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# INVESTIGATE THE DEMAND OF GREEN TALENTS OF SMART MACHINERY INDUSTRY IN SOUTHERN TAIWAN

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***ABSTRACT***

*Green talents play a key role in enterprises, especially when enterprises face the challenges of sustainable development and net zero emissions. For enterprises, the net zero emissions issues need to consider the relationship between environmental sustainability, social responsibility, and the enterprise's economic interests. The present study conducted questionnaire survey and in-depth interview to investigate the demand of green talents of smart machinery industry in southern Taiwan. According to the results of questionnaire survey and in-depth interview, the demand of green talents of smart machinery industry generally focuses on environmental safety and energy conservation managers. However, most enterprises do not have high demand for new green talents. Basically, most of the new manpower added by enterprises after transformation is based on existing personnel being sent out for training. In terms of operational function requirements. First of all, they focus on energy management, energy conservation, carbon reduction, and inventory. Secondly, information skills, communication skills, and legal aspects are also key knowledge. Most of the interviewed enterprises have no streamlined manpower planning in terms of promoting net zero emissions.*

***Keywords:*** *Green talents, Net zero emissions, Smart machinery industry, Southern Taiwan.*

## 1. INTRODUCTION

Since the adoption of the United Nations Framework Convention on Climate Change (UNFCCC) at the Earth Summit held in Rio de Janeiro in 1992, international solutions to respond to climate change have flourished. Countries and enterprises hope that through reduce the greenhouse gas emissions and achieve the set goals by purchasing carbon credits or negative carbon emission technologies. Among them, net zero emissions and carbon neutrality are currently the key issues that attract the most attention in the world.

The "Paris Agreement" at the end of 2015 was the first time in history that all 195 countries agreed to reduce carbon emissions, hoping to jointly curb the trend of global warming and control the increase in global average temperature above the pre-industrial revolution level and below 2 °C before 2100. In recent years, the commitment of "net zero emissions" and "carbon neutrality" has become an important means for countries to demonstrate to the outside world that they are moving towards sustainable development and jointly fighting climate change [1]. Taiwan passed the "Greenhouse Gas Reduction and Management Act" in 2015, which stipulated that greenhouse gas emissions would be reduced by 50% in 2050 compared with 2005, and set a mid-term goal of reducing greenhouse gas emissions by 20% in 2030 compared with 2005.

However, one of the first tasks for enterprises to achieve carbon reduction and net zero emissions is to have relevant talents for planning and executing green jobs, which can also be called green talents [2]. According to the definition of the United Nations International Labour

Organization (ILO), green jobs refer to occupations that can contribute to environmental protection and sustainable development. Work content may include improving energy efficiency, limiting carbon emissions, reducing pollution and waste, protecting ecosystems, mitigating the impact of climate change, etc.

In terms of industry, whether in traditional industries such as machinery and construction, or in emerging industries such as renewable energy and environmental protection technology, there will be a demand for green jobs.

The National Development Council's survey and estimation of talent supply and demand in key industries from 2021 to 2023, report shows that smart machinery is the one of the main key industry.

Based on the above international trends, policy trends and employment and education directions. The present study hopes to achieve the following purposes:
1) Investigated the demand of green talents of the smart machinery industry in south Taiwan.
2) Investigated the new manpower and functional needs of smart machinery industry enterprises after their transformation, and adjust manpower resource policies.

**Net Zero Emissions**

Net zero emissions also known as net zero carbon emissions, first came from the "Paris Agreement" signed by various countries in 2015, which agreed to achieve net zero emissions by 2050, so that all man-made greenhouse gases, including energy and minimize non-energy emissions, and then use different methods (such as carbon capture, forest carbon sinks, etc.) to store or reuse the gases that cause the greenhouse effect. In short, net zero emissions refers to the amount of man-made greenhouse gas (mainly carbon dioxide) emissions offset by man-made removals within a specific period of time to achieve the net zero goal. Furthermore, if net zero emissions are to be achieved, in addition to considering carbon dioxide emissions, all greenhouse gases (such as methane, nitrous oxide, etc.) should be targeted at net zero emissions. Ultimately we hope to achieve a balance between economic development and environmental protection.

