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Explore the Impact of Sustainable Development Strategies on Green Employment

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Abstract: This multiple case analyses show that sustainable development policies in both China and European countries can greatly impact the green labor market. In China, the sustainable development polices greatly impact its forestry, renewable energy, and infrastructure sector. The demand of green jobs keeps increasing from 2005 to 2020.However, the green transition process per se is painful for small coal factories and employees from carbon intensive industries. In the EU-25 area, the number of green jobs also keep increasing. Unlike China, the most environmentally polluting industries release more than 90% of carbon dioxide and greenhouse gases but only generate a small fraction of jobs (14%) in the labor market. By the end of 2030, the number of green jobs will increase up to 12 million in European countries.

Keywords: Sustainable Development, Green Economy, Greening Process, Green Jobs

1. Introduction

1.1. Background

In the past few decades, the world has experienced unprecedented economic growth and development. The world gradually enters the Anthropocentric era [1]. That being said, the extraction of natural resources from environment have exceeded the sustainability threshold on Earth [2]. Human beings cannot maintain the economic development at the current scale without taking sustainable development goals into considerations. Carbon dioxide emissions, extreme weather condition, flooding, bush fires, and habitat destruction are all signals due to negative human impact on the ecosystem [3]. Under such context, the UNDP has launched the 17 sustainable development goals (SDGs) to regulate economic and social activities. The SDGs are designed to minimize human beings' impact on Earth [4]. Since 1970 till now, the total number of global populations has expanded by more than 3 billion [5]. Due to the rapid economic development, millions of people have been pulled out of extreme poverty. The social well-being of individuals has been enhanced significantly within this period. But meanwhile, the over-extraction of natural resources has also led to significant negative impact on the natural environment. Under such context, countries like China and EU member countries decide to design and implement sustainable development strategies to transit towards a low-carbon and green economy [6]. The implementation of sustainability-related strategies is expected to remarkably reshape the existing labor market. It is because more and more "green jobs" will be created accordingly.

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1.2. Research Aim

This conference paper mainly aims to develop an in-depth understanding of the impact of sustainable development strategies on green employment. Case study analysis method is used to explore how the number of green jobs is impacted by sustainable development strategies, and how employees in carbon-intensive industry is affected. The sustainable development strategy impacts in China and EU countries are selected as the case studies in this research. By comparing and contrasting the selected case studies, this research can further identify what challenges the green employment are currently facing and how the status quo can be further improved.

2. Literature Review

The relationship between sustainable development strategies, green economy, and green employment have been greatly discussed in the existing literature [7, 8, 9, 10]. At its fundamental, sustainable development means that the current social and economic development should not be at an expense of the future generations' needs [11]. According to the triple bottom line theory, sustainable development should look for striking a balance between economic sustainability, social sustainability, and environmental sustainability [12]. Regarding economic sustainability, business entities should not just look for maximizing the profits for internal shareholders and investors [13]. Sustainability initiatives need to be considered when designing corporate-level goals. As for social sustainability, companies and organizations need to consider both positive and negative effects on human society [14]. Most importantly, they should work on maximizing the average well-being of individuals in human society. The interests and critical needs of all social groups should be protected accordingly. Last, environmental sustainability is about minimizing human beings' impact on, and restoring the natural environment [15]. In fact, in order to guide different countries in the world to craft sustainable development strategies, the UNDP has launched the 17 sustainable development goals (SDGs) as the shown in figure 1below [4]. Different countries such as China and the EU member countries have developed different sustainable development strategies based on these goals.

Figure 1: 17 Sustainable Development Goals of the United Nations.

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Green economy under the context of sustainable development refer to economic activities that are closely related to promoting social and environmental sustainability [16]. Loiseau et al. suggested that green economy mainly deals with economic activities that tend to maximize economic and social outputs, and meanwhile minimizing the effects on the eco-system. Another definition of green economy is given by the United Nations. That is, green economy is a type of economy that aims to improve human beings' well-being and minimize the negative environmental impact [17]. As countries are investing natural resources in devising sustainable development strategies, it is predictable that traditional economic activities, especially those from highly-polluting or carbon-intensive industry are transforming into green economic activities. For instance, in this green transition process, government incentives or policies that look for reducing carbon emission and enhancing energy efficiency will promote the rapid development of renewable energy sector (e.g. wind power and solar power) [18]. As a result, the number of the so-called "green jobs" will increase accordingly. In this green transition process, the employment in the fossil-fuel sectors will drop. Government's sustainable development strategies will thus incur high adjustment costs as the affected employees need to be protected in the green transition. And also, new green jobs will incur new challenges such as the need for re-skilling/retaining, financial support for green enterprises, and/or high cost in the greening processes [19].

