & Duanduan, 2011, pp.32-33).

Another justification for lowering energy intensity target to 16 per cent is that of the "low hanging fruit", or doing the easiest work first. During the 11th FYP, inexpensive and accelerated energy saving measures, such as the closure of outdated facilities, led much of China's achievement in reducing energy-intensity to 19.1 per cent during the period of 2006 and 2010. As such, the potential for further shutting down small and inefficient facilities has already been exhausted, implying, therefore, that increasing energy efficiency will be more challenging (Seligsohn, 2010, ¶ 2).

Ultimately, the failure of achieving 20 per cent reduction during the 11th FYP reflected the higher than anticipated economic growth. During the period of 2006 and 2012, China maintained an extraordinary annual average economic growth rate of 10.7 per cent (CRI, 2011, ¶ 2), which was essentially driven by large investments in energy intensive heavy industry (Hsu & Seligsohn, 2011, ¶ 2). Responding to the environmental implications of the 11th FYP, the Chinese Premier Wen Jiabao set an annual economic growth target of 7.0 per cent, being even lower than the previous target of 7.5 per cent, in order to stimulate a more sustainable economic growth (Bi & Zhu, 2011, ¶ 1)

### 5.2.3 Expanding renewable energy

During the past 11th FYP, China has increased its non-fossil fuels generation to 8.8 per cent of the total primary energy consumption, being one of the world's leading producers in renewable energy (The World Bank, 2011, ¶ 1). In order to continue empowering China's renewable energy sector, the 12th FYP set a target for an increase of non-fossil fuels in total primary energy consumption to 11.4 per cent by 2015 (Jiabao, 2011, p.13). In 2009, China has become the world's largest investor in renewable energy projects, investing $34.5 billion, essentially in solar panels and wind turbines (Loon, 2010, ¶ 6).

China is the biggest Solar PV producer in the world, manufacturing 45 per cent of global solar PV in 2009 (UNEP, n.d., ¶ 5). Furthermore, presently China also holds the largest market for solar hot water, with approximately 66.7 per cent of world's capacity (UNEP). With the increasing development in solar photovoltaic and in the solar thermal industry, an estimated 655,000 jobs were created in 2009 (UNEP, n.d., ¶ 7).

China's wind power industry has been continuously surpassing earlier development targets. For instance, from 2005 to 2009, the supplementary generation capacity from wind power revealed an annual growth rate exceeding 100 per cent (Li & Ma, 2009, p.10). To this, the previous target for wind additional installation of 70 gigawatts (GW) by 2020 has been replaced to the present five-year Plan. In 2009, China's new installations of 13.8 GW reflected leadership in added capacity and held second in installed capacity (UNEP, n.d., ¶ 2). Also, the wind power industry employed nearly 22,000 Chinese in 2009 (UNEP, n.d., ¶ 7).

The 12th FYP calls for the continuous development of hydropower, substantially for the construction of large-sized hydropower stations. Extraordinarily, the new Plan accentuates preconditions for the construction of such, stressing the need to appropriately protect and restore the surrounding biodiversity (NDRC 2011, chapter 11, section 1).

China's renewable energy boom has been clearly benefiting the country's long run towards the green economy. Massive investments have not only progressed the tackling of climate change and air pollution but have also provided a powerful green business card for China. Further, investments have allowed China to diversify its energy portfolio, while reinforcing its energy security and domestic energy supply. However, although China has increasingly advancing its green industries, especially the solar panel industry, non-fossil fuels are likely to have a marginal impact on China's total GHG emissions (Chang & Gao, 2011, p.78)

#### 5.2.4 Advancing energy efficiency

The Chinese government has had a remarkably successful track with its energy efficiency programs. Responding to its soaring exports and energy intensity per unit of GDP, China adopted various policies so as to promote energy efficiency in 2004 (Zhou, Levine, & Price, 2010, p.7)These policies encompassed the enforcement of new buildings standards and appliances; the adjustment of present and the creation of new fiscal incentives for energy conservation; the closure of small and inefficient coal-based power plants; and the implementation of major energy-conserving technology projects, such as the "Ten Key Projects" and "Top 1000 enterprises energy conservation action", which also fall under the 12$^{th}$ FYP (Zhou, Levine, & Price, 2010, p.7)

The 12$^{th}$ FYP will continue to upgrade the already existent conservation policies and will encourage investments in R&D so as to advance in innovative strategies, with a greater focus on energy efficiency in the industrial sector, buildings and transportation (Jiabao, 2011, pp.22-27).

