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# A STUDY ON CAPITAL BUDGETING IN RENEWABLE ENERGY PROJECTS WITH REFERENCE TO NTPC

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## ABSTRACT:

Capital budgeting is crucial for determining the strategic direction and evaluating the financial viability of significant energy projects. Green energy necessitates significant initial expenditures, prolonged return times, and dynamic regulatory frameworks, rendering this process increasingly vital. This research examines the decision-making processes of NTPC Limited, India's premier power generation corporation, concerning investments in wind, solar, and hybrid energy projects. NTPC employs standardized approaches such as Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period to evaluate project profitability and guide decision-making. The organization considers factors beyond financial statistics when allocating resources. It further examines sustainability objectives, risk management measures, and governmental incentives. The results indicate that NTPC's organized and cohesive capital planning is crucial for facilitating India's shift to greener, more sustainable energy sources while concurrently improving the company's financial performance.

**Keywords:** Capital Budgeting, Renewable Energy Investments, Project Appraisal Techniques, Risk Assessment, Financial Feasibility Analysis and Sustainable Energy Projects

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## 1. Introduction

Capital budgeting is a fundamental aspect of financial management that determines the investments a firm should pursue and the implications of those decisions on its future. Capital budgeting fundamentally involves evaluating and prioritizing long-term projects to ensure that resources are allocated to opportunities that generate substantial returns. This method is considerably more significant in the realm of renewable energy. Projects related to solar, wind, and biomass need substantial initial capital, have extended payback durations, and are influenced by technological and regulatory ambiguities.

Effective capital budgeting enables organizations and investors to assess risk, profitability, and feasibility through a structured framework. It ensures that limited resources are allocated to the most feasible projects, while acknowledging the distinct challenges posed by renewable energy. Factors that may impact project cash flows encompass alterations in government policy, subsidies, environmental regulations, and fluctuating energy prices. The

decision-making process is further complicated by site-specific variables and technology innovations that affect efficiency and productivity. Conventional methodologies such as Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period require adaptation due to the evolving market dynamics.

Robust capital budgeting processes guarantee financial sustainability while promoting broader sustainability goals. Through meticulous management of costs, benefits, and risks, corporations can formulate investment plans that maximize returns while minimizing environmental effect. Efficient financial planning fosters innovation, enhances investor trust, and accelerates the shift from fossil fuels to renewable energy sources. In an era where sustainability is paramount, capital budgeting serves as a financial instrument that facilitates both economic and environmental progress.

**Problem Statement:** As the globe transitions to renewable energy, making prudent investment decisions is increasingly vital. Solar, wind, and biomass initiatives possess the capacity to enhance environmental and societal conditions; nevertheless, they also include disadvantages, including substantial initial expenditures, extended payback periods, and uncertainties associated with regulatory frameworks, technological advancements, and fluctuating energy prices. Traditional capital budgeting methods are commonly employed; nevertheless, they often neglect specific risks and the evolving nature of financial circumstances. This disparity may lead to suboptimal investment decisions, underscoring the need for enhancement and refinement of financial evaluation methods. Achieving consistent earnings necessitates meticulous project evaluation and efficient resource distribution. Investors, governments, and organizations must understand risk management and financial sustainability to facilitate the proliferation of renewable energy while maintaining economic stability.

## 2. Literature Survey

Briera, T. (2024). This research examines the impact of global climate finance on reducing funding costs for renewable energy projects in developing countries. The execution of Variable Renewable Energy (VRE) projects is occasionally obstructed by elevated finance costs, which impede the global transition to renewable energy. The research highlights how particular financial instruments, such as grants, concessional loans, and guarantees, can enhance project feasibility and mitigate investment risks. The paper highlights the significance of international organizations in advancing accessible finance through case studies and contemporary trends. It also examines how reduced financing costs enhance the feasibility of renewable technologies. The paper delineates the policy ramifications for governments and investors and emphasizes how strategic climate finance could accelerate the adoption of renewable energy. Ultimately, it advocates for coordinated global initiatives to eliminate financial barriers and advance sustainable energy futures.

