

NATIONAL TECHNICAL UNIVERSITY OF UKRAINE
"IGOR SIKORSKY KYIV POLYTECHNIC INSTITUTE"
FACULTY OF MANAGEMENT AND MARKETING
DEPARTMENT OF INTERNATIONAL ECONOMY

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_____ Serhii VOITKO
December “_____” 2024 p.

MASTER THESIS

for a master's degree according
to the educational program
"International Economics"
specialty 051 "Economics"

Thesis title: “ Attracting international investment in renewable energy on the basis of sustainable development ”

Completed: student of the
2nd year, group US-32mpi
Yang Meng

Supervisor:

Associate professor of the
Department of international
economics, PhD in Economics,
Tetiana IVANOVA

Reviewer:

Professor of the Department of
economic cybernetics, Dr.Sc. in
Economics,
Olha ILYASH

I hereby certify that this Master's
Thesis contains no borrowed
material from other authors' works
without proper citation.

Student Yang Meng

Kyiv - 2024

National Technical University of Ukraine
"Igor Sikorsky Kyiv Polytechnic Institute" Faculty
of Management and Marketing
Department of International Economics

Level of higher education - second (master's)

Specialty - 051 "Economics"

Professional Educational program "International Economics"

APPROVED

Head of the Department

_____ Serhii VOITKO

November "___" 2024

OBJECTIVE

for a Master's Thesis of a student

Yang Meng

1. The theme is "Attracting international investment in renewable energy on the basis of sustainable development", scientific supervisor – Tetiana IVANOVA, PhD. in Economics, Associate Professor of Department of International Economics, approved by the order of the University from November 08, 2024, № 5019-c.
2. The deadline for students to submit a Master's Thesis is December 11, 2024.
3. The Objective of research is international investment activities in the renewable energy sector and their related influencing factors.
4. Initial data: 2015-2024 data of renewable energy investment, current status data of renewable energy development in countries- the United States, China, Germany, Denmark, market data, technical parameter data, enterprise and project case data

5. List of tasks to be developed:

- Clarify the theoretical basis of international investment
- Analyze the actual situation of international investment in the renewable energy field
- Study the experiences and challenges of different countries in attracting investment
- Explore the characteristics and strategies of renewable energy projects in attracting investment
- Propose directions and measures to enhance investment attractiveness

6. Approximate list of graphic (illustrative) material: not less than 7 tables and not less than 33 figures.

7. Approximate list of publications: 73 publications

8. Date of issuance of the task: November 24, 2024

Calendar plan

No	Name of stages	Term of implementation	Note
1	Selection of the Master's Thesis Topic (with supervisors) and its approval at the department meeting.	October 23, 2024	
2	Issuance of the task	October 24, 2024	
3	Development of the Master's Thesis Plan	October 28, 2024	
4	Selection and Analysis of Scientific Literature Related to the Research Topic	November 01, 2024	
5	Preparation of the Theoretical Chapter and Approval of Its Content with the Academic Supervisor	November 04, 2024	
6	Research on the Selected Scientific Topic	November 18, 2024	
7	Conducting a Comprehensive Analysis of the Practical Component of the Scientific Study	November 20, 2024	
8	Final Completion of the Second Chapter of the Master's Thesis	November 22, 2024	
9	Preparation of Materials for the Third Chapter	November 25, 2024	
10	Summarizing the Obtained Scientific Results, Utilizing Materials from Foreign Literature and Experience for Further Analysis, and Preparing General Conclusions	November 28, 2024	
11	Formatting the Master's Thesis Materials and Submitting Them for Review to the Academic Supervisor	November 30, 2024	
12	Addressing the Supervisor's Identified Shortcomings, Preparing the Presentation and Visual Aids for the Defense	December 01, 2024	
13	Checking the Master's Thesis for Textual Similarities and Plagiarism, Obtaining a Supervisor's Review	December 06, 2024	
14	Submitting the Master's Thesis for Peer Review and Receiving the Reviewer's Feedback	December 09, 2024	
15	Submitting the Review, Supervisor's Feedback, and Bound Master's Thesis to the Department (Additional documents, such as an implementation certificate or act, copies of scientific articles or conference abstracts, are submitted if available).	December 11, 2024	
16	Defending the Master's Thesis Before the State Examination Commission According to the Approved Schedule.	According to the approved schedule	

Student

Yang Meng

Supervisor

Tetiana IVANOVA

ABSTRACT

Master's thesis of Meng Yang on the topic "Attracting International Investment in Renewable Energy for Sustainable Development" from the specialty 051 "Economics", educational and professional program "International Economy", Igor Sikorsky Kyiv Polytechnic Institute, 2024, Kyiv.

The master's thesis consists of an introduction, 3 chapters, conclusions, a list of used sources. The work is completed in the volume of 130 pages, contains 33 figures, 7 tables.

The aim of the master's thesis is to improve the theoretical provisions and to develop the practical recommendations regarding attracting International Investment in Renewable Energy for Sustainable Development.

Research methods. During the scientific research, the method of search and synthesis was used to determine approaches to the interpretation of the concept of "International Investment", its economic meaning and use; the analytical method, in particular the method of comparative analysis, to characterize international investment in renewable energy in different regions; methods of generalization and abstraction are used to provide suggestions on possible ways to attract international investment in renewable energy; scenario method to assess the economy effectiveness of the renewable energy investment.

The object of research is international investment in renewable energy.

The subject of the study is the theoretical, methodical and practical aspects of how to attract the international investment in renewable energy.

According to the results, the predict trends based on the current renewable investment data among different regions were determined in order to improve their investment environment.

Keywords: Renewable energy; International investment; Sustainable development; Policy support; Technological innovation; Investment strategies

АБСТРАКТ

Магістерська дисертація Мена Янга на тему «Приваблення міжнародних інвестицій у відновлювану енергетику для сталого розвитку», спеціальності 051 «Економіка», освітньо-професійної програми «Міжнародна економіка», Інститут імені Ігоря Сікорського Київського політехнічного інституту, 2024 року, Київ.

Магістерська дисертація складається з вступу, трьох розділів, висновків та списку використаних джерел. Робота виконана в об'ємі 130 сторінок, містить 33 малюнки та 7 таблиць.

Мета магістерської дисертації полягає в удосконаленні теоретичних положень та розробці практичних рекомендацій щодо приваблення міжнародних інвестицій у відновлювану енергетику для сталого розвитку.

Методи дослідження:

Під час наукового дослідження використовувався метод пошуку та синтезу для визначення підходів до інтерпретації поняття «Міжнародні інвестиції», їх економічної змістовності та використання. Аналітичний метод, зокрема метод порівняльного аналізу, був застосований для характеристики міжнародних інвестицій у відновлювану енергетику в різних регіонах. Методи узагальнення та абстракції використовуються для пропонування можливих шляхів приваблення міжнародних інвестицій у відновлювану енергетику. Метод сценаріїв використовується для оцінки економічної ефективності інвестицій у відновлювану енергетику.

Об'єктом дослідження є міжнародні інвестиції у відновлювану енергетику.

Предметом дослідження є теоретичні, методичні та практичні аспекти приваблення міжнародних інвестицій у відновлювану енергетику.

На підставі результатів були визначені прогностичні тенденції на основі даних про сучасні інвестиції у відновлювану енергетику в різних регіонах з метою вдосконалення їх інвестиційного середовища.

Ключові слова: Відновлювана енергетика; Міжнародні інвестиції; Стале розвиток; Політична підтримка; Технологічна інновація; Інвестиційні стратегії.

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INTRODUCTION

Relevance of the topic of the work. In the pursuit of sustainable development on a global scale, attracting international investment in the renewable energy sector holds paramount significance. With the exacerbation of environmental issues and the escalating demand for clean energy, renewable energy has emerged as a crucial solution to global energy challenges and climate change mitigation. Attracting international investment can provide essential financial support for renewable energy projects, accelerating technological research, development, and innovation, and promoting the large-scale development and utilization of renewable energy worldwide. This, in turn, effectively reduces dependence on traditional fossil fuels, curbs carbon emissions, mitigates global warming, optimizes the energy structure, enhances energy supply security and stability, and fosters a virtuous cycle of economic development and environmental protection, laying a solid foundation for the sustainable development of human society.

Analysis of recent research and publications: In the field of renewable energy investment, numerous scholars and research institutions have conducted extensive and in-depth studies. The International Energy Agency (IEA) and other organizations have continuously monitored global renewable energy investment trends, analyzing investment flows, scale

changes, and their influencing factors. Many studies have focused on the practices and outcomes of renewable energy policies in different countries and regions. For instance, research on the renewable energy target setting and subsidy policies in European countries and their incentive effects on investment, as well as the impact of policy tools such as carbon pricing and Renewable Portfolio Standards (RPS) in the United States on investment decisions. Concurrently, studies on renewable energy technological innovation have also emerged, covering technological advancements in battery energy storage, solar panel efficiency improvement, and offshore wind turbine design optimization, and their influence on investment attractiveness. However, despite the abundant research, further exploration is still needed in areas such as how to comprehensively utilize multiple policy tools to achieve optimal investment results, how to further promote the coordinated development of technological innovation and investment, and how to strengthen international cooperation to optimize the global renewable energy investment landscape.

The aim of this master's thesis is to conduct an in-depth analysis of issues related to attracting international investment in renewable energy for sustainable development. By refining theoretical explanations, analyzing actual investment situations, and proposing practical and feasible strategic recommendations, it provides comprehensive and in-depth decision-making references for policymakers and relevant stakeholders, promotes

the continuous growth of international investment in the renewable energy sector, and contributes to the achievement of global sustainable development goals. Specifically, the research will delve into the theoretical underpinnings of international investment in renewable energy, including its definition, nature, forms, risk-return characteristics, etc.; comprehensively analyze the current actual situation of international investment in renewable energy, such as investment trends, major players, geographical distribution, and their influencing factors; conduct detailed research on the successful experiences and challenges faced by different countries in attracting investment, and perform a comparative analysis; explore the unique characteristics and effective strategies of renewable energy projects in attracting international investment; and ultimately propose specific directions and measures to enhance the attractiveness of international investment in renewable energy, including international cooperation strategies, investment activity stimulation measures, and investment project economic efficiency assessment methods.

In order to achieve the goal set in the qualifying master's thesis, a number of the following tasks must be solved:

1. Clarify the theoretical basis of international investment
2. Analyze the actual situation of international investment in the renewable energy field
3. Study the experiences and challenges of different countries in

attracting investment

4. Explore the characteristics and strategies of renewable energy projects in attracting investment

5. Propose directions and measures to enhance investment attractiveness

The object of research is international investment activities in the renewable energy sector and their related influencing factors.

The subject of this research revolves around how to attract international investment in renewable energy for sustainable development, covering theoretical, methodological, and practical aspects.

The practical significance of this research lies in providing scientific bases and decision-making references for policymakers, assisting them in formulating more effective renewable energy policies and international investment promotion strategies. By thoroughly analyzing the current situation, problems, and influencing factors of international investment in renewable energy, it helps policymakers clarify policy directions and optimize the combination of policy tools. For example, formulating reasonable subsidy policies, tax incentives, carbon pricing mechanisms, etc., to attract more international investment. It also provides market insights and investment guidance for enterprises and investors, enabling them to gain a deep understanding of investment opportunities, risk characteristics, and development trends in the renewable energy

market, and formulate investment strategies rationally, thereby improving the scientific and accurate nature of investment decisions. The research results contribute to promoting the positive interaction between renewable energy technological innovation and investment, accelerating the R&D and application promotion of renewable energy technologies, driving the rapid development of the renewable energy industry, achieving energy structure optimization and sustainable development goals, and simultaneously promoting the rational allocation of resources and coordinated economic development on a global scale.

During the research process, a combination of scientific research methods is employed.

-Through literature retrieval and comprehensive analysis, a wide range of literature on renewable energy investment, international economic cooperation, policy analysis, etc., is collected and sorted.

-The research findings of predecessors are summarized to clarify the research direction and focus, providing a solid theoretical foundation for the research.

-Data collection and statistical analysis methods are used to collect information such as global and regional renewable energy investment data, project cases, and policy documents.

-The case study method is adopted to conduct in-depth analyses of representative countries and enterprise investment cases, summarizing

successful experiences and lessons learned to provide practical bases for proposing policy recommendations and investment strategies.

-Comparative analysis is used to compare different countries, regions, investment entities, and investment projects horizontally and vertically, analyzing their commonalities and differences to identify the key factors affecting investment attractiveness.

-Additionally, scenario analysis is employed to construct different investment scenarios, predict investment trends, and assess the economic efficiency of investment projects, providing support for dealing with uncertainties and formulating forward-looking strategies.

Structure the qualifying master's thesis includes the content, introduction, overview, three sections in which the topic of the thesis is gradually revealed, conclusions and a list of references.

CHAPTER 1. THEORETICAL FOUNDATIONS OF INTERNATIONAL INVESTMENT

1.1. The essence and features of international investment

1.1.1. Definition and scope of international investment

International investing refers to investing in assets outside of one's domestic market, such as stocks, bonds, and real estate in other countries. It is a way to diversify one's portfolio and potentially gain exposure to new markets and opportunities. [1] It usually includes three aspects:

1. The forms of capital involved in international investment activities are diversified. There is capital in the form of physical capital, such as machinery and equipment, commodities, etc. There is also capital in the form of intangible assets, like trademarks, patents, management techniques, intelligence information, production know-how, etc. Additionally, there is capital in the form of financial assets, such as bonds, stocks, derivative securities, etc.

2. The subjects participating in international investment activities are diversified. The investment subject refers to the legal persons or natural persons who independently exercise the decision-making power for foreign investment activities and bear the corresponding responsibilities, including official and non-official institutions, multinational corporations, multinational financial institutions and individual resident investors. Among them, multinational corporations and multinational banks are the

main players.

3. International investment activities are transnational business operations of capital. This distinguishes them from both international trade and simple international credit activities. International trade mainly involves the international circulation and exchange of commodities to realize the value of commodities. International credit mainly focuses on the lending and recovery of currency. Although its purpose is also to achieve the value appreciation of capital, during the specific operation process of capital, the owner of the capital has no control over it. However, international investment activities are a combination of various capital operations and realize the appreciation of capital in the process of operation.[12]

International investment is a primary engine for boosting economic growth and rapid recovery, with a view to contributing to the attainment of 2030 Sustainable Development Goals. Governments invest a significant portion of their national budgets in investment projects. However, there is often a sizeable investment gap due to the vast demand for development. To address the investment deficit, governments often need to cooperate with international players, such as foreign governments, multilateral financial and development institutions, or business entities, including through public-private-partnership.[2] This concept plays a crucial role in the global economic landscape as it enables the movement of financial

resources to areas where they can be utilized most effectively for the acquisition of tangible and intangible assets and the establishment of sustainable business operations on an international scale. It encompasses a wide range of activities, including not only the direct investment in physical assets such as factories and infrastructure but also the purchase of financial assets like stocks and bonds of foreign companies. The scope of international investment is not restricted by geographical boundaries or specific industries. It covers various sectors from manufacturing to services, and from traditional industries to emerging technologies. When private sector actors invest abroad, they expand their business and open up new markets. For the states hosting these investments, this can result in additional tax revenues, increased employment opportunities, and easier access to new technologies. In this context, international investment plays an essential role in assisting countries, especially developing ones, in mobilizing global resources, bridging financing gaps, and promoting economic development.

Based on the concept of renewable energy, the international investment includes the financing of renewable energy projects, such as solar farms, wind turbines, and hydroelectric power plants. It has elucidated that international investment has been a significant driver in the establishment and expansion of renewable energy projects.[3] This financial support is essential for the procurement and installation of the

requisite infrastructure and equipment. For solar farms, it is crucial for the acquisition of photovoltaic panels and associated energy storage systems to ensure the reliable conversion and storage of solar energy. In the case of wind turbines, investment is directed towards the development and deployment of advanced turbine technologies that can effectively harness the kinetic energy of the wind and convert it into electrical power. For hydroelectric power plants, funds are allocated for the construction of dams, turbines, and associated transmission infrastructure to capitalize on the potential energy of water flow.

Moreover, international investment in the renewable energy sector permeates into research and development initiatives. It fuels the exploration of novel technologies and scientific breakthroughs. And international investment has been channeled into laboratories and research institutions worldwide to drive the innovation of renewable energy technologies. This includes efforts to enhance the efficiency of energy conversion processes, improve the durability and performance of renewable energy devices, and develop more effective energy storage solutions. Such investment is vital for addressing the intermittency issues associated with renewable energy sources and for integrating them more seamlessly into the existing energy grid. With this diverse array of technologies that constitute emerging renewable energy sources, some of these technologies have already begun to gain traction in the marketplace

and have achieved grid parity. While certain of these technologies are still some distance from commercialization, they are potentially the most advantageous for future sustainable energy. Additionally, the rate of progress of all these technologies is faster than ever before. There exist some technical impediments for some of the emerging technologies; however, research progress indicates that these obstacles will be surmounted shortly. The mainstream renewable energy sources in conjunction with the emerging renewables possess the potential to supplant conventional environmentally hazardous energy technologies, and these renewables will completely replace them in the near future. The concept of smart cities has provided a boost to these renewables, and they are the primary source of clean and environmentally friendly energy in the near future.[4]

Technology transfer is another salient aspect of international investment. It facilitates the dissemination of state-of-the-art renewable energy technologies from technologically advanced regions to those in need of technological upgrading. This process is not only about the transfer of hardware and equipment but also the transfer of knowledge, know-how, and best practices. The role of international investment in bridging the technological gap between developed and developing countries in the renewable energy domain is very important. [5]

Furthermore, investment in capacity building is an integral part of

international investment in renewable energy. It focuses on enhancing the human capital and institutional capabilities in recipient countries as the International Renewable Energy Agency showed, international investment is directed towards training programs, the establishment of research and development centers, and the strengthening of regulatory frameworks.[6] This enables countries to better manage, operate, and expand their renewable energy sectors, thereby promoting the sustainable growth and development of renewable energy on a global scale.

1.1.2. Categories and forms of international investment

International investment can be systematically categorized into two principal forms: foreign direct investment (FDI) and foreign portfolio investment (FPI).

Foreign direct investment (FDI) represents a profound and long-term engagement of an investor in a foreign economic landscape. It is characterized by the acquisition of a substantial ownership stake or the attainment of control over a foreign business entity. This level of involvement goes beyond a mere financial transaction and delves into the realm of strategic management and operational influence. When an investor undertakes FDI, they are making a significant commitment not only of financial resources but also of managerial acumen and time. The long-term nature of FDI implies that the investor is prepared to weather the

various economic cycles and uncertainties that the foreign market may present. This form of investment often requires a comprehensive understanding of the host country's economic, political, and social environment, as well as its regulatory framework and business culture. It is not a decision made lightly but is based on in-depth market research and analysis. Strategic decision-making is at the core of FDI, as the investor aims to align the operations of the foreign entity with its own global business objectives, whether it be to gain access to new markets, resources, or technological capabilities. The multifaceted nature of FDI and its implications for both the investing and host countries, highlighting how it can contribute to economic growth, employment generation, and technology transfer, provided that the right policies and institutional frameworks are in place.[7]

Foreign portfolio investment (FPI), in contrast, is primarily oriented towards the pursuit of financial returns through the acquisition of financial assets in a foreign country. Unlike FDI, which focuses on the long-term control and strategic direction of a business, FPI is more concerned with the short-term or medium-term trading of assets such as stocks, bonds, and other financial instruments. The motivation behind FPI is predominantly financial gain, and investors engaging in this form of investment are constantly monitoring market trends, interest rates, and other economic indicators to make timely buy and sell decisions. From the dynamics of FPI

and how it is influenced by global financial market conditions, we can find it can provide liquidity to the financial markets of the host country and can also serve as a means for international investors to diversify their portfolios. However, it is also more susceptible to sudden changes in market sentiment and global economic shocks compared to FDI. [8]

When International investment in renewable energy is talked about, it can be classified into several categories, such as direct investment, portfolio investment, and project finance. Direct investment involves the establishment of new businesses or the acquisition of existing companies in the renewable energy sector. Portfolio investment refers to the purchase of shares or bonds of renewable energy companies by institutional investors or individuals. Project finance is a form of financing where a specific renewable energy project is funded by a group of investors, with the project's cash flows serving as the source of repayment.

1.1.3. Features of international investment [9][10]

1. Diversification of investment objects

Among multinational enterprises, large companies rely on their advantages in capital, technology and management to conduct global layouts. Meanwhile, small and medium-sized enterprises focus on specific segmented or emerging fields to seek differentiated competitiveness. Within financial institutions, commercial banks provide services to assist

enterprises in their overseas investments and diversify risks. Investment banks promote activities such as corporate mergers and acquisitions. Sovereign wealth funds carry out large-scale overseas investments. Governments of various countries make outward investments for economic and strategic interests and support domestic enterprises to "go global". International organizations offer financial and technical assistance to developing countries, thus promoting the balanced development of the global economy.

2. Diversification of investment objects

The objects of international investment demonstrate diversified characteristics in terms of industrial distribution and asset types. In terms of industrial distribution, manufacturing, as a significant investment field, attracts substantial international capital, covering numerous sub-industries such as automobile manufacturing and electronic equipment manufacturing. Enterprises actively expand the global market and drive the development of local related industries through overseas investment in factory establishment and other means. The proportion of investment in the service sector has been constantly rising, involving multiple areas like financial services, information technology services, and logistics services. Many countries have attracted a large amount of international investment by virtue of their unique advantages, thus promoting the vigorous development of this sector. Investment in the agricultural field has been

receiving increasing attention, covering aspects such as agricultural product cultivation, agricultural technology research and development, and agricultural product processing. International investment has injected new vitality into the development of the agricultural industry. Investment in the energy and resources field has remained stable all along, including traditional energy sources such as oil, natural gas, and coal, as well as renewable energy sources like solar energy, wind energy, and hydro energy. Countries and enterprises actively lay out investment projects in energy and resources on a global scale according to their own needs and resource distribution.