In the industrial sector, the 12$^{th}$ FYP stresses that it will further strengthen the elimination of outdated production capacity industries, adjust raw material industries, enhance industrial capacity, while advancing manufacturing equipment and encouraging the expansion of such (NDRC 2011, chapter 9, section 1). The Chinese government has been particularly assertive in eliminating backwards, inefficient coal-fired power plants.

China has been determined in shutting small and inefficient power plants and energy intensive manufactures, as well as preventing the opening of such. During the period of 2007 and 2011, over 50,000 megawatts (MW) of small coal-fired generators were on the run to be shut (NELT, 2011, p. 9). According to the Energy Information Administration (EIA), by the year of 2009, the Chinese government had already shut 54,000 MW of small and inefficient power plants, and another 8,000 MW was anticipated by China's National Energy Administration to be shut in 2011 (NETL, 2011, p. 9) .Accordingly, the 12$^{th}$ FYP calls for the development of clean and efficient large-capacity coal-fired

power plants (NDRC 2011, chapter 11, section 1). The closure of inefficient power plants has demonstrated to continuously advance energy efficiency in China (Chan & Gao, 2011, p.78).

In the transport sector, the new Plan accentuates efforts to advance fuel cell vehicles technologies, plug-in-hybrid and pure electric vehicles (NDRC 2011, chapter 10, section 1); proactively enhance energy efficiency strategies, security technology and environmental conservation; and reinforce investments in R&D capacity (NDRC 2011, chapter 9, section 1).

The 12th FYP focuses on investments so as to advancing energy efficiency in existing and new buildings, accentuating the transition to green construction and green buildings. The building sector is to improve structure and service patterns through the enrichment of information technology, building techniques and materials, and through the supress of outdated and excessive production capacity (NDRC 2011, chapter 9, section 1).

### 5.3 Is China on the right track towards the Green Economy?

China's 12th Five-Year Plan shows unprecedented signals of a new departure. The new Plan actively attempts to phase out the antiquated "grow first, clean up later" mentality through massive investments that are continuously enforcing commitments to *greening* growth, mitigating climate change, while minimizing air pollution. Considering China's previous environmental performances and the 12th FYP's environmental strategies, one can conclude that:

- Massive investments in the renewable energy sector have been benefiting China's carbon intensity reduction and energy mix portfolio; it has attracted much attention from foreign leading energy companies and will continue to do so as the country develops its green technologies; China's green industries, essentially the solar panel industry, have been notably gaining competitive advantage in the global green market; the expansion of non-fossil fuel sources to 14.1 per cent will be probably met by 2015, yet renewables will have little impact on China's primary energy sources;
- China has had a remarkable track in energy efficiency over the 11th FYP, particularly owed to its "cleaning up initiative", which aimed at the removal of inefficient power plants, being the single most important driver in lowering China's carbon emissions to 19.1 per cent over that period; the 12th FYP sets encouraging energy efficiency strategies for the industry, buildings and transportation sector; investments in R&D and greener technologies, are likely to advantage China's position in scientific innovations, benefiting not only the environment but the country's economic efficiency; however, the less ambitious energy targets reflect the low-

hanging fruit, meaning that increasing energy efficiency over the 12th FYP will require greater efforts;

- The stabilisation of China's average annual GDP growth at 7 per cent over the 12th FYP is central to China's realisation of lowering energy and carbon intensity to16 and 17 per cent by 2015, respectively, and, most importantly, to the prospering of cutting 40 to 45 per cent GHG emissions per unit of GDP by 2020;
- In spite of the government's commitment in realigning its energy sector through the encouragement of renewable and energy efficiency initiatives, these are anticipated to have little impact on China's *total* GHG emissions and energy demand, hence, undermining the fighting against climate change.

The Chinese government established relatively modest targets for energy and carbon intensity reduction and renewable energy sources expansion for the 12th Five-Year Plan period; yet, one may wonder how the heavy reliance on coal is actually being managed.