Praveen, B. (2020). This research examines the importance of capital budgeting in shaping long-term financial management and corporate sustainability. Capital budgeting encompasses the evaluation, selection, and execution of investment projects that mitigate risks and maximize shareholder returns. The paper indicates that poor investment decisions may adversely affect financial success; thus, adequate preparation is essential. It analyzes prevalent methodologies such as Net Present Value (NPV), Payback Period, and Internal Rate of Return (IRR) to illustrate their application in assessing project profitability. The research underscores the significance of aligning available resources and organizational strategy with investment decisions. The paper illustrates, through practical examples, how enterprises can optimize capital allocation to ensure success. It is emphasized that handling uncertainty necessitates continuous observation and assessment. The research concludes that meticulous capital budgeting enhances productivity, promotes sustainable growth, and strengthens decision-making.

Charoenwong, B. (2024). This research examines the impact of capital budgeting approaches on investment efficiency and the risks associated with resource misallocation in uncertain circumstances. It delineates a procedure whereby enterprises aggregate critical data and formulate flexible, context-sensitive investment strategies. The research illustrates how early information acquisition can mitigate conflicts arising from time-to-build constraints. The paper empirically verifies the model using firm-specific data on sales, investment expectations, and forecasting mistakes. It examines the inefficiencies that arise when organizations fail to adjust their investments based on new facts. The findings indicate that systematic capital planning facilitates effective resource alignment with successful projects. The research emphasizes the necessity of planning and uncertainty management, offering significant

insights into corporate investment strategies amid uncertainty. It demonstrates how effective capital budgeting minimizes waste and enhances overall corporate performance.

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Zhang, R. (2023). This essay analyzes the intricacies of healthcare business planning, emphasizing the necessity for healthcare organizations to distribute resources efficiently. It delineates the components of a comprehensive budgeting system, including the establishment of accurate objectives aligned with business goals, the assessment of capital needs, and the application of statistical forecasting methods. The research highlights that employing interdisciplinary teams can enhance precision and effectiveness. There is discourse around strategies to address fluctuations in patient volumes and alterations in rules. The essay demonstrates, via case studies, that well planned budgets can enhance operational efficiency and patient care outcomes. It encourages continuous monitoring and adjustment to the dynamic healthcare environment. The research provides valuable guidance for hospital administrators by demonstrating how meticulous budgeting may improve financial planning, optimize service delivery, and promote sustained organizational success.

Putri, M., Ramadanty, J., & Mukhtaruddin. (2024). This systematic literature review examines the evolution of capital budgeting strategies in investment decision-making, focusing on their use and evaluation in contemporary business environments. The research analyzes various capital budgeting methodologies, highlighting their relevance in assessing social and financial impacts. The strategies encompass Social Return on Investment (SROI), Internal Rate of Return (IRR), and Net Present Value (NPV). The authors discuss how market volatility and stakeholder expectations complicate investment decisions. The report underscores the necessity for organizations to adopt a holistic approach, integrating financial metrics with strategic and social considerations. It also examines how technology could enhance the accuracy and efficiency of capital budgeting processes. The evaluation identifies deficiencies in the existing knowledge base and recommends further investigation, particularly on sustainability and value creation. The research elucidates the dynamic nature of capital budgeting and its impact on organizational effectiveness.

Sharma, P. (2025). This article provides a comprehensive examination of the capital budgeting methodologies employed by enterprises to evaluate potential investments aimed at optimizing long-term value. It encompasses both traditional approaches such as the Payback Period and Accounting Rate of Return, alongside more sophisticated techniques like Net Present Value (NPV) and Internal Rate of Return (IRR). The author examines the merits and drawbacks of each method, emphasizing the significance of selecting the appropriate options based on the business objectives and the nature of the investment. The research also addresses the challenges firms face in budget formulation, including uncertainty and risk evaluation. It underscores the influence of strategic alignment and stakeholder interests on investment decisions. The essay illustrates, through case studies and examples, how effective capital budgeting may enhance financial performance and facilitate informed decision-making. To address the evolving business landscape, the author advocates for lifelong learning and the revision of budgeting practices.

Baker, H. K., & Powell, G. E. (2020). This comprehensive reference offers a practical approach to financial management, benefiting both professionals and students seeking to grasp fundamental concepts and processes. The authors examine critical subjects such as working capital management, financial strategy, and investment opportunities through succinct explanations and practical examples. The book underscores the importance of value maximization and the interrelations among various financial decisions. It

employs examples and case studies to facilitate comprehension of complex topics for readers from diverse backgrounds. The authors also address contemporary issues in financial management, including risk mitigation and ethical difficulties. The book emphasizes the cultivation of critical thinking skills to evaluate financial situations and make educated judgments. The objective of the offered guidance is to equip readers with the abilities necessary to adeptly navigate the dynamic realm of financial management.