3. Research Methodology

3.1. Research Method

As this research looks for developing an in-depth understanding on the sustainable development strategies on the green employment in different countries, multiple case study analysis is an effective research method for this context [20]. Case study analysis is a commonly-used method for a researcher to closely analyze a particular social phenomenon and its potential impacts or consequences [21]. Unlike other types of research methods, case study analyses do not intend to observe a generalized pattern or testify a theory/hypothesis [22]. Instead, this research method can provide insights on understanding how sustainable development strategies adopted by China and EU countries affect the labor market such as increase in green jobs and how laborers in the carbon-intensive markets are affected. One key advantage of case study is that the researchers can collect data with high flexibility [23]. For instance, in this case study, the researchers collect secondary data from the data-base of China's national bureau of statistics, international labor organization, and OECD report. Another advantage is that the researcher can develop an in-depth understanding by deeply diving into the existing literature and data to derive meaningful findings and observations [24]. However, one potential problem is that the derived findings or observations cannot be easily generalized. For instance, in this case study, the research results only show how China's and EU's sustainable development strategies affect the labor market. The research findings cannot be directly applied to represent other countries' context. But policy-makers in other countries can gain insights from the research findings.

3.2. Research Design

In general, this case study analysis contains six major components [23]. At the first stage, the researcher specifies the key purpose of the case study evaluation. At the second stage, the researcher identifies the key theoretical foundation of the research, and provide definitions for important terms. At the third stage, China's and EU's case studies are explained and analyzed accordingly. At the fourth stage, the researcher defines how evidence is collected and illustrate key research findings/observations derived from the case studies. Fifthly, the research implications and

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recommendations are proposed accordingly. At the sixth stage, the researcher concludes key findings of the case study.

3.3. Data Collection

Secondary data have been obtained from authoritative organizations including China's national bureau of statistics, the international labor organizations (ILO), and OECD report. In China's case study, relevant data includes the increase in green jobs in China's forestry, renewable energy, and infrastructure sector between 2005~2020 due to the impact of China's sustainable development strategies are cited. Also, data related to the number of employees in the carbon-intensive industry who are affected by the green transition are illustrated accordingly. In the EU's case study, advanced scenario, moderate scenario, and international energy agency reference scenario cited from the ILO and OECD report are used to illustrate how sustainable development strategies can affect green employment in EU countries.

4. Results and Findings

4.1. Impact of Sustainable Development Policies on Green Employment in China

According to the State Sustainability Strategy, China's current sustainable development strategies can have significant impact in six major areas of green employment/jobs, including retrofitting, mass transit, smart grid, wind power, solar power, and advanced iofuels [25].

China's sustainable development strategies result in the so-called "green restructuring" effect on the labor market [26]. For instance, in the Wind Power industry alone, thousands of jobs such as "environmental engineers", "Iron and steel workers", "construction equipment operators", "construction managers", etc, will be created. The direct, and indirect & induced employment due to China's sustainability development strategies from 2005~2020 can be illustrated in table 1 below [27]. When China's sustainable development strategies (e.g. "Low-carbon" strategy) were launched in 2005, it can create direct green employment in different green industrial sectors. Lately, more and more indirect and induced employment opportunities were also created within the period.

Table 1: Green Employment Analysis Attributed to China's State Sustainable Development Strategy (Unit: 1,000 persons).

Sector	**Sub-sector**	**Direct Employment (2005~2020)**	**Indirect Employment (2009~2020)**
Forestry	Forestation	7,000	11,000
	Sustainable forestry	210	67
Electricity	Wind Power	500	2,070
	Solar Energy	190	620
Steel	Steel and Refinery	-250	---

Source: National Bureau of Statistics, 2021.

So far, green employment in the forestry, electricity, and infrastructure (steel) industry have been greatly impacted by China's sustainable development strategies [28]. The forestry industry under China's low-carbon strategy has contributed significantly to combating the global climate change [29]. On the one hand, forests can store an amount of carbon in the form of woody biomass. They can also absorb carbon dioxide and release oxygen in the photosynthesis process. As such, forests are

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often considered as a form of "carbon-neutral" or "carbon sinks" [30]. By definition, carbon sinks refer to anything that can absorb more carbon from the atmosphere than they release to the atmosphere [31]. Carbon sources, on the contrary, refer to things that can produce more carbon into the atmosphere [32]. In terms of green employment, the forestry industry under China's sustainable development strategies can generate green jobs particularly in afforestation/reforestation, sustainable forest management, and forest tourism. For instance, in the afforestation and reforestation process, new green jobs such as forestry designer, engineer, inspector, and even forestry program trainer, are created to address the increase demand for sustainable development in China [26]. In the central government's strategy, "Conversion of croplands to forests", the central government and municipal governments at all levels facilitate labor force training and recruitment in the afforestation/reforestation process. Eventually, as shown in Table 2 below, between 2009~2020, more than 2.6 million jobs were created just in the afforestation and reforestation [27].