The development of the net zero concept and its implementation have been guided by several key documents over the years. These documents shape global efforts to combat climate change and establish the key framework and targets for achieving net zero emissions. The following will introduce some of the main relevant documents by year and explain the relationship between them:
1) UNFCCC (1992): The UNFCCC is an international environmental treaty that serves as the basis for global climate action. Primarily, preventing dangerous human interference with the climate system and stabilizing greenhouse gas concentrations. The UNFCCC lays the foundation for subsequent agreements and documents related to net zero.
2) Kyoto Protocol (1997): The "Kyoto Protocol" is an international treaty under the "United Nations Framework Convention on Climate Change" that sets binding emission reduction targets for developed countries. This document establishes the first commitment period from 2008 to 2012 and sets the stage for future climate action negotiations.
3) Copenhagen Accord (2009): The Copenhagen Accord is a political agreement reached at the 2009 United Nations Climate Change Conference (COP 15). While not legally binding, it recognizes the need to limit global temperature rise to 2 °C above pre-industrial levels and provides a framework for countries to submit voluntary emissions reduction targets.

4) Paris Agreement (2015): The "Paris Agreement" is a landmark international agreement adopted under the "United Nations Framework Convention on Climate Change". It aims to limit global warming to well below 2 °C and strive to limit temperature increases to 1.5 °C above pre-industrial levels. The Paris Agreement sets out a framework for countries to submit and regularly update their Nationally Determined Contributions (NDCs) outlining their emissions reduction targets and strategies.
5) Intergovernmental Panel on Climate Change (IPCC) (2021) special report on global warming of 1.5 °C: The IPCC released this report, which comprehensively assesses the impact of global warming rising by 1.5 °C above pre-industrial levels. The report highlights the urgency of limiting temperature rise to 1.5 °C and outlines pathways to achieve this, including the importance of achieving net zero emissions by mid-century.
6) Zero Carbon Campaign (ZCC) (2020): ZCC is a global initiative led by climate champions at the UNFCCC that mobilizes non-state actors to commit to net zero emissions by 2050.
7) The EU's Carbon Border Adjustment Mechanism (CBAM): The CBAM is the world's first policy weapon to implement sustainable climate issues. It will be put into trial operation in October 2023, foreign enterprises must complete the first product carbon emission declaration in January 2024 for products exported to the EU.

These documents are interconnected and build on each other's goals and aspirations. The "UNFCCC" provides the overarching framework, while the "Kyoto Protocol" and "Paris Agreement" set binding and voluntary targets respectively. The "IPCC Report" provides a scientific basis for the urgency of achieving net zero emissions. The "ZCC" mobilizes non-state actors to commit to net zero emissions, complementing government efforts. Together, these documents and initiatives shape global discussion and action on net zero emissions, driving the transition to a sustainable and low-carbon future.

**Green Talent and Net Zero Emissions**

In order to continue to maintain the operational development of enterprises in the context of sustainable development and environmental management, existing talents may not be able to fully meet the relevant challenges, because there will be diverse demands from economic, legal, social and other aspects, so the term "green talents" appeared in academia and practice, and gradually gained attention [3; 4; 5].

1) Increasing environmental awareness: People are increasingly aware of environmental issues such as climate change, resource depletion, and environmental degradation.
2) The rise of the green economy: The concept of green talent is closely related to the green economy, emphasizing renewable energy, sustainable technologies and eco-friendly practices.
3) Focus on education and research programs: The development of education and research programs dedicated to sustainability research and environmental science plays a vital role in cultivating green talent.
4) Corporate emphasis on sustainable development: The integration of sustainable development into corporate strategies and the emphasis on corporate social responsibility (CSR) highlights the need for professionals who specialize in sustainable development roles and contributes to the recognition of green talents.

Therefore, according to the definitions of the United Nations Environment Program (UNEP) and the International Labour Organization (ILO), green jobs refer to occupations that contribute to environmental protection or sustainable living, including improving energy efficiency, maintaining biodiversity, limiting greenhouse gas emissions, etc. Green talent refers to individuals who possess unique knowledge, skills and a strong commitment to solving pressing

environmental challenges and advancing sustainable development goals in different fields and sectors. This unique group is characterized by their likely multidisciplinary expertise, innovative problem-solving skills, and their dedication to mitigating environmental degradation and promoting sustainable development. These individuals actively contribute to the development of innovative solutions, sustainable technologies and environmental policies, playing a key role in driving towards a more environmentally friendly and economically viable future [4; 6].

The rise of a green economy focused on renewable energy, environmentally friendly technologies and sustainable business practices has created a need for professionals often referred to as “green talent” with the skills to drive cross-sector sustainability initiatives and innovation, individuals who require knowledge and skills [3; 4].
The business community is increasingly paying attention to CSR, which has also prompted people to realize that green talents are important assets for organizations.
The relationship between green talent and achieving net zero is multifaceted:

1) Green talents help develop and implement innovative technologies and practices that reduce carbon emissions in various sectors [7].
2) Green talent can drive policy advocacy and development and promote the adoption of net zero strategies.
3) Green talent cultivates sustainable entrepreneurship innovation, entrepreneurs who focus on green technologies and sustainable business practices are critical to driving market driven emission reduction solutions. They create new opportunities for sustainable growth while helping organizations and industries move towards net zero transition [4].

