

Impact on the Financial Investments in the Economy and Return of Capital – Case Study of the Wind Energy Production

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Abstract This study examines the power loss of an electrical substation where wind turbines are connected to transmit power from the respective substations, as well as the economic implications on return on capital and investment among other economic factors. The modeling of wind turbines, their impact on the voltage profile and their financial consequences are all included in the analysis. The study discusses and elaborates the findings, making judgments on the cost of energy and its growth by the characteristics addressed. In determining the results of the operation and integration of wind turbines, especially their effects on the power grid, with a focus on the voltage profile, energy losses and their financial implications, the conclusions are based on simulation and comparative techniques. Findings from relevant modeling and simulations are used in the paper. A case study model of the Selac substation in the rest of the Kosovo power system has been created, which takes into account wind turbines, substations, cable lines, transformers, loads, price indices and the cost of capital return from the investment of the wind turbines. The paper also discusses the economic benefits resulting from improving the voltage profile and power supply by minimizing active and reactive power losses. Therefore, the paper examines the relevance between financial investments of renewable wind sources and the impacts of electrical losses on the economic performance of these investments.

Keywords: Financial Investments, Return Capital, Energy Cost, Wind Turbines, Power Losses and Voltage

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1. Introduction

Power systems are very significant for the functioning of economic, industrial and general social life. Therefore, their operation needs to be reliable and safe and monitored at all times (Rexhepi, V. 2023), (Rexhepi V. Hulaj A., citation 2020 [1,2]).

The share of renewable energy sources in production is increasing rapidly, although most of the load demand of power systems is provided by conventional generation plants with limited resources and CO₂ emissions. Global warming, pollution, energy crises, and economic policies have made the use of renewable energy sources popular today. Modern energy, development, and utilization of renewable energy sources bring a great effect on modern distribution system networks are increasingly being represented by distributed generators (DG), which primarily generate electricity from renewable energy sources (solar energy and wind energy). These generators'

power and energy production are uncontrolled, and they are frequently situated in areas of high demand. They are directly connected to the distribution network and have a range of production capacities between several kW and many MW. The passive distribution network becomes active with the connection of DG, and the power flow is considerably altered (Li, J., & Huang, Y. (2019)), (Strielkowski, W. & Petrenko Y, citation 2021 [3,4]).

By deploying the DGs, the distribution network's nature was transformed from one of passive distribution to one of active distribution. As a result, to cut losses and boost the power system's stability and effectiveness, most DGs are placed close to the load centers. Protection, power quality, and voltage regulation are only a few of the issues that the integration of DGs into power distribution networks presents (Shaqiri, R., Bogdanov, D., & Nasufi, citation 2016 [5]).

A distribution network with several significant difficulties (system voltage, protection loss of the power grid, system restoration, and network) has been explored about the impact of renewable resources (as distributed

generation, or DG) (Seyed, E. & João P.S. Catalão, citation 2019).

Like other REs, integrating wind energy into the grid could have a positive or negative effect on the integrity of the system. Concerns about grid stability, harmonics, and voltage profile fluctuations might arise when wind energy is connected to the power system (.Bogovič, J., & Pantoš, M. (2022), (Innocent, O. & Charles, I, citation 2022 [6,7])

In particular, the transient stability of power systems with high levels of wind generation is diminished and has recently gained considerable attention. Wind power generation accounts for a significant portion of this renewable energy and reduces the inertia of the power network. To raise the level of operating safety for power systems, it is crucial to accurately assess the impact of wind power generation on power transient stability. In reality, both tiny and huge disturbances can have a significant impact on a power system. The system must be able to adapt to these rapidly changing conditions and guarantee satisfactory performance because load changes, and minor disruptions, occur continuously (Xia, S. & Zou, W. (2018). Wind power generation typically faces reliability issues when it comes to the production, planning, and scheduling of electricity supply. Utility operators never seem to have enough confidence in the system's ability to handle peak loads. (Costa, Á.M.; Orosa, J.A.; Vergara, citation 2021 [8].

The siting of wind turbines in locations with sufficient wind power availability is necessary for the economic justification of their integration into the electricity system. It is particularly difficult to choose the location and power of wind generators to obtain outcomes in terms of acceptable energy losses and opportunities to enhance voltages because such places are frequently found in rural areas with weak electrical systems (Zhiguo, Zh., & Jiasen Ch. Citation 2023 [9,10].