### 5.4 China still runs on coal

As previously discussed, coal is still the single most primary energy input in China's energy system and it is anticipated to remain so in the foreseeable future; though China's renewable energy sources are advancing. Holding around 14 per cent of the world's total coal reserves (EIA, 2010, p.15), China is not likely to discard such an abundant and inexpensive energy source, mainly because the 12th FYP's key priorities are to sustain economic growth while ameliorating living standards. And the most accessible way of delivering these priorities is to employ the prevailing inexpensive and abundant secure energy supply (Chang & Gao, 2011, p.81). That said, one of the strategic challenges the Chinese government will face during the 12th FYP is that of moving towards a sustainable economic model while improving living standards and boosting employment.

Attempting to respond to ever increasing environmental concerns, as mentioned earlier, China introduced a mandate to progressively shut down small and inefficient coal-fired power plants during the 11th FYP. Although the closure of these have benefited both energy efficiency and local pollution, such initiative is somewhat critical. Rather than undermining the existence of coal-fired power plants, the Chinese government is to substitute these with efficient large-capacity ones. As such, the replacement of coal power plants reflects nothing else than the harsh reality that China is not to interrupt investments for the coal industry and will, as a result, not succeed in lowering its *total* GHG emissions.

Noteworthy in the 12th FYP is the absence of a stated reduction target for the coal industry. It was only in March, 2012, that China's National Development and Reform Commission (NDRC) released the new Plan for the country's coal industry. The stated target aims at restricting national coal production and consumption to approximately 3.9 billion tons by 2015 (Tu, 2012, ¶ 1). According to Jianjun Tu, if China's annual GDP growth is to solidify at 7 per cent for the five years to come – the set GDP growth target for the 12th FYP –, the country is to anticipate the achievement of curbing 3.9 billion tons by 2015 (Tu, 2012, ¶ 3). However, China's economy is not likely to be retained at an annual growth of 7 per cent – the economy is expected to grow by nearly 40 per cent over the 12th FYP (Boyd & Copsey, 2011, p.14) – hence, meeting both China's coal production and consumption targets will be fairly challenging.

Briefly, China's continued reliance on coal undermines the country's objective of *greening* its economy, mitigating climate change and delivering prosperous lives to its people. Although the Chinese government has been seeking ways to reverse the horrifying environmental conditions induced by its inefficient, unclean and unsafe combustion of coal, the country will fail in alleviating its *total* greenhouse gases emissions. According to Chang and Gao (2011, p.81), the Chinese government considers inexpensive and abundant coal as the most appealing option to content China's increasing energy demand. As such: "The government is not likely to reduce the use of coal, despite its contribution to atmospheric greenhouse gases. Indeed, it may not be possible to do so without creating major economic disruption", (Chang & Gao, 2011, p.81).

## 6. Conclusion

The purpose of this research paper was to explore the controversial concept of the green economy while accentuating one of its major sectors of concern: the heavy energy industry. The leading objective of this study was to investigate how China's 12th Five-Year Plan currently responds to the green economy paradigm, to examine the government's commitments in *greening* the energy sector and, finally, to analyse whether these commitments were in line with the attempts to mitigate climate change. In order to conclude this study, underlying key passages will be primarily reflected to invigorate the reasoning.

The "global interlocking crisis" has left many governments and business leaders uneasy with the prevailing business as usual. Ban Ki-Moon alerts that the obstinacy to maintain business as usual will lead to "a global suicide pact" (UN, 2011, ¶ 3), as aspirations for nourishing accelerated GDP growth surpass any environmental intricacy caused by it. As such, the United Nations Environment Programme stresses the need to mobilize and re-focus the global economy towards investments in clean technologies and "natural" infrastructure, considering that it has the greatest opportunity for absolute growth, the tackling of climate change and employment boom (UNEP, 2008, ¶ 1).

The green economy, one that "results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities" (UNEP) - or in a more appealing version, one that concurrently boosts economic growth and sustainable development - has been given much credence as governments continuously seek for an alternative economic trajectory. Various initiatives encompassing incentives for *greening* the economy have disclosed the importance and the rapid dissemination of the green economy paradigm. Particularly, the *Green Economy Report* (GER), introduced by the UNEP, has been attempting to encourage governments and business to pursue and massively invest in green growth strategies. The *Report* convenes for annual global investment of $ 1.3 trillion (UNEP, 2011, p.24), of which more than a half is to be employed in expanding renewable energy and advancing the energy efficiency by 2050 (Pereira, 2011, pp.42-45).