### 3. Capital Budgeting Process


With the help of capital planning, businesses may give serious consideration to long-term investments. By prioritizing valuable projects and rejecting less promising ones, it becomes easier to allocate resources in a way that promotes growth and sustainability.

1. Identify Potential Projects: One aspect of this is seeking investment opportunities that mesh with the long-term objectives of the business. This may entail constructing a new manufacturing facility or releasing a new line of products.
2. Evaluate Projects: Here, research on financial matters is useful. Organizations evaluate the financial feasibility of a project in several ways. A few typical approaches are:
3. Net Present Value (NPV): This method reduces the worth of future cash flows to their current value in order to demonstrate the value of money over time. The general consensus is that a project is a good idea if its net present value is positive.
4. Internal Rate of Return (IRR): Find the discount rate that causes a project's net present value to be zero using this procedure. If the project's IRR is more than the company's cost of cash, then it's a solid project.
5. Payback Period: The time it will take for the project to recoup its initial investment is the sole metric considered in this strategy. Although it is a simple and fast statistic, it does not account for cash flows beyond the payback period.
6. Select Projects: Financial tools including net present value (NPV), internal rate of return (IRR), and payback analysis help businesses identify profitable projects that complement their long-term goals.
7. Implement Projects: The task is complete after it has received approval. Obtaining the necessary funds and resources and completing the task according to plan are all part of this.
8. Monitor and Review: Businesses make sure their large-scale projects are successful by reviewing their results. In the future, better decisions will be possible thanks to improved capital budgeting.

**Strategies of Capital Budgeting In Renewable Energy Projects**

**Net Present Value (NPV) Analysis:** One important tool for determining a project's viability is its net present value. One measure of a company's profitability is the present value of its cash inflows and outflows. By determining whether the long-term advantages outweigh the substantial initial expenditures, the NPV aids individuals in making prudent decisions regarding the placement of green energy investments.

**Internal Rate of Return (IRR) Assessment:** Businesses can compare green energy projects to other investments using the internal rate of return (IRR), which determines the expected rate of return on an investment. A greater internal rate of return (IRR) than the minimal rate of return allows investors to choose the most profitable ventures.

Payback Period Calculation: Time required to recoup original investment is known as the payback period. Because of the substantial initial investment required for renewable energy projects, this tool is useful for helping investors manage liquidity risks and develop prudent financial strategies. This fosters growth and stability in the long run.

**Profitability Index (PI) Method**: Dividing the initial investment by the present value of the future cash flows yields the profitability index. When the PI reaches one, it's time for project managers to prioritize initiatives that will maximize their return on investment.

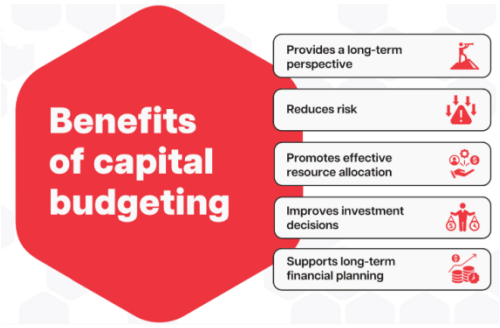
**Sensitivity Analysis:** The purpose of a sensitivity analysis is to determine the impact on project outcomes of potential changes in critical variables, such as energy prices, operational expenses, or government incentives. This approach clarifies the dangers faced by renewable energy investors, allowing them to take the necessary precautions to safeguard their capital.

**Scenario Analysis:** Various potential outcomes, including the best, worst, and most likely ones, are considered in a scenario analysis. Projects are made more robust when decision-makers are able to account for variables including energy consumption, technology efficacy, and regulatory changes.

**Risk-Adjusted Discount Rate:** Capital planning accounts for unknowns specific to a project by using a risk-adjusted discount rate. This ensures that investments with higher risk are examined more thoroughly, which prevents individuals from overestimating the potential returns on green energy initiatives.

**Staged Investment Strategy:** Staged investments allow businesses to assess the cash flows and performance of green energy projects before committing more capital. With this strategy, you may be adaptable when introducing new regulations or technology without jeopardizing your financial stability.