Wind energy's environmental impact is negligible in comparison to that of conventional energy sources. Wind energy uses no fuel and emits no greenhouse gases in compared to coal and oil. Within a few months, the clean energy produced by the turbine will equal the energy required in the manufacture and transportation of the materials needed in the construction of the wind power plant (Zhiguo, Zh.. & Jiasen Ch. (2023)

As a result, the function of renewable energy sources in the power system is crucial, affecting both the availability of clean energy to users and its favorable environmental effects. The need for debate and treatment in this field depends on each nation's ability to reach its goals, according to European policies for achieving the standards for the production of renewable energy [11]. The advantages of renewable energy include:

- Very low lifetime CO2 emissions.
- Considerable economic resource potential; No price uncertainty.
- Diversity and overall social improvement,
- Modular and quick installation; and
- Possibilities for industrial, economic, and rural development Olabi, AG. & Sayed E. citation 2023 [12,13].

Another aspect is handling renewable resources in terms of their performance criteria. Taking into account how they affect the functioning of the reproductive systems, unexpected inflows of producing power, the

characteristics of the appropriate system's voltage parameters, and the effect of the system's frequency (Dolf, G., & Gorini, R. (2019).

The key parts of the electricity system are generation, transmission, and distribution [14]. The technical, economic, techno-economic, techno-ecological, and economic-ecological effects of integrating wind farms into the distribution network, however, are numerous (Agajie, T.F. & Tanyi, E. (2023).

The market of wind power offers promising development potential due to the benefits of wind energy and the harm caused by fossil fuel consumption. Accurate daily power scheduling is essential to modifying the original energy structure and implementing the new energy plan as the power system undergoes complicated changes as a result of the development of wind generation (Dapkute, A., & Siozinys, M. (2023), (Müller, U.P. & Pleßmann, G. (2019) [15]. Power dispatching plans may be made more logically and the cost of maintaining the power system can be decreased using high-precision estimates of the future power output of wind farms [16]. Therefore, optimizing grid scheduling, lowering the cost of economic operation, and assuring the normal functioning of wind farms all depend on accurate wind power prediction (.Y. Zhang, P. & S. Lei, (2017). The form of energy consumption affects economic development to a great extent, and climate change caused by energy consumption has also become a global problem faced by human beings (Farghali, M. & Chen, Z. citation 2023 [17]. Economic growth is significantly influenced by the way energy is consumed, and climate change based on by energy consumption has now become a concern that affects all of humanity (Wu, X., & Zhang, Y. citation 2021 [18].

The paper considers a review of the literature on the uncertain status of wind energy investments, incentive rates for making investments, and their subsidies.

2. Literature Review

A comprehensive source of data on incentives that support renewable energy and energy efficiency is the State Incentives for Renewable Energy and Efficiency (DSIRE) database. Wind speed is a key factor in defining wind energy generation because it is an unexpected phenomenon (L. Brian. (2018) (Husain, R., Ali, J., Manasra citation 2022 [19,20]. For the estimate of potential wind energy to be as accurate as possible, wind speed data from a metrological station established in a specific location must be thoroughly analyzed [21]. Zhang, Y. & Gao, Sh. (2018). The time of day, the facility's elevation, and the kind of terrain all contribute to the substantial variability in velocity data caused by wind sources [22]. . As a result, it is important to carefully review and interpret wind speed data (Wu, X. & Zhang, Y. (2021)

Regarding the percentage annual growth in the total installed capacity, wind energy is one of the most rapidly expanding technologies (L. Brian. Citation 2018 [23].

To determine how well probability distribution functions describe the statistical characteristics of actual wind speed, earlier studies compared recorded wind speed values with statistical distributions (Husain, R, Ali, J.,

Manasra. (2022) [24]. The researchers concluded that the Weibull probability density function's level of accuracy is acceptable, and as such, it can be used to describe wind variations in a particular wind regime and can offer a realistic representation of the actual wind frequency distribution for various heights above ground level (Zhang, Y. & Gao, Sh. (2018), (M. A. Khan et al (2021)). Because of its ease of use and excellent accuracy, the Weibull PDF is frequently employed for the statistical distribution of wind speed data analysis (Barthelmie, R.J., Pryor, S.C. (2021)) making it essential to investigate the statistical features of wind speed for the estimation of energy output compared various Weibull estimation techniques using wind speed data gathered over a lengthy meteorological period at 101 meters above sea level (Husain, R., Saeed, S., Jawad ,A.H., & Ali, J. citation 2022 [25]. The assessment of the project's costs and benefits, along with the economic effects of wind energy development—including its capacity to reduce energy costs, government energy and other project financing incentives, policy effects on project economics, analysis tools to aid stakeholders in project evaluation, and community economic impacts—are essential components of any energy development project planning process [26,27]. The largest winners in this regard are emerging nations.