*Greening* the energy sector will be among the former major drivers of the green economy, exceptionally because projections underline an energy demand rise of 90 per cent by 2035, due to the rapidly increasing population and economic growth in emerging countries (OECD, 2011, ¶ 1). Energy generation is the foremost prompter of GHG emission, essentially because power generation implies an elevated use of fossil fuels such as gas, oil and, particularly coal, being the biggest $CO_2$ emitter among fossil fuel sources (UNEP, Climate Change Mitigation, ¶ 4). As such, renewable energy and energy efficiency must be regarded as "twin pillars" in sustainable energy strategies (Prindle, Eldridge,

Eckhardt, & Frederick, 2007, p.7), and the advancement of such are central in fostering the run towards a low-carbon energy sector, while awakening the green economy.

Responding to the ever increasing environmental concerns, the Chinese government committed the country in pursuing green growth strategies, which are consistent to the green economy underlying ideas. China's 12th Five-Year Plan (FYP) demonstrates promising attempts in tackling the implications caused by the country's unsustainable economic growth strategies. The new Plan discloses a set of tactics aimed at *greening* its energy-intensive industries, essentially at enlarging non-fossil fuel sources by 14.1 per cent and enhancing energy efficiency, through a reduction in energy and carbon intensity by 16 and 17 per cent, respectively.

China's renewable energy sector has been attracting much attention from foreign leading energy companies, as China became the world's largest investor in renewable energy projects in 2009, investing $34.5 billion in solar panels and wind turbines (Loon, 2010, ¶ 6). Regarding energy efficiency, China has had a remarkable track over the 11th FYP, particularly owed to its "cleaning up" initiative, which aimed at the removal of inefficient power plants, being the single most important driver in lowering China's carbon emissions to 19.1 per cent over that period. However, given the low-hanging fruit, increasing energy efficiency over 12th FYP is likely to require greater efforts.

Considering that China's economy is expected to grow by nearly 40 per cent over the 12th FYP (Boyd and Copsey, 2011, p.14), simultaneously its absolute energy demand, the present green strategies are not likely to offset China's dependency on coal and will have, therefore, little impact on reducing its *total* carbon dioxide emissions, which, in turn, will reflect the government's inability to mitigate climate change. That said, China should prioritise investments in advancing R&D in order to continue upgrading green technologies and conservation strategies, which are crucial to any attempts in de-carbonising coal. And if China alone is not capable of delivering prominent outcomes, the government should seek additional partnerships, so as to reinforce technology transfer.

Yet, it is pivotal to note that China's engagement in *greening* its economy is exceptional, given its wide national discrepancy of development stages and institutional immaturity in mastering extraordinary green strategies. Pan expresses this development right to the point: "China made efforts and also harvested successes more than any other country on earth with respect to energy saving and carbon emission reduction during the 11th Five-Year Plan period. Almost no country, developed or developing, denies China's efforts and achievements", (2011, p. 170). To this end, one can conclude that China is on the right track towards the green economy.

## References

Abrahams, A. (2012, March 28). *OECD Environmental Outlook to 2050 in a wake-up call for increased environmental vigilance*. Retrieved May 3, 2012, from European Environmental Bureau: http://www.eeb.org/index.cfm/news-events/news/eeb-press-release-oecd-environmental-outlook-to-2050-is-a-wake-up-call-for-increased-environmental-vigilance

Bapna, M., & Talberth, J. (2011, April 5). *Q&A: What is a "Green Economy?"*. Retrieved May 10, 2012, from World Resources Institute: http://www.wri.org/stories/2011/04/qa-what-green-economy

Berger, G., & Sedlacko, M. (2010, March). *5th ESDN Workshop: From Green Growth towards a Sustainable Economy?* Retrieved April 11, 2012, from ESDN Workshop Series Madrid: http://www.esdn.eu/pdf/doc_workshops/2010%20madrid/WS_Madrid_background_and_discussion_paper_FINAL.pdf

Bi, W., & Zhu, W. (2011, February 27). *China Cuts Economic Growth Target As Premier Wen Calls For Sustainability.* Retrieved May 23, 2012, from Bloomberg: http://www.bloomberg.com/news/2011-02-27/china-cuts-economic-growth-target-as-premier-wen-calls-for-sustainability.html

Blaikie, N. (2007). *Approaches to Social Enquiry: Advacing Knowledge 2nd edition.* Cambridge: Polity Press.