There is a symbiotic relationship between green talents and net zero emissions. Green talents contributes the necessary expertise, innovation, policy development and entrepreneurial drive to achieve the net zero emissions targets needed to effectively combat climate change. While green talents play a vital role in advancing net zero ambitions, a number of challenges and considerations must be addressed. A key challenge is the lack of skilled professionals with expertise in sustainability and emissions reduction strategies personnel. Businesses have a growing need for talent who can lead, innovate, and implement sustainable practices, but education and training program needs are currently unable to keep up with this demand [3]. Another consideration is the need for interdisciplinary collaboration among green talent. Achieving net zero emissions is a complex undertaking that requires expertise across sectors including energy, agriculture, transport, and policy development. Effective coordination and collaboration between professionals from different backgrounds is essential to address the multifaceted challenges of net zero emissions [5].

**Smart Machinery Industry**

According to the National Development Commission [8] "Survey and Estimation of Talent Supply and Demand in Key Industries from 111 to 113 Years" report, the smart machinery industry includes machine tools, mechanical components, industrial machinery, and industrial robots that are registered, approved and established in the machinery, electronic, and semiconductor production machinery and equipment, industrial automation and system integration and other sub-fields. However, the above-mentioned fields are cross-field industries and are difficult to map to the "Industry Statistical Classification" of the Accounting and Accounting Office of the Executive Yuan [9]. According to the planning team members’ many years of experience in coaching industrial zones and enterprises, in principle, enterprises related to machine tools, mechanical components and industrial machinery will probably be

related to the "machinery equipment machinery industry" and the "electronic components industry" Union.

Through the continuous efforts of Taiwanese enterprises over the years, the "machinery equipment machinery industry" has developed into a feature that integrates diverse professional technologies, is technology- and capital-intensive, has high processing levels and added value, and has a wide range of applications. The current global supply chain due to the impact of geopolitics and the epidemic, enterprises and countries have begun to think about the possibility of replacing "long chains" with "short chains" and replacing "globalized" production with "localization" and "regionalization". Coupled with the global declining birth-rate and increasing labour costs, and driven by the trends of artificial smart (AI), green, service-oriented and other machinery technologies, there will also be opportunities for the vigorous development of smart machinery that replaces old ones with new ones. Therefore, the machinery and equipment machinery industry is one of the important foundations of smart machinery.

**Taiwan's Net Zero Emissions Policy**

The two major governance foundations are:

1) Climate legal system: The "2050 net zero emissions" goal, just transition, low-carbon diet, and the rights and responsibilities of various ministries will be clarified into law, and the level of climate governance will be raised to the Executive Yuan. In addition, the "carbon pricing" mechanism has also been officially launched, and carbon fee revenue will become an important financial source for a just transformation.
2) Technology research and development: Taiwan's short-term goal (2030) is to achieve "low carbon", which requires increasing natural gas and reducing coal burning, giving priority to mature wind power and photovoltaics, and continuing to develop thermal energy and ocean energy; the long-term goal (2050) is to move towards "low carbon" to "zero carbon", relevant technologies and transformations should be in place as scheduled, for example: using gas-fired units with "carbon capture" and "hydrogen" power generation to build a zero-carbon power system, and convert coal to backup.

The four major transformation strategies are:

1) Energy transformation: Increase renewable energy, popularize the use of carbon-free fuels, further integrate the green energy ecosystem, and promote energy transformation.
2) Industrial transformation: The machinery sector focuses on process improvement and energy conversion, the commercial sector adjusts its business model, and the construction sector introduces carbon reduction technologies and construction methods to achieve a circular economy. In the transportation sector, the Ministry of Economic Affairs has proposed a vision of reaching 100% electric vehicle sales in 2040, in an attempt to create a people-oriented green transportation life and significantly increase the electrification of transportation.
3) Life transformation: Practice a low-carbon diet and reuse instead of buying in bulk. People can also choose net zero recycling buildings and take more public transportation to reduce unnecessary energy waste.
4) Social transformation: Including the two concepts of "justice transformation" and "citizen participation", the government advocates "trying not to leave anyone behind", improving the support system, promoting public-private collaboration, and turning conflicts into sustainable opportunities.

## 2. RESEARCH METHOD

The purpose of the present study is to investigate the demand for green talents of the smart machinery industry in southern Taiwan, analyse the key green talent categories, job content and possible corresponding functional connotations of transformation needs under trends such as net zero emissions and carbon neutrality, and reveal The research purpose was completed through questionnaire survey and in-depth interviews with industry experts.