The currently available research on the local economic implications of deploying RE is inconclusive and primarily focuses on employment-related effects. Studies utilizing structural methodologies or empirical identification techniques make up this category. On the one hand, the local sourcing of parts and services has certain favorable effects on the RE industry or on associated businesses. The manufacturing and building phases appear to be when the benefits are most noticeable. Only when a significant portion of parts and services are supplied by local businesses do the positive spillovers into linked industries become apparent. On the other hand, detrimental effects are noted as a result of rising energy production prices or the displacement of alternative investments (Jianzhou, W. & Xuejiao Ma. (2018)).

Insufficient research has been done on the local socioeconomic effects of wind farms in rural locations. Despite this, four distinct study strands may be found in published publications. First, some studies concentrate on the immediate economic effects on the local area.

Economics, not necessity, governs decisions about investing in wind energy. For the project to achieve its full economic potential, the wind farm must have the lowest total lifespan cost feasible. The financial performance of a project may be complicated by a particular design decision, which may have an impact on capital expenses, taxes, insurance, energy revenue, maintenance costs, and government subsidies [28]. To analyze different design concepts and select the best one based on the unique economic and engineering aspects of the individual wind farm project, a method for streamlining the computations is necessary (Olabi. A.G. & Sayed ET. (2023)

To increase power output, wind turbines that produce electricity from the wind are joined nearby and operated as a wind farm [29]. This has advantages, such as lower installation, operating, and maintenance costs (Tian, K. & Yang, C. (2020).

3. The State and Future of Kosovo's Generation Power System

About 80% of the generation in Kosovo's structure is made up primarily of fossil fuels. While the capacity of renewable energy sources, primarily wind farms, hydroelectric dams, and photovoltaic (PV) solar power plants is roughly 20% [30]. The system design of the various systems and the unconnected profile determine the amount of installed wind capacity in a system that does not jeopardize the system's reliability and performance. Systems will not be able to handle their high levels much longer if there is a significant gap between such outputs and needs (Mahesh, K. (2020).

Both new and old generators that are linked to the network must comply with the network's specifications for voltages, voltage disturbances, power factor, operation, ground level, and voltage isolation, as well as the ultimate requirement of financial effect. However, the rise in energy costs, their trends, and the financial effects on the energy market are some of the most important aspects (Copena, D. & Simón, X. (2019).

The voltage requirement means that, for various circumstances, such as various loading levels and various wind output levels, the voltage shouldn't vary much [31,32]. This relates to the dimensioning of the system, including the number of controllable devices and the system's strength, although it is mostly a reactive power management issue. Additionally, dealing with the effects of brief disruptions brought on by, for example, lightning and other problems, presents a difficult problem (Hernández-Mayoral, E.; Madrigal-Martínez (2023).

3.1. Hypothesis

In this context are brought up some of the hypotheses, such as:

Hypothesis 1: What is the economic impact between the market energy price and that regulated by the regulatory and the impact in the community for renewable energy investments?

Hypothesis 2: What is the velocity of return on capital for the projects?

Hypothesis 3: What is the economic outcome of maximum, average, and minimum production on wind energy production losses in the project?

4. Selaci Substation Case Study

Voltages and angles are constrained by the voltage of the DSO or include voltages and angles over the entire profile [33,34]. A microgrid operator sets reactive power restrictions that reflect the reactive power reserves available at any given moment. (Choton, K., Das, Octavian Bass., Ganesh, K., Thair, S., Mahmoud., & Daryoush. H, (2018). In advance, active and reactive powers at load buses, as well as active and reactive powers at microgrid buses, are determined; they may originate from actual measurements or system estimators. (Semich, I., Secil, V., & Nese, B. citation 2020 [35].

Voltages and angles are constrained by the voltage of the DSO or include voltages and angles over the entire profile. A microgrid operator sets reactive power restrictions that reflect the reactive power reserves available at any given moment (Costa, ÁM. & Fernández-Arias P. (2021)). In advance, active and reactive powers at load buses, as well as active and reactive powers at microgrid buses, are determined; they may originate from actual measurements or system estimators (Semich, I. & Büilent, O. (2020)).

Mixture models that include pretreatment methods for denoising decomposition are therefore becoming more and more common. A single deterministic forecast, however, is unable to account for the uncertainty and fluctuation risk of the wind speed, even though the point forecast provides the theoretical forecast value of the wind speed at some point in the future. (Oh, J.; Park, J.; Ok, C (2022)). Therefore, interval prediction provides the maximum and minimum wind speed under a specified level of confidence throughout this time, which has a more precise practical guiding importance (Jianming Hu, Yingying Lin, A. (2020)).