Bouvier, C. (2010, March 25). *5th ESDN Workshop: From Green Growth towards a Sustainable Economy?* Retrieved April 12, 2012, from ESDN Workshop Series Madrid: http://www.sd-network.eu/pdf/doc_workshops/2010%20madrid/Christophe%20Bouvier_UNEP_WS%20Madrid.pdf

Brundtland, G. H. (1987). *Our Common Future, From One Earth to One World.* Oslo: World Comission on Environment and Development.

Bryman, A., & Bell, E. (2003). *Business Research Methods.* New York: Oxford University Press.

Bulcão, L. (2012, April 15). *Economia verde: preservar o planeta pode dar lucro*. Retrieved May 3, 2012, from Veja: http://veja.abril.com.br/noticia/economia/o-que-e-economia-verde

Chang, C., & Gao, J. (2011). *China: A Country Case Analysis.* Berkeley Roundtable on the International Economy.

China Daily. (2012, February 27). *China's coal consumption continues to rise.* Retrieved May 17, 2012, from China Daily: http://www.chinadaily.com.cn/bizchina/2012-02/27/content_14705069.htm

CIA. (n.d.). *The World Factbook: China.* Retrieved 10 May, 2012, from Central Intelligence Agency: https://www.cia.gov/library/publications/the-world-factbook/geos/ch.html

Cosbey, A. (2011). *Are there downsides to a green economy? The trade, investment and competitiveness implications of unilateral green economic pursuit.* New York; Geneva: United Nations.

CRI. (2011, March 03). *Looking back on the 11th Five-Year Plan.* Retrieved May 07, 2012, from China.org: http://china.org.cn/china/NPC_CPPCC_2011/2011-03/03/content_22043374.htm

Der Spiegel. (2005, July 03). *The Chinese Miracle Will End Soon.* Retrieved May 10, 2012, from Der Spiegel: http://www.spiegel.de/international/spiegel/0,1518,345694,00.html

Development Asia. (2012). *Going Green - Why is Asia moving toward a green model of economic growth* . Asian Development Bank.

EIA. (2010, November). *Country Analysis Briefs - China.* Retrieved May 2, 2012, from Energy Information Agency: http://www.eia.gov/EMEU/cabs/China/pdf.pdf

Elkington, J. (2012). The Green Economy: Business Contribution to Securing Sustainability. *Global Compact Conference* . Arnhem: The Global Compact.

Global Forest Coalition et al. (2006, October 31). *Biofuels: A Disaster in the Making*. Retrieved May 13, 2012, from Energy Bulletin: http://www.energybulletin.net/node/21845

Green Economy Coalition. (2012). *Introducing the big picture*. Retrieved 11 April, 2012, from Green Economy Coaltion: http://www.greeneconomycoalition.org/big-picture

Harvey, F. (2011, November 9). *World headed for irreversible climate change in five years, IEA warns.* Retrieved May 7, 2012, from The Guardian: http://www.guardian.co.uk/environment/2011/nov/09/fossil-fuel-infrastructure-climate-change

Hilton, I., Boyd, O., Copsey, T., Angang, H., Jiaochen, L., Jianqiang, L., et al. (2011). *China's Green Revolution: Energy, Environment and the 12th Five-Year Plan.* China Dialogue.

Hsu, A., & Seligsohn, D. (2011, March 01). *What to Look for in China's 12th Five-Year Plan?* Retrieved April 10, 2012, from ChinaFAQs: http://www.chinafaqs.org/blog-posts/what-look-chinas-12th-five-year-plan

IEA. (2010). *World Energy Outlook.* OECD Publishing.

IEA. (2011). *CO2 Emissions from Fuel Combustion Highlights.* IEA.

IEA. (2011, May 30). *Prospect of limiting the global increase in temperature to 2ºC is getting bleaker.* Retrieved April 4, 2012, from International Energy Agency: http://www.iea.org/index_info.asp?id=1959

IEA. (2011, November 9). *The world is locking itself into an unsustainable energy future which would have far-reaching consequences, IEA warns in its latest World Energy Outlook [Press Release]*. Opgeroepen op May 10, 2012, van IEA: http://www.iea.org/press/pressdetail.asp?PRESS_REL_ID=426

IEA Press. (2011, November 9). *The world is locking itself into an unsustainable energy future which would have far-reaching consequences, IEA warns in its latest World*

*Energy Outlook.* Retrieved May 10, 2012, from IEA: http://www.iea.org/press/pressdetail.asp?PRESS_REL_ID=426

International Energy Agency. (2010). *World Energy Outlook 2010: Excecutive Summary.* IEA.

