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INFRASTRUCTURE FINANCING MODELS IN POWER SECTOR AT NTPC

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ABSTRACT: Infrastructure financing is essential for the development, expansion, and sustainability of the power sector, especially for capital-intensive enterprises like NTPC. This paper analyzes infrastructure finance options utilized in the power sector, focusing on NTPC, the largest electricity producing business in India. The article examines traditional and contemporary methods of financing, including equity financing, debt financing, public sector funding, public-private partnerships (PPPs), green bonds, and multilateral financial assistance. The emphasis is on how NTPC structured its finances to satisfy the increasing energy demand while maintaining financial viability, risk management, and long-term sustainability. The research examines the influence of government policies, market conditions, and regulations on funding decisions within the electricity sector. NTPC's transition to renewable energy and the evolving methods of financing sustainable and enduring infrastructure projects are emphasized. The research identifies optimal practices and insights for the Indian energy sector by analyzing the advantages and disadvantages of various funding methods.

Keywords: *Public-Private Partnership (PPP), Project Finance, Debt Financing, Equity Investment, Risk Allocation Mechanisms*

I. INTRODUCTION

The energy sector's infrastructure projects require large amounts of capital, which is why funding for these projects often involves a combination of public and private sources. Budgets, commercial banks, bonds, and area-specific investment trusts form the basis of these models.

PRIMARY SOURCES OF CAPITAL

Funding for power projects comes from several key sources:

Government Funding: Capital projects, such as the construction of power plants and cable connections, receive substantial funding from federal and state budgets. It is common practice to use this strategy when seeking funding for projects that are considered public goods.

Private Investment: The private companies that funded the power projects want their money back. Funding for this comes from infrastructure funds and private equity firms.

Commercial Banks and NBFCs: One way to secure long-term loan capital is through commercial banks or non-banking financial corporations (NBFCs). Things that take a long time to complete require this.

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International Financial Institutions: Financial institutions such as the World Bank and the Asian Development Bank provide assistance to poor countries in the form of loans, grants, and expert advice for energy projects.

Funding for large-scale construction projects might come from either the public sector or private sources, or even a combination of the two. Investments in India's physical infrastructure come from both the government and private sector.

Infrastructure spending in India has increased at an annual rate of 11%. It would increase from 7.7 trillion INR in FY 2019 to 12.2 trillion INR by the end of FY 2023. Expenditure on infrastructure is expected to rise even more due to the importance of trains, gas, and roads in driving growth. Expenditures on infrastructure up to fiscal year 2028 are shown in the graph below.

An estimated 25 lakh crores of rupees are going into the infrastructure financing industry, which is seeing consistent growth. This area has expanded thanks to infrastructure financing corporations. Meanwhile, banks have been more cautious, which has led to a decline in their activity. A number of infrastructure financing schemes, including the National Infrastructure Pipeline, are detailed in this article. The report concludes with the government's assessment of the industry.

Models for Infrastructure Financing are organized ways to raise capital for construction projects. Not only are these tactics critical for making money, but they are also critical for providing basic services and advancing society. From this vantage point, essential systems like power lines, water and sewage systems, transportation networks, and computer networks are all part of infrastructure. Infrastructure financing models show, in its most basic form, how to pay for large-scale projects. They are the ones that foot the bill for these initiatives. crucial structures, essential to society's functioning, would either not exist or deteriorate in the absence of sufficient funding, making these models extremely crucial.

II. TYPES OF INFRASTRUCTURE FINANCING

Public Financing

Infrastructure is typically funded via public finance, which means that the government creates and distributes the funds. Its primary sources of revenue include taxation, fiscal allocations, and the asset sale of government debt.

The market, treasury bonds, or even the government itself can be a source of funding for governments. Municipal bonds and local taxes are two potential funding sources for state and local initiatives. Rural areas in India can apply for government funds to help pay for infrastructure projects like road construction and electricity. Ahmedabad and Pune are among the cities that have issued bonds to fund the construction of water and sewage systems. The government may find it difficult to raise funds due to budget limits and fiscal deficits, but at least everyone will be able to afford it.

Private Financing

The term "private finance" refers to funding that originates from non-governmental organizations (NGOs), individuals, or corporations, as opposed to public institutions.

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Firms can fund infrastructure projects using their own funds, bank loans, or the stock market, as demonstrated by Reliance Jio's investments in telecoms. Logistics and renewable energy are two areas where private equity and VC firms are actively involved. One important source of this funding is FDI, or foreign direct investment. Funds from outside the country are known as foreign direct investment (FDI), and they are used to fund projects in return for advantages, such as access to markets. As an example, the Delhi-Mumbai Industrial Corridor in India involves Japan. Although private finance makes things more efficient and innovative, it is typically directed towards projects with a high potential for profit rather than investing in public infrastructure.