However, the wind power system has several issues of its own, such as random volatility, intermittent, and poor robustness in response to extreme events. These issues will bring high uncertainty risk to the supply side and the demand side of the new energy power system (Jianzhou, W., Haipeng, Zh., Qiwei, L. & Aini J. (2022), affecting the grid's capacity and posing a serious threat to the grid's stable and safe operation. High-precision wind power forecasting and a thorough understanding of how it will evolve will be crucial in helping to resolve this issue. (Jianzhou, W., Haipeng, Zh., Qiwei, L. & Aini J. (2022)).

By balancing energy costs, wind energy projects can contribute to the economy more favorably. Wind turbines can be installed and immediately used to reduce consumer electricity consumption. (Yuchen, F., Shuqiang, Zh., Wang, N., Zhiwei, L., & Jinshan L. (2019). Net metering is a concept that enables the wind turbine to be located close to a load and send power directly to the consumer, lowering the amount of energy the user must purchase at retail rates. After being returned to the electricity system, the amount of energy not utilized by the residential economy is credited to the consumer (Wu, X., Shen, X., Zhang, J & Zhang, Y. (2021)).

The Selaci project for the generation of wind energy consists of a system substation with 27 wind turbine sources installed, each with a capacity of 105 MW, while the 110 kV side is comparable to the energy system as a powerful and active balancing factor that works in conjunction with reactive power balance. and the 10 kV side is intended for transformers, cables, and lines. When the substation's turbines are used to operate voltage and active power loss problems, their performance is examined in this study (Galparsoro, I., Menchaca, I., & Garmendia, J.M. citation 2022 [36]).

In the scenario depicted in Figure 1, the Selaci wind park is not connected, and the voltage profile on the 110 kV bus bars is lower than the nominal value of 106.6 kV. According to Kosovo's network code, these voltage levels are allowed, but when the load increases, the voltage drops below the nominal levels, putting the entire energy system at risk. On the busbars of the electrical substations,

the voltage and current values, when the turbines are turned on in the power system, are displayed.

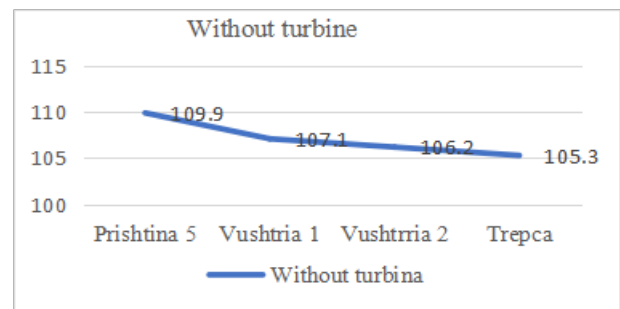


Figure 1. Voltage profile at SS Vushtrria 1 at SS 110/10 kV

The section of the electrical power system where the wind turbines are connected is shown in Figure 2. The effect of a wind power plant on voltage regulation depends on the grid's power flow, the distance, and the setup of the power system. One of the most crucial aspects of their planning is how a wind power project would affect power grid losses. Both positive and negative effects on active energy losses might result from connecting a wind power station to the transmission system. The capacity factor, CF, is defined, in a yearly period, as the percentage of the year during which the WF should have been operating at nominal power to generate the entire production obtained in the year. Usually, the electricity losses in onshore and offshore WFs are calculated from the estimated yearly capacity factor.

The wake losses, electric losses up to the point when the electricity delivered into the grid is assessed, and production losses because the WTG is mechanically available are not included in the gross value, or Gross CF. (Mostafa, R., Rory, F.D., Barrett, M., & D. Maeve. (2022)).

In comparison to a lossless scenario, the addition of losses effectively alters both the overall generation cost and the best generation dispatch. The distribution of power flows (Nwosu, C.M., Oti., & Ogbuka, C.U. (2017) along transmission lines and the energy mix throughout power systems can both be impacted by active power losses [37]. Therefore, as large-scale RES are typically located far from load centers, the losses might particularly influence the utilization of potential energy produced by these sources. (Akinyemi, A. S., Musasa, K., & Davidson, I. E. (2022)). The voltage on the busbar is lower than the voltage on the primary side of the transformer when the system is running normally and no wind turbine is connected. An interruption in power could occur if the wind turbine is shut down. One major constraint restricting the addition of wind power facilities to the transmission network is the impact of voltage rise (Monika Yadav, Nitai Pal (2023). Reliability issues involve ongoing disruptions in the provision of electricity. The following options to improve the dependability of the power supply may be provided by wind power plants: boost the system's overall generation capacity, system reserve, and transmission network load reduction. (Risi B-G., Riganti, F.F., Laudani, A., citation 2022 [38]).

