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Draft Report: Financial and Economic Viability Analysis

Financial and Economic Viability of Kalpasar Project

Submitted by:
Grant Thornton Bharat LLP
&
G Tech Infrastructure Pvt. Ltd.

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Financial and Economic Viability Analysis

The present Chapter describes the Financial and Economic Viability Analysis of the Kalpasar Dyke project as per the Scope of Work set forth in the following section.

National Centre for Coastal Research (NCCR) vide File No. MoES/NCCR/47/Kalpasar/Financial/2022, dated: 12.07.2022 issued Letter of Acceptance (LOA) to Grant Thornton Bharat LLP (Lead Partner undertaking the Assignment in Association with G Tech Infrastructure Pvt. Ltd.), hereinafter referred to as 'GT or the Consultant'.

32.1 Data Sources

The Financial and Economic Viability Analysis is based on collection of data from various existing reports to be shared by NCCR, secondary data (comparable benchmarks from similar projects) and literature review. Since primary data collection is outsider the purview of the Financial and Economic Analysts, no primary data collection has been undertaken. As an when felt necessary, the team might has interacted with NCCR and the Kalpasar Department of the Government of Gujarat for a better understanding and appreciation of the complexities involved.

This data is being used in building the financial and economic model to assess the financial and economic feasibility of the project. To this end, several parameters are being analysed. A more detailed description of these parameters is provided in the relevant sections which follow. Given the scale and scope of the project, a number of direct and indirect benefits are expected to accrue to all the stakeholders of the project (Government, financiers and local population, among others). In particular, the lower strata of the society (e.g., daily wage earners, agricultural economy) is expected to particularly benefit from various aspects of this project. The proposed analysis aims to capture these financial and economic benefits, which will also comprise Social Cost Benefit Analysis.

32.2 Important Considerations

In understanding the Financial and Economic Viability Analysis presented in this chapter, following considerations are important:

a. Cost phasing is based on the Project Structure (Capital Budgeting structure) as suggested by the Authorities.

b. The Project Cost Estimate is as per the Detailed Project Report. GT has not prepared/revised the same. However, in such cases where necessary information has not been shared, certain assumptions have been made. These are mentioned in Section 32.8 (a)

c. Opex as mentioned in the DPR forms the basis of calculating the Operational Cash Outflow. In case of any gross mismatch from established standards, GT has discussed the same with the Authorities. The authorities in turn have done the necessary corrections/modifications and shared it with GT. As and where necessary, suitable market led assumptions have been incorporated.

d. For the purpose of conducting economic analysis, GT is mostly relying on the data made available by the Authorities in the form of EIA, SIA Reports and other information as received from the Kalpasar Department. Apart from physical inspection of the project site and project-benefit area, GT shall not conduct any primary data collection activities.

32.3 Financing options

An indicative list of the possible financing options is given in the table 32.3.1 below.

Table 32.1 :Indicative List of Possible Financing Options

Equity	Debt
Domestic • State Government / Public Utilities • Central Government • Private Corporates • Other institutional investors • Viability Gap Funding by Govt. • Revenue from real estate development rights	**Domestic** • Banks / FIs • Government bonds • Specialised infrastructure financing institutions
Foreign (1) International developers (2) Equipment suppliers (3) Dedicated infrastructure funds (4) Other international equity investors (5) Multilateral agencies	**Foreign** (1) International commercial banks (2) Export Credit Agencies (3) International Bond markets (4) Multilateral agencies (5) Bilateral aid agencies

Key Considerations for Government

(1) Such projects are highly capital intensive with long gestation periods

(2) Construction period is generally 5-8 years and much longer periods of the order of 30-50 years are necessary for debt servicing;

(3) Such projects are undertaken by governments in view of its social responsibility to provide sustainable infrastructure; returns are not the prime drivers;

(4) Other drivers for such government supported projects are economic development of the area, reduction in traffic , reduction of emissions etc,. which cannot always be expressed in purely financial terms, but have a positive economic effect

(5) Government subsidies and support in the form of equity and viability gap funding are an important part of project during construction as well as during operation of the project;

(6) Government of Gujarat (GoG)/ Government of India (GoI) as Co-sponsors may jointly; contribute to the equity of the project;

(7) Both GoG and GoI may allow certain policy incentives (rebates in taxes payable apart from GST ITC) during the construction and concession period

(8) GoG may facilitate the acquisition of land at subsidised rates for development of the reclaimed land

(9) GoG/ GoI may provide equity support through Viability Gap Funding if necessary for Initial cash losses;

(10) GoG may consider ensuring electricity supply to the project on a no profit-no-loss basis;

(11) GoG may have to provide guarantee for refinancing domestic loans for the bullet portion to be paid at the end of 15th year;

(12) Sale of property development rights will also form a source of funding for the project;

(13) GoI may also provide guarantee for raising funds through bonds.