Table 2: Green Jobs created in the Forestry Industry (Unit: 1,000 persons).

Sector	Sub-sector	Direct employment		Indirect Employment	
Forestry		2005~08	2009~20	2005~08	2009~20
	Afforestation and reforestation	5,660	1,340	8,400	2,600
	Sustainable Management	110	100	37	30

Source: Adapted from ILO Report 2021.

Also, China's sustainable development strategies also have significant impact on the new energy sector, particularly in wind power and solar power industries. Wind power and solar power are two typical green energy sources. They can replace the role of fossil fuels in generating electrical power and thus remarkably reduce the emissions of greenhouse gases (GHGs). As shown in table 3, between 2005~2020, the net installed capacity of wind power increases from only 12.6 million kW to approximately120 million KW. It shows that China's wind power is gradually replacing fossil fuel and other non-renewable energy sources in generating electricity. The net job opportunities also increase from only 19 thousand persons to close to 1.48 million by the end of 2020.

Table 3: Green Jobs created in the Wind Power Sector.

Year	Wind Power Capacity (1MW)	Jobs Created (1,000 persons)
2005	1,250	2.0
2006	2,600	5.0
2007	6,000	11.0
2008	12,100	24.0
2009	21,000	42.0
2010	25,000	50.0
2011~20	120,000	150.0

Source: Adapted from ILO Report 2021.

Additionally, the employees in the traditional carbon-intensive industry such as coal industry have also reduced significantly within the period. For instance, the total number of employees reduced due to the closure of power plants can be illustrated in table 4 below. More than 6.06 million employees lost their jobs due to China's low carbon strategies.

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Table 4: Reduction of employees due to the closure of small coal power plant in China

Year	Affected Power Capacity from small coal plants (1MW)	Reduced jobs (1,000 persons)
2005	2,400	1.5
2006	3,100	20.0
2007	15,000	90.0
2008	16,000	100.0
2009	1,400	60.0
2010	1,000	50.0
2011~20	29,000	180

Source: Adapted from ILO Report 2021.

4.2. Impact of Sustainable Development Policies on Green Employment in EU

Very similarly, the green labor market in EU member countries have also experienced significant impact from sustainable development strategies/policies launched by governments at all levels. As shown in figure 2 below, before 2005, in the EU-25 area, the most polluting industries (shaded region) accounted for nearly 90% of the total carbon dioxide emissions. But the total share of employment is only less than 14% in these industries [33].