Public-Private Partnerships (PPP)

The public and private sectors join together in a public-private partnership, dividing up the responsibilities, advantages, and risks. Common examples of schemes are Design-Build-Finance-Operate (DBFO), Build-Own-Operate (BOO), Build-Lease-Transfer (BLT), and Build-Operate-Transfer (BOT). For a limited period, private companies purchase, maintain, and occasionally even own public infrastructure before handing it back to the government. Partnerships between public and commercial sectors enable the construction of national highway projects such as the Delhi Metro Airport Express line. Good services can be more easily provided through PPP, although disagreements over risk sharing, funding distribution, and rate changes are possible.

Multilateral and Development Financing

International financial institutions (IFIs) and bilateral organizations are especially important for helping developing nations finance their infrastructure. Several organizations provide low-interest loans for extended periods of time, including the World Bank, the Asian Development Bank (ADB), and the African Development Bank (AfDB). In order to fund vital infrastructure projects, bilateral organizations such as USAID (the United States government) and JICA (the Japanese government) offer grants or low-interest loans. Businesses that are environmentally friendly, such as those that use renewable energy and public transportation, also benefit from climate finance and sustainable development programs. The Asian Development Bank has lent a hand to India's metro system, while the World Bank has financed rural highway construction in Africa. Loans are made more affordable with these funds, but there may be obligations and regulations that you must follow.

Project Financing

The use of Special Purpose Vehicles (SPVs) to establish distinct financial entities is common practice when this method of funding is employed. The projected profits of the project, such as those from airport fees, sales, or tolls, are used to determine the funding, rather than the sponsoring company's financials. Lenders are often only recouped from the profits made by the projects that take out non-recourse or limited-recourse loans. For large-scale infrastructure projects like power plants and airports, the best financing option is a syndicated loan that involves multiple banks. Detailed economic analysis and guaranteed income sources are required for this technique, which reduces risk.

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Infrastructure Bonds and Capital Market Instruments

The utilization of capital markets to fund infrastructure projects is a lengthy process. Municipal bonds are a way for local governments to raise funds for essential services like water, sewerage, and housing. For environmentally beneficial projects like public transportation and renewable energy, the general public should purchase green bonds. Indian "Masala Bonds," which are offered globally and are pegged to the rupee, have just recently been introduced. These bonds shield borrowers from currency risk and are attractive to investors from other countries. Municipal bond sales in India have funded numerous smart city projects. These strategies encourage investment activity, but they are highly dependent on investors' credit and financial management skills.

Alternative and Innovative Financing

The increasing demand for infrastructure spending is prompting the development of new funding mechanisms. Infrastructure Investment Trusts (InvITs) and Real Estate Investment Trusts (REITs) allow investors to pool their capital and profit from assets such as energy projects, commercial properties, and toll highways. The funds collected from users, such as those for subway fares and tolls, are used to maintain the system. Securitizing future income, like airport fees or electricity pricing, is another innovative concept. Another is blended finance, which combines grants with firm investments. A third is crowdfunding. To maximize the use of its roadways, the National Highways Authority of India (NHAI) launched InvITs. Businesses can reinvest the increased revenue from these tactics into new ventures.

III. RELATED WORK

Fajardo, A. et al. (2025) Hybrid business and finance models that leverage private investment in conjunction with specific subsidies and anchor customers to increase the firm's financial viability are discussed in this article, although mini-grids are the main focus. Because of differences in wealth and location, it argues, there is no universal method to acquire capital. This emphasizes the significance of having tailored blended financing strategies. In order to secure external financing for distributed power infrastructure in low-income locations, the paper analyzes portfolio bundling and risk reduction strategies. This highlights the critical need for government assistance and active participation from the local community.

Zhang, Y. (2024) Regarding power sector infrastructure in particular, this empirical research looks at how green finance tools and public-private partnerships might help with long-term energy growth. This research uses econometric analysis of national and regional data to show that making green bonds and green funding more accessible greatly decreases carbon emissions and increases investment in renewable energy. Obtaining substantial funding for energy infrastructure development is made easy with PPP models, according to the report. They facilitate risk sharing among public and private investors, which is why they are so popular. Due to their attractiveness to institutional investors seeking low-risk investments in environmentally beneficial initiatives, green bonds are an excellent means of raising capital. Along with other elements, the research highlights the importance of technological

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innovation. It argues that fresh, beneficial concepts and norms are the key to getting the most out of financial instruments. To speed up the decarbonization of the power sector and guarantee long-term investment stability in both developed and emerging countries, the research shows that financial and institutional measures must be integrated.