The induction generator can be used with fixed-speed wind turbines due to its capacity to deliver a sizable amount of dampening torque in the prime mover. The SCIG is depicted as a PQ bus with the real power and

reactive power requirements given (Ghaderi, D., & Bayrak, G., (2019). The location of the wind generator in relation to the load determines how wind power affects a transmission system (Akinyemi, A. S., Musasa, K., & Davidson, I. E. (2022).

It is possible to see that for the loads shown by comparing the voltage on the busbars with the voltage that is permitted in the network of the Kosovo power system. Voltage limitations are permitted by Table 1 of the Kosovo system's electrical equipment code.

Table 1. Voltage in normal and extreme condition

	Voltage in normal condition		Voltage in condition extreme	
	Min voltage	Maax voltage	Min voltage	Max voltage
400 kv	380 kv	420 kv	360 kv	440 kv
220 kv	209 kv	231 kv	198 kv	242 kv
110 kv	99 kv	121 kv	88 kv	130 kv

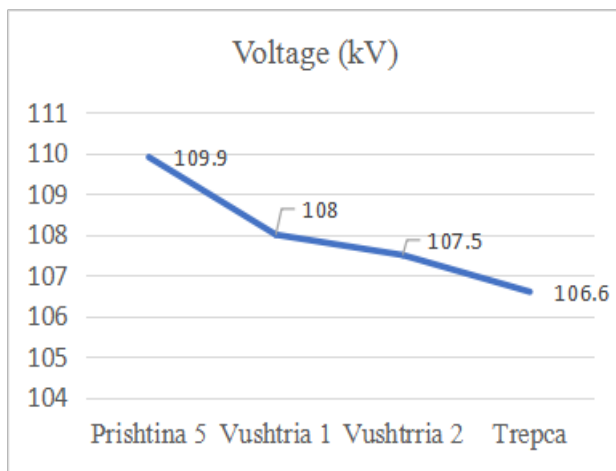


Figure 2. The profile voltage in some substations and wind turbine

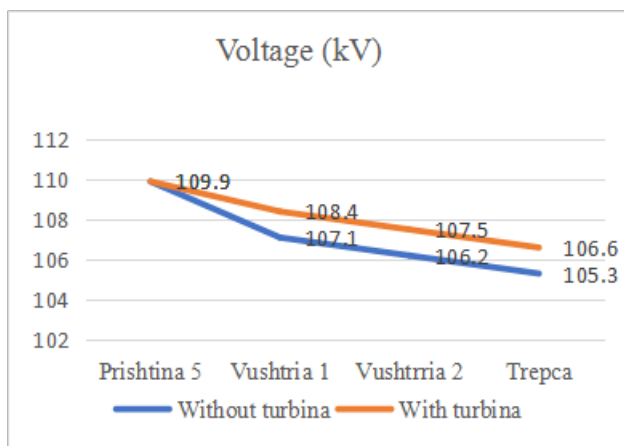


Figure 3. Performance of the voltage (without and with wind turbines are not connected)

Comparing the voltage on the busbars with the voltage that is allowed in the network of the electricity system of Kosovo, it can be seen that for the loads presented in the system, the voltage is within the limits allowed according to the network code of Kosovo. The voltage value is shown in Figure 3 when are connected the wind generators (105 MW). By comparing the voltage on the busbars with the voltage that is allowed in the network of the electricity system of Kosovo, it can be seen that the

voltage for the system's loads is within the ranges permitted by the country's network code. When the 105 MW of wind turbines are linked, the voltage value is displayed in Figure. The results of the voltage profile when wind turbines are connected and out of operation are presented in Figure 3.

5. Wind Generation Financial Impact - case Study Selaci Substation

Due to its comparatively developed technology improved cost efficiency, and resource efficacy, wind power is currently regarded as one of the energy sources with the highest rate of growth in the world (Lu, X., McElroy, M. B., & Kiviluoma, J. citation 2009 [39,40]. However, the expansion of wind power can have both beneficial and bad effects on regional economies. The input-output method used in many research typically only takes positive effects into consideration and ignores the opportunity costs associated with the development of wind power (Liu, F., Ma, J., Zhang, W., & Wu, M. A citation 2019 [41].

The cost and financial impact of producing wind energy are relevant and practical tools in economic considerations Dorrell, J.; Lee, K. (2020). The model evaluates the operational and capital investments made in the SS Selaci and the impact of these investments on the economic aspects based on specific data introduced by the user or predefined data (derived from industry norms), where an investment chain may include parts, equipment, work, workers, operations, power loss, etc. The analysis of the financial impact on energy production, revenues earned and a comparison of power prices for January 2022 through December 2022 is shown in the table below.

