

# Equity investment portfolio in renewable energy companies to influence the UN's 2030 agenda

## Portafolio de inversión en acciones de compañías energéticas renovables para incidir en la agenda 2030 de la ONU

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### Abstract

Companies need more and more financing, in particular energy companies can be a good instrument to generate a higher return by investing in their shares and to collaborate so that these companies have income from the purchase of their shares. In this work 5 companies related to the topic of renewable energies were considered, these are: Iberdrola, Gamesa, Vestas, General Electric (GE), and Brookfield Renewable Partners L.P. (BEP), this portfolio will be analyzed following the Markowitz model. The results yield a weighting in the distribution of money when invested in this way: 55% to Iberdrola shares, 20% to Gamesa, 2% to Vestas, 0% to GE, and 23% to BEP. It was found that the stocks with the highest risk are Vestas, and the lowest risk are Iberdrola. These results could motivate investment in this type of companies and the result would be to have more economically sound companies and thus meet the Sustainable Development Goals of the United Nations (UN).

### Resumen

Las empresas necesitan de financiamiento cada vez mayor, en particular las empresas energéticas pueden ser un buen instrumento para generar un mayor rendimiento al invertir en sus acciones y así también en colaborar para que estas empresas tengan ingresos por compra de sus acciones. En este trabajo se consideraron 5 empresas relacionadas con el tema de las energías renovables, estas son: Iberdrola, Gamesa, Vestas, General Electric (GE), y Brookfield Renewable Partners L.P. (BEP), este portafolio se analizará siguiendo el modelo de Markowitz. Los resultados arrojan una ponderación en la distribución del dinero cuando se invierte de esta forma: 55% a las acciones de Iberdrola, 20% a Gamesa, 2% a Vestas, 0% a GE, y 23% a BEP. Se comprobó que las acciones con más riesgos son la de la compañía Vestas, y la de menor riesgo la de Iberdrola. Estos resultados podrían motivar a la inversión en este tipo de empresas y el resultado sería contar con empresas económicamente más sólidas y así enfrentar los Objetivos de Desarrollo Sostenible de la Organización de las Naciones Unidas (ONU).

Company	Country	Cotization	Currency	Year
Iberdrola S.A. (IBE.MC)	Spain	MEDIQON Group	EUR	5
Gamesa Renewable Energy S.A. (SGRE.MC)	Spain	MEDIQON Group	EUR	5
Vestas Wind Systems A/S (VWS.CO)	Denmark	Copenhagen Real Time Price	DKK	5
General Electric Company (GE)	United States	NYSE - Nasdaq Real Time Price	USD	5
Brookfield Renewable Partners L.P. (BEP)	Bermuda	NYSE - Nasdaq Real Time Price	USD	5



	Iberdrola	Gamesa	Vestas	GE	BEP
Yield (%)	0.042%	0.065%	0.284%	-0.032%	0.077%

Empresa	País	Índice de cotización	Moneda	Año
Iberdrola S.A. (IBE.MC)	España	MEDIQON Group	EUR	5
Gamesa Renewable Energy S.A. (SGRE.MC)	España	MEDIQON Group	EUR	5
Vestas Wind Systems A/S (VWS.CO)	Dinamarca	Copenhague Real Time Price	DKK	5
General Electric Company (GE)	Estados Unidos de América	NYSE - Nasdaq Real Time Price	USD	5
Brookfield Renewable Partners L.P. (BEP)	Bermuda	NYSE - Nasdaq Real Time Price	USD	5



	Iberdrola	Gamesa	Vestas	GE	BEP
Rendimiento (%)	0.042%	0.065%	0.284%	-0.032%	0.077%

### Portfolio, Risk, Investment, Companies, Renewable Energy

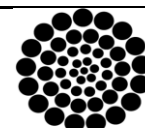
### Portafolio, Riesgo, Inversión, Empresas, Energías renovables

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## Introduction

Wind energy, together with photovoltaic solar energy, has been the one that has increased its exploitation the most and its prices have decreased (IEA - International Energy Agency, 2022), so this renewable energy has become attractive both for energy generation and for investments (Aquila et al., 2020). In Mexico, it is possible to invest in a portfolio of financial assets in Mexico or abroad through various forms of financing from multiple banks.