Prasad, N., Bajpai, M., & Agarwal, S. (2023) Power firms' project financing techniques are analyzed in this literature-based research to determine the influence of unique financial concepts. The authors state that the ever-increasing capital needs for infrastructure connected to power generation, transportation, and distribution cannot be met by traditional means of financing, like government subsidies and loans from commercial banks. Several novel financial instruments are examined in this article, including structured finance, green financing, crowdsourcing, energy asset securitization, and peer-to-peer lending systems. It has been demonstrated that these novel ideas can aid energy projects in raising capital, reducing costs, and distributing risks. New financial concepts, according to the authors, boost investor confidence in renewable energy's growth and increase the likelihood that projects will receive funding. The research shows that in order for the power sector to grow steadily and sustainably, a diverse financial landscape is required, one that uses both old and new financial tools. Particularly in developing nations where energy demands are on the rise and finances are tight, this is the case.

Van Ouwerkerk, J., et al. (2022) Modeling power systems is the main focus of this essay, however it significantly impacts decisions on the funding of power sector infrastructure. The authors take a look at how assumptions about investment risks, discount rates, financing structures, and capital costs affect the long-term effects of capacity expansion. The paper analyzes various modeling frameworks and finds that decisions about the combination of generation, grid expansion, and technology adoption are heavily influenced by financial considerations. The findings show that poor infrastructure investment plans might result from using simple or incorrect financial assumptions. Because of this, investing in the system is more expensive and fraught with danger. The research highlights the need of combining financial modeling with technical planning to guarantee that infrastructure projects are feasible and can be funded in the long run. To build economically feasible and long-lasting infrastructure, the research adds to the current literature by stressing the need of integrating funding decisions in the power sector into comprehensive system planning processes.

Lyeonov, S., et al. (2021) The effects of feed-in tariffs (FiTs) and power purchase agreements (PPAs), two policy-driven revenue sources, on energy sector financing are analyzed in this research. To learn how stable tariffs affect investment behavior, the authors look at the past and present policies of several countries. Income estimates are considerably more manageable with certain tariff arrangements and long-term Power Purchase Agreements, according to the research. This facilitates the acquisition of both loan and equity capital while simultaneously lowering the cost of borrowing. The research emphasizes the importance of these tools for green energy projects, which are costly and susceptible to legislative shifts. One of the best ways to attract private investment into power plants, according to the results, is to have clear and consistent tariff regulations.

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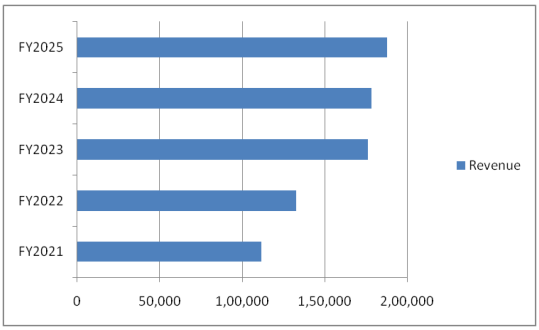
IV. DATA EVALUATION

REVENUE GROWTH SUPPORTING INFRASTRUCTURE FINANCING

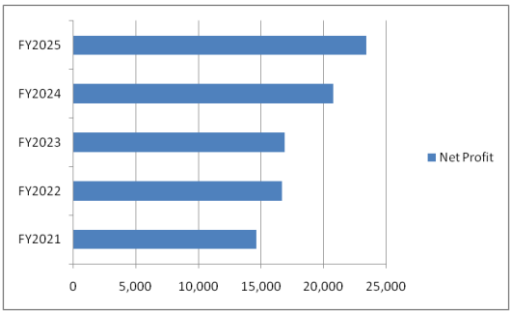
Year	Revenue
FY2021	1,11,531
FY2022	1,32,669
FY2023	1,76,207
FY2024	1,78,525
FY2025	1,88,138



The income increases significantly and continuously from FY2021 and FY2025. From fiscal years 2022 and 2023, there is a clear uptick. Operations may be running more smoothly or energy demand may be increasing if this is the case. Growth is somewhat slower in FY2024, but it really takes off in FY2025. As a result, the economy will remain steady. Profits have increased at a quick rate during the last five years, according to the trend.