Key Considerations for Debt Financing

(1) Project would require debt funding spread over at least 30 - 50 years;

(2) Quantum of debt and repayment profile will depend upon the projected revenues over 30-50 year period;

(3) Debt would be funded through various instruments i.e., External Credit Agency (ECA)/Multilateral funds, Govt. guaranteed bonds and domestic Rupee loan;

(4) Funding from ECA/Multilateral institutions will provide cheap and long-term source of funds spread over 30 years and hence it is to be maximised depending upon their comfort and import level from their countries;

(5) Raising of funds through bonds (including Local Area Bonds / Municipal Bonds) will require Government guarantee as the project SPV will not get desired rating on standalone basis;

(6) Part of funds can be raised from domestic lenders for tenor up to 15 - 25 years with structured repayment keeping a portion as bullet repayment at the end of tenor to be refinanced later;

(7) Being long gestation and capital-intensive project there may be cash losses in the initial years and government may have to fund the same by way of viability gap funding.

Debt Financing options

a. *Funding from ECAs / International Cooperative Agency*

(1) ECAs like JICA, Korean Exim, KFW etc. can provide cheap long term funding i.e. 30 – 50 years plus for such projects;

(2) Repayment would be spread over 30 - 50 years after construction and moratorium period of 5 to 8 years;

(3) Low interest rate during construction which will increase after moratorium to match with cash flow projections. Similarly principal repayment can also be structured as per the cash flow projections.

b. Funding from Multilateral / Development Agencies

(1) ADB and World Bank can provide long term funding at attractive rates;

(2) Repayment would be spread over 15 - 20 years after construction and moratorium period of 10 years

(3) MFAs / Development agencies generally provide fixed rate loans

c. Government Guaranteed Bonds

(1) The SPV can raise 10-15 years funds by issue of government guaranteed bonds;

(2) Tax free features can make them more attractive;

(3) SPV can repay these bonds by raising fresh debt once operations are stabilised.

d. Rupee Term Loans

(1) Indian banks can provide debt up to 15 years with 6 to 8 years of construction and moratorium period and 8-9 years of repayment period;

(2) Repayment will be step-up to match the cash flows;

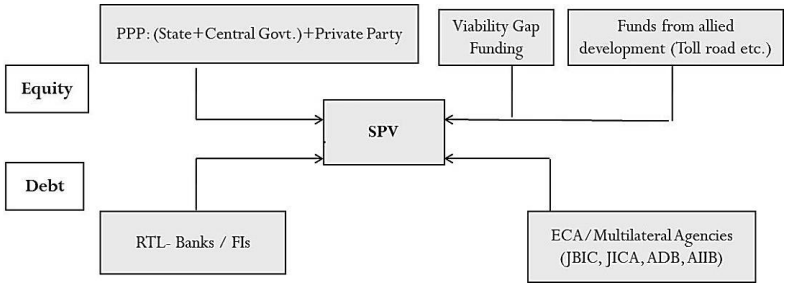
(3) Step up repayment with full amortisation of Rupee loan at the end of 15 years; or

(4) 30%-40% of loan repayment over 15 years and balance bullet repayment at the end of tenor to be refinanced by fresh debt.

32.4 Project Structuring

Modalities for Project Structuring are currently being explored. Possible project structures with necessary caveats will be discussed with the Authorities in the next stage. For now, presented below is a schematic representation of one possible structure which can be considered. Further, a list of comparable project structuring is given in Table 32.2 for the analyst team to draw necessary references.

