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Situationer

Power Project Costs and Time Overruns have been Increasing Steadily and Alarmingly

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A "power project cost and time overrun" refers to a situation where a power plant construction project exceeds its initially estimated budget and completion timeline, meaning it costs significantly more to build and takes longer than planned, often due to various factors like design complexities, unexpected geological conditions, regulatory delays, or poor project management.

Cost and time overruns in power projects have been a persistent issue globally, with several high-profile cases illustrating the challenges faced between 2014 and 2025. Cost and time overruns in power projects have been a significant concern across various countries, including the USA, China, the European Union (EU), India, Australia, and Canada. These overruns often result from factors such as underestimation of project complexities, regulatory challenges, supply chain disruptions, and unforeseen technical issues (Figure 1).

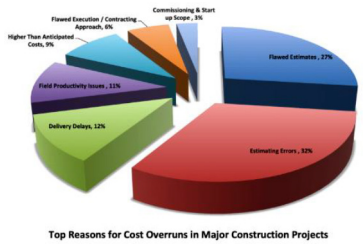


Figure 1. Reasons for cost overruns in major construction projects.

In India, as of 2021, 12 out of 13 hydro projects, 30 out of 34 thermal projects, 18 out of 42 transmission projects, and one out of 26 renewable projects were delayed in execution. Such delays led to significant time and cost overruns. For example, the delay in executing 12 hydro projects led to a cumulative time overrun of over 100 years, and a cost overrun of Rs. 31,530 crore. Similarly, the delay in 30 thermal projects led to a cumulative time overrun of 148 years, and a cost overrun of Rs 41,100 crore[1].

The steady increase in power project cost and time overruns globally from 2014 to 2025 stems from a confluence of interconnected factors, exacerbated by evolving geopolitical, economic, and environmental challenges. Below is a structured analysis of the causes and consequences:

1. Key Causes of Overruns

1.1 Supply Chain Disruptions

1.1.1 COVID-19 Pandemic (2020–2022)

Lockdowns, factory closures, and logistics bottlenecks delayed material deliveries (*e.g.*, solar panels, turbines) and inflated costs.

1.1.2 Geopolitical Conflicts

The Russia-Ukraine war (2022–present) disrupted energy markets, spiking prices for fossil fuels and critical materials like steel and aluminum.

1.2 Transition to Renewable Energy

1.2.1 Technological Complexity

Wind, solar, and battery storage projects face delays due to unproven technologies, grid integration challenges, and land acquisition disputes.

1.2.2 Supply Chain Gaps

Limited global capacity for rare-earth minerals (*e.g.*, lithium, cobalt) and reliance on concentrated production hubs (*e.g.*, China) increased costs.

1.3 Regulatory and Environmental Hurdles

1.3.1 Stricter Regulations

Climate policies (*e.g.*, carbon taxes, emissions standards) and lengthy Environmental Impact Assessments (EIAs) prolong timelines.

1.3.2 Public Opposition

Local resistance to projects (*e.g.*, hydropower dams, transmission lines) leads to legal battles and redesigns.

1.4 Economic Volatility

1.4.1 Inflation and Currency Fluctuations

Post-pandemic inflation (2021–2023) raised labour and material costs, while weaker currencies in emerging markets increased import expenses.

1.4.2 Rising Interest Rates

Central banks' monetary tightening (*e.g.*, U.S. Federal Reserve, ECB) elevated borrowing costs for long-term infrastructure financing.

1.5 Climate Change Impacts

1.5.1 Extreme Weather Events

Hurricanes, floods, and wildfires disrupted construction schedules and damaged infrastructure (*e.g.*, Texas grid failure, 2021).

1.6 Labor and Skill Shortages

Aging workforces in traditional energy sectors and insufficient training for renewable technologies slowed project execution.

1.7 Political and Bureaucratic Inefficiencies

Corruption, permitting delays, and inconsistent policies in some regions stalled progress (*e.g.*, India's coal plant approvals, and African grid projects).