NET PROFIT TREND (INTERNAL FINANCING STRENGTH) (₹ CRORE)

Year	Net Profit
FY2021	14,635
FY2022	16,676
FY2023	16,913
FY2024	20,812
FY2025	23,422



Net profit is clearly on the rise from FY2021–FY2025. There was moderate economic growth from FY2021 to FY2023. Having said that, it had a significant improvement in both earnings and expenses in FY2024 and FY2025. The company is clearly well-run and profitable because of this. The company has demonstrated its ability to generate consistent profits.

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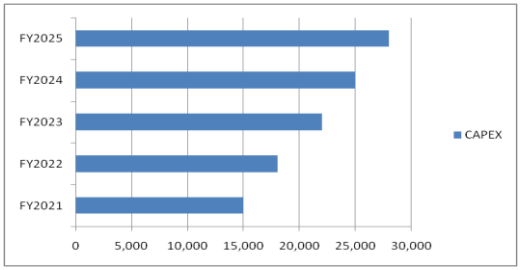
CAPITAL EXPENDITURE (CAPEX) – INFRASTRUCTURE EXPANSION (₹ CRORE)

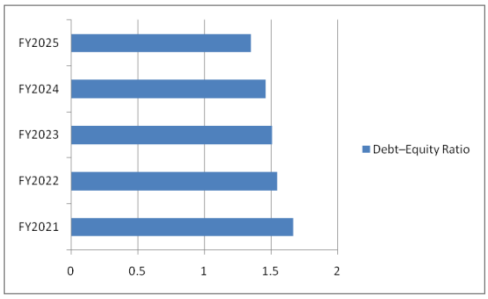
Year	CAPEX
FY2021	15,000
FY2022	18,000
FY2023	22,000
FY2024	25,000
FY2025	28,000



The rate of increase for capital expenditures (CAPEX) remains constant from fiscal years 2021–2025. This trend is becoming more common, therefore funds are still going into projects to upgrade infrastructure, increase capacity, and bring everything up to date. The gradual increase over time indicates deliberate planning for the future, rather than impulsive expenditure.

DEBT–EQUITY RATIO (FINANCING STRUCTURE)

Year	Debt–Equity Ratio
FY2021	1.67
FY2022	1.55
FY2023	1.51
FY2024	1.46
FY2025	1.35



The capital structure appears to be improving as the debt-to-equity ratio continues to decline from FY2021 to FY2025. Businesses are increasingly turning to equity funding rather than loans, as seen by this graph. Less debt means a more stable economy and less risk of long-term financial ruin. Over time, the cash flow of the company has improved.

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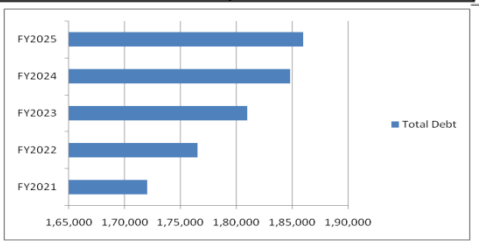
TOTAL LONG-TERM DEBT (₹ CRORE)

Year	Total Debt
FY2021	1,72,000
FY2022	1,76,500
FY2023	1,81,000
FY2024	1,84,800
FY2025	1,86,000



The corporation is borrowing money to fund expansion and capital expenditures, as evidenced by the fact that their total debt is going up from FY2021 to FY2025. Conversely, the rate of increase remains constant and manageable throughout. The decline in the debt-to-equity ratio indicates that the increase in equity and earnings is offsetting the increase in debt. This level of debt seems manageable and consistent with our economic goals for the future.

V. CONCLUSION

The power industry requires infrastructure finance solutions to meet the increasing demand for energy while also producing affordable, dependable, and long-lasting electricity. Due to the high cost, lengthy construction period, and high risk nature of power projects, a comprehensive financing strategy that incorporates public and private funds as well as innovative financial technology and institutional backing is essential. A plethora of viable alternatives exist for securing long-term finance and streamlining operations. Green bonds, invITs, blended financing, asset monetization, and public-private partnerships are a few examples.

The likelihood of investors trusting you increases significantly when you have supportive legal frameworks, practical power purchase agreements, risk mitigation strategies, and stable regulatory regimes. Building electrical infrastructure that works for everyone becomes easier with better local financial markets, digital finance technologies, and community engagement. Adopting long-lasting, transparent, and adaptable finance models that keep up with technological developments and legislative shifts is crucial for a growing power sector, easier use of green energy, and the achievement of long-term economic and environmental objectives.

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