International Energy Agency. (2011). *World Energy Outlook 2011: Executive Summary.* IEA.

International Rivers. (n.d.). *Three Gorges Dam*. Retrieved May 10, 2012, from International Rivers: http://www.internationalrivers.org/campaigns/three-gorges-dam

IPCC. (2007). *4th Assessment Report, Working Group I report: Climate Change 2007: The Physical Science Basis.* Cambridge: Cambridge University Press.

IPCC. (2007). *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge, United Kingdom and New York: Cambridge University.

IPCC. (2011). *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation. Prepared by Working Group III of the Intergovernmental Panel on Climate Change.* Cambridge, United Kingdom and New York: Cambridge University Press.

Jiabao, W. (2011). *Report on the Work of the Government: Fourth Session of the Eleventh National People's Congress.* National People's Congress.

Kai, M. (2006). *The 11th Five-Year Plan: Targets, Paths and Policy Orientation* . NDRC.

Lenton, T. M., & Hermann Held, E. K. (2008). *Tipping elements in the Earth's climate system.*

Li, J., & Ma, L. (2009). *Chinese Renewables Status Report, Background paper.* Renewable Energy Industry Association.

Loon, J. v. (2010, March 17). *Renewable Energy Investment May Reach $200 Billion in 2010.* Retrieved May 17, 2012, from Bloomberg: http://www.bloomberg.com/apps/news?pid=newsarchive&sid=aqM_.nmSwKvg

Lyn, T. E. (2012, February 15). *Worsening air pollution costs China dearly: study.* Retrieved May 17, 2012, from Reuters: http://www.reuters.com/article/2012/02/16/us-china-pollution-costs-idUSTRE81F09M20120216

Mandil, C. (2006). *Energy technology scenarios and strategies for a more secure and sustainable energy future. Press Release.* Paris: IEA.

Matthews, B., & Ross, L. (2010). *Research Methods, A Practical Guide For Social Sciences.* Essex: Pearson Education Limited.

Mitchell, D. (2008). *A Note on Rising Food Prices. Policy Research Working Paper 4682.* Washington: The World Bank.

NDRC. (2011). *China's 12th Five-Year Plan (2011-2015), Full English Version.*

NETL. (2011). *Reducing Freshwater Consumption at Coal-Fired Power Plants: Approaches Used Outside the United States.* National Energy Techonology Laboratory.

Ocampo, J. A., Cosbey, A., & Khor, M. (2011). *The Transition to a Green Economy: Benefits, Challenges and Risks from a Sustainable Development Perspective.* United Nations Conference on Sustainable Development.

OECD. (2011). *Green Growth Strategy for Energy.* OECD Publishing.

OECD. (2011). *Towards Green Growth.* OECD Green Growth Studies, OECD Publishing.

OECD. (2012). *Environmental Outlook to 2050.* OECD Publishing.

Pan, J. (2012). *Flexibility Required to Meet China's Mandatory Green Targets Set in the 12th Five-Year Plan.* Institute for Urban and Environmental Studies, Chinese Academy of Social Sciences.

Pereira, J. A. (2011). Rio+20, Agenda 2012. *EXAME*, 42-45.

Platt, K. H. (2007, July 9). *Chinese Air Pollution Deadliest in World, Report Says.* Retrieved May 11, 2012, from National Geographic News: http://news.nationalgeographic.com/news/2007/07/070709-china-pollution.html

Prindle, W., Eldridge, M., Eckhardt, M., & Frederick, A. (2007). *The Twin Pillars of Sustainable Energy: Synergies between Energy Efficiency and Renewable Energy Technology and Policy.* American Council for an Energy-Efficiency Economy.

Reed, J. (2011, January 13). *China's car market to triple by 2020.* Retrieved May 25, 2012, from The Financial Times: http://www.ft.com/intl/cms/s/0/314d1646-1f33-11e0-8c1c-00144feab49a.html#axzz1wAfT1BFu

Rockstrom, J., & al, e. (2009, September 17). *Planetary Boundaries: Exploring the Safe Operating Space for Humanity.* Stockholm Resilience Centre.