According to research on power project cost and time overruns, studies show a significant trend of cost escalations, with many projects experiencing average cost overruns exceeding 50%, particularly in hydropower projects, and time overruns often reaching several years due to factors like geological uncertainties, design changes, and inflation not factored into initial estimates; with some reports indicating an average cost overrun of around 66% across various power plant types, highlighting the substantial risk associated with power project construction. Table 1 shows cost time overruns on global data samples (Figure 2).

Table 1. Cost time overruns

Year	Avg. cost overrun (%)	Avg. time overrun (Months)
2014	15%	6
2018	22%	9
2022	35%	14
2025	45% (Projected)	18 (Projected)

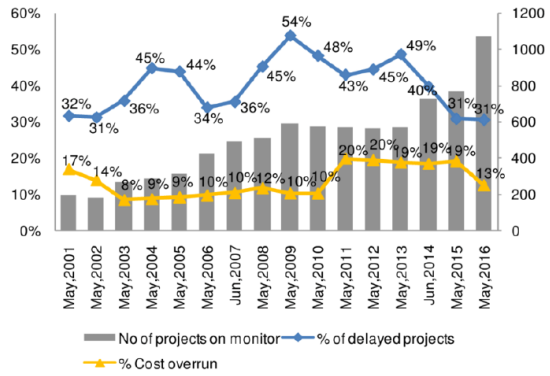


Figure 2. Time delays and cost overruns are increasing concern.

2. Impact of Different Factors

Different factors can significantly impact power project costs and time overruns, including poor initial planning and cost estimations, design changes, site conditions, weather fluctuations, complex regulatory processes, labour issues, material price volatility, unforeseen geological challenges, inadequate project management, scope creep, contract disputes, and political instability; all of which can lead to delays, increased expenses, and ultimately, project failure if not properly mitigated[3]. If one looks into the causes of overruns (2023 Data), the causes are shown in Table 2.

Table 2. Impact of different factors based on 2023 data.

Cause	Contribution to overruns (%)
Supply Chain Disruptions	30%
Regulatory Delays	25%
Labour Shortages	15%
Extreme Weather	10%
Currency Fluctuations	10%
Technological Complexity	10%

3. Regional Breakdown of Overruns

While cost overruns are a global phenomenon, certain regions like South Asia and Latin America may experience higher rates due to factors like the infrastructure development stage and regulatory environments. Table 3 shows regional shares of global overruns (2025 Projection) (Figure 3).

Table 3. Regional shares of global overruns

Region	Share of global overruns (%)
Asia-Pacific	40%
Africa	25%
Europe	15%
North America	12%
Latin America	8%

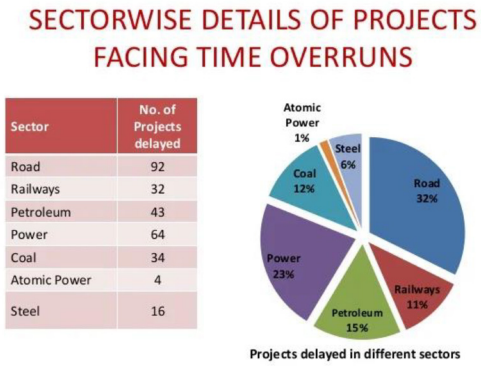


Figure 3. A global estimate of delayed projects.

4. Alarming Consequences

The Consequences Power Project, a large-scale energy infrastructure project, experienced significant cost and time overruns, leading to several negative consequences including increased project budget, delayed completion, financial strain on the developers, potential impact on electricity market stability, reputational damage, legal disputes, and missed economic opportunities due to the extended construction period[3]. Table 4 provides for the consequences of overruns.

5. Key Impacts of Cost and Time Overruns on the Consequences Power Project

5.1 Economic Strain

- Higher energy prices for consumers and industries, exacerbating inflation and reducing competitiveness.
- Financial losses for governments and investors, risking defaults on project loans (*e.g.*, developing nations' debt crises).