In terms of asset types, direct investment in physical assets is a common form. Enterprises invest in factories, mines, and real estate to obtain production resources and expand market space. Portfolio investment enables investors to indirectly participate in international investment by purchasing financial assets such as stocks and bonds, realizing the diversified allocation of assets. Technological investment has gradually become an important trend. Enterprises acquire advanced technologies or conduct technological cooperation through investment to enhance their core competitiveness and gain an advantageous position in the global market competition.

3. Diversification of investment motives

The motives for international investment are characterized by

diversification. Market-seeking investment refers to the situation where enterprises, in order to break through the limitations of the domestic market, actively seek to enter target market countries to expand the scale of product sales, meet the needs of consumers in different regions, and increase their market share. Resource-seeking investment mainly occurs because some countries or enterprises are short of resources themselves. To ensure the stable supply of raw materials, they actively invest in overseas resource projects, involving multiple aspects such as energy resources, scarce mineral resources, and agricultural resources. Such investment helps to guarantee the resources required for enterprise production and operation. Efficiency-seeking investment prompts enterprises to search for regions with cost advantages and good production and operation environments around the world. By investing in places with lower labor costs, higher production efficiency, and complete infrastructure, they can reduce production costs, improve production and operation efficiency, and enhance the competitiveness of their products in the international market. Strategic asset-seeking investment aims to help enterprises acquire strategic assets such as advanced technologies, well-known brands, and management experience, thereby enhancing their core competitiveness and realizing sustainable development and strategic layout in the global market.

4. Diversification of investment approaches

International investment approaches are rich and diverse. Greenfield

investment means that enterprises build brand-new physical facilities such as factories, mines, and research and development centers overseas. Enterprises can make layouts according to their own development strategies and production requirements, and fully utilize local resource advantages to build a complete industrial chain. Cross-border mergers and acquisitions refer to the situation where enterprises acquire or merge with enterprises in other countries to quickly enter the target market, obtain resources and technologies. This helps enterprises integrate upstream and downstream resources in the industrial chain and enhance their market competitiveness. Under the joint venture model, enterprises and foreign enterprises jointly invest to set up new enterprises, sharing resources, risks, and benefits. It plays an important role in many fields such as automobile manufacturing and resource development, and promotes technology transfer and the development of local industries. Portfolio investment enables investors to indirectly participate in international investment by purchasing securities assets such as stocks and bonds of foreign companies. Investors can flexibly adjust their investment portfolios according to market changes to realize the optimal allocation of assets. Project financing is applicable to large-scale infrastructure construction, energy development and other projects. By integrating multiple funding sources such as government subsidies, enterprise investments, and bank loans, and using the future income rights of the projects as guarantees, it raises the funds

needed for project construction and promotes the smooth implementation of large-scale projects.

5. Complexity of the investment environment [11]

The international investment environment is extremely complex. In terms of the political environment, the political systems, policy stability, and international relations of different countries have a significant impact on international investment. Politically unstable countries may bring risks to investors in terms of asset security and project operation. Differences in policies and regulations increase the complexity of enterprises' investment decision-making. Changes in geopolitical relations will also affect the flow and scale of international investment. In the economic environment, there are significant differences among countries in terms of economic development levels, macroeconomic policies (including monetary policies and fiscal policies), and market sizes. These factors affect investment opportunities, costs, and returns. Countries with relatively rapid economic growth may bring more investment opportunities, but may also be accompanied by problems such as inflation. Exchange rate fluctuations will affect the costs and returns of investment projects. Different levels of development of financial markets mean that enterprises face different situations in terms of financing channels and costs. In the social and cultural environment, cultural differences cover multiple aspects such as language, religious beliefs, customs, and values, posing challenges to

enterprises in activities such as market promotion, human resource management, and business negotiations. Social environmental factors such as labor quality, social welfare systems, and population structures also have an impact on investment. In the natural environment, geographical locations and the distribution of natural resources affect the site selection of investment projects and the acquisition of resources. Meanwhile, increasingly strict environmental protection requirements and environmental factors such as climate change increase the costs and complexity of investment projects and have an impact on the long-term feasibility of investment projects.

6. Uncertainty of investment risks and returns [11]

The risks and returns of international investment are highly uncertain. In terms of risk factors, technological risks arise from the rapid technological updates. If the technologies or projects invested by enterprises fail to keep up with the technological development trend, they may face the risks of technological backwardness and a decline in product competitiveness. Market risks are affected by multiple factors such as changes in market demand, adjustments in competitors' strategies, and fluctuations in the industry cycle. The uncertainty of these factors makes it difficult to accurately predict the returns of investment projects. Legal risks stem from the complexity and differences of legal systems in different countries. When enterprises invest overseas, if they are not familiar with

local laws, they are prone to legal issues such as contract disputes, intellectual property infringement lawsuits, and labor disputes, which will bring economic losses and reputation damage to enterprises. In terms of return uncertainty, the returns of international investment projects are comprehensively affected by multiple complex factors. Even if detailed market research and feasibility analysis have been conducted before investment, actual returns may still deviate from expectations due to various unexpected situations. Multiple risks are intertwined, jointly resulting in the difficulty of accurately estimating the returns of international investment.

Therefore, it is clear that international investment in renewable energy comes with both risks and rewards. The risks of political instability, technological failures, economic fluctuations and currency exchange rate changes in the host country are among the significant risks that investors face, like a sudden change in government policies or a financial crisis can have a substantial negative impact on the value of an investment. However, international investment also offers the potential for higher returns due to access to emerging markets, diversification benefits and technological advancements. Renewable energy projects can generate stable cash flows over a long period of time, and they also offer environmental and social benefits.

1.2. Principles and models for attracting international investment

1.2.1. Core principles guiding international investment attraction

The core principles for attracting international investment in renewable energy include providing a stable regulatory environment, offering attractive financial incentives and ensuring transparency and predictability in policy-making.

Firstly, a stable and transparent legal and regulatory framework is of utmost importance. This framework serves as the bedrock upon which all investment activities are built. It encompasses a comprehensive set of laws and regulations that govern various aspects such as business establishment, operations, taxation, and dispute resolution. A stable legal and regulatory environment instills confidence in investors as it minimizes the risks associated with sudden and unpredictable changes in the rules of the game. On the other hand, transparency ensures that investors have access to clear and understandable information about the legal and regulatory requirements. This enables them to accurately assess the potential risks and rewards of their investment decisions. Laws related to foreign ownership restrictions, if clearly defined and consistently applied, allow investors to gauge the extent of their possible control and participation in local businesses.

Secondly, ensuring property rights protection is a non-negotiable

principle. Investors pour in their capital with the expectation that their assets will be safeguarded whether they are tangible or intangible. Robust property rights protection mechanisms prevent expropriation, unauthorized use or infringement of investors' property. This includes intellectual property rights, which are crucial in many industries such as technology and pharmaceuticals. When a country has a reliable system in place to protect property rights, it signals to investors that their innovative ideas and valuable assets will be respected and secure which will encourages them to bring in their cutting-edge technologies and make long-term investments.

Finally, fostering a competitive business environment is essential. A competitive environment promotes innovation, efficiency and productivity. It encourages companies to continuously strive for improvement and offer better products and services. This can be achieved through measures such as promoting fair competition policies, reducing barriers to entry and exit in markets and investing in infrastructure and human capital. A well-developed infrastructure, including transportation, communication and energy networks, reduces the cost of doing business and enhances the overall competitiveness of the economy. Additionally, a skilled and educated workforce is a valuable asset that attracts knowledge-intensive and high-tech investments. A country that can effectively combine these elements - a stable and transparent legal and regulatory framework, strong property rights protection and a competitive business environment -

positions itself favorably in the global race to attract significant international investment. [13]

1.2.2. Traditional models of attracting international investment

Traditional models of attracting international investment typically involve offering tax incentives, subsidies, and establishing special economic zones.[10] These measures aim to reduce the cost of doing business and increase the potential returns for investors.

These models demonstrated in the renewable energy sector encompass public-private partnerships (PPPs), concessional financing, and export credit agencies. Public-private partnerships involve a collaborative effort between the public and private sectors to finance and develop renewable energy projects. This form of cooperation brings together the resources and expertise of both sectors, enabling more efficient and effective project implementation. In a PPP arrangement, the public sector may contribute land, regulatory support, or financial incentives, while the private sector brings technological know-how, management expertise, and capital.

Concessional financing refers to loans or grants provided at favorable terms by international financial institutions or donor countries. This type of financing is designed to support projects that may not be commercially viable under traditional financing conditions. Concessional loans typically

have lower interest rates, longer repayment periods, or grace periods compared to commercial loans. Grants, on the other hand, do not need to be repaid and can be used to cover a portion of the project cost. International financial institutions and donor countries provide concessional financing to promote sustainable development and address global challenges such as climate change.

Export credit agencies provide guarantees and insurance to support exports of renewable energy equipment and services. [14] These agencies help to mitigate the risks associated with exporting, such as non-payment by foreign buyers or political instability in the importing country. By providing guarantees and insurance, export credit agencies enable renewable energy companies to expand their markets and increase their exports. This support is crucial for the growth of the renewable energy industry, as it allows companies to access new markets and customers.

1.2.3. Emerging models in the context of digital economy

In the digital economy era, emerging models such as the development of digital infrastructure, e-commerce platforms and fin-tech solutions have become important for attracting international investment. These models offer new opportunities and channels for cross-border investment.

For attracting international investment in renewable energy, the emerging models include crowdfunding, blockchain-based financing and

peer-to-peer energy trading.

Crowdfunding has emerged as an innovative means of attracting capital for renewable energy projects. It enables a large number of small investors to pool their resources and contribute to initiatives that they believe in. Through online crowdfunding platforms, project developers can present their renewable energy proposals to a global audience. This democratizes the investment process, allowing individuals who may not have the means or opportunity to engage in traditional large-scale investment to still have a stake in the growth of the renewable energy sector. Crowdfunding campaigns have been successful in raising significant amounts of capital for small to medium-sized renewable energy installations, such as community solar farms. These campaigns not only provide the necessary funds but also create a sense of community ownership and support around the projects.[15]

Blockchain-based financing represents a revolutionary approach in the financial landscape of renewable energy. Blockchain technology, with its decentralized and immutable ledger, offers enhanced security and transparency. It allows for the creation of smart contracts that can automate various aspects of the investment process, from the initial capital raise to the distribution of returns. In the context of renewable energy financing, this means that investors can have greater confidence in the integrity of the transactions. According to our research, we can figure out how blockchain

can address issues such as fraud and mismanagement that have sometimes plagued traditional financing models. It enables a more efficient and trustworthy way to raise capital for large-scale renewable energy projects, such as offshore wind farms, by providing a clear and auditable record of all financial activities.[16]

Peer-to-peer energy trading is another significant development. It empowers consumers to become active participants in the energy market. By leveraging digital platforms and smart grid technologies, individuals or businesses with excess renewable energy generation can sell it directly to other consumers. This eliminates the need for traditional energy utilities to act as intermediaries in all transactions. A case study in "Peer-to-peer energy trading using renewable energy sources and electric vehicles" demonstrated that in certain regions where peer-to-peer energy trading has been implemented, it has led to increased energy efficiency, reduced costs for consumers, and a more resilient and decentralized energy grid. It also encourages the adoption of renewable energy sources at the individual and community levels, as it provides an economic incentive for generating and sharing clean energy.[17]

Although these emerging models still lack more data and experimental support, their initially demonstrated fundraising potential provides strong support for the development of renewable energy.

1.3. Methods for assessing the effectiveness of international investment in projects

1.3.1. Financial metrics for effectiveness evaluation

In the evaluation of international investment projects, financial metrics play a crucial role. Usually, net present value, the internal rate of return and return on investment are used in this evaluation structure.

Net present value (NPV) [18] is a fundamental metric that quantifies the current worth of all projected future cash inflows and outflows associated with an investment, factoring in the time value of money. By discounting future cash flows back to the present using an appropriate discount rate, which often reflects the cost of capital or the required rate of return, NPV provides a clear indication of the value added or depleted by the investment. A positive NPV suggests that the investment is expected to generate more value than the initial outlay and is potentially attractive.

The internal rate of return (IRR) [19] is another significant metric. It represents the specific discount rate at which the NPV of an investment project equals zero. In essence, it is the rate of return that the investment is anticipated to achieve over its lifespan. This metric is highly valuable as it allows investors to compare the expected return of an investment with their own hurdle rate or the minimum acceptable rate of return. If the IRR exceeds this threshold, the investment may be considered viable and

worthy of further consideration.

Return on investment (ROI) [20] is a widely recognized and straightforward metric that measures the profitability of an investment by calculating the ratio of the gain or loss from the investment relative to its cost. It offers a simple yet effective way to assess how efficiently an investment utilizes its resources to generate returns. A higher ROI indicates a more efficient use of capital and a greater potential for financial gain.

The importance and widespread application of these financial metrics in the assessment of international investment projects are obviously. These metrics, with their distinct characteristics and calculations, together form a comprehensive framework that enables investors to make well-informed and rational decisions. They provide a quantitative basis for evaluating the potential financial rewards and risks associated with different international investment opportunities, thereby guiding investors in allocating their resources in a manner that maximizes their financial objectives and aligns with their risk tolerance levels.

1.3.2. Non-financial indicators and their significance

In addition to financial metrics, non-financial indicators such as environmental impact, social benefits, and technological innovation also play an important role in assessing the effectiveness of international investment in renewable energy projects. Non-financial indicators such as

environmental impact, social responsibility, and governance (ESG) factors have gained increasing importance in investment decision-making [21]. They provide a more comprehensive assessment of the long-term sustainability and societal impact of an investment.

Environmental impact is an important non-financial indicator in assessing renewable energy projects. It primarily measures the reduction in carbon emissions and other pollutants that are generated as a consequence of these projects. In the area of renewable energy, a significant focus is on minimizing the environmental footprint. This measurement directly reflects the positive contribution of such projects towards combating climate change and reducing the negative impacts on the ecosystem.

Social benefits is another key non-financial aspect, encompass job creation, community development and improved access to energy. Job creation not only provides livelihoods but also stimulates local economies. Community development can involve infrastructure improvements, educational initiatives and enhanced social cohesion. Improved access to energy is a key for ensuring the well-being and economic growth of communities, particularly in areas where energy availability is limited.

Technological innovation within renewable energy projects refers to the utilization of new technologies and processes that have the potential to enhance the efficiency and cost-effectiveness of these projects. This can involve advancements in solar panel technology, wind turbine design,

energy storage solutions and smart grid systems. By continuously innovating and adopting new technologies, renewable energy projects can become more competitive and sustainable in the long run.

1.3.3. Challenges and limitations in assessment methods

Despite the importance of financial and non-financial indicators, there are challenges and limitations in assessing the effectiveness of international investment in renewable energy projects, including the difficulty in accurately predicting future market conditions, the complexity of quantifying non-financial factors and the influence of external macroeconomic uncertainties.

One of the challenges is the uncertainty in future market conditions, like changes in energy prices, regulatory policies and technological advancements. Another limitation is the difficulty in quantifying non-financial benefits, such as environmental impact and social benefits.

To face with these challenges, it is necessary to use a combination of quantitative and qualitative methods and to conduct sensitivity analysis to assess the robustness of investment decisions. Therefore, scenario analysis can be used to evaluate the impact of different market conditions on the financial performance of a renewable energy project as we have utilized this model to conduct deductions on multiple data indicators, striving to obtain relatively accurate demonstrations for the suggestions put forward

in our efforts to attract international investment in the renewable energy sector.

The scenario method is a planning tool that can be used to design long-term objectives while the future remains undecided and uncertain. And there are three main categories of scenario: predictive scenarios, exploratory scenarios, and normative scenarios. And it is based on four distinct stages: construction of the basis, development of images of future situations, verification of the quality of the scenarios produced, and study of the consequences of these scenarios. [22]

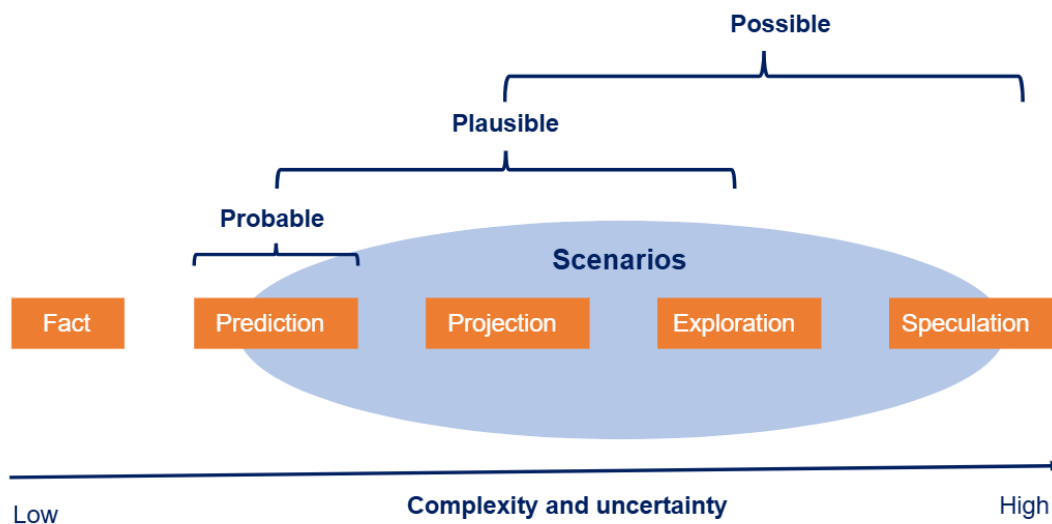


Fig. 1.1 Different approaches to designing scenarios [22]

Conclusions to Section 1

This section comprehensively presents an in-depth overview of the fundamental theoretical underpinnings of international investment. The theoretical foundations of international investment in renewable energy

encompass a wide range of aspects, including the precise definition and extensive scope of international investment, diverse categories and various forms of investment, distinct risk and return characteristics, well-established principles and effective models for attracting investment, as well as reliable methods for assessing the effectiveness of investment. In recent years, the global investment in renewable energy has been experiencing a significant upward trend, propelled by multiple factors such as an enhanced sense of climate change awareness, well-crafted government policies and remarkable technological advancements. Traditional models for attracting investment, such as public-private partnerships (PPPs) and concessional financing, have been widely employed and have demonstrated their effectiveness. Meanwhile, emerging models in the digital economy hold tremendous potential and may revolutionize the investment landscape. Financial and non-financial indicators are also very important in evaluating the effectiveness of investment. However, it must be noted that there are inherent challenges and limitations in assessment methods which require further research and improvement.

The implications for attracting international investment in renewable energy lie in the absolute necessity for a holistic approach that meticulously takes into account both financial and non-financial aspects, as well as the astute adaptation to emerging trends in the global economic landscape. To

attract international investment in renewable energy, countries must take proactive measures to provide a stable regulatory environment, offer highly attractive financial incentives, ensure absolute transparency and predictability in policy-making and judiciously utilize a combination of financial and non-financial indicators for attracting international investment.

CHAPTER 2: ANALYSIS OF INTERNATIONAL INVESTMENTS IN RENEWABLE ENERGY

2.1. International investment activity in the renewable energy sector

2.1.1. Trends and patterns of investment flow

Renewable energy, including solar, wind, hydro-power, bio-fuels and others, are at the center of the transition to less carbon-intensive and more sustainable energy systems. Generation capacity has grown rapidly in recent years, driven by policy support and sharp cost reductions for solar photovoltaic and wind power in particular. And the deployment of renewable in the power, heat and transport sectors is one of the main enablers of keeping the rise in average global temperatures below 1.5°C. In the Net Zero Emissions by 2050 scenario in Fig 1.2, the investment requirements of renewable power generation reached on the second important part of the all-energy requirements. [23] Meanwhile, renewable transport fuels and renewable heat contribute to significant emissions reductions in transport, buildings and industry. At this situation, renewable energy has emerged as a crucial pillar in the pursuit of sustainable development. In today's world, where environmental concerns and the need for clean energy sources are paramount, attracting international investment in renewable energy has become a topic of significant importance.

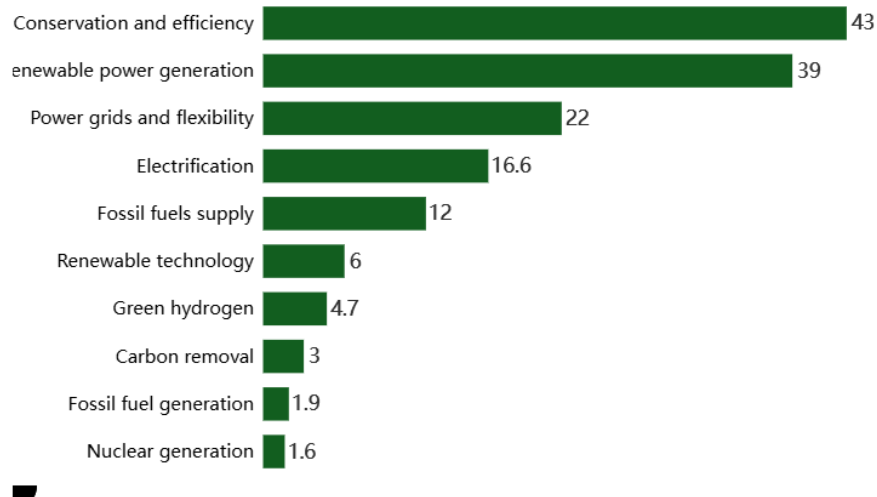


Fig.1.2 1.5°C scenario investment requirements, aggregate, 2023-2025 (\$T)

Source: International Renewable Energy Agency (IRENA) World Energy Transitions Outlook 2023.