Investment processes are considered as economic activities for electricity companies, and are closely related to the structure of power generation (Zhang et al., 2022). Therefore, scientific investment decision-making is essential to ensure economic benefit through the share value of these power companies.

It can be said that compared to fossil energy companies, the value performance of renewable energy companies is more vulnerable to various constraints such as grid interconnection, availability of the renewable resource, government restrictions, among others. The performance of fossil companies may be more stable (Odeh et al., 2018).

The premise of portfolio optimisation is to measure the value of investment and changes in that value given a single power generation technology, where the technology is affected by different uncertain factors. First, after the full opening of an electricity market, the price of electricity will change based on supply and demand; changes in the price of coal, natural gas and other energy will also cause fluctuations in the cost of fuel.

Secondly, due to differences in weather, region and climate, there are intermittent changes in wind power, light energy and other renewable energies, and electricity production is unstable. This can lead to vibrations in the electricity grid after connection to the grid. Thirdly, the rapid expansion of installed capacity and increased investment in research and development (R&D) facilitates technological breakthroughs and the continued reduction of costs associated with renewable energy from renewables. However, the concrete path to such cost reductions remains uncertain.

The objective of investment portfolios is to improve the return on investment (Davis & Owens, 2003), for this the Markowitz portfolio model is employed, as done by Xu et al., (Xu et al., 2022), where they optimised an investment portfolio with energy companies that are subject to power dispatch effects; or the one done by (Bai et al., 2019), who introduced a portfolio allocation approach to improve the performance of these portfolios of renewable energy stocks in China by taking uncertainty into account in the portfolio optimisation process.

Few researches have linked these investment portfolios to the United Nations (UN) Agenda 2030 Sustainable Development Goals, as Wang et al. did, (Wang et al., 2020) where they linked the investments to China's sustainable development goals and found an economic benefit in the investments. In this paper we present a methodological proposal to optimise an investment portfolio with energy companies that have branches towards renewable energy using the Markowitz model and show how that performance impacts positively on the UN Sustainable Development Goals.

## Material and method

### Companies

Stock market data of 5 companies listed on different stock exchanges in the world are used, these data were obtained from the financial website yahoo finance (Yahoo Finance - Stock Market Live, Quotes, Business & Finance News, 2022), 5 years of daily data with closing prices of the shares are used, i.e. 1248 data per share are available. Table 1 presents the information on the companies' shares.

### Box 1

**Table 1**

Investment portfolio shares

Company	Country	Index	currency	Years
Iberdrola S.A., (IBE.MC)	Spain	MEDIQON Group	EUR	5
Siemens Gamesa Renewable Energy, S.A. (SGRE.MC)	Spain	MEDIQON Group	EUR	5
Vestas Wind Systems A/S (VWS.CO)	Denmark	Copenhagen Real Time Price	DKK	5
General Electric Company (GE)	United States	NYSE - Nasdaq Real Time Price	USD	5
Brookfield Renewable Partners L.P. (BEP)	Bermuda	NYSE - Nasdaq Real Time Price	USD	5

Source: Own elaboration.

As shown in table 1 not all companies are quoted in the same currency, therefore all prices are converted to US dollars (USD) to have a reference currency, with respect to the exchange rate, these were carried out on 14 September 2022 with the following values, for euros (EUR) 1 EUR = 1 USD, and for Danish kroner (DKK) 1 DKK = 0.13 USD (SIE - Foreign Exchange Market, 2022).

### Markowitz model

The Markowitz portfolio model is widely used because it minimises the variance and covariance of a portfolio, i.e. it reduces risk and maximises investor returns. According to Montgomery (Montgomery, 2005) the portfolio return can be expressed with the following parameters.

$$R_i = \frac{\sum_{t=1}^T R_{it}}{T} \quad (1)$$

where  $R_i$  is the return on instrument  $i$ ;  $R_{it}$  is the return earned on instrument  $i$  in period  $t$ ; and  $T$  is the number of periods under analysis..

### Measure of portfolio risk

The measure of dispersion that is calculated by averaging the sums obtained is known as the variance and can be expressed as equation 2.

$$\sigma^2 = \frac{\sum_{t=1}^T (R_{it} - R_i)^2}{T-1} \quad (2)$$

where  $\sigma^2$  is the sample variance.

The return is calculated for each share, the average returns per share are shown in table 2.