The case's treatment relates to a general indicator that is used to analyze the financial model for the production of energy from the Selaci wind generator based on the discrepancy between the sale of energy at the regulated price and the electricity price on the market for the months of January through December 2022. The following expressions provide an overview of the variables used and the indices used in their calculation:

$$DBIVBAPSE = SP \cdot AP = TBAPR - QP \cdot SEBP = TBSE (1)$$

QP = Quantity produced

AP = Adjusted Price

TBAPR = Total Based Adjusted Price Revenue

SEBP = Stock Exchange-Based Price

TBSE = Total Based Stock Exchange Revenues

DBIVBAPSE = Difference Between Input Values, Based Adjusted Price and Stock Exchange.

Alternative research methodologies include the: Comparative techniques are used to track changes in electrical and financial performance [42]. This approach is also useful for financial analysis. (Zhang, Y., Zhang, C., Sun, J & Guo, J (2018). The experimental approach is used to determine the accuracy of the electrical parameter calculations and research cases. These techniques are crucial, and their examination yields findings that provide an overview of the financial cost and electrical impact Perifanis, N.-A.; Kitsios, F. (2023), (Liu, Y., Abdul, K., Khalid, Z & Said FF (2022).

Table 2. Compares the stock exchange process to income-based adjusted process

No	Month	Quantity producing MW/h	Adjusted Price in €	Total monthly based adjusted price income	Energy based price exchange	Total value based price energy exchange	Difference between adjusted value and energy exchange
		A	B	C = A x B	D	E = A x D	F = E - C
1	January	28,972	85	2,462,620	205.04	5,940,418.88	3,477,798.88
2	February	29,859	85	2,538,015	194.55	5,809,068.45	3,271,053.45
3	March	26,278	85	2,233,630	285.96	7,514,456.88	5,280,826.88
4	April	25,524	85	2,169,540	189.44	4,835,266.56	2,665,726.56
5	May	14,590	85	1,240,150	205.11	2,992,554.90	1,752,404.90
6	June	16,216	85	1,378,360	237.11	3,844,975.76	2,466,615.76
7	Jul	16,416	85	1,395,360	371.59	6,100,021.44	4,704,661.44
8	August	14,598	85	1,240,830	495.95	7,239,878.10	5,999,048.10
9	September	27,493	85	2,336,905	390.42	10,733,817.06	8,396,912.06
10	October	17,630	85	1,498,550	193.91	3,418,633.30	1,920,083.30
11	November	30,807	85	2,618,595	223.01	6,870,269.07	4,251,674.07
12	December	26,714	85	2,270,690	260.78	6,966,476.92	4,695,786.92
	Total	275,097		23,383,245		72,265,837.32	48,882,592.32

Table 3. Impact of capital investments for wind energy production, period january – december 2022 selaci substation

Month	Revenue by Value	Operating expenses	Total project investment	Return on investment minus costs
	A	B	C	D=A-B
January	23,383,245	9,800,000	220,000,000	13,583,245

6. Results

Based on the analyses of the production of wind energy for the months of January through December 2022, related to the price according to the generation of megawatts, in which the Selaci project is the case study, the results show a positive performance in terms of saving public money, where Kosovo as a state is the main gainer in terms of economic development because based on the price adjusted to €85 per MWh determined by the Energy Regulatory Office in Kosovo is the value added to profits obtained as a result of changes in stock market prices (Rexhepi, Sh., & Vataj, Gj., (citation 2023) [43]. Based on an analysis of the Selaci project's wind energy output for the months of January through December 2022, there were 275,097 MWh produced. The purchase price, which varied depending on supply and demand, ranged from the least expensive €189.44 per MWh to the most expensive €495 per MWh, with the government of Kosovo receiving the largest share at €48,882,592.32 per MWh. The Selac Company had a turnover of €23,383,245 from 275,097MWh of wind energy produced by the SELACI wind turbine, with an adjusted price of €85 per MWh, and a deficit in respect to the price of energy on the stock market of €48,882,592.32. It is worth €72,265,837.32 based on this production and the stock market price, which is based on the average price of €271.07 per MWh. Based on this case study, the economic advantage is highlighted for the community as a whole. Income from structured investments was determined from Table 3 based on the formulas shown for return on investments and added value. The length of the return on investment and the amount of the annual installment for each investment will be chosen in a way that will effect the additional value in order to meet the return of the principal. The production of wind energy is very cost-ffective and advantageous for the nation, hence ERO proposed that the Agreement for the

Purchase of Wind Energy have a 12-year period and cost 85 €/MWh. This was the conclusion reached after carefully examining all the relevant variables.