Global energy investment is projected to exceed USD 3 trillion for the first time in 2024, with a significant portion of USD 2 trillion directed towards clean energy technologies and infrastructure. Since 2020, investment in clean energy has been accelerating, and currently, spending on renewable power, grids, and storage has surpassed the total spending on oil, gas, and coal.[24]

Over the past ten years, there has been a significant increase in international investment activity in the clean energy sector as the data shown from IEA (2024) [24].

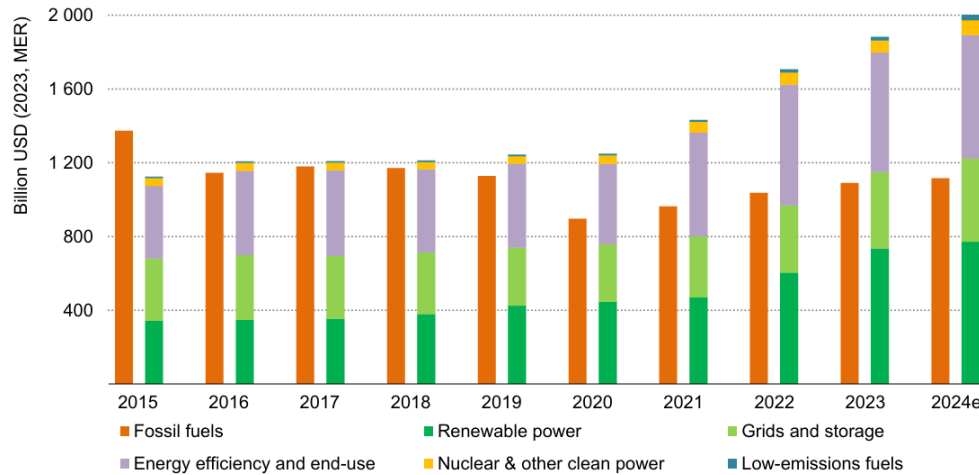


Fig. 1.3 Global investment in clean energy and fossil fuels, 2015-2024e[24]

And according to the report, the global investment in renewable energy has indeed been on an upward trend in the past five years. In 2019, the investment volume in renewable energy amounted to \$424. By 2023, it had surged to \$735, which is over twice the figure in 2019. Despite a deceleration in the growth rate in 2024, the upward momentum has persisted. Looking ahead to 2024, early projections suggest that the investment could go increasing and potentially reach \$771 billion dollars or more depending on various market factors.[24] This growth can be attributed to several factors, including the increasing awareness of climate change, government policies and incentives, and technological advancements in the renewable energy sector.

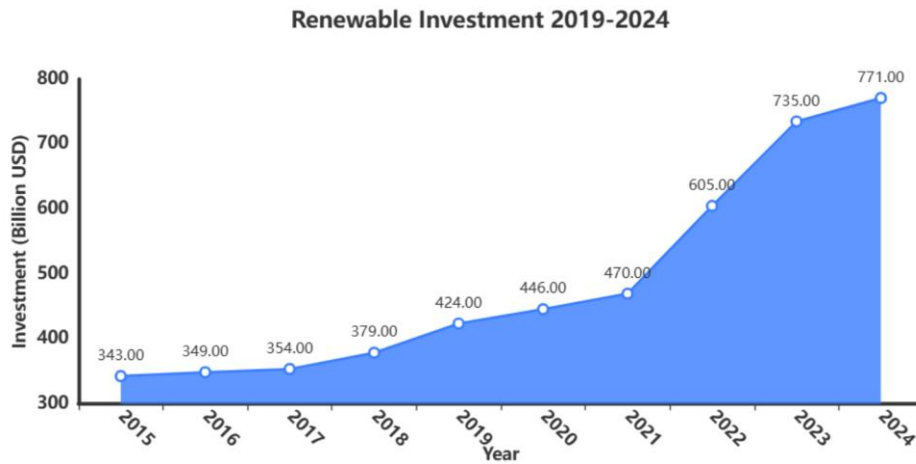


Fig.1.4 Renewable Energy Investment 2019-2024

Source: Compiled by author based on [24]

This remarkable growth trend can be attributed to several crucial factors. Firstly, the mounting concerns over climate change have compelled governments and international organizations to formulate and implement more stringent environmental policies and emission reduction targets. These policies have created a favorable policy environment that encourages investment in renewable energy projects. For instance, many countries have introduced feed-in tariffs, tax incentives, and subsidy programs to promote the development of solar, wind, and other renewable energy sources.

Secondly, the continuous technological advancements in the renewable energy field have led to a significant reduction in production costs. The efficiency of solar panels and wind turbines has increased substantially, while the costs of manufacturing and installation have declined. This has enhanced the economic viability and competitiveness of

renewable energy projects, attracting more investors.

Thirdly, the changing global energy consumption pattern and the increasing demand for clean energy have opened up vast market potential. As consumers and industries become more environmentally conscious, the demand for renewable energy - based electricity and heat is on the rise. This has spurred investors to pour capital into the construction and expansion of renewable energy generation facilities.

Moreover, the development of energy storage technologies and smart grid systems has further improved the stability and reliability of renewable energy supply, making it a more attractive investment option. Looking ahead, with the further deepening of global efforts to address climate change and the continuous innovation in renewable energy technologies, it is expected that international investment in this sector will continue to grow, playing an even more crucial role in promoting the global energy transition and sustainable development.

But there are major imbalances in investment, and Emerging Market and Developing Economies (EMDE) outside China account for only around 15% of global clean energy spending. [24] This disparity is a cause for concern as it hinders the global transition to sustainable energy at a more rapid pace.

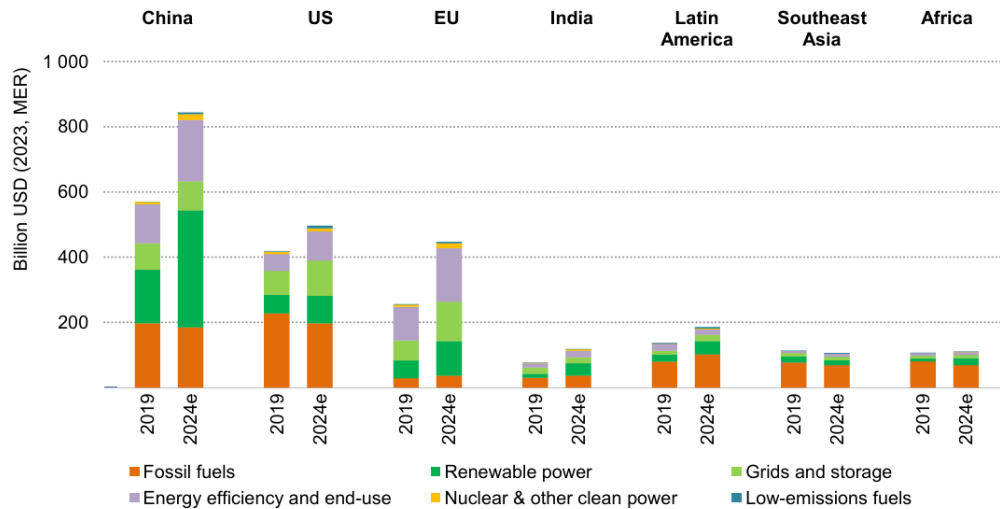


Fig. 1.5 Annual energy investment by selected country and region, 2019 and 2024e [24]

One of the main reasons for such a significant gap is the limited access to affordable financing in these economies. Unlike developed regions, EMDEs often face higher borrowing costs and more stringent lending conditions, which deter potential investors and developers. Additionally, the lack of well-developed infrastructure and technological capabilities in many of these areas makes it more challenging and costly to implement large-scale clean energy projects. Political instability and regulatory uncertainties also play a role, as investors are reluctant to commit their funds in an environment where policies can change abruptly.

However, if efforts are made to address these issues, the untapped potential in EMDEs could be unlocked. For example, international cooperation and assistance programs could be established to provide financial and technical support, helping to build the necessary infrastructure and regulatory frameworks. This would not only boost clean

energy investment in these economies but also contribute to global efforts in combating climate change and achieving energy security. It would also create new economic opportunities and employment in the EMDEs, promoting their overall development and integration into the global clean energy supply chain. Therefore, the investment potential in the global market remains huge.

The investment flow has been mainly directed towards solar and wind energy, with solar energy attracting the largest share. And the investment in solar PV now surpasses all other generation technologies combined, and it continues to show an upward trend as it is shown in Fig.1.6. Solar investment accounted for approximately 54% of the total renewable energy investment in 2024[24].

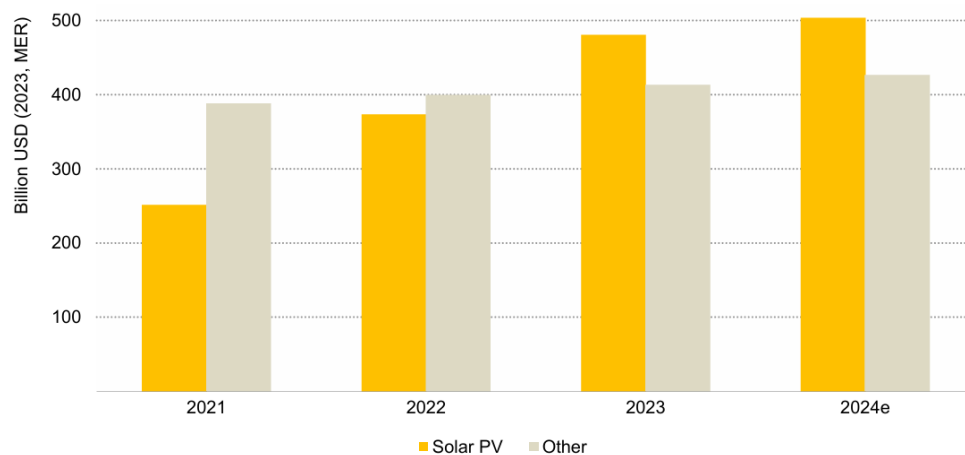


Fig. 1.6 Global annual investment in solar PV and other generation technologies, 2021-2024e [24]

This remarkable growth can be attributed to several key factors.

1. The continuous decline in the cost of solar photovoltaic

technology has made it more economically viable and attractive. The decreasing prices of solar panels, inverters, and other essential components have significantly reduced the overall project costs, thereby increasing the return on investment.

2. The growing global awareness of environmental protection and the urgent need to address climate change have driven governments and enterprises to prioritize clean and renewable energy sources. Solar power, as a clean and abundant energy option, has received extensive support and incentives in many countries. These include favorable policies such as feed-in tariffs, tax credits, and subsidies, which have further stimulated the expansion of solar photovoltaic investment.

3. Technological advancements in energy storage and grid integration have enhanced the stability and reliability of solar power systems, making them more suitable for large-scale deployment and integration into the existing energy infrastructure.

4. As a result, not only have existing investors increased their stakes in solar photovoltaic projects, but also a large number of new investors, including institutional investors and venture capitalists, have been attracted to this promising sector, fueling the continuous upward trend and solidifying its position as a leading force in the global energy investment landscape.

Also, we found the integration of renewables and upgrades to existing

infrastructure have sparked a recovery in spending on grids and storage.

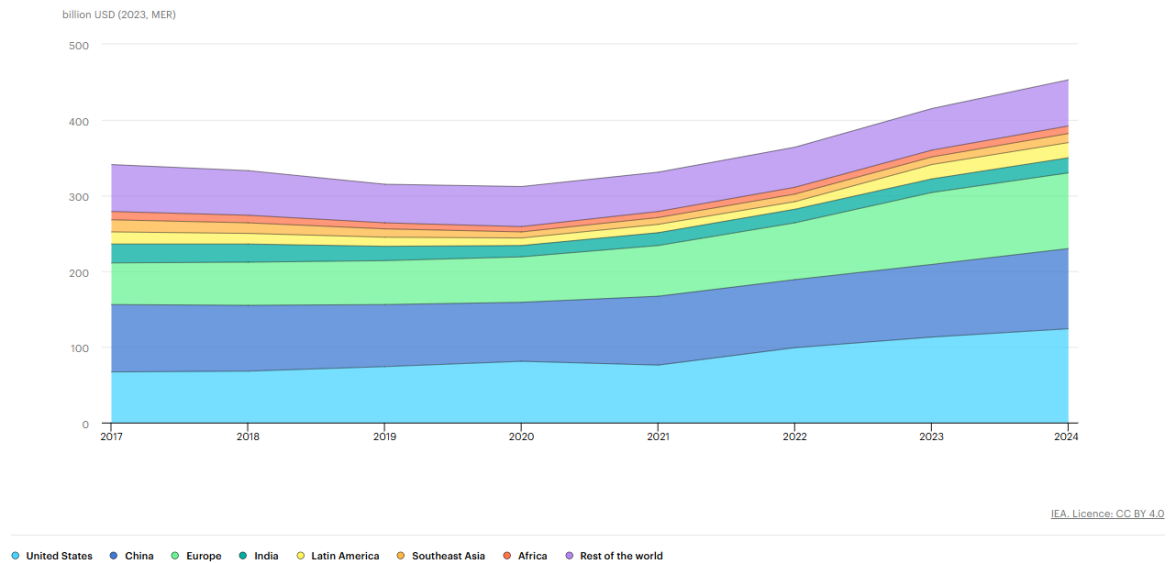


Fig. 1.7 Investment in power grids and storage by region 2017-2024 [24]

This is mainly because as the share of renewable energy in the power mix continues to increase, the traditional power grid infrastructure needs to be adapted and enhanced to accommodate the intermittent and variable nature of renewable energy sources such as solar and wind. Advanced grid technologies like smart grids enable better management and distribution of electricity generated from renewables, ensuring a more stable and reliable power supply.

In terms of energy storage, it plays a crucial role in balancing the supply and demand of electricity. With the growth of renewable energy, the need for storing excess energy during peak generation periods and releasing it during low generation or high demand periods has become essential. This has led to increased investment in various energy storage technologies such as lithium-ion batteries, pumped hydro storage, and

thermal energy storage.

The recovery in spending on grids and storage not only supports the further development and large-scale integration of renewable energy but also creates new business opportunities and employment in related industries. It promotes innovation in grid and storage technologies and accelerates the transformation of the entire energy system towards a more sustainable and efficient model.

The investment flow in the renewable energy sector has also shown certain trends and patterns. Solar and wind energy have received the majority of investment, while other renewable energy sources such as geothermal and hydro power have also attracted significant attention.

According to the report of Global Wind Energy Council in 2024, the global wind industry installed a record 117GW of new capacity. In 2023, the record represents a 50% hike from the previous year, which reflects the resilience of the industry even as it faced prolonged supply chain and macroeconomic difficulties and the wind energy investment occupies an important share in the renewable energy field. [25]

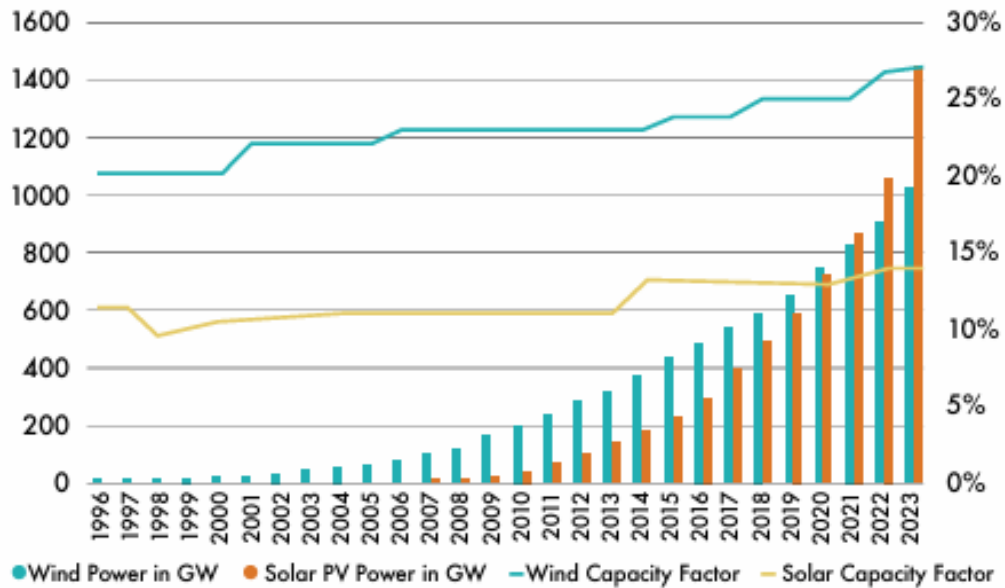


Fig. 1.8 Global Total installation Power in GW and Capacity Factor, Wind vs Solar PV [25]

This significant growth in wind power installation capacity is mainly attributed to several factors.

1. The continuous technological innovation and improvement in wind turbine efficiency have made wind energy more economically viable and competitive. The larger and more advanced turbines can generate more electricity with lower costs per unit, attracting more investment and deployment.

2. The increasing global awareness of environmental protection and the urgent need to reduce carbon emissions have driven governments and enterprises to actively promote the development of wind energy. Many countries have introduced favorable policies and incentives, such as feed-in tariffs, tax credits, and subsidy programs, which have effectively stimulated the expansion of the wind power

market.

3. The improvement of grid connection and energy storage technologies has enhanced the stability and reliability of wind power integration into the power grid. This has alleviated concerns about the intermittency and variability of wind energy, making it more acceptable and applicable in a wider range of power supply systems.

Looking ahead, with the further development of wind energy technology and the strengthening of international cooperation in addressing climate change, it is expected that the global wind power industry will continue to maintain a strong growth momentum and contribute more to the global clean energy transition and sustainable development.

In the aspect of geothermal energy, although its investment scale is relatively smaller compared to solar and wind energy, it is also growing steadily. According to relevant research estimates, in some countries rich in geothermal energy resources and actively developing them, such as the United States and Iceland, the annual investment in the geothermal energy field can range from several hundred million dollars to several billion dollars.

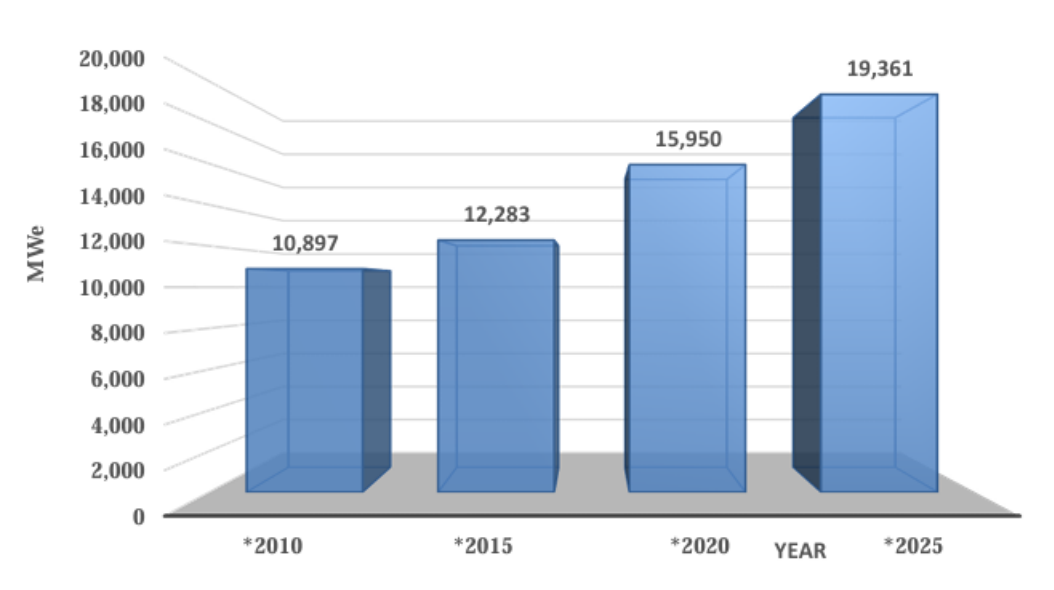


Fig. 1.9 World Total Installed Geothermal Capacity 2010 to 2025[26]

For hydropower, the data of the International Hydropower Association (IHA) indicates that the investment in large hydropower projects remains strong. Although 2023 was a disappointing year for delivery of new hydropower capacity. IHA has identified delivery of 13.7GW of new capacity, of which 6.5GW is PSH. It is important to note that there will inevitably be variability from year to year in the capacity delivery figures, due to the nature of large infrastructure developments. [27] But projects like the Baihetan Hydropower Station in China still have huge investments. [28] The global annual investment in hydropower is also at the level of tens of billions of dollars. Moreover, in some emerging markets and developing economies, hydropower investment is regarded as a crucial part of infrastructure construction and energy development, and there is a continuous inflow of investment.