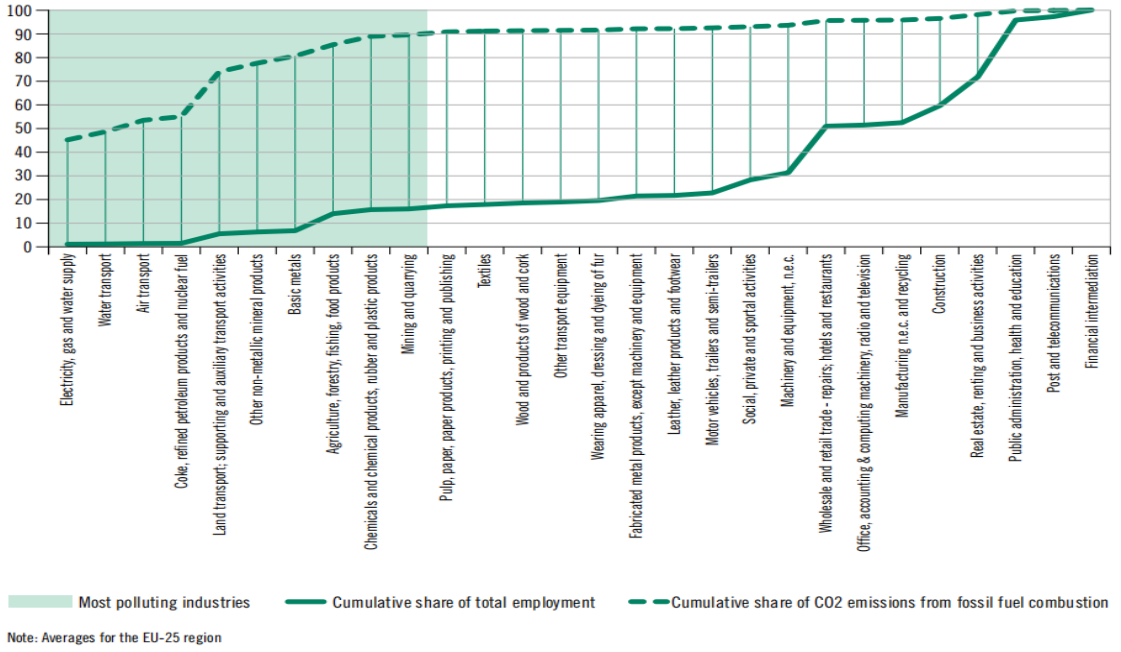

Figure 2: Carbon dioxide emission and green employment in EU-25 area.

From 2005 onwards, as EU countries gradually implement sustainable development strategies and policies, the labor market structure has fundamentally changed. As EU countries adapt the sustainable development goals, the demand for green workers especially in the energy sector surges. According to the international labor organization (ILO) report, the job creation based on advanced scenario, moderate scenario, and international energy agency reference scenario can be illustrated in figure 3 below.

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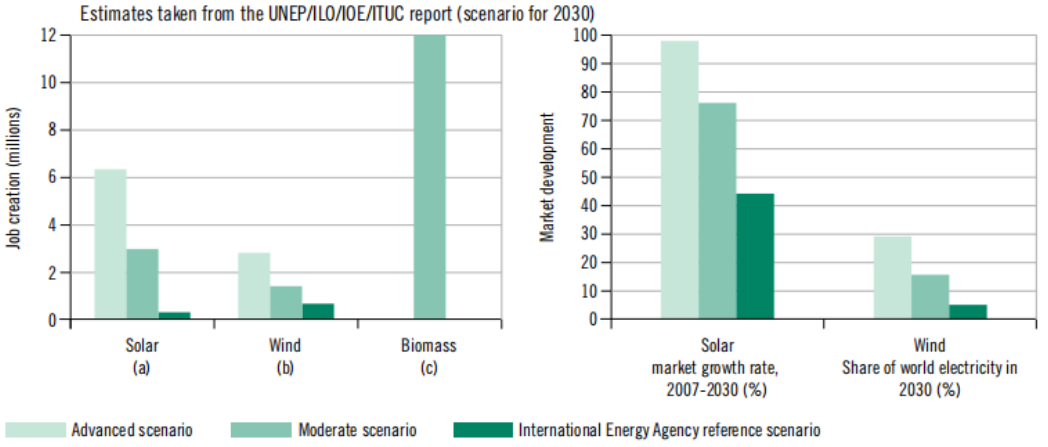

Figure 3: Job creation simulation in the renewable energy sector between 2007~2030.

Researchers from the ILO has cited reliable sources from UNEP, ILO, IOE, and ITUC, and developed three simulation models to project the net job creations after implementing sustainable development strategies in EU countries. The researchers found that only 2.3 million people were hired initially in the renewable energy sector in the EU-25 area. By the end of 2009, the net number of employees increased to 3 million. By the end of 2020, an average of 12 million green jobs are created. Under this trend, by the end of 2030, a total number of 21.7 million green jobs will be created in total [33]. Under the advanced scenario, in the solar energy sector, the net job creation will be 6.2 million. The wind power sector will generate roughly 3.5 million jobs. The Biomass sector will have around 12 million jobs.

4.3. Findings and Summary

Both China's and EU's case studies show that sustainable development strategies result in significant green restructuring. In China, Chinese central government's sustainable development strategies are mainly designed to support green economic investment in building retrofitting, mass transit, smart grid, wind power, solar power, and advanced biofuels. After implementing these strategies, millions of green jobs have been created in the forestry, renewable energy, and infrastructure sectors. Similarly, in EU countries, between 2005~2030, it is projected that the total number of green jobs will continue to rise up to 12 million in the green energy sector. In both cases, green jobs are gradually replacing jobs in the carbon-intensive industries. But meanwhile, it also expected that government should anticipate dramatic changes in the green industries. That is, policy-makers should prepare the workforce for the green restructuring. They should be equipped with desired and qualified skills to meet the green demands. However, the major difference in China and EU regarding the green employment is that the percentage of green employment in China's labor market is still smaller than that in the EU countries. Now over 20% of employment jobs in EU are related to the green economy. The EU commission estimates that European countries can jointly meet the goal of 45% green jobs by the end of 2030.