Figure 32.1: Indicative Financing Structure



Key Financing Attributes

The equity portion (~30% of total project cost) is expected to be partly contributed by state/central governments. Also, the project SPV is expected to be provided a sovereign guarantee by central government thereby providing additional comfort to the lender consortium. In its traditional form, the debt financing (70% of the project cost) can be provided by a consortium of Multilateral Funding Agencies such as ADB, AIIB etc at all-in-cost of LIBOR+3% – LIBOR+5%. That is an all-in-cost of 5.3%-7.3%. As per IMF forecasts, India is expected to witness GDP growth rates of 8.5%-9.5% over the next 2-3 years. Given these growth rates, the rating is expected to witness upwards movement. Also, given the sovereign guarantee by the central government, the rupee term loans are expected to cost 7%-9%. Thus, depending upon the Rupee-Dollar funding mix, the borrowing costs are expected to range from 7%-8%.

Estimation of Weighted Average Cost of Capital (WACC)

For estimation of WACC, the cost of equity and cost of debt will be sourced from the publicly available DPRs of similar large infrastructure projects. Some of the comparable projects are provided here at Table 32.2.

Loan Tenor

The project is expected to be a very long-gestation project (30-50 years) with ballooning revenues during the last 15 years of the project. The debt component may carry a 5-year moratorium during which interest may be capitalised with a 25-year (Approximate that could be further extended) repayment period. That is an overall door-to-door tenor of 30 - 50 years. A ballooning repayment structure is proposed to match the project cash flow profile. Once the construction period is over, the execution risk will decrease considerably, and the debt may be refinanced at a lower cost and longer tenors (from ADB/ECA/Multilateral funds). This would require cash-flow securitisation of project cash flows from allied sources such as toll revenues, wind & solar power generation, industrial and domestic water connections, revenues from state tourism, etc., through TRA/Escrow mechanism. Additionally, long-term tax-free bond options can be explored to refinance the loans.

Table: 32.2: Comparable Projects for Project Financial Structuring

	Project Name	**Total Cost (Rs Crore)**	**Model**	**Financing Structure (As per the DPR)**	
1	Semi High Speed Rail Corridor Thiruvananthapuram to Kasargod	63940	SPV Model	Equity (20%-30%): Govt. of Karnataka and Ministry of Railways	Loan (70%-80%): Soft loans from Bi/Multilaterals
2	Metro: Delhi – Ghaziabad - Meerut	16592	PPP Mode	Equity (30%-50%): Govt of Delhi, Govt of India, Govt of Haryana, Private Partner	Loan (50%-70%): Soft loans from Bi/Multilaterals
3	Bengaluru Suburban Railway	15767	SPV Model	Equity (40%): Govt of India, Govt of Karnataka, Private	Loan (60%): Soft loans from

	Corridors			Partner	Bi/Multilaterals
4	Pune Metro	10700	SPV Model	Equity (50%): Govt of India and Govt of Maharashtra	Loan (50%): Soft loans from Bi/Multilaterals
5	J&K Metro	10600	PPP Model	Equity (40%): Govt of India, Govt. of Jammu and Kashmir, Private Partner	Loan (60%): Soft loans from Bi/Multilaterals
6	Chennai Metro (3+4+5)	29192+14761+16382=60335	SPV Model	Equity (40%): Govt of India and Govt of Tamil Nadu	Loan (60%): Soft loans from Bi/Multilaterals
7	Jaipur Metro	3349	BOT Model	Equity (50%): Govt of India and Govt of Rajasthan, Private Partner as Concessionaire	Loan (60%): Taken by Concessionaire
8	Uttar Pradesh Major District Roads Improvement Project	3531	SPV Model	Equity (30%): Govt of India and Govt of UP	Loan (70%): ADB
9	Rajasthan state highway project	11707	PPP Model	Equity (65%): Govt. of Rajasthan and Concessionaire	Loan (35%): ADB
10	Maharashtra State Road Improvement Project	4142	SPV Model	Equity (30%): Govt. of Maharashtra	Loan (70%): ADB
11	Karnataka State Highway Improvement III Project	5334	PPP model (hybrid annuity contract)	Equity (40%-50%): Govt. of Karnataka and Concessionaire	Loan (50%-60%): ADB

32.5 Methodology for Conducting Financial Analysis

Objectives of the Financial Analysis:

(1) Phasing of costs as per the Detailed Project Report;

(2) Phasing of operational expenses as per the implementation schedule proposed in the DPR;

(3) Identifying the various sources of revenue accruing to the project;

(4) Quantification of the revenue as per Industry standards;

(5) Preparing a Cash Inflow – Outflow statement based on accounting principles;

(6) Preparing a functional Financial Model for necessary Financial Analysis to arrive at the Project NPV, Project IRR under different scenarios;

(7) Identifying the critical parameters affecting the Financial returns from the project and conduct a Sensitivity Analysis;and

(8) Suggesting a few (at least two) project financing structures based on experience; market intelligence and other relevant information.