This has influenced the promotion of foreign investors for the development of wind energy-producing projects. The net income approach is used to apply the investment calculation model. The value of the cost of the investment and the entire value of the income from the investment were used in the net income approach.

$$ROI = (\text{Net income} / \text{Cost of Investment}) \times 100 \%$$

The income for the period January - December 2022 was in the amount of €23,383,245.

The cost of operating expenses for the period January - 2022 were in the amount of €9,800,000.

$$ROI = (23,383,245/9,800,000) \times 100 = 238 \%$$

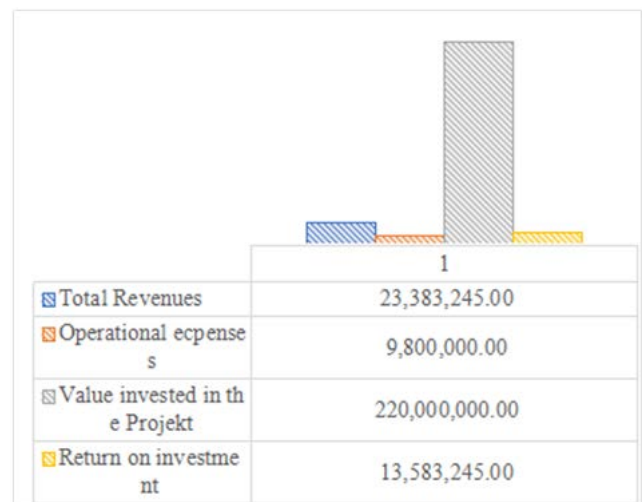


Figure 4. Total Revenues and Operational expense

According to Figure 4, the cost of investment has a very high return benefit, where the benefit is up to 238%, the ratio of cost to income. Based on the results, the

investment had a high-profit performance, which positively affects the return on capital.

Model of calculation formula

I = Total investment in years t

RP = Revenues for the period

RE = Return on Equity investment

OC = Operating costs

NP = Net profit

EMI investment and Return on Equity is calculated based on the following formula.

$IKE = (tp - ko) = fn \ i/t = KIE$

This method enables the calculation of the percentage of the investment through the current operating cost.

$ROI = (Revenue - cost) / Cost \times 100$

$ROI = (23,383,245 - 9,800,000) \times 100 = 13,583,245$

$I = 220,000,000 / 13,583,245 = 16 \text{ years}$

Table 4. Losses in the power system with an operating wind turbine

Branch ID	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		Vd % Drop in Vmag
	MW	Mvar	MW	Mvar	kW	kvar	From	To	
TX5-23	3.800	0.000	-3.782	0.220	18.1	220.3	101.9	101.6	0.31
TX5-24	3.800	0.000	-3.782	0.220	18.1	220.0	102.0	101.6	0.31
TX5-25	3.800	0.000	-3.782	0.220	18.2	220.4	101.9	101.5	0.31
TX5-26	3.800	0.000	-3.782	0.222	18.3	222.4	101.4	101.1	0.31
TX5-27	3.600	0.000	-3.584	0.198	16.3	198.1	101.8	101.5	0.31
TX5-28	3.800	0.000	-3.782	0.220	18.2	220.5	101.8	101.5	0.31
TX5-29	3.800	0.000	-3.782	0.220	18.2	220.4	101.9	101.5	0.31
TX5-30	3.800	0.000	-3.782	0.221	18.2	220.6	101.8	101.5	0.31
TX5-31	3.800	0.000	-3.782	0.221	18.2	220.7	101.8	101.5	0.31
TX5-32	3.800	0.000	-3.782	0.220	18.1	220.1	101.9	101.6	0.31
TX5-33	3.800	0.000	-3.782	0.220	18.1	220.3	101.9	101.6	0.31
TX5-34	3.800	0.000	-3.782	0.220	18.1	220.2	101.9	101.6	0.31
TX5-35	3.800	0.000	-3.782	0.221	18.2	220.8	101.8	101.4	0.31
TX5-37	3.800	0.000	-3.782	0.220	18.1	220.3	101.9	101.6	0.31
					5815.9	18118.5			