Sagawa, A., & Koizumi, K. (2007). *Present State and Outlook of China's Coal Indsutry.* Institute of Electrical Engineers of Japan.

Seligsohn, D. (2010, October 2010). *What Will China's Next Energy Intensity Target Be?* Retrieved May 11, 2012, from ChinaFAQs: http://www.chinafaqs.org/blog-posts/what-will-chinas-next-energy-intensity-target-be

Smith, R. K. (2004, October). *Inductive vs. Deductive Methodologies.* Opgeroepen op May 23, 2012, van Clear Direction Inc. : http://www.cleardirection.com/docs/articles/indvdeduct.asp

The Green New Deal Group. (2008). *A Green New Deal.* nef.

The Secretary-General's Advisory Group On Energy and Climate Change. (2010). *Energy for a Sustainable Future: Summary Report and Recommendations.* New York: AGECC.

The World Bank. (2011, March 30). *Empowering China's Green Growth.* Retrieved May 12, 2012, from The World Bank: http://www.worldbank.org/en/news/2011/05/31/empowering-chinas-green-growth

Thomas, D. R. (2003). *A general inductive approach for qualitative data analysis.* University of Auckland.

Tu, K. J. (2012, April 18). *China's Problematic Coal Plan.* Retrieved May 17, 2012, from The Diplomat: http://the-diplomat.com/china-power/2012/04/18/china%E2%80%99s-problematic-coal-plan/

UN. (2011, January 28). *Warning of 'global suicide,' Ban calls for revolution to ensure sustainable development.* Retrieved April 4, 2012, from UN News Centre: http://www.un.org/apps/news/story.asp?NewsID=37405&Cr=sustainable+development&Cr1

UNCSD. (2012). *Objective & Themes*. Retrieved May 15, 2012, from Rio+20 United Nations Conference on Sustainable Development: http://www.uncsd2012.org/rio20/objectiveandthemes.html

UNEP. (2008). *"Global Green New Deal" - Environmentally-Focused Investment Historic Opportunity for 21st Century Prosperity and Job Generation.* Nairobi: UNEP.

UNEP. (2010). *Green Economy - Developing Countries Success Stories.* UNEP.

UNEP. (2011). *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication.* Retrieved 2012, from UNEP: www.unep.org/greeneconomy

UNEP. (2011). *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication. A synthesis for Policy Makers.* Retrieved 2012, from United Nations Environment Programme: www.unep.org/greeneconomy

UNEP. (n.d.). *Climate Change Mitigation*. Retrieved April 38, 2012, from United Nations Environment Programme: http://www.unep.org/climatechange/mitigation/Introduction/tabid/29397/Default.aspx

UNEP. (n.d.). *Green Economy, Success Stories: Renewable Energy in China.* Retrieved May 17, 2012, from United Nations Environment Programme: http://www.unep.org/greeneconomy/v2/SuccessStories/RenewableEnergyinChina/tabid/29865/Default.aspx

United Nations. (2010). *Objectives and Themes of the United Nations Conference on Sustainable Development: Report of the Secretary General.* A/CONF.216/7.

United Nations Environment Programme and Bloomberg New Energy Finance. (2011). *Global Trends in Renewable Energy Investment Report 2011 - Analysis of Trends and Issues in the Financing of Renewable Energy.* UNEP.

Walsh, B. (2011, October 11). *The Worst Kind of Poverty: Energy Poverty.* Retrieved May 12, 2012, from Time: http://www.time.com/time/health/article/0,8599,2096602,00.html

William Prindle, M. E. (2007). *The Twin Pillars of Sustainable Energy: Synergies between Energy Efficiency and Renewable Energy Technology and Policy.* ACEEE.

Xinhua. (2009, November 16). *China to cut 40 to 45% GDP unit carbon by 2020.* Retrieved May 17, 2012, from China Daily: http://www.chinadaily.com.cn/china/2009-11/26/content_9058731.htm

Xinhua. (2010, July 21). *China's reliance on coal to drop 7% by 2015.* Retrieved May 17, 2012, from China.org: http://www.china.org.cn/business/2010-07/21/content_20540625.htm

Zhou, N., Levine, M. D., & Price, L. (2010). *Overview of Current Energy Efficiency Policies in China, Energy Policy, Volume 38: Issue 11.* China Energy Group.