## 4. Benefits of Capital Budgeting




**There are several distinct benefits of capital budgeting, including:**

Capital budgeting provides a long-term perspective: One of the numerous advantages of capital planning is that it allows for:

Capital planning provides an overview of the future. The anticipated returns are weighed against the initial and continuing expenditures in a capital budget. Businesses might benefit from using Net Present Value (NPV) as a tool to gain a long-term perspective. It verifies that investments are in harmony with the company's objectives and contribute to sound planning, efficient use of resources, and sustainable growth over time.

Capital budgeting reduces risk: By reducing operational and financial risks, capital budgeting aids companies in making prudent decisions when considering new investments or projects. It achieves this by factoring in potential risks and uncertainties in addition to the time value of money.

Capital budgeting promotes the effective allocation of resources: Businesses can potentially make better use of their resources and accomplish more if they could identify the obstacles to capital budgeting. By investing in projects that propel them closer to their strategic objectives and yield substantial returns, companies are able to maximize their resources, accomplish more, and secure their future success.

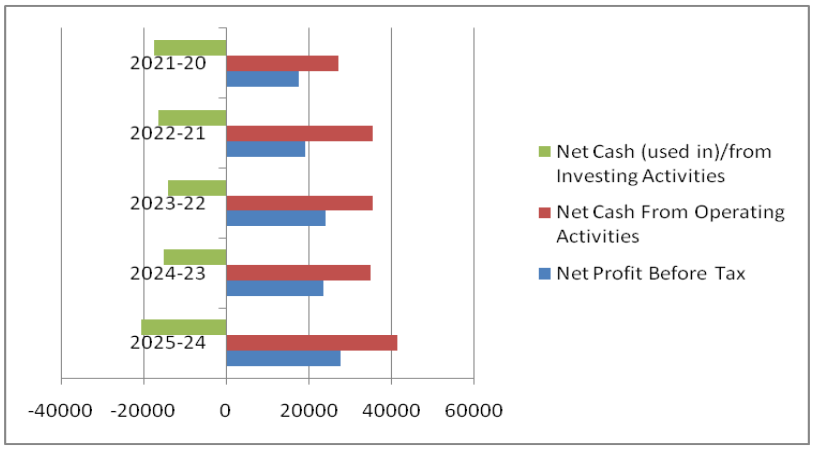
Capital budgeting supports improved investment decisions: The primary objective of capital budgeting is to analyze the expenses, monetary impacts, and projected returns of new investments. Businesses are able to make more educated investment decisions as a result, which improves their financial results. Financial teams may better assess and manage risk with the help of capital planning, which also prioritises investments in projects with the highest potential for return on investment.

Capital budgeting helps with long-term financial planning: Companies can improve their financial stability by investing just in projects with a high probability of producing a profit. Through capital budgeting, financial teams are able to make decisions that support sustainability, new product development, and market growth, among other long-term objectives.

## 5. Data Analysis And Interpretation

### 1. Cash Flow

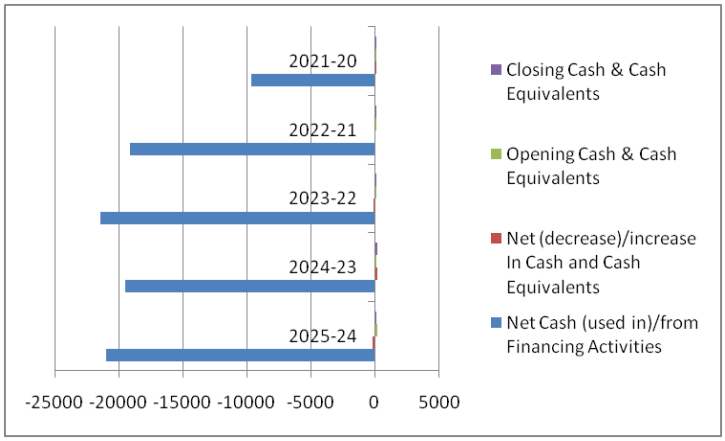
| Cash Flow | 2025-24 | 2024-23 | 2023-22 | 2022-21 | 2021-20 |
|---|---|---|---|---|---|
| Net Profit Before Tax | 27650.43 | 23545.17 | 24067.09 | 19165.75 | 17434.63 |
| Net Cash From Operating Activities | 41318.27 | 34830.91 | 35398.57 | 35388.19 | 27057.78 |
| Net Cash (used in)/from Investing Activities | -20545.69 | -15118.16 | -14062.76 | -16365.84 | -17341.63 |




**Interpretation:** Strong operational performance and ongoing investment efforts are reflected in the company's cash flow. From ₹17,434.63 crore in 2021–2022, to ₹27,650.43 crore in 2024–2025, the net profit before taxes increased consistently, indicating greater profitability. The effective creation of cash from main activities is demonstrated by the steady increase trend of Net Cash From Operating Activities, which stands at ₹41,318.27 crore. The continuous investment in long-term assets and capital expenditures is evidenced by the negative net cash spent in investing operations, which supports future growth. The business makes daring investments in its expansion while still producing a substantial cash flow.