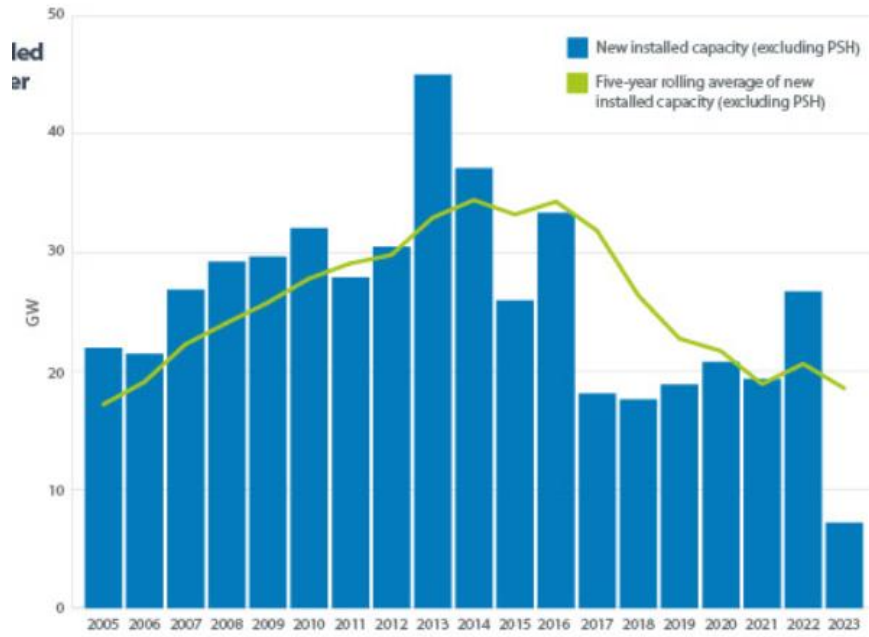


Fig. 2.0 New Installed hydropower capacity [27]

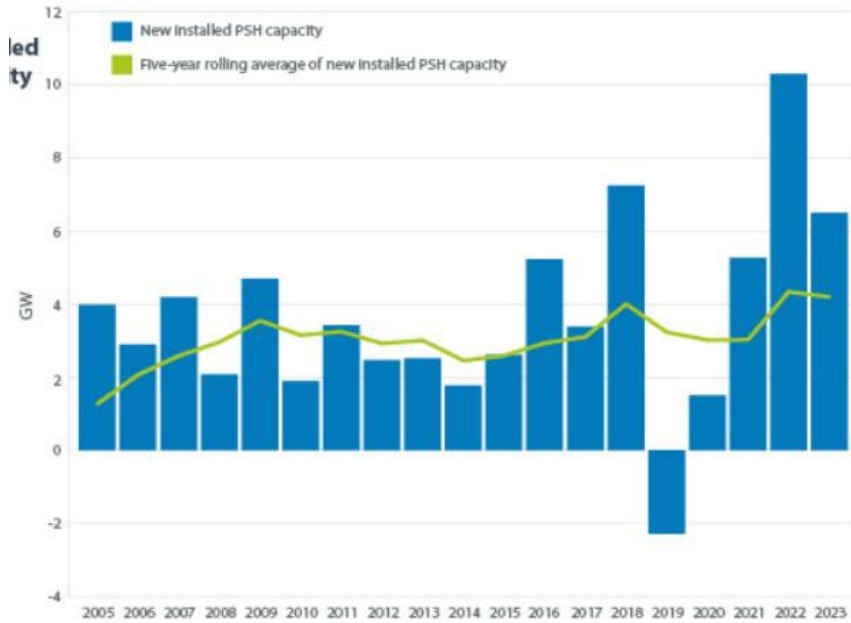


Fig. 2.1 New installed PSH capacity [27]

Table 1.1 The Baihetan Hydropower Station in China

Information	Description
Project Name	Baihetan Hydropower Plant
Total Installed Capacity	16 GW

Rank in the World	Second-largest (after Three Gorges Dam)
Number of Generating Units	16 (each with 1 GW capacity)
Annual Electricity Generation	62,400 gigawatt-hours
Population Served	Approximately 75 million people
Location	Jinsha River (upper reaches of Yangtze River, through Sichuan and Yunnan)
Dam Structure	Ultra-high double-curvature arch configuration, maximum height of 289 meters, arc length of 709 meters
Material Consumption	About 8 million cubic meters of low-heat cement
Flood Spillways	Three pressure-less flood spillways, discharge speed of 47 meters per second
Related Projects in the Region	Xiluodu Station (13.86 GW), Wudongde Station (10.2 GW), Xiangjiaba Station (6.4 GW)
Total Capacity of Related Projects	More than twice the capacity of Three Gorges Dam
Clean Energy Benefit	Save up to 19.68 million tonnes of standard coal, cut carbon dioxide emissions by 51.6 million tonnes
Electricity Generated Since Commissioning	Over 53 billion kWh since June 2021
Transmission Project	Part of "East Powered by the West", two UHVDC transmission lines to Jiangsu and Zhejiang Province
Length of Transmission Lines	Baihetan-Jiangsu line: 2,080 kilometers; Baihetan-Zhejiang line: 2,140.2 kilometers
Operation Time of Transmission Lines	Baihetan-Zhejiang line set to enter operation by 2023, capable of transmitting up to 8,000 megawatts

Compiled by author based on [28]

In addition, investment has been concentrated in certain regions, such as Europe, North America, and Asia, where there is strong government support and a growing demand for clean energy.

Table 1.2 Renewable Energy Investment in Certain Regions 2015-2024
(Billion USD)

Certain regions	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Advanced Economies	181	173	164	172	180	189	209	241	267	279
Emerging market and developing economies	63	63	62	73	80	77	86	109	128	134
China	99	112	129	134	164	179	175	254	340	359
North America	63	61	50	56	63	67	69	75	82	91
Central and South America	24	20	17	17	18	21	27	38	42	38
Europe	82	81	80	82	82	85	103	125	137	140
Africa	11	10	8	8	9	10	12	17	21	22
Middle East	2	2	3	3	3	3	4	5	5	6
Eurasia	3	3	3	4	6	5	4	4	4	4

Compiled by author based on [24]

Based on the data, the possible reasons of the trends were given below:

Table 1.3 Trend analysis for certain regions (2015-2024)

Region	Trend Description	Possible Reasons
Advanced Economies	Exhibit a generally increasing trend in the values over the years. The growth is relatively steady, with a notable acceleration from 2019 onwards.	Technological advancements, economic policies promoting growth in certain sectors, overall improvement in the economic environment.
Emerging market and developing economies	Also show an upward trend, albeit with some fluctuations. The growth rate seems to have picked up in recent years.	Increased globalization, infrastructure development, rising domestic consumption.
China	Has experienced significant growth, especially from 2019 to 2023.	Continuous economic expansion, large - scale infrastructure projects, position in the global manufacturing and trade network.
North America	The values have gradually increased over time, with a relatively stable growth pattern.	Domestic demand, technological innovation in the region, its role in the global economy.
Central and South America	Showed some fluctuations but an overall upward trend.	Commodity prices, regional economic integration efforts, domestic policies.
Europe	The values have been relatively stable with a slow upward trend.	The EU's economic policies, technological development, efforts towards sustainable growth.
Africa	The region has seen a slow but steady increase.	Increasing foreign investment, infrastructure development, growth

		of some key sectors.
Middle East	The values are relatively low and have increased marginally.	The region's economy is highly dependent on oil and gas, slow growth due to fluctuations in global energy prices and efforts to diversify the economy.
Eurasia	The values have remained relatively stable.	A relatively consistent economic situation in this region over the years.

Compiled by author based on [24]

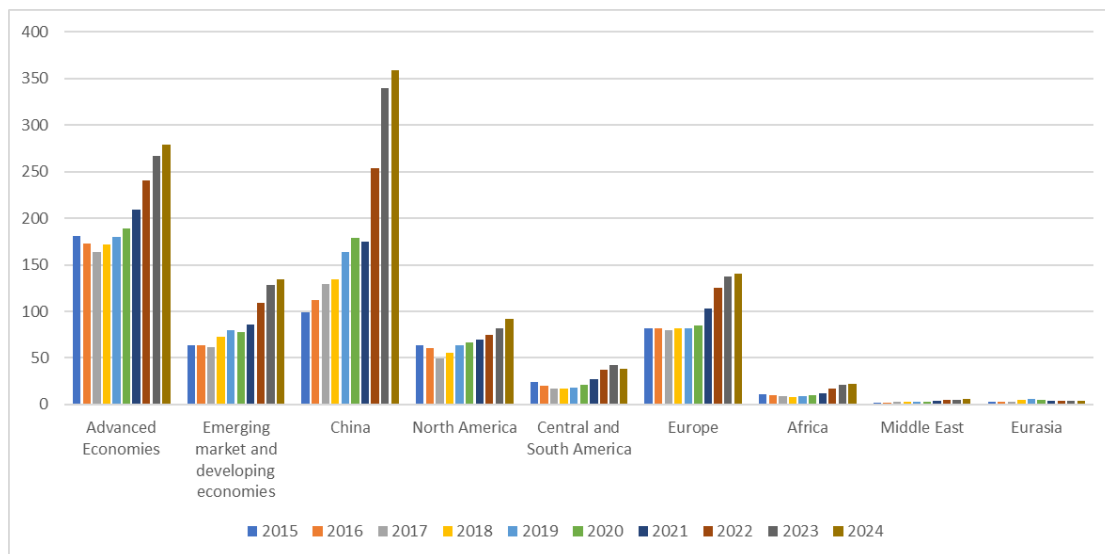


Fig.2.2 Renewable Energy Investment in Certain Regions 2015-2024 (Billion USD)

Compiled by author based on [24]

And the Fig. 2.2 clearly showed us the possible trends changing in these regions.

- The trends suggest that emerging market and developing economies, especially China, will continue to play an increasingly important role in the global economy. They may contribute more to global GDP growth and influence global trade and investment patterns.

- Advanced economies need to adapt to the changing global economic

landscape and find new sources of growth to maintain their competitiveness.

- Regions with slower growth, like Africa and the Middle East, need to focus on diversifying their economies to reduce their dependence on a single sector or resource and promote sustainable growth.

Otherwise, we also need to attach importance to the trend of return in this sector.

According to a study by IEA, the rate of return on investment in renewable energy projects reached 422.7% in 2021[29] (the newest data). This return is much higher than traditional investment options in some cases. Moreover, as the world transitions towards a low-carbon economy, the demand for renewable energy is expected to increase, further enhancing the potential returns on investment.

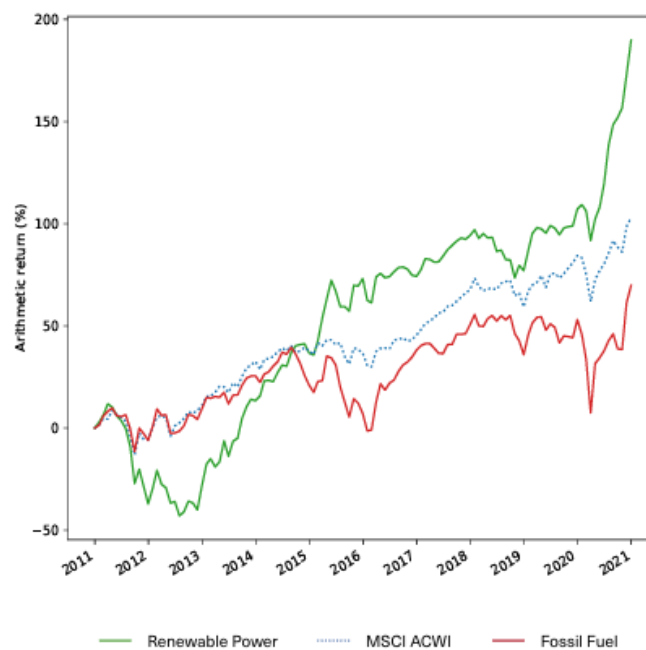


Fig. 2.3 Global Markets Portfolio 10-Year Monthly Returns [29]

Table 1.4 Key Results for Global Markets Portfolios [29]

Global Markets Portfolios		
	Fossil Fuel	Renewable Power
10 Years		
Total Return	59.0%	422.7%
Arithmetic Return	69.8%	189.1%
AAR	4.7%	18.0%
Annualised Volatility	6.3%	6.2%
Best Monthly Return Date	24.1% Apr-20	18.9% Jul-20
Worst Monthly Return Date	-26.2% Mar-20	-18.0% Sep-11
Sharpe Ratio	0.30	0.86
Beta	1.31	1.08
5 Years		
Total Return	59.3%	186.6%
Arithmetic Return	62.7%	116.8%
AAR	9.8%	23.4%
Annualised Volatility	7.3%	6.1%
Best Monthly Return Date	24.1% Apr-20	18.9% Jul-20
Worst Monthly Return Date	-26.2% Mar-20	-14.5% Mar-20
Sharpe Ratio	0.45	1.06
Beta	1.48	1.08

As Fig 2.3 and Table 1.4 showed, we can get the main information that the returns of the two global market portfolios are graphically represented in comparison with the MSCI All Country World Index (ACWI). Commencing from 2013, a progressive annual enhancement in the returns of the global renewable portfolio is observable. From 2015 onwards, its performance has surpassed that of the global fossil fuel portfolio as well as the MSCI ACWI. The subpar performance of the global fossil fuel portfolio in 2015 synchronizes with a decline in oil prices, a reduction in investment, and diminished returns on invested capital among the largest oil and gas enterprises.

The superior performance of renewables since 2015 corresponds to a phase of ameliorated fundamentals and augmented cost-competitiveness. This is buttressed by the more extensive implementation of supportive

policies globally, the reduction in technology costs, and the low-interest-rate environment. The returns on invested capital for the leading renewable power developers have gradually ascended to a range between 6% and 8% during the period from 2017 to 2019. The proportion of renewable power in global energy investment has escalated to nearly one-fifth, which particularly manifests the robust anticipations for continuous deployment even during the crisis in 2020.

In the context of comparing the returns of the portfolios, the global renewable portfolio demonstrates higher returns and lower volatility throughout the period under consideration. It exhibits a Sharpe Ratio that is 56 basis points greater than that of the global fossil fuel portfolio, thereby accentuating the relatively elevated average risk-adjusted return associated with renewable investments. The global renewable portfolio has a beta value of 1.08, whereas the global fossil fuel portfolio possesses a beta of 1.31 in relation to the MSCI ACWI. This indicates that the fossil fuel portfolio exhibits a more pronounced responsiveness to market fluctuations.

Even in different markets, the rates of return on investment generally follow similar trends, with the returns on renewable energy being higher than those on fossil fuels.

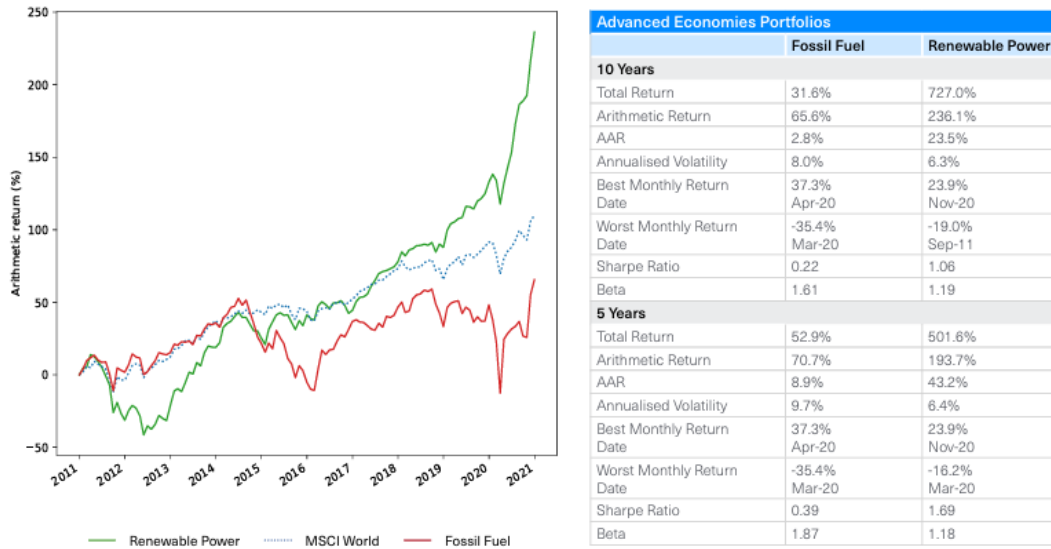


Fig. 2.4 Advanced Economies Portfolios [29]



Fig. 2.5 Emerging Market and Developing Economies Portfolios [29]

2.1.2. Major players and their investment strategies

In the international renewable energy investment market, several key players are making significant contributions. These major players consist of institutional investors, energy companies, and private equity firms in the private sector, and governments and SOES investment.

Although energy investment decisions are primarily driven and financed by the private sector, governments have essential direct and indirect roles in shaping capital flows. They can introduce tax incentives, subsidies, and regulatory frameworks that encourage or mandate certain types of energy investments. By providing financial support and guarantees, they can reduce the risks associated with clean energy projects and make them more attractive to private investors. Indirectly, governments can invest in research and development to drive technological innovation, which in turn can create new investment opportunities. They can also promote education and training programs to build a skilled workforce for the energy sector. Moreover, governments can use diplomatic and international cooperation channels to facilitate cross-border energy investments and technology transfer. In addition, by setting emission reduction targets and energy security goals, they can guide the overall direction of energy investment and ensure that it aligns with national and global sustainable development objectives.

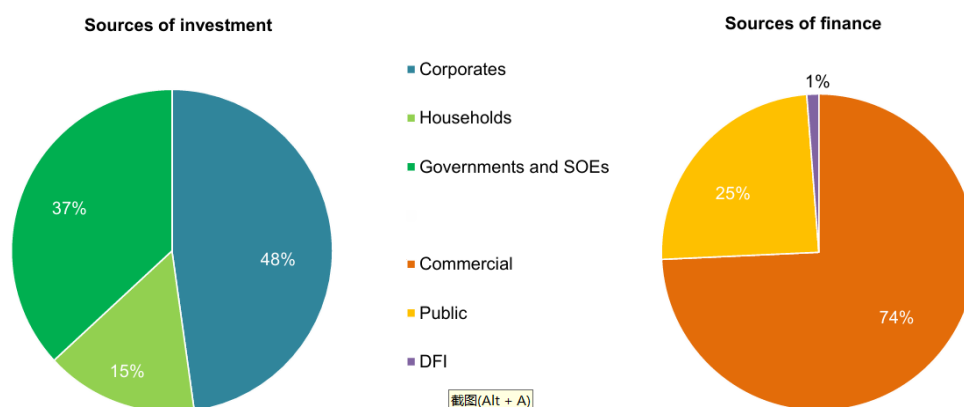


Fig. 2.6 Sources of finance and investment in the energy sector, average 2018-2023[29]

Fig. 2.6 has showed, in sources of investment, corporates have the highest rate of 48%, governments and SOES has 37% which can rank in the second floor, while the households have 15% portion which is also one of the most imports sources.[24] The significant share of corporate investment indicates their crucial role in driving the energy investment landscape. Corporations, often with a focus on profitability and market expansion, are actively involved in various energy projects, especially those related to emerging and potentially lucrative clean energy technologies. Their investment decisions are influenced by factors such as market trends, technological advancements, and regulatory policies. The 37% contribution from governments and state-owned enterprises (SOEs) reflects their strategic importance. Governments may invest directly to support national energy security, meet emission reduction targets, or promote the development of specific regions or industries. SOEs, on the other hand, might be engaged in large-scale infrastructure projects or in sectors where private investment is less forthcoming due to high risks or long payback periods. The 15% from households, although relatively smaller, should not be overlooked. Households can invest in energy-related assets either directly, such as through rooftop solar installations, or indirectly via investment funds and stocks related to the energy sector. Their investment behavior can be affected by personal environmental awareness, financial incentives, and the availability of accessible

investment channels. Overall, understanding the distribution and characteristics of these different investment sources is essential for formulating effective energy investment policies and strategies, as well as for predicting future trends in the energy market.

Moreover, a detailed analysis of the main sources of investment in the private investment sector was also conducted. These players have distinct investment strategies.

Table 1.4 Comparison institutional investors & energy companies & Private equity firms

Investors	Features
Institutional investors	-Prefer to invest in large-scale renewable energy projects through project finance or direct investment. -Spread their risk and participate in projects with significant potential returns.
Energy companies	-Focus on acquiring existing renewable energy assets or developing new projects in-house. -Prefer to control over the project and enables them to integrate renewable energy into their existing business operations.
Private equity firms	-Target early-stage companies with innovative technologies and high growth potential. -Help startups grow and scale their operations.

Compiled by author based on [30][31]

Some institutional investors prefer to invest in large-scale renewable energy projects through project finance or direct investment. This approach allows them to spread their risk and participate in projects with significant potential returns. Energy companies may focus on acquiring existing renewable energy assets or developing new projects in-house. This gives them control over the project and enables them to integrate renewable

energy into their existing business operations. Private equity firms often target early-stage companies with innovative technologies and high growth potential. By providing capital and strategic support, private equity firms can help these startups grow and scale their operations.