### Questionnaire Survey

The present study uses a questionnaire survey method to investigate the positions and functional needs of green talents in southern Taiwan. After the questionnaire is designed, expert validity will be applied first, and three experts from industry and academia were invited to review the content and revise it to confirm that the content of the questionnaire and the scale are easy to fill in. For some preliminary drafts of the questionnaire. A pre-test was also conducted to clarify unclearly defined questions, items and inappropriate measurement methods.

### In-depth Interview Outline

Semi-structured in-depth interviews offer high flexibility and low restrictiveness. They provide a considerable degree of interview flexibility, allowing participants to express their genuine feelings in the given context. Through relaxed conversation and interaction, unexpected insights often emerge. Therefore, this thesis chooses semi-structured in-depth interviews to explore the inner world of senior executives from the case, industry, government, and professional technical sectors. Before conducting face-to-face interviews, an interview outline is prepared. During the actual interviews, the purpose of the interviews is explained, relevant questions are addressed, and participants from the case, industry, government, and professional technical sectors are ensured to fully understand all in-depth interview outline.

Table 1. Outline of in-depth interview

| Thoughts on driving forward net zero emissions |
|---|
| 1. What adjustments or personnel transfers have been made to the organizational structure/ departments/ project teams? |
| 2. What are the current key tasks and progress (such as energy management, carbon inventory, greenhouse gas emission measurement, energy saving and carbon reduction planning, and report writing, RE100)? |
| 3. What difficulties are encountered in promoting net zero emissions? |
| 4. Which departments/ positions will be affected and may manpower be streamlined? Or may personnel be transferred to other departments? |
| 5. Why do companies want to push for net zero emissions? |
| Thoughts for the workers in net zero emissions |
| 1. What kind of green talents does the company need (such as sustainability chiefs, sustainability managers, carbon auditors, energy-saving managers, worker in various units who can cooperate the operations, etc.)? Approximately how many worker are needed for each? |
| 2. What are the main sources of green talents? (For example, internal staff training, external recruitment of experienced worker, external recruitment of graduates from relevant departments) |
| 3. What are the work contents of the main green talents? (It can be explained from the work process or work theme, such as understanding the system, introducing the system, conducting inventory, setting emission reduction targets, proposing emission reduction plans... etc.) |
| 4. What knowledge, skills and attitudes do net zero worker need? |
| 5. Perform net zero emission worker need to have any prerequisites? (Such as academic qualifications, work experience, certificates, etc.) |

**Participants of In-depth Interview**

To enhance the richness and diversity of in-depth interview data, six experts from the smart machinery industry were selected as participants for in-depth interview. This selection aims to achieve a balanced representation across different perspectives, thus providing a comprehensive insight into the issues under examination. The affiliation of the six experts were all above manager and the experience were all more than 8 years. Table 2 show the affiliation and experience of these participants.

Table 2. Basic data of the participants of the in-depth interview

| No. | Affiliation | Experience |
|---|---|---|
| A | Special Assistant to the Chairman | 8 yrs |
| B | Associate General Manager | 20 yrs |
| C | General Manager | 15 yrs |
| D | Special Assistant to the Chairman | 30 yrs |
| E | Associate General Manager | 20 yrs |
| F | General Manager | 20 yrs |

## 3. RESULTS AND DISCUSSIONS

**Results of the Questionnaire Survey**

1) In terms of "types of green talents needed and estimated number of worker needed", except for "energy-saving managers", the demand for new recruitment of other related green talents is not high.
2) In terms of "the main sources of needed green talents", the enterprises surveyed have the highest proportion of "internally dispatched staff for training".
3) In terms of "units that may be downsized in response to net zero emissions promotions" and "dispositions that may be downsized", most enterprises have no plans for downsizing.
4) In terms of "net zero emissions work content progress", the average rating score of the 29 question items is less than 3, and most of them are close to 2 points. In other words, most of the enterprises surveyed are still in the understanding stage of issues such as net zero emissions, and only a few enterprises are promoting certain work projects.
5) In terms of "importance of net zero emissions work content", the top five with the highest rating scores are "planning carbon reduction plan (PCRP)- power system" (3.79), "PCRP-energy management system" (3.45 ), "PCRP- lighting system" (3.41), "PCRP- air conditioning system" (3.40), "PCRP- public equipment" (3.39), basically, it reflects that the interviewed enterprises have entered into the early stages of introduction of net zero emissions from the perspective of actual operating costs and promotion progress, and are paying higher attention to the parts directly related to carbon reduction plans and operating costs.
6) In terms of "types of green talents needed and estimated number of people needed", the average rating score of people needed for the 12 green talents is less than 0.5 except for "energy-saving managers" (0.63), which represents the interviewed enterprises' new expectations for related green talents. The demand for employment is not high.
7) In terms of "main sources of needed green talents", among the 12 green talents, in addition to "others", the remaining 11 talents interviewed by enterprises hope to be "internally dispatched for training" with the highest proportion. Among them, "sustainability managers" (50.0%), "sustainability managers" (50.0%) and "carbon auditors" (46.9%) have the lowest proportions of internal training, reflecting the difficulty in obtaining relevant talents through internal training for these strategic positions, because the existing job content may not have direct corresponding experience training for each position.