A project financing structure shall lay out all the components of the capital to be raised for the project with specific details on the amount, timing, interest rates, moratorium, indicative repayment schedules and any other commercial terms likely to affect the financial viability under the relevant financing structure . However, in detailing such commercial terms, GT is not expected to approach any of the Funding Agencies.

GT will analyse the feasibility of each financing structure suggested. The feasibility analysis will incorporate-

- Viability of the financing structure from a cash flow perspective under various economic scenarios being considered in the financial model. To the extent possible, the Consultant shall consider the possibility of cost and time escalations, as well. Specific focus on the ability to service debt and ensure adherence to various financial covenants likely to be in place (e.g. DSCR, EBITDA ratios etc.)

- Viability of the financing structure from a commercial perspective. To the extent possible, highlight precedents of projects having similar structures / components.

- Pros and cons of each structure beyond items covered in (i) and (ii)

- For each financing structure, identify the optimal mix of the components taking into account the intended social outcomes from the project as well as maximisation of revenue potential from the various sub-components.

Cash Flow Analysis

This will include cash flow projections over the potential life cycle of the project. The cash flows (inflows and outflows) will be projected considering inflows and outflows that are tangible (occurring directly on account of the project) and those that are intangible (social economic cost and benefits). These are discussed in detail in the subsequent sections. The cash flow projections will be employed for the computation of various profitability measures and indicators of project financial and economic viability. The cash flow project will also entail project cost estimates and schedule of principal and interest repayment.

Capitalisation and Coverage indicators

It is customary for such projects to be supported by debt. Therefore, the ability of projected cash flows and other benefits to support the debt servicing ability is important. This will be examined through various capitalisation and coverage indicators such as Debt-to-Equity ratio, EBITDA/Interest, EBITDA/ (Interest+Principal), Debt-to-EBITDA, NCA/Debt, among others.

Net Present Value (NPV) Analysis

The first and one of the most important indicators to examine the viability of the project is NPV analysis. We propose to compute NPV of the project at different rates of opportunity costs (or weighted average cost of capital) that reflect the risk of the project. This would account for the fact that project investors should be able to earn commensurate returns; sensitivity analysis at different opportunity costs will highlight the value of the project, and also accounts for differing risk-perceptions.

Project and Equity IRR

The project financial analysis will involve project and equity IRRs for the project. Project IRR is the Internal Rate of Return for the project at which the discounted NPV of cash inflows is equal to cash outflows. In addition, we also propose to estimate Equity IRRs that will examine the returns specifically to equity providers. Projects that involve debt have Equity IRRs that are different from project IRRs. Thus it is important to examine the returns from equity investors perspective.

This is so because returns from debt holders' perspective are specifically mentioned in the form of the interest cost.

Project Viability Gap Funding (VGF)

Kalpasar project is expected to make a sizable contribution to the local region in the form of agri-economy, employment generation, connectivity to metro cities, tourism, and fisheries, socio-economic development and welfare (education, per capital availability of drinking water, etc.). A sizable component of such benefits do not directly accrue to government. To make such projects financially feasible, government support is required in the initial stages, in the form of viability gap funding. The NPV analysis and IRR analysis is expected to highlight the VGF support which might be necessary to be provided to the project by the government to make it sustainable.

32.6 Methodology pertinent to the Kalpasar Project

Land Reclamation and Development

Consequent to the construction of the dyke across the Gulf and creation of the fresh water reservoir, the presently tidal affected land between EL + 5.0 m MSL and EL + 8.0 m MSL in the periphery of the proposed reservoir will open up for reclamation and development. Based on a reconnaissance field survey of the peripheral areas reinforced with computer-based estimation, such land areas are 2,38,464 ha, which are mostly governmental lands. Because of the project-induced development in the region as well as several upcoming developments in the neighboring areas, like Dholera Special Investment Region (SIR), Petrochemical Petroleum Investment Region (PCPIR), etc., there is a high value-additive setting for these lands to be appropriately reclaimed and developed towards value-based land utilisation.