Institutional investors, such as pension funds and insurance companies, have demonstrated a growing attraction to renewable energy. Renewable energy projects, with their long-term stability and environmental benefits, are becoming an increasingly attractive option for institutional investors like pension funds and insurance companies. They offer stable cash flows over extended periods, aligning with the long-term investment strategies of such entities. [30][31]

Table 1.5 Institutional projects in renewable investment 2014-2024

Project	Region	Investment Amount	Project Description
M&G Investments in Primrose Solar Projects	The UK	Long-term financing	In the fourth quarter of 2014, M&G Investments provided long-term financing for two projects of Primrose Solar Company. The company was jointly established by Vanguard Point Partners and York Capital Management. The projects involve five solar power stations with a total installed capacity of about 80 megawatts.
Buffett's Investment in Iowa Renewable Energy Projects	The USA	Nearly 4 billion US dollars	In 2022, Buffett planned to invest nearly 4 billion US dollars to build more wind and solar power projects in Iowa, USA, and also planned to fund related technical research on carbon capture, energy storage and small nuclear reactors.
Junlian Capital and Others' Investment in Sunshine Hydrogen Energy	The PRC	660 million yuan	In December 2023, Sunshine Hydrogen Energy Technology Co., Ltd. completed a Series A financing of 660 million yuan. Led by Junlian Capital, with Hillhouse Ventures, CDH Investments, China Merchants Venture Capital, Renfa Carbon Neutrality, Zhongsu Capital, Shanghai Lingang Hydrogen Energy Fund, and

			Howbuy FOF following the investment. Sunshine Hydrogen Energy will accelerate the iteration of flexible hydrogen production technology and capacity upgrading.
Recurrent Energy Financing for European Projects	Canada	1.3 billion euros	In May 2024, Recurrent Energy, a subsidiary of Canadian Solar, reached a multi-currency revolving credit financing agreement of 1.3 billion euros with ten banks for the development and construction of solar and energy storage projects in European countries such as Spain, Italy, the UK, the Netherlands, France and Germany.
Silk Road Fund and Masdar Cooperation	The PRC	Up to 20 billion yuan	In November 2024, the Silk Road Fund and Abu Dhabi Future Energy Company of the UAE signed a memorandum of understanding, planning to jointly invest in renewable energy projects developed, invested or operated by Masdar. Masdar has a large number of renewable energy investment projects in "Belt and Road" regions such as the Middle East, Central Asia, Southeast Asia and Africa.
Aviva Investors' Investment in Ecotricity Projects	The UK	About 70 million pounds	In 2024, the renewable energy company Ecotricity refinanced its operating wind and solar asset portfolio at a price of about 70 million pounds. The investor is Aviva Investors.
Octopus Group's Investment Plan	The UK	742.5 billion US dollars (planned investment in the next ten years by sample institutional investors)	According to Octopus's 2020 report, based on a survey of institutional investors managing 6.9 trillion US dollars in assets, global institutional investors plan to increase their allocation ratio of renewable energy infrastructure from the current 4.2% to 8.3% in the next five years and to 10.8% in the next ten years. Only in the next ten years, the planned investment of the institutional investors in the sample in renewable energy will reach 742.5 billion US dollars.

Compiled by author based on [33-39]

Before the global financial crisis and especially after it with regulatory changes leading to reduced debt market liquidity, access to investment for renewable energy projects became a challenge as traditional lenders left a gap. Unlocking private capital from pension funds, insurance companies,

etc. was seen as crucial, and institutional investors have increasingly participated in energy and infrastructure, especially in renewable energy. Despite the challenges like unfamiliar risk profiles and less liquid assets, renewable energy suits their long-term investment, diversification, return, and carbon reduction needs. With maturing renewable technologies and business models, overall risk is decreasing, attracting more institutional investment, which helps projects' financial viability and construction. The trend of institutional investors' increasing activity in this sector is set to continue and accelerate, and developers will seek new ways to utilize this potential. So far, most of the activities of institutional investors have been concentrated in the fields of solar energy and onshore wind energy. Part of the reason is that these projects have a sufficient scale, making institutional investors feel that they are worthy of investment. Moreover, their technologies are mature enough to reassure institutional investors. Meanwhile, they can obtain the support of relevant financial support programs to ensure the financial viability of the projects. [31]

Energy companies, in light of the powerful and overarching global impetus that is driving the transition towards a low-carbon business paradigm, have wholeheartedly and vigorously engaged themselves in the domain of renewable energy investments. [40] In this era of heightened environmental awareness and the urgent need to combat climate change, these energy companies recognize the significance and inevitability of

pivoting their strategies. A considerable number of vanguard energy enterprises, which have always been at the forefront of industry trends and technological advancements, have boldly and publicly enunciated their audacious aspirations. They aim not only to maintain their competitive edge but also to lead the charge in the renewable energy revolution. They plan to escalate their renewable energy capacities substantially in the proximate years. This ambitious goal is customarily effectuated through a dual-track approach. On one hand, they actively pursue the appropriation of extant renewable energy assets, which allows them to quickly expand their portfolios and gain immediate access to established projects with proven track records. On the other hand, they also place great emphasis on the indigenous incubation of pioneering projects. By pouring resources into research and development, they seek to create novel and innovative solutions that can potentially disrupt the market. Through such comprehensive efforts, these energy companies are capacitating themselves to fortify their stance for a sustainable future, ensuring their long-term viability and relevance in a rapidly evolving energy landscape.

For example, Iberdrola has proclaimed its intention to infuse over 75 billion euros into renewable energy undertakings over the forthcoming decade. And this investment will bring a lot of advantages for both the profits and the sustainable development. [41]

-Investments aimed at leading the energy transition. The total

investment for the next six years (2020 - 2025) is set at €75 billion, with 90% (€68 billion) being organic. Of the organic growth, 51% will be channeled into renewables and 40% into networks. In Spain, there will be a 60% investment increase, reaching nearly €14.3 billion (21% of the group's total). Over €7 billion will go to renewables and more than €4.5 billion to networks. 50% of the €75 billion (€34 billion) will be invested in the United States and the United Kingdom. Over €11 billion is allocated to other international areas, and 83% of the investments target countries with an A rating.

-Tax contribution. In 2019, the company paid €8.2 billion in taxes. By 2025, it expects to contribute €12 billion, with an average of €10.3 billion per year from 2020 - 2025.

-Renewables capacity to double. The renewable capacity will double from 32 GW in 2019 to 60 GW in 2025. The breakdown includes 26 GW of onshore wind, 4 GW of offshore wind, 16 GW of solar, and 14 GW of hydro.

-Environmental commitment: carbon neutral by 2030. With current CO₂/kWh emissions two thirds below the European average, Iberdrola's investment strategy in clean energy and networks will lead to a "zero carbon" company in Europe by 2030 and reduce its global CO₂ emissions by 86% to 50g/kWh by the end of the decade. As an additional contribution, the company will plant 20 million trees by 2030 (8 million trees by 2025).

-Intelligent, digital and innovative solutions for clients. By 2025, the number of contracts with customers worldwide will increase to 60 million, offering intelligent and innovative solutions. For residential customers, products will support energy storage, heat pumps, self-production, and electric mobility. For industrial clients, it includes smart solutions, electrification processes, and green hydrogen.

-Green hydrogen, a strategic vector for industry. In line with European recovery plans, it contemplates the installation of 600 MW by 2025 (800 MW by 2027 together with Fert Iberia). The first projects in Spain will be completed with initiatives in other countries while leading the development of the supply chain and alliances with more industrial groups.

Conversely, private equity firms, are ceaselessly prowling for high-growth vistas within the renewable energy precinct. [42] They preponderantly target nascent companies that harbor innovative technologies and evince prodigious growth potential. The ingress of private equity into renewable energy startups has been on an ascendant trajectory. Data furnished by IEA intimates that the private equity sector has beheld a twofold augmentation in investment in renewable energy startups over the past several years, with sundry firms pledging prodigious amounts to catalyze the evolution and commercialization of embryonic technologies.

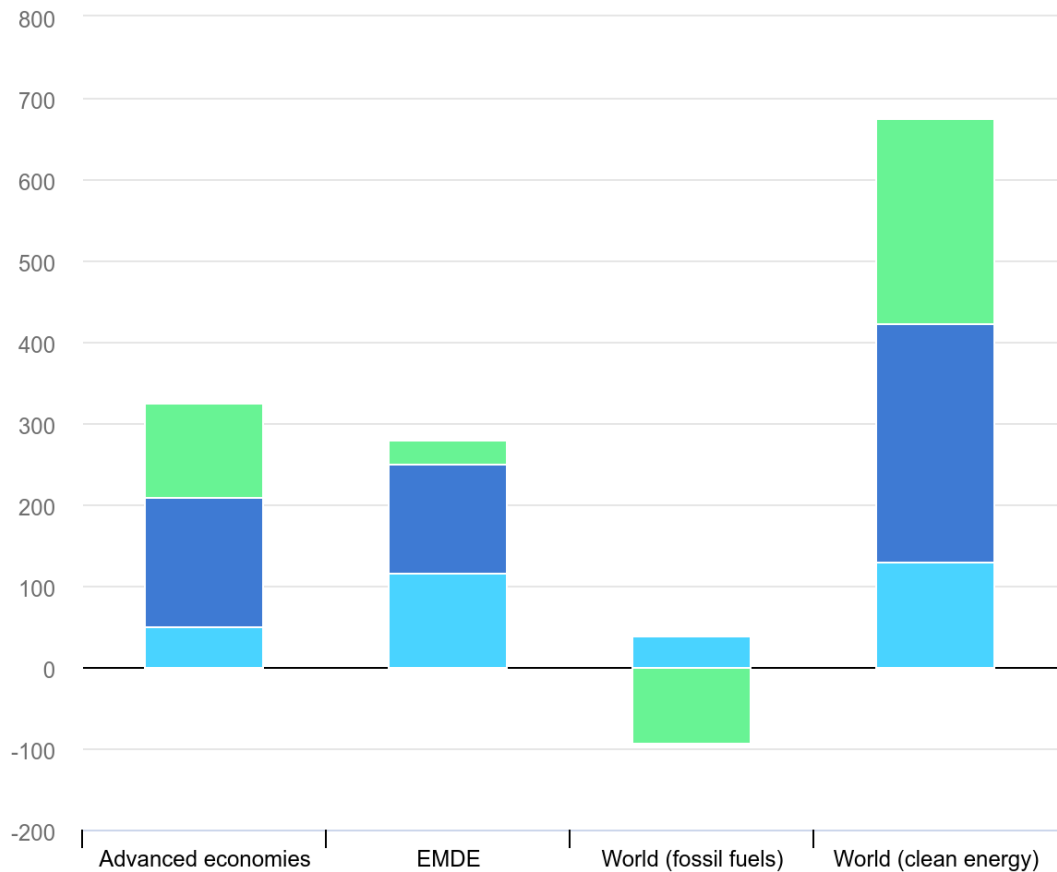


Fig. 2.7 Change in energy investment volume by region and fuel category, 2016 versus 2023[24]

In general, corporate entities constitute the major source of investments in the energy domain. They possess the largest proportion of investments in both the fossil fuel and clean energy sectors. Nevertheless, notable disparities exist among different countries. In emerging markets and developing economies (EMDE), half of all energy investments are executed by governments or state-owned enterprises (SOEs), whereas in advanced economies, this figure is merely 15%. [24] The investments from SOEs predominantly stem from national oil companies, especially in the Middle East and Asia, where such investments have experienced a

significant upsurge in recent years. Additionally, some state-owned utilities also contribute to these investments. Consequently, the financial viability, investment strategies, and the capacity of SOEs to draw in private capital have emerged as crucial aspects for ensuring a secure and affordable energy transition.

The portion of total energy investments that are either made or determined by private households (even if not directly financed by them) has doubled, ascending from 9% in 2015 to 18% at present. [24] This augmentation is attributable to the concurrent growth in rooftop solar installations, investments in building energy efficiency, and the purchase of electric vehicles. Currently, these investments are primarily carried out by more affluent households. Thus, well-crafted policies are indispensable for making clean energy technologies more accessible to a broader spectrum of the population. A comparison reveals that households have accounted for over 40% of the increment in clean energy investment expenditures since 2016, representing the largest share by a significant margin. This phenomenon has been particularly conspicuous in advanced economies, where, due to robust policy support, households have contributed to nearly 60% of the growth in energy investments. [24]

Presently, three quarters of global energy investments are financed by private and commercial sources, approximately 25% by public finance, and a mere 1% by national and international development finance institutions

(DFIs). [24] Despite the relatively small proportion of public finance and DFI contributions, the role of government participation in energy investment is of paramount importance. The energy sector is not only a key driver of economic growth but also has far-reaching implications for environmental sustainability and national energy security. Government investment can act as a catalyst, especially in areas where the risks are high or the returns may be long-term and less attractive to private investors. In the research and development of nascent clean energy technologies, such as advanced nuclear fusion or next-generation energy storage systems, the uncertainty and capital-intensive nature often deter private and commercial entities. Here, government funds can help bridge the funding gap and drive technological breakthroughs. Moreover, in regions with underdeveloped energy infrastructure, government investment can help build the necessary foundation for energy access and distribution, which is a prerequisite for attracting further private and commercial investment. It can also play a regulatory role to ensure that energy investments align with national and international climate goals and social welfare objectives. In conclusion, while private and commercial sources dominate global energy investments, the active engagement of government through public finance and DFIs is essential for a balanced, sustainable, and secure global energy investment landscape.

2.1.3. Geographical distribution of investments

The geographical distribution of international investments in renewable energy is highly uneven. As was previously mentioned, Europe, North America, and Asia are the predominant destinations for renewable energy investment. China, the European Union and the United States have taken the lead on clean energy investment, accounting for almost 60% of the current global spending on clean energy.[24] These regions attract a significant portion of global investment due to various factors. However, it is important to note that there are also substantial differences within these regions. In Europe, countries like Germany, the United Kingdom, and France have been at the forefront of renewable energy investment. These countries have made significant efforts in promoting renewable energy sources and have implemented policies and incentives to attract investment. On the other hand, in Asia, China and India have emerged as major players in the renewable energy sector. With their large populations and growing energy demands, they have been actively investing in renewable energy projects.

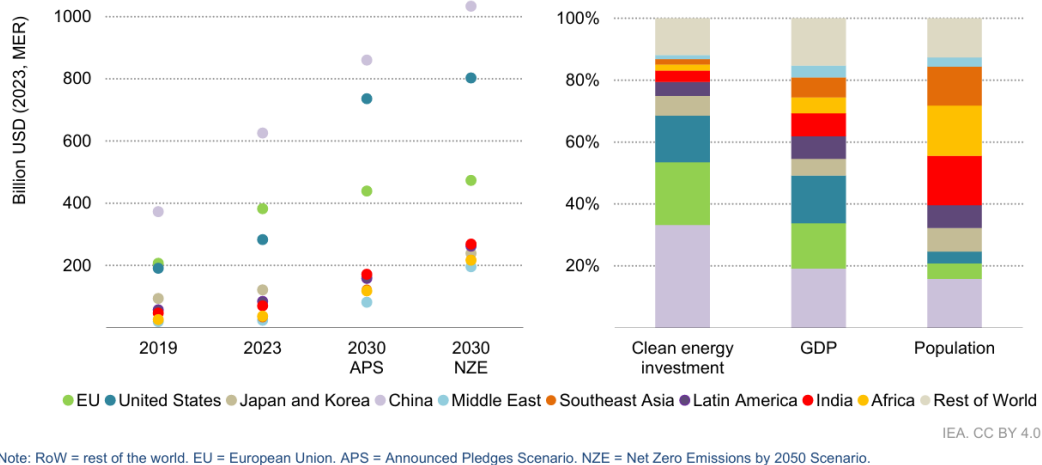


Fig. 2.8 Shares of clean energy investment (left), GDP and population (right) by selected countries and regions [24]

In addition to these traditional markets, some emerging economies and developing countries are also attracting increasing attention from international investors. These countries offer immense potential for renewable energy development. They possess abundant natural resources such as solar, wind, and hydro power. For instance, India has an estimated solar power potential of over 750 gigawatts (GW) according to the Ministry of New and Renewable Energy, attributable to its copious natural endowments such as solar, wind, and hydroelectric power. [43] Brazil, with its extensive river systems, holds a hydropower potential of approximately 120 GW as reported by the Brazilian Ministry of Mines and Energy. Moreover, their growing energy demand provides an opportunity for the development of renewable energy sources. [44]

However, they also face several challenges. Weak regulatory frameworks can make it difficult for investors to navigate the market and

ensure the stability of their investments. In Kenya, the deficient regulatory mechanisms have resulted in grid malfunctions in certain solar energy projects. It is reported that around 10% of small-scale solar projects in Kenya have faced grid connection issues in the past year, thereby complicating investment operations. Additionally, lack of access to finance can be a major obstacle for the development of renewable energy projects in these countries. [45] While for Vietnam, despite its rich offshore wind energy reserves with an estimated potential of 50 GW as assessed by the Institute of Energy, the scarcity of available financing has hampered project commencement. Only about 20% of the planned offshore wind projects have been able to secure sufficient funds, deterring international investment and impeding the overall development of renewable energy in these regions. [46]

2.2. Study of the impact of international investment on the development of renewable energy in different countries

2.2.1. Case studies of successful countries (Denmark & Germany & China)

Several countries have been successful in attracting international investment in renewable energy and have achieved significant progress in renewable energy development.

Denmark can be regarded as one of the most energy-secure and

sustainable countries within the Organization of Economic Cooperation and Development (OECD). It has achieved zero dependence on foreign energy sources and attained self-sufficiency in its domestic energy production and consumption, thereby providing valuable insights and lessons for other countries globally. The crux of Denmark's successful model lies in its unwavering dedication to energy efficiency. This is manifested through the imposition of long-term taxes on energy fuels, electricity, and carbon dioxide emissions. Here comes some useful experience for reference.

-Policy Support: Its wind energy industry has thrived due to a combination of factors. In terms of policy support, the Danish government has formulated long-term and stable energy strategic plans. It has set a clear goal of achieving 100% renewable energy supply by 2050 and divides the energy transition into multiple stages. In each stage, specific investment priorities and policy measures are defined. In the early stage, it focused on promoting the development of offshore wind power by setting staged installation capacity targets and providing corresponding support.

-Subsidies: Moreover, the government offers direct investment subsidies for renewable energy projects. Eligible wind energy projects can receive a certain proportion of capital subsidies to cover the upfront costs such as equipment procurement and infrastructure construction.

-Tax incentives are also in place. Renewable energy enterprises enjoy

preferential or reduced corporate income tax rates within a certain period, and relevant expenditures for project construction and operation can be deducted when calculating taxable income.

-Grid access: Renewable energy power generation projects have the priority to connect to the grid. The government ensures that grid operators provide timely and efficient access services and promotes grid upgrades and intelligent transformations to adapt to the volatility of renewable energy.

-Establish green power certificate market mechanism: Renewable energy power generation enterprises can obtain corresponding green certificates for the green power they produce and trade them in the market to increase overall revenue.

-The advanced technology: Denmark holds a preeminent position in the global export of wind energy technology, commanding approximately one-third of the international market share for wind turbines. It managed to eliminate the use of almost all oil-fired power plants within a period of less than five years and instituted a phased prohibition on future coal-fired power plants during the 1990s. Its latest strategic objective aims to procure 30 percent of the total energy supply from renewable sources by 2025. Danish companies and research institutions have continuously carried out research and innovation in wind turbine design, manufacturing, and installation technologies, improving the efficiency and reliability of wind

power generation.

The collaborative approach among the government, industry, and research institutions is highly effective. The government provides policy guidance and financial support, the industry actively participates in project investment and operation, and the research institutions conduct in-depth research and technology transfer, jointly promoting the development of the wind energy industry.

Table 1.6 Targets impacting Danish climate policies

Framework	Area	Obligation/target
Government platform 2015	Phase-out of fossil fuels	Denmark is to be climate neutral by 2050
Danish climate law	Low emission society by 2050	Target is not specified
EU: 2020 targets	Greenhouse gas emissions from buildings, agriculture and transportation	To be reduced by 20 pct. between 2005 and 2020
	Fraction of renewable energy in total energy consumption	30 pct. by 2020
	Fraction of renewable energy in the transport sector	10 pct. by 2020
EU: 2030-targets	The total emissions from the EU are to be reduced by 40 pct. between 1990 and 2030. This includes the following targets for the EU as a whole:	The emission reduction targets for the EU as a whole are to be implemented as national reduction obligations for buildings, agriculture and transportation. The Danish reduction obligations have not yet been negotiated.
	<ul style="list-style-type: none"> ● 43 pct. reductions from large emitters such as power plants and the oil and gas sectors. ● 30 pct. reductions of emissions from buildings, agriculture and transportation. ● At least 27 pct. renewable energy in total energy consumption by 2030. ● At least 27 pct. increase in energy efficiency by 2030. 	

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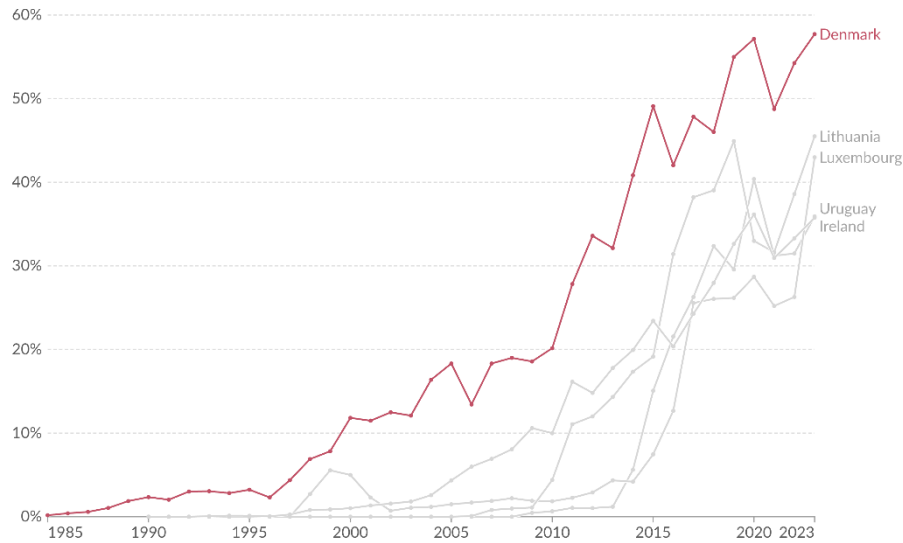


Fig. 2.9 Share of electricity production from wind [49]

Germany has made remarkable achievements in the solar power field with its comprehensive renewable energy policy framework.