8) In terms of "job content importance scores", a difference analysis was conducted based on industry. The differences in most items did not reach a statistically significant level. Among the items with differences, most of the items with differences were that the importance score of the smart machinery industry was higher than that of the pharmaceutical industry.
9) In terms of "functional importance", among the items with differences, most of the functional importance scores of the smart machinery industry were higher.

**Results of the In-depth Interview**

1) The talents of cross-disciplinary overall planning: Since the net zero emission plan involves many aspects, including environmental protection, social responsibility, corporate governance, etc., the task force needs to be established to promote the net zero emissions plan and the project. In addition to leadership skills, leaders of task force also need to have overall planning capabilities and conceptual knowledge in various fields to manage, communicate, coordinate and integrate the work of different departments, and help solve problems so that the net zero emissions plan can be launched and done.
2) The main source of green talents: The machinery industry prefer environmental engineering expertise if new hired employees are needed, while external-hired mid- to high-level employees require relevant experience. At present, the main sources of relevant talents are mostly employees from existing enterprises who are sent out for training. Every company has its own particularities. Therefore, it is a more appropriate measure for enterprises to cultivate their own internal employees. Most enterprises have limited knowledge of the channels for cultivating talents, and mostly choose Enterprises Human Resource Upgrade Program or SME Human Resource Upgrade Program. Therefore, they need talents with project management, problem analysis and solution capabilities to carry out overall planning of the project site and solve various problems at the individual project site. In addition to leadership skills, project leaders also need to have overall planning capabilities, knowledge of relevant concepts, and communication and coordination skills to manage and integrate the work of various departments and assist in solving difficulties.
3) Main work content of green talents: Since the net zero emissions plan work involves many aspects, the person in charge of promoting the net zero emissions plan work must not only have leadership skills, but also need to have integration and communication skills. Meanwhile, they need to report progress and difficulties to superiors, seek advice from superiors, and promote net zero emissions plans. Secondly, every company attaches great importance to saving electricity and water. Therefore, energy saving management is also a major task.
4) Prerequisites for green talents: Each industry has its own industrial characteristics, and each company’s machinery technology and processes are also different. Therefore, in addition to communication and practical experience, there will also be differences in the prerequisites for talents. The talents must be able to communicate, plan and arrange time, coordinate cross departments, and complete the work. The talents must have relevant experience in net zero emissions. Experience will be more important than academic qualifications. In addition, writing plans to obtain government resources is also an ability that enterprises.

## 4. CONCLUSIONS AND SUGGESTIONS

The present study conducts correlation analysis on the new positions and the functions in the survey results, and then initially plans the courses for environmental safety managers, energy conservation managers, and enterprise sustainable development project managers.

1) In terms of demand for green talents, overall the main 123eman dis for environmental safety and energi conservation managers.
2) Most of the new green talents added by the company after its transformation will be based on existing personnel being sent out for training. In terms of functional requirements, first of all, they focus on energi management, energi conservation and carbon reduction, and inventory. Secondly, information skills, communication skills, and legal aspects are also key points.
3) Most of the enterprises have energi streamlined manpower planning in promoting net zero emissions. Even if the company updates automated and energi-saving production equipment and streamlines its operating personnel, they will be transferred to other units within the company that are short of workers.

The demand for green talents in key industries generally focuses on environmental safety and energi conservation managers. However, most enterprises do not have high demand for new green talents. Basically, most of the new manpower added by enterprises after transformation is based on existing personnel being sent out for training. In terms of functional requirements, first of all, they focus on energy management, energy conservation and carbon reduction, and inventory. Secondly, information skills, communication skills, and legal aspects are also key points. Most of the interviewed enterprises have no streamlined manpower planning in terms of promoting net zero emissions. Even if the company updates automated and energy-saving production equipment and streamlines its operating personnel, they will be transferred to other units within the company that are short of workers. Therefore, there will be no impact on the employment of existing employees of the company.

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