Revenue Estimation

To estimate revenue generation from the reclaimed land, the following methodology has been followed:

(a) The government portion of the land reclaimed shall be valued considering the jantri rate for the nearby Survey Numbers, appropriately appreciated by a multiplication factor approximately equivalent to the appreciation factor calculated for the pre and post development of land in Dholera SIR.

(b) The said value of the land has been monetised in a phase wise manner over a period of 30 years (standard PPP concession period) with a tentative schedule. The schedule is considered perusing other comparable similar projects.

Provision for Toll Road Construction

For toll road construction two main components of cost need to be suitably accounted: CAPEX and OPEX.

These are long-gestation projects (e.g., 40 years). Assuming a 10-year construction period, the capital expenditure can be phased at 10% for each of the years (Typically though, Capex Projects follow a S Curve). Given the useful economic life of the project, the project costs need to be depreciated over the long gestation period. Through appropriate securitisation structure, the revenues from toll can be used to service debt. The proposed financing may include 70:30 of debt equity ratio. Debt may come with a moratorium period of 5-8 years.

First phase of debt financing may be costly, however, once the construction period is over and toll revenues start, cheaper debt can be obtained through refinancing as most of the project construction and execution risk will be over.

The financial costs such as taxes, interests, and depreciation charges can be considered as transfer payments and adjusted in the financial costs to convert into economic costs.

The main operating and maintenance (O&M) costs include all costs and opex items as mentioned by L&T in their latest report submitted in November, 2022.

Revenue Estimation

Under the broad umbrella rules of Govt of Gujarat toll policy, the following factors have been considered to estimate the toll revenues. Willingness to pay will be a factor of time and fuel cost savings depending upon vehicle milage (commercial light and heavy vehicles, private transport, etc.). This aspect will help in establishing the toll tax. Toll tax, coupled with traffic volume and composition, will help in estimating the average revenue profile. For example, TAS report offers two scenarios (Table 2-26 and 2-27) with distance savings, perceived travel cost savings, and accordingly, the proposed toll rates for bus, car, truck, LCV, and MAVs. The resulting number needs to be multiplied by expected annual/5-year/or 10-year traffic growth rates (TAS Table 3-24). Revenue forecasts to be obtained from TAS (Refer Table 4-19), these can be suitably revised to reflect the present conditions.

Provision for Generation of Renewable Energy

a) Wind Power Generation

The area where a number of Wind Turbine Generators are installed is called as Wind Farm. The essential requirements for establishing a wind farm for optimal exploitation of wind are as under:

(1) Wind resource at site;

(2) Adequate open land availability;

(3) Suitable Terrain and Topography;

(4) Proper Approach to the site;

(5) Suitable power evacuation Facility and

(6) Micro siting Layout

All the above written parameters are easily met at Kalpasar.

The governing feature of the wind climatology in India is the monsoon circulations. Winds in India are influenced by the strong South-West summer monsoon winds which start in May-June and weaker North-East winter winds in December-January. Wind energy is intermittent and highly site specific; therefore an extensive wind resource assessment is essential for deciding potential sites. The locations having annual mean power density greater than 200Watts/m2 at 50 meter height are considered suitable for commercial wind power development.

On the basis of Annual mean power density, Vadgam and Jambusar Nada have been selected for the erection of Wind Farm. These areas are at the periphery of proposed reservoir and near to the power evacuation facility.

It is proposed to have 700 turbines of S120, 2100 kW capacity with a hub height of 105 Meter along the coast of Gulf of Khambhat. Hence total of 1470 MW is proposed.

Total 1470 MW will be installed in three clusters of Vadgam1, Vadgam2, and Jambusar region.