1. Policy Support and Planning Guidance:

Since the introduction of the Renewable Energy Act in 2000 [50], Germany has given renewable energy sources priority in grid access and a 20-year guaranteed remuneration. This has significantly promoted the growth of solar power capacity. Although there were fluctuations due to subsequent adjustments in the subsidy mechanism, the early policy laid the industrial foundation and attracted a large amount of investment.

In 2022, the government released the "Easter Package", setting clear targets for the share of renewable energy in electricity production (80% by 2030 and 100% by 2035), requiring an average annual new installed capacity of more than 20 GW [51]. This provides policy direction and market expectations for the continuous expansion of the industry and

strengthens investors' confidence.

2. Public Participation and Market Diversification:

The encouragement of a large number of small solar panel operators to participate has made tens of thousands of small operators an important part of the energy system. For example, in 2023, all solar PV operators jointly produced about 12% of the net power consumption, contributing to a total renewable energy share of 52%. [50]

Stimulating public enthusiasm, a large number of private investors, especially households and small businesses, actively participate. Many homeowners install rooftop solar panels (more than 70% of the new capacity in 2023 came from rooftop installations, with homeowners responsible for 6.5 GW of new installed capacity). They often combine them with solar energy storage batteries. At the same time, balcony solar panels have also become popular due to policy convenience (relevant regulatory reforms in 2023 promoted this). A YouGov poll shows that 68% of homeowners with suitable rooftop space have purchase intentions, and 16% plan to purchase in 2024, forming a broad base of private investment and a distributed energy development pattern. [50]

3. Technological R & D and Innovative Applications:

Despite facing pressure from Asian manufacturers in cost competition, German enterprises maintain an advantage in module system integration research and the implementation of innovative applications. For example,

they have developed integrated solutions that allow households to store surplus solar energy and share or trade electricity with neighbors and other prosumers, adapting to the trend of future energy self-sufficiency and decentralized production, reducing dependence on subsidies, enhancing the sustainability and competitiveness of the industry, and also providing investors with differential investment highlights.

4. Cost Control and Benefit Enhancement:

The cost of solar PV has been continuously and significantly decreasing over the past years (a reduction of 87% in cost and 85% in battery storage cost from 2013 to 2023). It has become the cheapest power generation method in Germany (the lowest cost can reach 3.7 euro cents per kWh) [52]. Moreover, new solar (and wind power) installations in auctions are not only cheaper than new traditional energy power plants but also lower than the operating costs of existing fossil fuel power plants. The significant cost advantage has greatly enhanced the investment attractiveness and return expectations. At the same time, Germany is also considering using policy means (such as "resilience bonuses or auctions", paying higher feed-in tariffs for solar systems produced in Europe) to protect the local industry and balance costs and benefits, guiding investment to more strategically and sustainably oriented directions. Although there are some controversies and challenges, such exploration provides ideas for other regions in industrial support and cost-benefit

balance. [53]

China has emerged as a major force in the global renewable energy market.

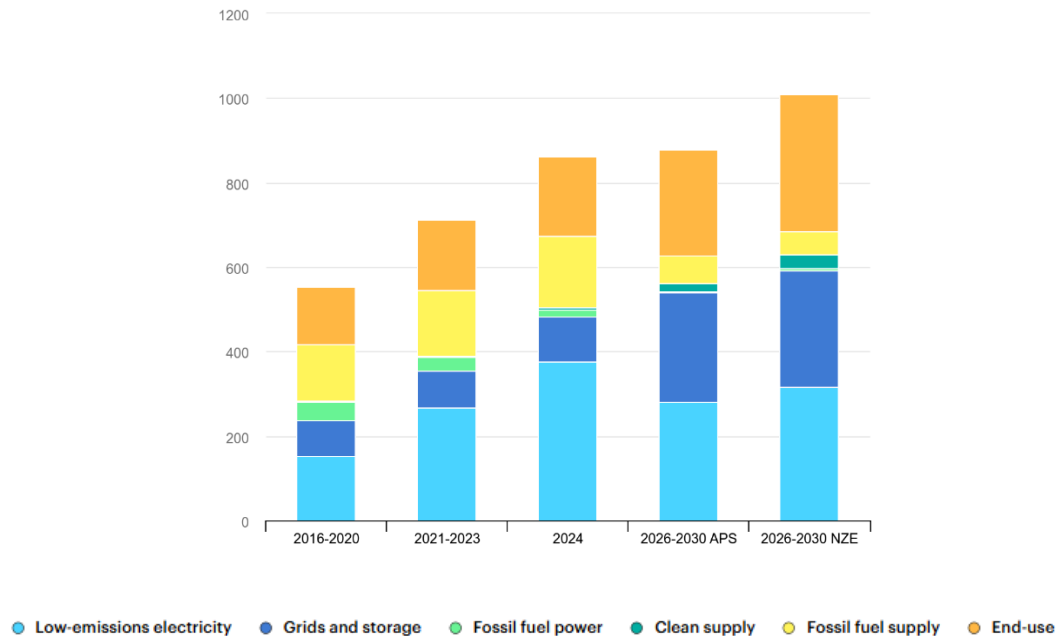


Fig. 3.0 Past and future energy investment in China in the Announced Pledges Scenario and in the Net Zero Emissions by 2050 Scenario, 2016-2030 [24]

The Chinese government has been highly committed to promoting renewable energy development and has implemented a series of powerful supportive policies. And it also has lots of experience to refer on attracting the investment based on renewable energy.

1. Policy-Driven Growth and Clear Goals

- The "14th Five-Year Plan for Renewable Energy Development" issued by the National Development and Reform Commission and other departments has put forward clear goals. [55]By 2025, the total

consumption of renewable energy is expected to reach around 1 billion tons of standard coal, the annual power generation of renewable energy is expected to reach around 3.3 trillion kilowatt-hours, the national responsibility weight for the total consumption of renewable energy power is expected to reach around 33%, the responsibility weight for the consumption of non-hydro renewable energy power is expected to reach around 18%, the utilization rate of renewable energy will remain at a reasonable level, and the scale of non-electric utilization of geothermal heating, biomass heating, biomass fuels, and solar thermal utilization will reach more than 60 million tons of standard coal.

- "Guiding Opinions on Vigorously Implementing the Renewable Energy Substitution Action", [54] proposing that positive progress should be made in the renewable energy substitution in key areas during the "14th Five-Year Plan" period. By 2025, the national consumption of renewable energy will reach more than 1.1 billion tons of standard coal.

- During the "15th Five-Year Plan" period [56], the production and living patterns that prioritize the utilization of renewable energy in various fields will basically take shape. By 2030, the national consumption of renewable energy will reach more than 1.5 billion tons of standard coal, which will strongly support the achievement of the carbon peak goal by 2030.

- Announcement of dual carbon goals (peaking carbon emissions

before 2030 and achieving carbon neutrality before 2060) which has spurred significant investment and expansion in renewable energy capacity.

2. Thriving New Energy Sectors and Trade Potential

-The "new three" industries (solar cells, lithium batteries, and electric vehicles) had robust growth with a 30% jump in exports in 2023.

-Anticipated continuation of investment trend towards low-emission power in 2024, showing a promising market for renewable energy-related technologies and products.

3. Technology advanced

- Chinese companies have made substantial investments in research and development. They have continuously increased R & D efforts in solar and wind power generation technologies, energy storage technologies, and intelligent grid technologies. Through independent innovation and cooperation with international research institutions, significant technological advancements have been achieved.

4. Strong Domestic Foundation

-Ample domestic manufacturing capacity in clean energy technologies provides a solid base for investment.

-Continued government support for clean technologies, which helps in reducing risks and increasing the attractiveness of investment in the renewable energy sector.

5. Consideration of International Market and Domestic Energy

Balance

-Awareness of challenges in exporting clean technologies to major international markets (Europe and the United States), emphasizing the need to enhance international competitiveness and adapt to global trade policies.

-While investing in renewables, also maintaining a focus on energy security with continued but strategically managed investment in fossil fuels like coal, ensuring a stable energy supply during the energy transition process.

As a result, China has a large installed capacity of solar and wind power. It has not only met a large part of its domestic energy demand but also actively participated in international cooperation and investment in the renewable energy field, making important contributions to global renewable energy development.

2.2.2. Challenges faced by countries with limited investment

(Ethiopia, Nigeria)

On the other hand, some countries face significant challenges in attracting international investment in renewable energy. These challenges may include political instability, which can create an uncertain business environment and deter potential investors. Weak regulatory frameworks might lack clear guidelines and incentives for renewable energy projects, making it difficult for investors to navigate the market. The lack of access

to finance is also a major obstacle, as many renewable energy projects require substantial upfront capital. Insufficient infrastructure, such as unreliable electricity grids, can hamper the implementation and operation of renewable energy systems.

Ethiopia is an African country with vast untapped renewable energy resources, especially in hydro-power and geothermal energy. However, it also faces challenges in attracting investment. One of the key issues is the lack of access to sufficient financing. The country's financial sector is relatively underdeveloped, and there are limited sources of capital available for large-scale renewable energy projects. International investors may be hesitant to commit funds due to concerns about the country's ability to manage and repay loans, especially considering the long payback periods typical of renewable energy investments. In addition, the lack of a well-developed infrastructure network beyond the power grid is also a hindrance. The transportation and communication infrastructure in some regions is not well-equipped to support the construction and operation of renewable energy facilities. This means that it is more difficult and costly to transport equipment and materials to project sites and to maintain effective communication and coordination during the project life cycle. Furthermore, political uncertainties and regional security issues in some parts of Ethiopia can also create an unstable investment environment, making investors more cautious about committing their resources to

renewable energy projects in the country.[57]

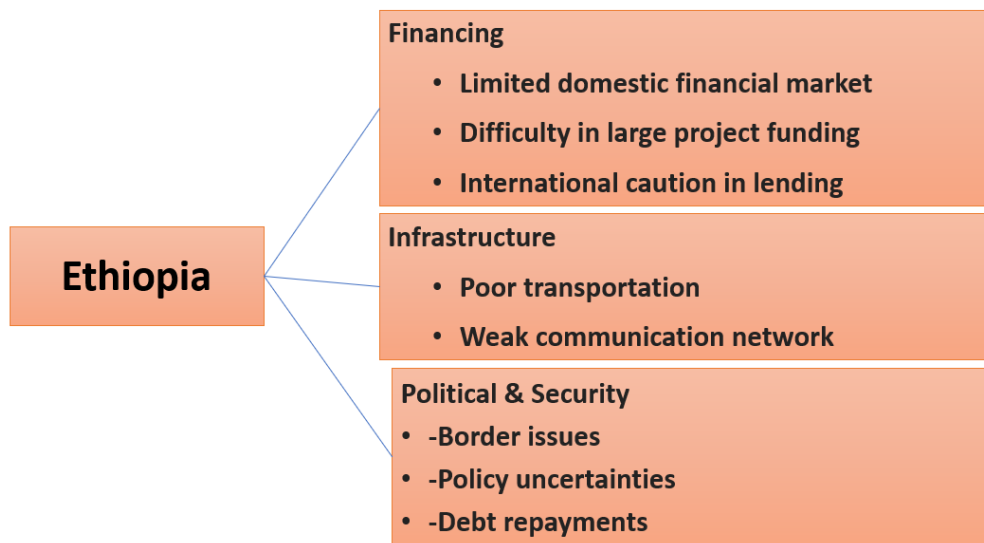


Fig. 3.1 Challenges faced by countries with limited investment- Ethiopia
 Compiled by author based on [57]

Nigeria, being one of the major economies in Africa, has significant potential for renewable energy development due to its abundant sunlight and wind resources. However, the inconsistent power supply has been a long-standing issue. The existing power grid infrastructure is outdated and suffers from frequent breakdowns and inefficiencies. This not only affects the reliability of electricity for the general population but also poses a major obstacle for renewable energy projects. Solar and wind farms may generate electricity, but without a stable grid to transmit and distribute it, the power cannot be effectively utilized. Moreover, the regulatory landscape is highly complex. There are multiple regulatory bodies with overlapping jurisdictions and sometimes conflicting regulations. This leads to confusion and delays in project approvals and implementations.

Investors interested in renewable energy projects often have to navigate through a maze of bureaucratic procedures and red tape, which increases the cost and risk of investment. Additionally, the lack of clear and consistent policies and incentives for renewable energy, such as feed-in tariffs or tax breaks, makes it less attractive for both domestic and international investors compared to other countries with more favorable investment climates. Finally, debt repayments, which have increased sharply in recent years, mean that many African governments have difficulty accessing the funds required for capital-intensive clean energy projects. Moreover, low sovereign debt ratings further limit access to outside investment – in 2023, only two countries, Botswana and Mauritius, held investment-grade ratings.[24][58]

In addition, countries with limited investment may also face competition from other countries that offer more attractive investment environments. This can make it difficult for them to attract the necessary capital and technology to develop their renewable energy sectors.

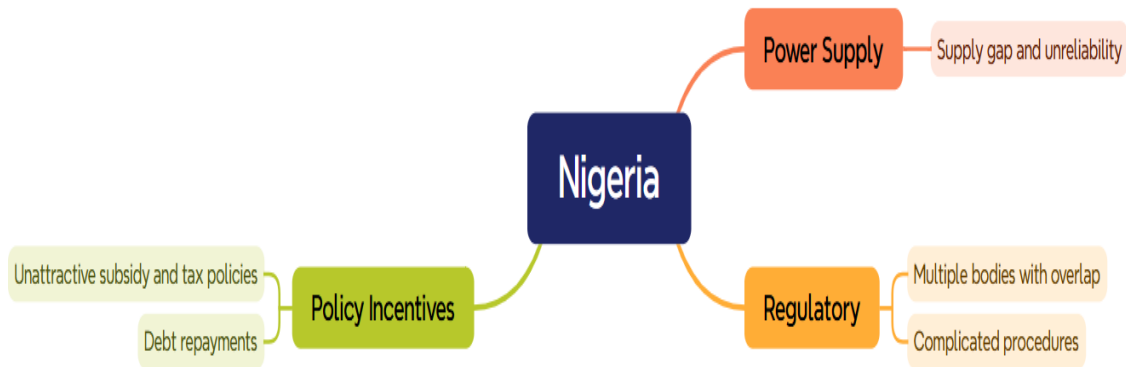


Fig. 3.2 Challenges faced by countries with limited investment- Nigeria
Compiled by author based on [58]

2.2.3. Comparative analysis of investment impacts

A comparative analysis of the impact of international investment on renewable energy development in different countries reveals several key findings.

1) Countries that have implemented strong and consistent policy support measures, along with stable regulatory environments that provide certainty and predictability to investors, are significantly more likely to attract a substantial amount of investment. This influx of investment then enables these countries to achieve rapid and sustainable renewable energy development.

Table. 1.7 Policy frameworks an incentive in China, the EU and the
 United States

Economic bloc	Policy	Incentive type	Energy sector beneficiaries
China	14th Five-Year Plan	Targets, various soft incentives (e.g., cheap financing, land)	Utility-scale renewables, grid expansion, storage
European Union	REPowerEU	Targets, state-backed loans	Renewables
	Fit for 55	Targets, state-backed loans	Renewables, hydrogen, efficiency
US	Inflation Reduction Act of 2022	Tax credits, loan guarantees	Renewables
	CHIPS Act of 2022; American Jobs Plan of 2021	Tax credits, grants	Energy transition assets

Source: S&P Global Commodity Insights

2) Countries that allocate significant resources towards investment in research and development and actively pursue technological innovation are able to make remarkable progress in improving the efficiency and cost-effectiveness of renewable energy technologies. By doing so, they enhance the competitiveness of these technologies in the global market, attracting more investment and facilitating further growth.

3) Countries that proactively collaborate with international partners and enthusiastically participate in regional and global initiatives are in a better position to access a wide range of finance sources, advanced technologies, and valuable expertise. This collaborative approach thereby accelerates their renewable energy development and helps them contribute to the global transition towards a more sustainable energy future.

In conclusion, countries with stable policies, clear regulatory frameworks, and accessible financing options have achieved more significant progress in renewable energy development. On the other hand,

countries with frequent policy changes and opaque regulatory environments have faced difficulties in attracting and effectively utilizing international investment [59].

2.3 Features of attracting international investment in renewable energy projects

1. Technological innovation and its influence

Technological innovation has served as a linchpin in galvanizing international investment within the renewable energy landscape. Substantial headway has been achieved in battery storage technology. The advent of lithium-ion batteries with augmented energy density and prolonged lifespan has revolutionized the storage of electricity harnessed from renewable sources. [60] During peak generation intervals, such as solar-rich days or windy spells, the surplus energy can now be effectively stockpiled and tapped into during troughs in generation or periods of heightened demand. This technological leap has precipitated a remarkable reduction in the unit cost of energy storage, as corroborated by a study in Nature Energy in 2022, thereby rendering large-scale renewable energy projects more economically tenable. [61]

In the sphere of offshore wind turbine design, extraordinary enhancements have materialized. Contemporary offshore wind turbines are fabricated with towering structures and expansive rotor diameters. The

lofty towers afford access to more potent and consistent wind currents at elevated altitudes. The augmented rotor diameters translate into a broader swept area, consequently seizing more wind energy. Certain state-of-the-art offshore wind turbines, possess rotor diameters surpassing 200 meters and are capable of generating multiple megawatts of electricity per unit. This augmentation in energy output and efficiency has rendered offshore wind projects more alluring to investors, given the prospective for a more lucrative return on investment. [62][63]

With respect to solar panel efficiency, ceaseless research and innovation have spurred the emergence of novel materials and manufacturing methodologies. Perovskite solar cells have demonstrated prodigious potential in recent times. They hold the promise of attaining superior conversion efficiencies in contrast to conventional silicon-based solar cells. [64]Additionally, the development of tandem solar cell architectures has amalgamated diverse semiconductor materials. These breakthroughs have not only amplified the electricity yield from a given solar panel area but have also instigated a diminution in the overall cost of solar power generation. Consequently, solar energy projects have acquired enhanced competitiveness in the market, magnetizing a substantial influx of international investment.[65]

To sum it up, the technological innovations in battery storage, offshore wind turbine design, and solar panel efficiency have coalesced in

a synergistic manner to curtail the costs entwined with renewable energy production and dissemination. They have concurrently fortified the dependability and performance of renewable energy systems, guaranteeing a more unwavering and incessant supply of clean energy. This has, in turn, metamorphosed renewable energy projects into more captivating and practicable propositions for international investors, precipitating a burgeoning investment spree and a meteoric expansion of the renewable energy sector on a global scale.

2. Policy environment and regulatory framework

A favorable policy environment and regulatory framework are essential for attracting international investment in renewable energy projects. Governments can use a variety of policy tools, such as feed-in tariffs, tax incentives, and renewable energy targets, to encourage investment in renewable energy.[66] In addition, a stable and transparent regulatory framework can provide investors with certainty and confidence, reducing investment risks. Countries implementing renewable portfolio standards (RPS) have witnessed a remarkable surge in investment. In the United States, where many states have their own RPS targets, the investment in renewable energy projects has grown by an average of 15% annually over the past decade.[67]

Carbon pricing is another policy instrument that has had a significant impact. European Union countries that have implemented carbon pricing

mechanisms have seen a shift in investment towards renewable energy. In countries like Germany and Sweden, where carbon prices have been steadily increasing, the share of investment in renewable energy compared to traditional fossil fuel energy has increased by approximately 20% in the past five years. [68]

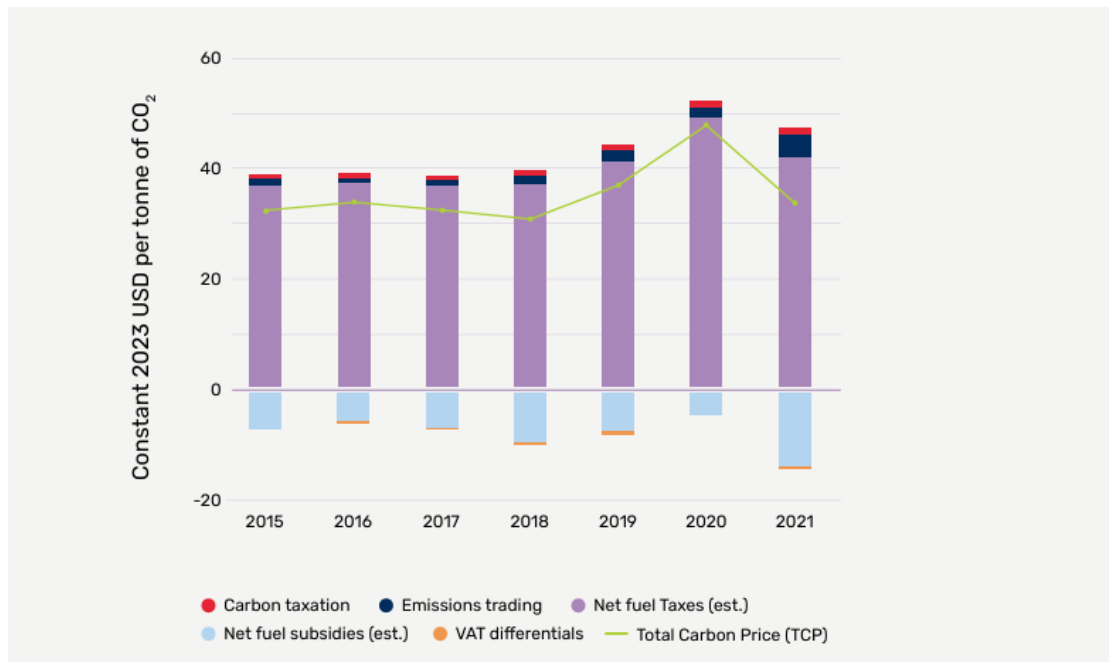


Fig. 3.3 Global total carbon price for the period 2015-2021 (USD 2023)

Source: world bank

Feed-in tariffs[69] have also been highly effective. In Germany, which was one of the early adopters of feed-in tariffs for solar and wind energy, the installed capacity of solar power increased from 3.8 gigawatts in 2008 to 59.2 gigawatts in 2020. This exponential growth was largely attributed to the attractive feed-in tariff rates that provided a stable and predictable revenue stream for investors.