5. Discussion

From the key results and findings in the previous section, it can be seen that policy-makers need to take prompt actions to meet the expectations and demands in the green employment market. In the green restructuring process, policy makers should first help the workforce meet the requirements in a green economy. Second, policy makers should play a vital role in facilitate the green transition

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process from carbon-intensive economy to a green economy. Third, the "greening" of the existing enterprises is also highly demanded.

5.1. Green Job Skill-Upgrading and Green-Collar Workers

The research results suggest that there will be a huge gap between the demand for green employment and the skills of the current workforce in China and other European countries. Albeit the number of green job opportunities will keep increasing by the end of 2030, policy-makers need to make sure that the existing workforce can be equipped with desired skills to meet the job-skill requirements in a green economy [34]. Both Chinese and European policy-makers should realize that the new green economy will create millions of job opportunities in the job market. In China, both provincial government and municipal government should invest, or otherwise guide the financial market to invest in green economy [35]. Meanwhile, migrant workers, and white collars to be ready for environmental-friendly technologies, clean energies, forestry, recycling, rural/urban environmental sustainability projects (e.g. green roofing). In Europe, on the other hand, the emergence of new sustainability technologies will trigger new training demands. The above-mentioned gives rise to the formation of green-collar workers, a unique term to refer to those who are currently employed in the sustainability-related market [36]. Continuous vocation training can convert existing white collars and others who have strong interests in sustainable development to acquire new skills for the green economy. For instance, vocational training should be designed for managers and executives in major enterprises within Europe. Managers should know how to conduct market assessment, product price, marketing of products, etc., that are closely related to the green economy. Business persons need to understand new concepts such as triple bottom line theory, restorative sustainability, and social entrepreneurship. They need to realize that business entities should not just blindly pursue economic profits without considering social and environmental sustainability. System designers need to be trained to understand how to construct solar farm and/or wind power plants. Only in this way, China, Europe, and other countries in the world can meet the growing green demand in the job market.

5.2. Facilitate a Smooth Green Transition to Green Growth

Another major finding in this research is that a certain portion of workers in the traditional market, especially carbon-intensive or environmental unfriendly industries may have to economically suffer from the green transition [37]. The fruits of a green economy have not yet shared by workers from all industries. For instance, in China, China's sustainable development strategies towards a green economy result in the closure of thousands of small coal factories. Eventually, more than 6 million coal workers have been negatively affected between 2003~2020 [33]. In fact, European policy-makers should also gain insights from the tragic and painful experiences from China's coal industry. Majority of Chinese coal workers were the only source of income for their families especially in the interior and western region of China. One way to facilitate a smooth green transition is that social protection floors should be set in the greening process. One the one hand, policy-makers should provide vocational training and other sustainability-related re-training programs to support those affected workers in the carbon-intensive industry. Also, government bodies are encouraged to provide financial supports and reimbursement packages to support workers who are transforming their jobs to green employment. The financial assistance/subsidies should target healthcare, housing, water and sanitation, and education under the social protection schemes.

5.3. Support the Greening of Existing Enterprises

At the enterprise level, government bodies or policy-makers should also provide necessary supports in the greening process. Particularly, the greening process in the small and medium enterprises are

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highly critical for policy-makers. Government bodies need to provide necessary information and financial resources to help SMEs realize and capture the potential opportunities in the green economy [38]. For instance, small and innovative startups need government supports to grow as part of the green economy. They often come up with innovative ideas and technologies to contribute to the long-term green transition. Moreover, SMEs in the traditional carbon-intensive industries are vulnerable to the green transition. Like the aforementioned, small coal factories might be shutting down immediately when the renewable energy sector keeps growing. The policy-makers need to provide technological support to help coal factories transform into producing renewable energy such as solar farms and wind power plants. Otherwise, both business owners and employees in these SMEs will suffer economic loss in the green transition.

6. Conclusion

Conclusively, this comparative case study demonstrates that sustainable development strategies in both China and Europe have a substantial impact on the green labor market. In China, sustainable development policies have a significant impact on the forestry, renewable energy, and infrastructure sectors. But jobs associated with carbon-intensive businesses are adversely affected. In EU, the percentage of jobs in carbon-intensive industry is much smaller as compared with China. The number of green jobs will keep increasing by the end of 2030. As such, policy-makers in both China and EU, and perhaps in many other countries can gain insights from the case study analysis. They should prepare the workforce for green economy through skill-upgrading programs, financially support the affected employees in carbon-intensive industry, and facilitate the greening process of the existing enterprises. Only in this way, the long-term sustainability goals can be attained.

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