### 2. Cash Flow

| Cash Flow | 2025-24 | 2024-23 | 2023-22 | 2022-21 | 2021-20 |
|---|---|---|---|---|---|
| Net Cash (used in)/from Financing Activities | -20967.59 | -19518.72 | -21450.16 | -19095.36 | -9646.47 |
| Net (decrease)/increase In Cash and Cash Equivalents | -195.01 | 194.03 | -114.35 | -73.01 | 69.68 |
| Opening Cash & Cash Equivalents | 197.16 | 3.13 | 117.48 | 90.05 | 20.37 |
| Closing Cash & Cash Equivalents | 2.15 | 197.16 | 3.13 | 17.04 | 90.05 |




**Interpretation:** In every year from 2021–2022, through 2025–2024, the company's cash flow from financing activities has been negative, suggesting that shares were repurchased, dividends were paid out, or debt was repaid. Accordingly, there is minimal temporal volatility in the Net Change in Cash and Cash Equivalents. Despite the strong operating cash flow, a significant portion is spent on financing and investments, leaving very little free cash at the end of the year, as seen by the lower liquidity in the opening and closing cash balances. The financial situation is solid and in control.

**3. Net Cash From Operating Activities**

Let's calculate NPV, IRR, Payback Period, and Profitability Index (PI) using:

Initial Investment ($I_0$) = Rs. 1,00,000 Cr.

**Cash inflows (CFi) from NTPC data:**

| Year | Cash Flow (Rs. Cr.) |
|---|---|
| 1 (Mar '21) | 27,057.78 |
| 2 (Mar '22) | 35,388.19 |
| 3 (Mar '23) | 35,398.57 |
| 4 (Mar '24) | 34,830.91 |
| 5 (Mar '25) | 41,318.27 |

**Discount rate (r) = 10%**

**Net Present Value (NPV)**

$$\text{NPV} = \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} - I_0$$

| Year | Cash Flow (Rs. Cr.) | Present Value (Rs. Cr.) |
|---|---|---|
| FY2025 | 27,057.78 | 24,597.07 |
| FY2024 | 35,388.19 | 29,265.75 |
| FY2023 | 35,398.57 | 26,612.03 |
| FY2022 | 34,830.91 | 23,782.51 |
| FY2021 | 41,318.27 | 25,685.13 |

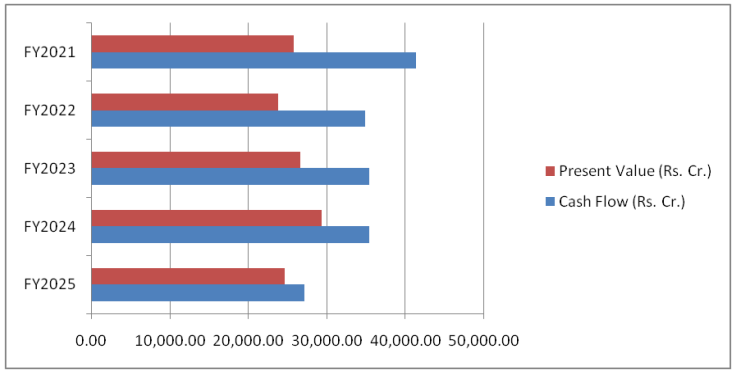
| | |
|---|---|
| **Total PV** | 1,29,942.49 |
| **NPV** | 29,942.49 |