In addition to these policy measures, clear and consistent regulations

regarding grid connection, permitting processes, and land use are equally crucial. Countries with streamlined grid connection procedures, such as Denmark, have reduced the time required for a renewable energy project to connect to the grid by an average of 30%, thereby enhancing the attractiveness for investors.[70] Similarly, in Australia, the implementation of a standardized permitting process has led to a 25% reduction in the administrative time and costs associated with renewable energy projects. Regarding land use [71], in the United Kingdom, the introduction of clear guidelines and zoning for renewable energy projects has increased the availability of suitable land for development and provided investors with greater certainty about project viability and longevity.

2.3.3. Market dynamics and competition

The surging demand for clean energy, which has been spurred by growing environmental awareness and the pursuit of sustainable development, has significantly altered the market landscape in the renewable energy sector. Concurrently, the influx of new players, ranging from innovative startups backed by venture capital to established corporations diversifying their portfolios, has further intensified the market competition.

This heightened competition has been a catalyst for multiple positive developments. In terms of cost reduction, companies have been compelled

to optimize their production processes, source materials more efficiently, and leverage economies of scale. In the solar panel manufacturing industry, the average cost per watt has declined by approximately 80% over the past decade. This reduction can be attributed, in large part, to the fierce competition that has driven manufacturers to continuously improve their technologies and streamline their operations. [72][73]

Regarding project quality, the competitive environment has forced project developers to raise the bar. They are now more inclined to adopt advanced engineering designs, utilize higher-quality equipment, and implement more stringent quality control measures. To stand out in the competitive market, developers have invested in state-of-the-art turbine technologies that not only enhance energy generation efficiency but also improve the reliability and durability of the entire project in Europe. This has led to a significant reduction in maintenance costs and downtime, thereby increasing the overall project quality and lifespan.

Moreover, the intense competition has also been a breeding ground for the development of innovative business models. In response to the challenges and opportunities presented by the market, companies have begun to explore novel ways of doing business. For example, the emergence of power purchase agreements (PPAs) with flexible terms and pricing structures has enabled renewable energy producers to secure long-term revenue streams and reduce market risks. Additionally, some

companies have adopted a community-based approach, involving local communities in the development and ownership of renewable energy projects. This not only fosters greater acceptance and support for the projects but also creates new economic opportunities for the communities.

These trends in cost reduction, project quality improvement, and business model innovation are likely to continue and shape the future of the renewable energy market. However, it is also crucial for market participants and regulators to strike a balance between competition and cooperation to ensure the sustainable growth and stability of the sector.

Conclusions to Section 2

The in-depth analysis of international investments in renewable energy clearly reveals that there has been an extremely significant increase in investment activity over the past few years. Among the major players in the investment market are institutional investors who bring substantial financial resources and long-term investment perspectives. Additionally, energy companies with their industry expertise and extensive networks also play a crucial role. Private equity firms, known for their agility and risk-taking appetite, are also actively involved. The geographical distribution of these investments is highly uneven. Europe, with its advanced regulatory frameworks and strong commitment to sustainability, remains one of the major destinations. North America, with its technological prowess and

large market size, also attracts a significant amount of investment. Asia, on the other hand, is emerging as a major force with its rapidly growing economies and increasing demand for clean energy. Successful countries in attracting investment typically have strong policy support that provides incentives for investors. They also possess advanced technology that ensures efficient generation and utilization of renewable energy. Moreover, collaborative approaches between the government, industry, and research institutions contribute to a favorable investment environment. Countries with limited investment often face various challenges. Political instability can deter investors as it creates uncertainty about the future. Lack of access to finance is another major obstacle, as renewable energy projects require significant capital investment. Technological innovation is an essential factor in attracting international investment as it leads to more efficient and cost-effective solutions. A favorable policy environment that provides clear regulations and incentives is also crucial. Market dynamics, such as growing demand for clean energy and falling costs of renewable technologies, play a significant role as well.

The factors influencing the attractiveness of international investment in renewable energy are diverse. Policy support, including subsidies, tax incentives, and feed-in tariffs, can greatly enhance the viability of renewable energy projects. Regulatory stability ensures that investors can make long-term plans with confidence. Technological innovation not only

improves the performance of renewable energy systems but also reduces costs. Market demand for clean energy, driven by environmental concerns and energy security issues, provides a strong impetus for investment. Access to finance is essential for the implementation of large-scale renewable energy projects. Countries that can effectively address these factors are much more likely to attract investment and achieve sustainable renewable energy development.

CHAPTER 3. DIRECTIONS FOR ENHANCING THE ATTRACTION OF INTERNATIONAL INVESTMENTS IN RENEWABLE ENERGY

3.1. Developing a strategy for international cooperation to increase investment in renewable energy

Based on what we have analyzed in Chapter 2., the following strategies aim to increase international cooperative investment in the renewable energy sector.

Firstly, in terms of policy coordination and support, governments of various countries should jointly formulate long-term goals and strategic plans for the development of renewable energy, clarifying the development direction and key areas. An international renewable energy development alliance could be established where member countries collectively commit to increasing the proportion of renewable energy in the energy structure to a specific level within a certain period and formulate corresponding phased goals and action plans. This provides stable policy expectations for investors and enhances their investment confidence. Additionally, countries need to refine policies and regulations related to renewable energy, including subsidy policies, tax incentives, and feed-in tariff policies, to attract international investment. Offering a certain percentage of tax reduction to enterprises investing in renewable energy projects or ensuring

the stability and attractiveness of the feed-in tariff for renewable energy generation mitigates the return risk for investors. Moreover, a regular policy dialogue mechanism for communication and consultation on renewable energy policies among governments of various countries should be established. Policy differences should be coordinated and policy conflicts avoided. For cross-border renewable energy projects that involve the policies and regulations of multiple countries, it is necessary for governments to jointly negotiate and formulate unified policy standards and approval processes to enhance the project advancement efficiency.

Secondly, regarding technological cooperation and innovation, countries should jointly contribute to establishing renewable energy technology R&D centers or laboratories, gathering top global scientific research talents and resources to carry out joint R&D projects. Some European countries and China have established joint R&D platforms in fields such as solar photovoltaic technology and wind power generation technology to jointly address technical challenges and improve the technological level. Developed countries should provide technical support and assistance to developing countries, promoting the transfer and sharing of renewable energy technologies globally. This can be achieved through establishing technology transfer mechanisms, conducting technical training courses, and implementing technology cooperation projects, helping developing countries enhance their renewable energy technology

level and reduce technology costs. Encouraging innovative cooperation among enterprises and between enterprises and research institutions is also crucial. Adopting models such as industry-university-research cooperation and technology alliances accelerates the innovation and application of renewable energy technologies. Some enterprises collaborate with universities and research institutions to jointly carry out the R&D and industrialization projects of renewable energy technologies, achieving the organic combination of technological innovation and market application.

Thirdly, for financial support and financing innovation, governments of various countries, international organizations, and financial institutions should jointly establish renewable energy funds to provide financial support for renewable energy projects. The funds can be used in various stages such as the preliminary development, construction, and operation of the projects, reducing the financing costs and risks of the projects. International financial institutions such as the World Bank and the Asian Development Bank have established multiple renewable energy funds, providing significant financial support for renewable energy projects in developing countries. Exploring diversified financing models is necessary, such as issuing green bonds, establishing renewable energy investment trust funds, and conducting project financing, to attract more international capital to participate in renewable energy investment. Green bonds, specifically issued to support environmental protection projects, have a

high market recognition and attractiveness as the funds raised are dedicated to the construction and operation of renewable energy projects. Moreover, governments of various countries or international organizations can offer financing guarantees for renewable energy projects, reducing the loan risks for financial institutions and increasing their lending willingness. Simultaneously, establishing risk sharing mechanisms where the risks are jointly borne by the government, enterprises, financial institutions, and other parties alleviates the concerns of investors.

Fourthly, in terms of project cooperation and demonstration promotion, countries should jointly undertake large-scale cross-border renewable energy projects, such as transnational power transmission lines, cross-border solar photovoltaic power stations, and offshore wind power projects. These projects can fully utilize the resource and market advantages of different countries to achieve the optimal allocation of resources and the scale effect of the projects. China and ASEAN countries have made certain progress in cross-border power cooperation and can further strengthen and expand the scope and scale of cooperation in the future. Building renewable energy demonstration projects in different regions showcases the feasibility and economic benefits of renewable energy technologies, providing references and models for other projects. Demonstration projects can attract more investor attention and participation in the investment in the renewable energy sector and promote

the wide application of renewable energy technologies. In regions rich in renewable energy resources, large-scale solar photovoltaic demonstration power stations or wind power demonstration projects can be established to demonstrate the advantages and potential of renewable energy technologies.

Finally, concerning market opening and trade facilitation, countries should gradually eliminate trade barriers and investment restrictions in the renewable energy sector, relax market access, and promote the free flow of renewable energy products and technologies. Canceling import tariffs and non-tariff barriers on renewable energy equipment and lowering the investment threshold for renewable energy projects provides a fair market competition environment for international investors. Strengthening international trade of renewable energy products is essential. Establishing trade rules and standards for renewable energy products and facilitating the integrated development of the global renewable energy market can be achieved by signing free trade agreements and conducting trade promotion activities. Optimizing trade facilitation measures is also important. Simplifying customs clearance procedures for renewable energy products, improving customs clearance efficiency, and reducing trade costs can be accomplished by establishing fast customs clearance channels for renewable energy products and adopting methods such as electronic customs declaration and paperless customs clearance.

3.2. Stimulating investment activity in the renewable energy sector

According to the research, efficacious methods can be taken to stimulate investment activities within the renewable energy sector:

Fiscal incentives:

A significant and specific proportion of initial investment subsidies should be thoughtfully extended to investors who are actively engaged in renewable energy projects. This action is crucial as it can effectively address the substantial start-up costs that often pose a major challenge for these investors. Tax preferences, without a doubt, play an extremely vital role in this context. Reducing or even exempting income tax and value-added tax for enterprises that are operating in the renewable energy domain can have a profound impact on enhancing investment returns. It is not only important but also imperative for the government to offer strong guarantees for green bonds that are associated with renewable energy. By doing so, the government aims to significantly lower the costs associated with bond issuance, thereby promoting the growth and development of the renewable energy sector.

Policy support:

Energy suppliers must be required to include a specific proportion of renewable energy within their supply portfolios. This obligation serves the purpose of spurring investment in renewable energy production. Simplifying the approval process is extremely necessary. This can be

accomplished by reducing the numerous approval links and minimizing the time taken for renewable energy projects, thus facilitating the project's progress. The establishment of long-term power purchase agreements is highly recommended. The government or large energy users should enter into long-term power purchase agreements with renewable energy producers to ensure a stable income stream. By mandating energy suppliers to incorporate a defined share of renewable energy, we can encourage greater investment in this sustainable source of power. Moreover, streamlining the approval process by reducing the number of approval steps and minimizing the time required for renewable energy projects will accelerate their development. Additionally, the formation of long-term power purchase agreements between the government or large energy consumers and renewable energy producers is crucial as it provides a guaranteed environment. Governments can make the policies with the fixed years both in short-term and long-term, and test the effectiveness of the policies. And they can also support the growth of renewable energy, such as strengthening financial support, improving relevant policies and regulations, and promoting technological innovation.

Technological research and development support:

Funding research and development projects holds tremendous significance. It is crucial for the government to allocate substantial funds to support the research and development of renewable energy technologies.

The aim here is to not only enhance technical efficiency but also to significantly reduce the associated costs. Moreover, the establishment of technology transfer platforms is absolutely essential as it facilitates the seamless transfer and application of advanced renewable energy technologies among various enterprises and different regions. In order to promote the development and application of renewable energy technologies, the government should increase investment in research and development projects and establish more effective technology transfer platforms. This will help to improve the technical level and reduce costs, and promote the wide application of renewable energy technologies in different fields

Financial innovation:

The establishment of renewable energy investment funds is of profound significance as it effectively attracts social capital and provides crucial funds for a diverse range of renewable energy projects. It is highly advisable to adopt crowdfunding and community investment models. These models can serve as an innovative approach to encourage the public to engage in renewable energy project investments via crowdfunding platforms or through community collaboration. By doing so, not only can a broader spectrum of investors be attracted, but also novel sources of funding can be tapped into, thereby promoting the sustainable development of renewable energy.

Regarding education and training:

It is essential to provide comprehensive training on renewable energy markets, technologies, and investment strategies not only to investors but also to relevant practitioners. Such training serves to significantly enhance their investment confidence and capabilities. Moreover, incorporating renewable energy knowledge into school curricula is of utmost significance as it plays a crucial role in cultivating environmental protection and sustainable development awareness among future investors. Additionally, establishing specialized research institutions dedicated to renewable energy can facilitate in-depth studies and technological innovations in this field. Offering incentives and subsidies to businesses engaged in renewable energy projects can encourage greater investment and drive the growth of the renewable energy sector. Governments can also collaborate with international organizations to share best practices and promote global cooperation in renewable energy development.

Public promotion and awareness enhancement:

Media publicity wields tremendous significance. It is of utmost importance to widely publicize the advantages and investment opportunities offered by renewable energy through a diverse array of media channels. This approach would not only enhance public awareness but also foster greater acceptance of renewable energy investment. Additionally, organizing specialized renewable energy investment seminars and forums

plays a crucial role in facilitating communication and cooperation among investors. To further promote renewable energy investment, it is recommended that governments and relevant institutions collaborate to establish dedicated renewable energy investment promotion platforms. These platforms could provide comprehensive information on renewable energy projects, investment policies, and technological advancements. Moreover, they could facilitate matchmaking between investors and project developers, thereby accelerating the development and deployment of renewable energy.

Improving infrastructure:

Strengthening grid upgrades is an essential step to guarantee the efficient transmission and distribution of renewable energy power. Simultaneously, it can lead to a reduction in transmission losses and costs. Investment in large-scale energy storage projects holds great significance in enhancing the stability and availability of renewable energy power.

To further improve the situation, it is advisable to explore innovative technologies for grid upgrades. The use of advanced materials in transmission lines can reduce resistance and enhance efficiency. Additionally, the development of intelligent grid management systems can optimize power flow and minimize losses. In terms of energy storage, research and investment should be directed towards emerging technologies such as solid-state batteries and flow batteries, which offer higher energy

density and longer lifespan. Moreover, collaborative efforts between the government, industry, and academia are crucial to drive innovation and accelerate the deployment.

3.3 Assessment of the economic efficiency of international investment programs in renewable energy

It is of crucial significance to assess the economic efficiency of international investment projects in renewable energy. In this part, the investment trends in various regions are predicted by applying the scenario method. By constructing different scenarios and taking into account numerous factors such as technological progress, policy changes, market demands and geopolitical influences, a comprehensive and in-depth analysis of the potential development paths of renewable energy investment in different regions is carried out. This method aims to provide valuable insights and reliable forecasts for investors, policymakers and other stakeholders, enabling them to make wiser decisions regarding international renewable energy investment, and thus facilitating the optimization of resource allocation and the sustainable and efficient development of the global renewable energy sector.

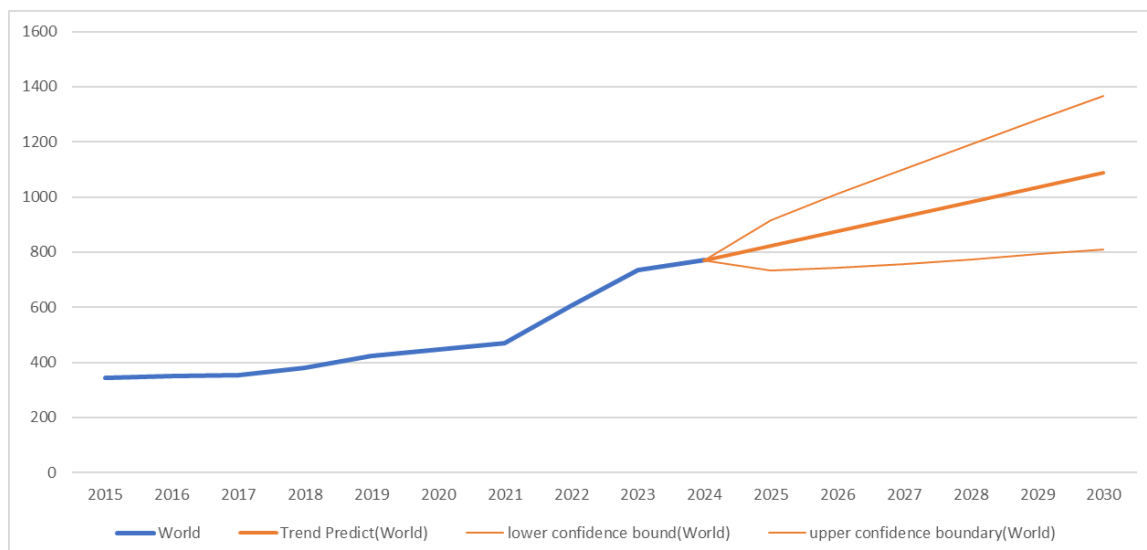


Fig. 3.4 Investment Scenario for World 2024-2030

Compiled by author based on [24]

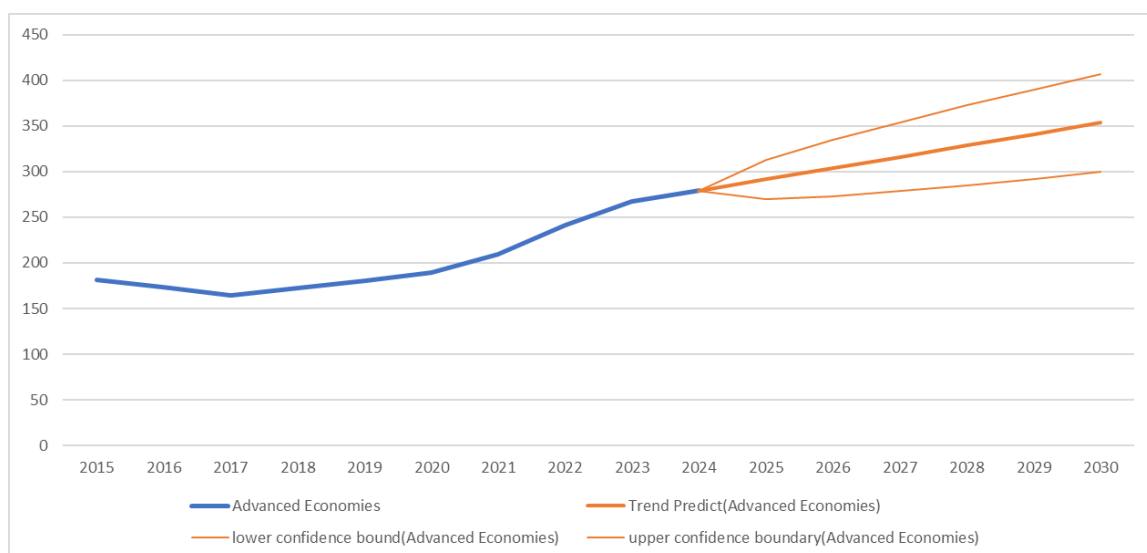


Fig. 3.5 Investment Scenario for Advanced Economies 2024-2030

Compiled by author based on [24]

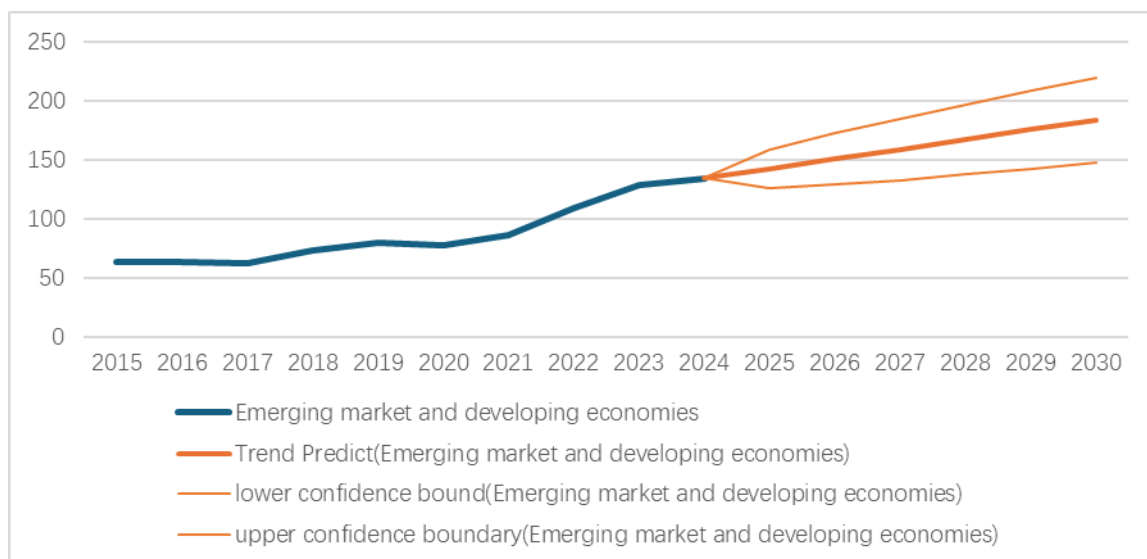


Fig. 3.6 Investment Scenario for Emerging market and development economies 2024-2030