716.1 MW, 390.6 MW, 363.30 MW respectively will remain the installed capacity of the three clusters.

Wind power output for Kalpasar project is presented below:

Table 32.3: Wind power output for Kalpasar project

Site Location	**Total Wind Turbine No**	**Capacity MW**	**Total Installed Capacity**	**Estimated Output KWH/WTG/YEAR**	**Total Annual output KWH in Lacs.**
VADGAM I	341	2.1 MW	716.1 MW	39.25 Lacs	13384.25 Units
VADGAM II	186	2.1 MW	390.6 MW	39.25 Lacs	7300.50 Units
JAMBUSAR	173	2.1 MW	363.30 MW	47.50 Lacs	8217.50 Units
TOTAL	700		1470 MW		28902.25 Lacs Units
Grid Level Availability		0.97*28902.25 Lacs Units		=28035.18 Lacs Units	
Power availability to Kalpasar Project Per Year (After 10% Wheeling Charges)				0.90*28035.18=2523.15 Million Units	
Power Required for Irrigation Water Pumping/Year				2500 Million Units	

Total Cost of the Project

As per the prefeasibility study and six specific studies of Kalpasar Project, for pumping of 6,500 Mm3 water from the reservoir at elevation at 70 metre (660 km long canal), required annually is 2500 million units. Considering this much power requirement for the project, and also the availability of huge land area as well as positive parameters of wind energy, it is proposed to install 1470 MW capacity wind turbines which will generate net annual 2523 million units. Hence total cost of 700 Wind turbine generators is given in the Table below.

Table 32.4: Costing for Wind Turbine Generators

Total No of Wind Turbine Generators	**Cost of One WTG (In Rs. Crore)**	**Total Cost (In Crore)**
700	17	11900

Note : Above cost has been given in account for surge in steel and iron ore prices in recent past.

The useful life of the WTG is 25 Years.

Operation and Maintenance -

Per MW Operation and Maintenance cost will be Rs. 1,000,000 at an Annual Escalation of 5.72%.(As per CERC Norms)

Power generated through this plant will be used for captive purpose.

b) Solar Power Plant

A Feasibility study has been done in Vadgam and Jambusar region wherein it has been found average solar radiation at 5.8 Kw-hr/m2/day.

Parameters which are required to commission a solar power plant are available in this area as given below:

Solar insulation in this area is 5.8 kWh/m2/day

3 Hectare land is required to install 1MW of Solar Project

3000 Hectare of land is available in this area without shadow effect wherein 1000 MW of Solar Power plant can be installed.

Easy supply of adequate fresh water from Kalpasar reservoir for cleaning of solar panels.

Distribution Network/Infrastructure available for wind can be used for solar power.

Power Generation from the plant-

We know that at the given solar insulation level, 1.5 Million Units of electricity can be generated from 1 MW Solar plant in a year. Therefore 1000MW of solar will generate 1500 Million Units of electricity in a year.

Components of Solar Power Plant

The main components of solar power plant are as under:

(1) Solar Panel;

(2) Solar Inverter;

(3) Combiners & Junction Box;

(4) Land Bank;

(5) Erection of Project;

(6) SCADA and Data Logger System;

(7) Robotic Cleaning

The overall project cost will be the summation of individual cost of the above written components.

The overall project cost is given in the Table below:

Table 32.5: Overall Project Cost

S.No.	Component Name	Cost (in Crore)
1	Solar Panel(Mono Crystalline Perk Half Cut)540watt Peak	2800
2	Solar Inverter(1MW,10MPPT)	225
3	Combiners and Junction Box	200
4	Protective Gears Arrangement	100
5	Erection	500
6	SCADA and data logger system	70
7	Robotic Cleaning	500
8	Total cost	4395

Note: Here we have assumed that land for the project will be provided by state authorities therefore we have not accounted the land cost.

Operation and Maintenance –

Operation and Maintenance will be done with the help of Robotic Cleaning which has been accounted for in the Capital Cost. For O&M we are taking Rs.2.5Lacs/MW as O&M cost with 5.72% escalation(As per CERC Norms) on annual basis.

Other necessary assumptions

Given the capacity of wind and solar power projects, assumptions (or estimates) can be obtained for comparable projects across India. These include project cost estimates based on plant capacity. Opex related estimates as a percentage of plant capacity. Competitive tariff rates for power can be employed to estimate the revenues.
Such projects are usually 70: 30 or 75:25 debt equity financed. Thus, financial projections can be obtained using these line items. Indicative broad project and financing assumptions are provided in Sec 20 (DPR).