According to the calculations in the section on investment return and added value, the impact of the return on capital investment for the invested value of 220 million euros will be €13,583,245; if you take this value of the capital impact, then it means that the investment in the Selaci project will be fully repaid in 16 years. The overall loss of active power as a result of all losses in lines, cables, and transformers is 7,286.2 kW, as shown in Table 4's case analysis conclusion. Additionally, the table. The graph also displays the voltage readings on each busbar in the system's electrical substations. The connection of parts like transformers, energy cables, remote controls, and other equipment results in losses that vary depending on the amount of energy produced, as shown in Table 4. These losses are the result of the connection. The amount of energy produced increases with increasing wind speed. The turbines may produce energy up to their full capacity of 105MWh when the wind is blowing at its optimum speed quota; however, for this amount produced, the impact of losses in kilowatts is 7.28 MWh.. By simulation (ETAP software) (ETAP software, Electrical Power System Analysis & Operation Software., (2023) the active and reactive losses were calculated, in the case when the generators of the wind park give maximum production, the active losses in this case are 7,286.2 kWh. Using the following formula, we applied the loss calculation module:

$$X = 7.28 \text{ MWh} / 105 \text{ MWh} = 6.93\% \text{ (2)}$$

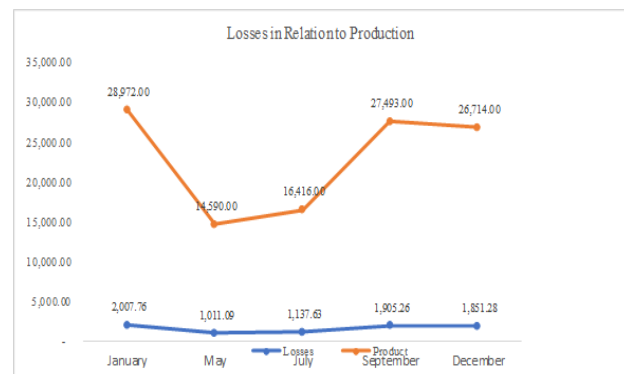


Figure 5. shows the network's active losses in relation to the energy produced by the turbine

Figure 5, shows the production of energy from the turbines in the amount of 28,972 MW/h, and for this produced amount of energy there are active losses that are 2,007 MW/h. Based on the results obtained in relation to the calculated losses, the financial impact varies depending on the adjusted price and according to the stock market. Based on the reference values, we find that the value for the calculation of losses is accomplished as follows.

According to the adjusted price:

$$X = 2,007 \times 85 = 170,595 \text{ (3)}$$

The discounted value for transmission losses is €2,292,025 and the net value of the energy obtained by the user is 26,965 MW/h or €2,292,025 if we produced 28,972 MW/h at the price of 85 = €2,462,620. According to the analysis and discussions on this subject, the research done for the Selaci project revealed that properly positioned and operated wind turbines increased the environmental and financial benefits for the communities looking forward to the development of renewable energy in particular and for the nation in general. The Energy Regulatory Office aims to comprehend and address the problems associated with the installation and use of wind energy. This entails interacting with stakeholders, facilitating research, and sharing findings on practical ways to track and reduce the effects of wind energy on the environment. Kosovo as a state must contribute financially to other initiatives in order for the financial stimulation to create benefits in the production of wind renewable energy, given that wind energy production is very inexpensive and advantageous for the country as a whole.

7. Conclusion and Recommendations

Wind farms are increasingly being used to supply consumers, but their integration poses challenges to the stability, security, and reliability of power systems. A key factor under discussion is the financial cost of investments and the performance of wind farms during operation, particularly concerning energy losses. This paper examines the losses associated with integrating wind farms, the financial implications, and the cost-benefit analysis of investment returns, focusing on a case study at the Selaci electrical substation. Furthermore, the integration of wind farms has both economic and social impacts. The models presented in this paper analyze the role of businesses in promoting citizen participation in Kosovo's renewable energy sector. They demonstrate that the local community, businesses, and other consumers benefit significantly from these investments. The paper explores the effects of integrating a 105 MW wind farm with the distribution network across several substations. Simulation results indicate that the wind farm influences the voltage profile, energy losses, short circuit currents, the radial network, and overall system stability. The issue of voltage profile disruption is more pronounced with distributed generation compared to systems without such sources. The case study reveals that the Selaci wind farm investment had a positive economic impact, not only regionally but more broadly, due to its favorable location, continuous energy production, and low operating costs. Given Kosovo's heavy reliance on coal, which struggles to meet demand, and its dependence on energy imports, the country's energy needs over the next decade will require substantial and long-term investments in Renewable Energy Sources (RES). The construction of new wind farms will significantly enhance voltage quality, increase generation capacity, and improve the security of energy supply for consumers. From a financial perspective, the costs of constructing new facilities play a crucial role in determining the return on invested capital and the potential for energy trading.

Author Contributions

Shaqir Rexhepi contributes to conceptualization, methodology, analysis, investigation, data collection, draft preparation, manuscript editing, supervision, project administration, and funding acquisition.

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