## Results

### Box 2

**Table 2**

Average stock returns

	Iberdrola	Gamesa	Vestas	GE	BEP
Yield ( $R_i$ )	0.042%	0.065%	0.284%	-0.032%	0.077%

Source: Own elaboration.

As can be seen in table 2 there is only one negative return which belongs to the company General Electric, this could modify the overall performance of the portfolio, on the contrary, the company Vestas is the one that presents the best performance, and the other three, Iberdrola, Gamesa, and BEP present positive returns.

To develop the Markowitz model it is necessary to calculate the standard deviation and the variance, table 3 shows the standard deviation of each of the shares.

### Box 3

**Table 3**

Standard deviation of actions

	Iberdrola	Gamesa	Vestas	GE	BEP
Standard deviation ( $\sigma$ )	1.46%	2.73%	7.69%	2.74%	1.90%

Source: Own elaboration.

The highest standard deviation within the portfolio is that of the company Vestas 7.69%, it is clarified that the units are percentages as they were calculated on the performance of these units. The lowest standard deviation is in the performance of the company Iberdrola. With these results it can be deduced that investing in Vestas carries a higher risk than investing in Iberdrola.

A variance-covariance matrix or Markowitz model is obtained, table 4 shows the results obtained.

### Box 4

**Table 4**

Modelo Markowitz

	Iberdrola	Gamesa	Vestas	GE	BEP
Iberdrola	1	0.38	-0.0059	-0.096	-0.091
Gamesa	0.38	1	6.7E-05	-0.0521	-0.0374
Vestas	-0.0059	6.7E-05	1	-0.0009	0.00756
GE	-0.096	-0.0521	-0.0009	1	0.0161
BEP	-0.091	-0.0374	0.00756	0.0161	1

Source: Own elaboration.

Table 4 shows the variance and covariance between the stocks in the portfolio, the diagonal of the matrix is equal to 1 as it represents the variance between the same company, and as the covariance indicates the relationship between two variables it can be seen that Iberdrola has a negative relationship between Vestas, GE, and BEP, while Gamesa has a positive relationship with Vestas and Iberdrola, GE, and BEP, while Gamesa has a positive relationship with Vestas and Iberdrola, Vestas only has a positive relationship with Gamesa and BEP, General Electric (GE) only has a positive behaviour with BEP, and finally BEP has a positive relationship with Vestas and GE.

The result of the portfolio is presented in table 5.

### Box 5

**Table 5**

Equity investment weighting

	Iberdrola	Gamesa	Vestas	GE	BEP
Investment	55%	20%	2%	0%	23%

Source: Own elaboration.

The investment weighting in a portfolio containing only companies involved in renewable energy can be seen in table 5, the model showed 0% investment for GE, 2% for Vestas, 20% for Gamesa, 23% for BEP, and 55% for Iberdrola, i.e. the lowest risk stock is Iberdrola and the model considered this variable to develop the portfolio.

### Conclusions

It can be said that companies are financed in different ways, one of them is to place their shares in Stock Exchanges, in this work 5 shares of companies related to renewable energies are analysed, in order to check how to build an investment portfolio, the companies are Iberdrola, Gamesa, General Electric, Vestas, and Brookfield Renewable Partners L. P. (BEP). P. (BEP), it was found that the shares with the highest return are Vestas with 0.284% and the company with the lowest return is General Electric with -0.032%, in terms of risk, i.e. its standard deviation, the one that varies the most is Vestas with 7.69% and the most stable of the 5 shares is Iberdrola.

The Markowitz model uses these two variables in addition to a variance-covariance matrix to determine the best investment weighting. The result of this weighting is that the investment money in the portfolio will be distributed as follows: 55% to Iberdrola shares, 20% to Gamesa, 2% to Vestas, 0% to GE, and 23% to BEP.

### Contributing authors

*Hernandez-Escobedo Quetzalcoatl:* I contributed to the idea of the project and the development of the research.

*Rodríguez-García Ernesto Raúl:* I contributed to the idea of the project and to the development of the research.

*Mendoza-González Felipe:* I contributed to the idea of the project and the development of the research.

*Rueda-Martínez Fernando:* I contributed to the idea of the project and to the development of the research.

### Availability of data and materials

The datasets used or analysed in this study can be obtained from the corresponding author.

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