5.2 Delayed Energy Transitions

- Slowed adoption of renewables jeopardises climate goals (*e.g.*, COP26/Paris Agreement targets), prolonging reliance on fossil fuels.

5.3 Energy Security Risks

- Project delays in critical infrastructure (*e.g.*, LNG terminals, nuclear plants) heighten vulnerabilities to supply shocks (*e.g.*, Europe's 2022 gas crisis).

5.4 Social and Political Unrest

- Public frustration over rising electricity costs and unreliable supply sparks protests (*e.g.*, Sri Lanka, 2022; South Africa, 2023).

Table 4. The consequences of overruns

Consequence	Economic cost (USD Billion)	Example
Energy Price Inflation	500	EU gas crisis (2022)
Debt Defaults	200	Sri Lanka power projects
Delayed Energy Transition	300	Missed COP26 targets
Social Unrest	N/A	South Africa protests (2023)
Environmental Damage	150	Prolonged coal use in Asia

5.5 Environmental Degradation

o Extended use of coal/oil due to delayed clean energy projects worsens air pollution and carbon emissions.

6. Projections to 2025

Trends are expected to persist due to:

- Ongoing geopolitical tensions (*e.g.*, China-Taiwan, Middle East instability).
- Accelerated renewable transitions requiring untested technologies (*e.g.*, green hydrogen).
- Climate-related disruptions intensifying (IPCC projections).

Overrun severity by project type

Purpose: Compare renewable vs. fossil fuel projects.

Project type	Avg. cost overrun (%)	Avg. time overrun (Months)
Solar	25%	12
Wind	30%	14
Hydropower	40%	24
Coal	20%	10
Natural Gas	18%	8

7. Mitigation Strategies

To mitigate power project cost and time overruns, key strategies include: thorough project planning, detailed cost estimation, robust risk management, effective change control processes, regular monitoring and reporting, vendor/contractor management, clear stakeholder communication, contingency planning, and addressing potential site conditions through thorough site investigations; all aimed at proactively identifying and managing potential issues that could lead to delays and cost increases.

- *Resilient Supply Chains*: Diversify material sourcing and invest in local production.
- *Streamlined Regulations*: Harmonize permitting processes and foster public-private partnerships.
- *Advanced Planning*: Use AI/data analytics for risk assessment and contingency budgeting.

This multifaceted crisis underscores the urgent need for global coordination to balance energy security, affordability, and sustainability.

8. Some Important Cases

8.1 Nuclear Power Projects

8.1.1 Hinkley Point C, UK

Initiated with an estimated cost of £16 billion in 2012, the Hinkley Point C nuclear power station's budget escalated to between £19.6 billion and £20.3 billion by 2017. Further complications, including environmental concerns over local fish populations, have threatened additional delays and cost increases.

8.1.2 Flamanville 3, France

The construction of the Flamanville 3 EPR nuclear reactor faced significant setbacks. Initially projected to be completed in 2012 at a cost of €3.3 billion, the project experienced multiple delays and budget overruns, with costs reaching €12.4 billion by 2019.

8.2 Hydroelectric Projects

8.2.1 Muskrat Falls, Canada

Originally estimated at $6.2 billion, the Muskrat Falls Generating Station's costs ballooned to over $13 billion by its completion, leading to public inquiries and federal interventions to manage the financial fallout.

8.3 Renewable Energy Initiatives

8.3.1 Central Queensland Hydrogen Project, Australia

The ambitious $12.5 billion green hydrogen project in Gladstone was cancelled after the Queensland government withdrew funding, citing escalating costs and financial imprudence.

8.4 Infrastructure Projects with Energy Implications

8.4.1 California High-Speed Rail, USA

Although primarily a transportation project, the California High-Speed Rail has significant energy implications. Initially estimated at $33 billion, projections soared to over $100 billion, with completion dates pushed from 2020 to 2033.

These examples underscore the complexities and challenges inherent in large-scale power and infrastructure projects, including underestimation of

costs, unforeseen technical difficulties, regulatory hurdles, and environmental concerns.

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