Compiled by author based on [24]

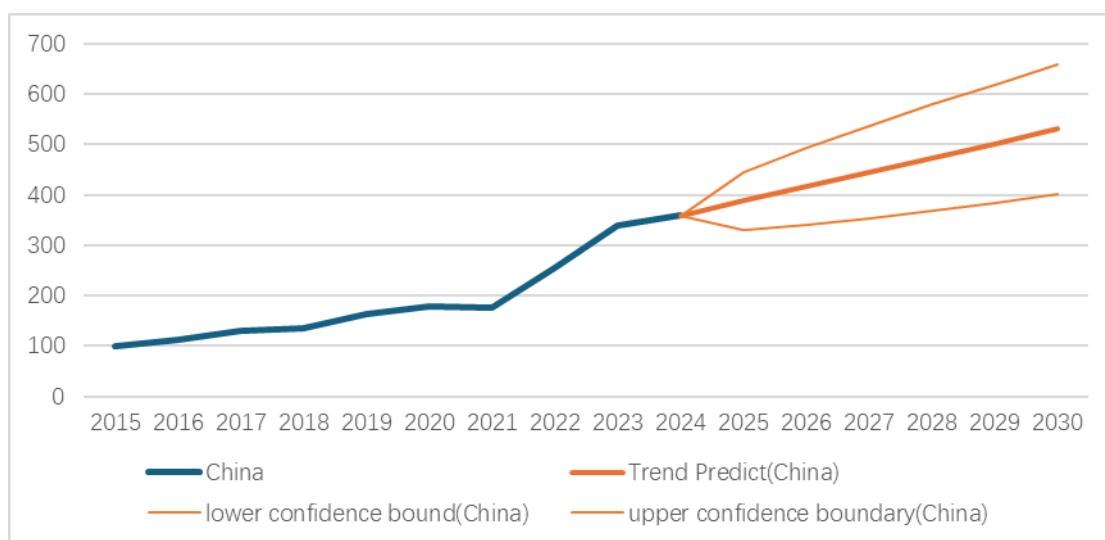


Fig. 3.7 Investment Scenario for China 2024-2030

Compiled by author based on [24]

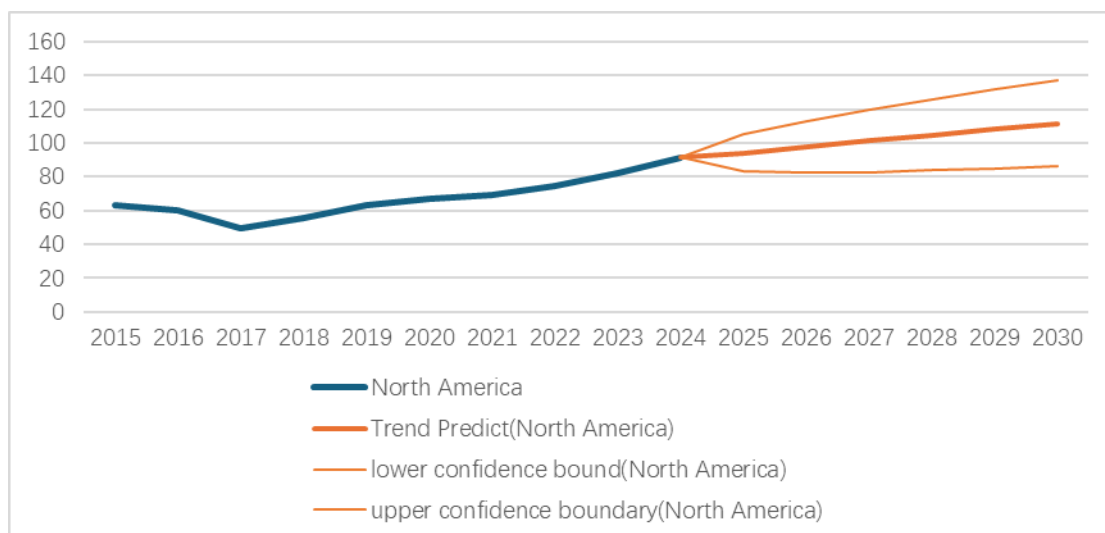


Fig. 3.8 Investment Scenario for North America 2024-2030

Compiled by author based on [24]

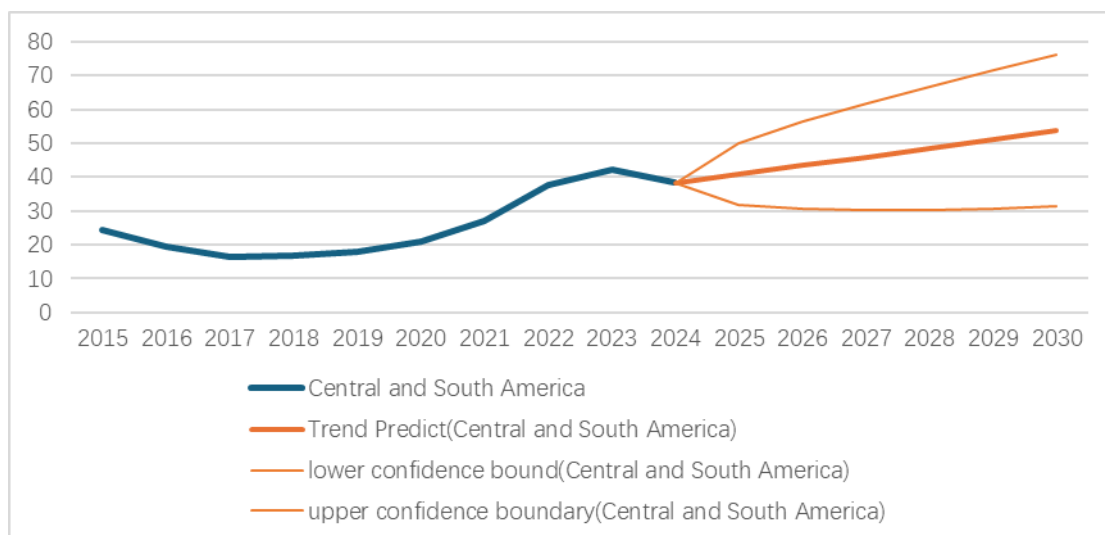


Fig. 3.9 Investment Scenario for Central and South America 2024-2030

Compiled by author based on [24]

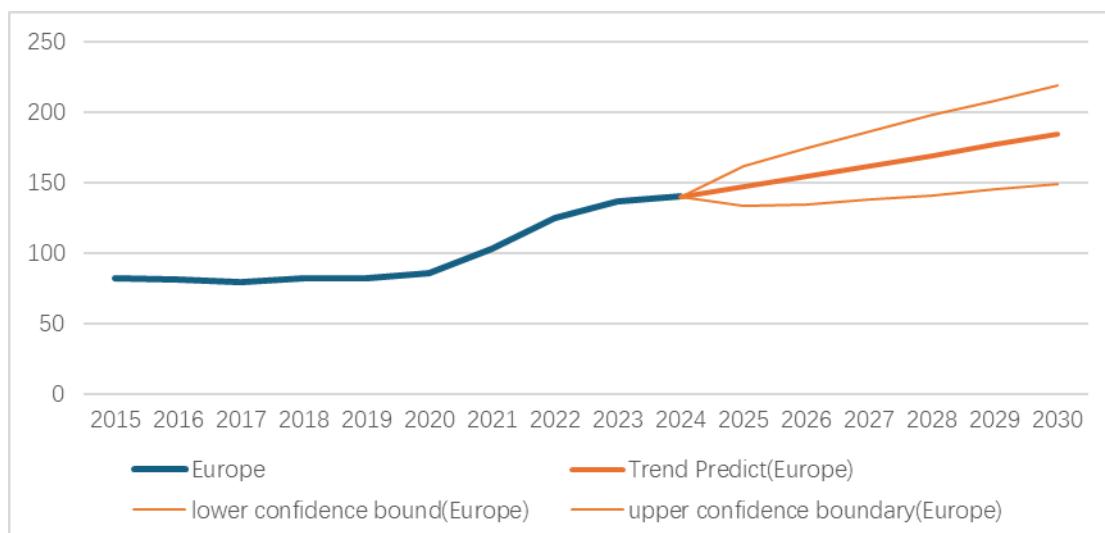


Fig. 4.0 Investment Scenario for Europe 2024-2030

Compiled by author based on [24]

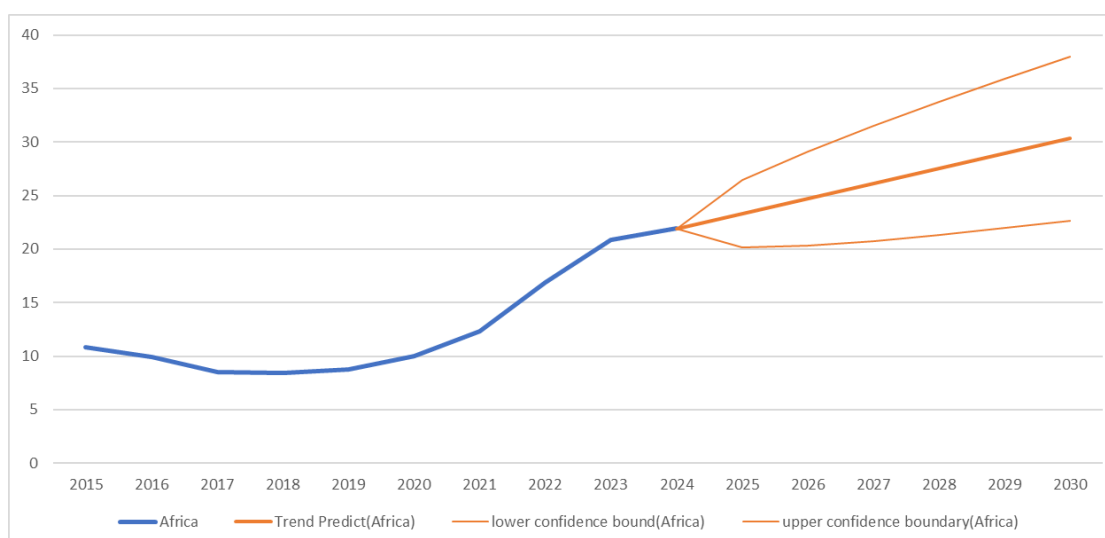


Fig. 4.1 Investment Scenario for Africa 2024-2030

Compiled by author based on [24]

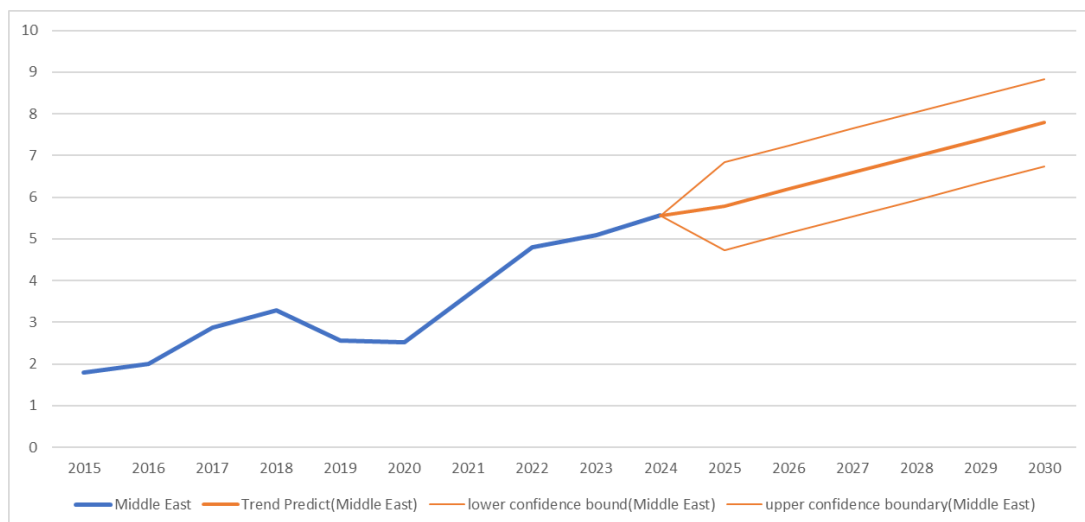


Fig. 4.2 Investment Scenario for Middle East 2024-2030

Compiled by author based on [24]

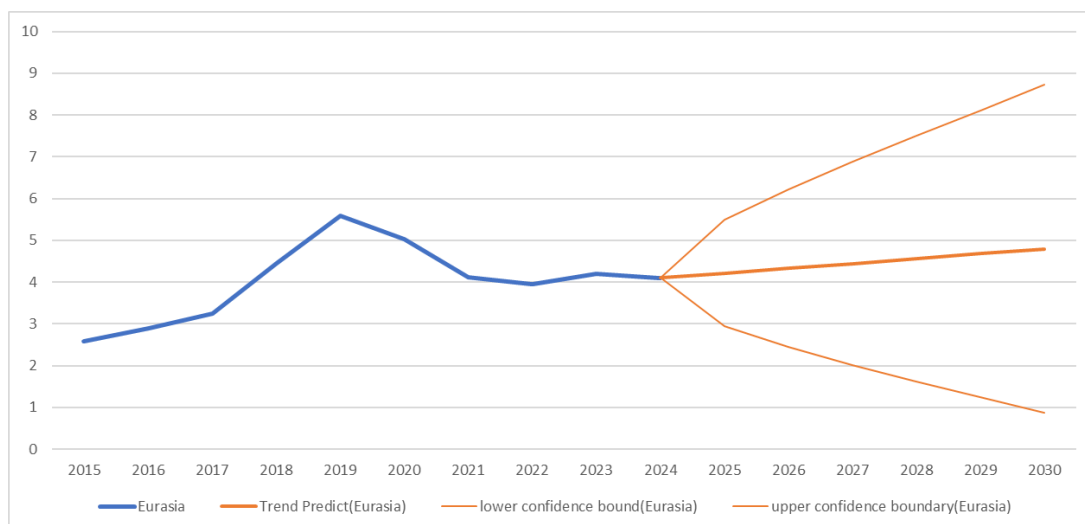


Fig. 4.3 Investment Scenario for Eurasia 2024-2030

Compiled by author based on [24]

The results of the prediction in this thesis were shown as below. Almost all the regions have an increasing trend based on the renewable energy investment, while, under the optimistic scenario, the trend will be higher more because of the proposals we mentioned in 3.2. Obviously, if there will be some pessimistic situations happen, such as policy, investment environment, technology development changing into the unexpected

direction, the trends will also lower than the normal trends, especially for the development regions.

Conclusions to Section 3

The proposed directions for enhancing the attraction of international investments in renewable energy are of utmost significance and possess extensive implications. Firstly, developing a strategy for international cooperation is essential. This involves establishing multilateral or bilateral agreements among countries to jointly promote renewable energy projects. For example, countries can collaborate in the construction of large-scale transnational renewable energy power plants, sharing the costs, risks, and benefits. Through such cooperation, it becomes possible to pool resources and expertise from different regions, thereby enhancing the overall efficiency and scale of renewable energy development. It also helps to address cross-border issues, facilitating the integration of renewable energy into the global energy grid.

Secondly, stimulating investment activity through incentive policies and fiscal measures is a key aspect. Governments can offer various incentives such as tax breaks, subsidies, and preferential land policies for renewable energy projects. Tax breaks can reduce the financial burden on investors, making their investment returns more attractive. Subsidies can be provided for the installation and operation of renewable energy

equipment, ensuring the economic viability of projects, especially in the initial stage. Preferential land policies can secure suitable locations for renewable energy facilities at a lower cost. Fiscal measures like grants and low-interest loans can also be implemented to encourage private and international investors to engage in the renewable energy sector.

Technological support and R&D promotion are vital drivers for the long-term development of renewable energy. Governments and relevant institutions should allocate sufficient funds to support research and development in areas such as advanced solar panel technologies, more efficient wind turbine designs, and improved energy storage systems. This will not only enhance the performance and cost-effectiveness of renewable energy technologies but also enable the exploration of new and emerging renewable energy sources. For instance, continuous R&D efforts may lead to the discovery of more efficient ways to harness tidal or geothermal energy. By promoting technological innovation, the renewable energy sector can maintain its competitiveness and attractiveness to investors who are always on the lookout for promising and cutting-edge technologies.

Capacity building and human resource development are often overlooked but are crucial elements. This includes providing education and training programs related to renewable energy at various levels, from vocational training to higher education. By cultivating a skilled workforce in fields such as renewable energy engineering, project management, and

maintenance, it ensures the smooth operation and expansion of renewable energy projects. Moreover, capacity building also extends to strengthening the institutional and regulatory capacity of countries to manage and oversee renewable energy investments effectively. This creates a stable and reliable investment environment, giving investors confidence in the long-term prospects of their investments.

These directions, when implemented comprehensively, have the potential to significantly increase investment in the renewable energy sector. The influx of more investment will, in turn, drive technological innovation as companies strive to develop more efficient and cost-effective solutions to gain a competitive edge. Ultimately, this will contribute to sustainable development by reducing carbon emissions, enhancing energy security, and promoting economic growth in a more environmentally friendly manner.

To enhance investment attraction, governments should indeed implement stable and transparent renewable energy policies. Stable policies provide certainty to investors, allowing them to plan their investments over the long term. Transparent policies ensure that the rules and regulations governing renewable energy investments are clear and accessible, minimizing the potential for misunderstandings and disputes. In addition to providing attractive incentive policies and fiscal measures as mentioned earlier, governments can also create special economic zones or

industrial parks dedicated to renewable energy, where investors can enjoy additional benefits and a more concentrated and supportive business environment. Investing in R&D and technological support should be a continuous and strategic effort. Governments can encourage public-private partnerships in R&D, where companies and research institutions collaborate to share the costs and risks while maximizing the benefits of innovation. This can lead to faster technological breakthroughs and the commercialization of new renewable energy technologies. Promoting capacity building and human resource development requires a holistic approach. It can involve collaborating with international organizations and educational institutions to develop standardized curricula and training modules. Scholarships and fellowships can be offered to attract talented individuals to study and work in the renewable energy field. International cooperation and partnerships can take many forms. Besides joint projects, countries can share their experiences and best practices in renewable energy policy formulation, project implementation, and regulatory frameworks. International organizations can play a coordinating role, facilitating the exchange of information and technology transfer among countries. Through international conferences and workshops, countries can learn from each other's success stories and avoid repeating the mistakes of others. This kind of international cooperation and sharing of best practices can accelerate the global adoption and development of renewable energy,

making it an even more attractive investment destination on a global scale.

CONCLUSIONS

This paper has comprehensively examined the various aspects of attracting international investment in renewable energy on the basis of sustainable development. Through in-depth analysis of theoretical foundations, current trends, and proposed strategies, it has provided valuable insights for policymakers and stakeholders.

The research began by exploring the theoretical underpinnings of international investment, including the definition, scope, categories, and risk-return characteristics. It also delved into the principles and models for attracting investment, as well as methods for assessing effectiveness. In recent years, the global investment in renewable energy has been on an upward trajectory, driven by factors such as climate change awareness, government policies, and technological advancements. Traditional models like public-private partnerships and concessional financing have been widely utilized, while emerging models in the digital economy hold great promise.

The analysis of international investments in renewable energy revealed several key findings. There has been a significant increase in investment activity, with major players including institutional investors, energy companies, and private equity firms. The geographical distribution

is uneven, with Europe, North America, and Asia being the major destinations. Successful countries in attracting investment have strong policy support, advanced technology, and collaborative approaches. Countries with limited investment face challenges such as political instability, weak regulatory frameworks, lack of access to finance, and insufficient infrastructure. Technological innovation, a favorable policy environment, and market dynamics are crucial factors in attracting international investment.

The paper then proposed directions for enhancing the attraction of international investments in renewable energy. This included developing a strategy for international cooperation through bilateral and multilateral cooperation mechanisms, the role of international organizations and partnerships, and negotiation strategies in international investment agreements. Stimulating investment activity was addressed through incentive policies and fiscal measures, technological support and R&D promotion, and capacity building and human resource development. The assessment of the economic efficiency of international investment programs in renewable energy was carried out through cost-benefit analysis methods, long-term economic sustainability assessment, and uncertainty and risk analysis.

The proposed directions have the potential to significantly increase investment in the renewable energy sector, drive technological innovation,

and contribute to sustainable development. Policy recommendations included implementing stable and transparent renewable energy policies, providing attractive incentive policies and fiscal measures, investing in R&D and technological support, and promoting capacity building and human resource development. International cooperation and partnerships can also play a crucial role in sharing best practices and mobilizing resources for renewable energy investment.

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