**Internal Rate of Return (IRR)**

$$0 = \sum_{t=1}^{n} \frac{CF_t}{(1 + IRR)^t} - I_0$$

**Solving for IRR (using trial/error or financial calculator) gives:** IRR≈19.3%

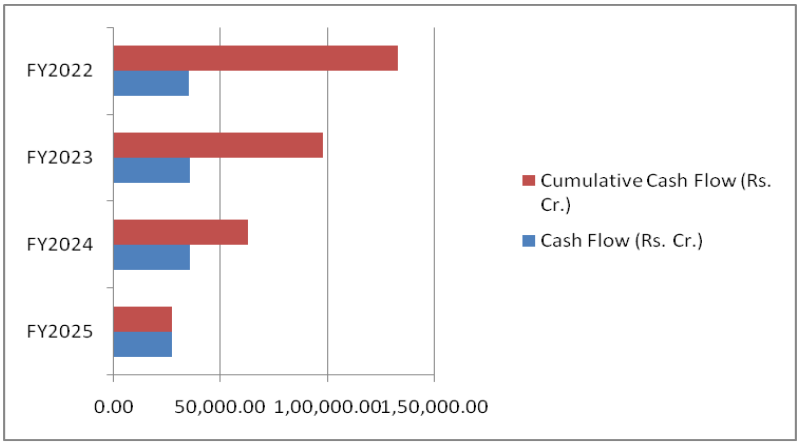
IRR > 10% discount rate → Acceptable project




**Interpretation:** The current value of future cash inflows is 1,29,942.49 Cr. The NPV is calculated to be 29,942.49 Cr after subtracting the initial investment of 1,00,000 Cr. To be financially feasible, a project must have a positive net present value (NPV). After accounting for discounts, the projected internal rate of return (IRR) is 19.3%. This indicates that the project is worth investing in since it is expected to produce a return greater than the required rate. A positive net present value (NPV), an internal rate of return (IRR) greater than the discount rate, a payback period shorter than the project lifespan, and a probability of success (PI) more than 1 are all indicators that indicate the solid financial situation and significant return potential of the venture.

**4. Payback Period**

| Year | Cash Flow (Rs. Cr.) | Cumulative Cash Flow (Rs. Cr.) |
|---|---|---|
| FY2025 | 27,057.78 | 27,057.78 |
| FY2024 | 35,388.19 | 62,445.97 |
| FY2023 | 35,398.57 | 97,844.54 |
| FY2022 | 34,830.91 | 1,32,675.45 |




**Profitability Index (PI)**

$$PI = \frac{\text{Present Value of Future Cash Flows}}{\text{Initial Investment}} = \frac{129,942.49}{100,000} \approx 1.30$$

**PI > 1 → Project is financially viable**

INTERPRETATION: The project successfully recovers its initial investment of ₹1,00,000 Cr in just over three years, as indicated by the cumulative cash flow analysis, which yields a payback period of around 3.06 years. The remaining ₹2,155.46 Cr from FY2022 is swiftly covered by the ₹34,830.91 Cr inflow for that year, resulting in a total cash inflow of 97,844.54 Cr by the end of FY2023. Quick recovery, a favorable net present value (NPV) of ₹29,942.49 Cr, an internal rate of return (IRR) of 19.3% over the 10% discount rate, and a profitability index of 1.30 all show the project's financial sustainability, substantial returns, and effective capital recovery.

## 6. Conclusion

Due to their high initial investment, long payback time, and many operational and financial risks, renewable energy projects have a capital budget. The Profitability Index (PI), Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period are some of the structured financial assessment tools that can help businesses make better investment decisions with lower risk and maximum return. Decisions are better informed by using sensitivity and scenario analysis, which account for uncertainties related to energy prices, technical efficiency, government regulations, and market demand. To stay up-to-date with the ever-changing renewable energy industry, it's crucial to regularly update financial models, conduct continuous oversight, and actively involve stakeholders. A robust capital budgeting system helps businesses achieve sustainability while still making a profit. This, in turn, attracts investors and spurs innovation, which in turn speeds up the transition to renewable energy sources and the building of related infrastructure.

## Future Scope

Real options pricing and scenario-based forecasting are two components of the more complicated models that will be used in future renewable energy capital budgeting to account for policy-driven incentives, changing tariffs, and technological uncertainty. Better capital budgeting decisions are possible with the help of AI, the IoT, and big data analytics through more accurate demand forecasting, performance prediction, and risk assessment. By making energy output measurements, project feasibility evaluations, and lifespan cost assessments more accurate, these technologies will enhance the precision of decision-making.

Increasing environmental, social, and governance (ESG) standards, carbon neutrality targets, and international climate obligations will increase the demand for green bonds, climate funds, and concessional financing. In the long run, this adjustment will improve the chances of capital budgeting and make investments in renewable energy more competitive and viable.

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