Increase in availability of Industrial and Drinking water

Total water available for storage in Kalpasar reservoir is 10,000 MCM at 50% dependability, of which 6568 MCM water is proposed to be allocated for irrigation in the Saurashtra region covering 39 talukas in six coastal districts viz. Bhavnagar (7 talukas), Amreli (3 talukas), Junagadh (12 talukas), Porbandar (3 talukas), Jamnagar (10 talukas) and Rajkot (4 talukas). Details of net-water availability (after accounting for losses) for these three major causes (industry, agriculture, and domestic) are provided in the reports. GT is in the process of estimating the direct financial benefit generated due to the provision of water for domestic, industrial, and agricultural purposes based on benchmarking of unit cost/MCM of water supply in similar projects. The preliminary estimations are given in Section 32.8 (b).

Sources for Calculation: Data provided by the authorities and conceptual structural plan report (CEPT University)

Leasing of reservoirs for freshwater fishing

While the DPR does not mention leasing of the reservoir for the freshwater fishing activity, this may well be an important source of direct revenues to the project. This can be estimated as a percentage of the fish harvest on an annual basis.
Sources for Calculation: Data provided in the conceptual structural plan report (CEPT University). Some initial computations are provided in Section 32.8 (Table 32.37-28). In addition, benchmarking from similar projects/studies may also be explored

Design Life of various Components

Table 32.6: Design Life of various components

S.No.	Component	Design Life
1	Structural Components	Minimum 100 Years
2	All fixed, cast-in, or non-replaceable components	Minimum 100 Years
3	Replaceable Mechanical and Electrical components	Minimum 25 Years
4	Hydromechanical Steel Structures (Gates and Valves)	Minimum 40 Years

Source: DPR, Version June 2022 Table 14.1

32.7 Methodology for Conducting Economic Analysis

Objectives of the Economic Analysis

(1) Conversion of Financial Project Cost Estimates into economic costs;

(2) Conversion of Opex estimates into economic costs;

(3) Identification of tangible economic benefits accruing due to the project (Economic benefits as already identified in the DPR shall be considered as the base; however, in case any other benefits have not been identified, the Consultant shall propose the same, subject to final acceptance of the Authorities);

(4) Review of population projection as per accepted standards and identification of beneficiary population out of the same (based on population projection and demographics as mentioned in the Social Impact Analysis);

(5) Quantification of the tangible economic benefits based on sound economic principles – To the extent possible, the quantifications shall be based on benefits accrued due to similar projects implemented nationally or globally;

(6) Conducting an economic analysis of the Present Value of Economic Benefits and Economic Return from the project;and

(7) Sequencing of economic benefits which are likely to accrue – An informed estimate of commencement of the economic benefits aligned with the Construction and Implementation Schedules is being used to carry out the necessary analysis

Fundamentals of Economic Analysis

The socio-economic impact of the project can be classified into tangible and intangible benefits. The tangible benefits (or tangible outputs) can be further classified as Traded and Non Traded Outputs in the nature of Incremental and Nonincremental outputs. Similarly, inputs or project (and associated) costs can be classified as Traded/Non Traded, further classified into Incremental and Nonincremental inputs.

Economic cost-benefit analysis establishes the overall economic merit of the project. Economic assessment includes monetizing benefits, such as time savings, decongestion benefits, environmental impact, accident cost savings, etc. This analysis is the central tool for measuring the net economic gain that can be achieved through the development of the project.

Economic valuation of project benefits and costs involves converting their financial values into economic values, also known as “shadow pricing.” This conversion requires economic prices of project outputs and inputs to be estimated. Economic prices reflect values of goods, services, and other project effects on the national economy. The basis for estimating economic prices differs between internationally traded and nontraded goods and services, between project outputs and inputs, and between incremental and non-incremental outputs and inputs.

Based on the above principles, input costs and outputs shall be converted into shadow prices. Further analysis and calculation of EIRR / ENPV follows the same method as is used for the calculation of FIRR.

Calculation of Economic Feasibility

Economic Internal Rate of Return (EIRR) will be computed based on sound economic principles and globally accepted norms of conducting Economic Analysis of the Project (also known as Social Cost Benefit Analysis) to arrive at the economic feasibility of the project. The EIRR indicates the rate of return at which the present value of the economic costs and benefits of the project are equal. In other words, it is the discount rate for which the net present value of the net effect on the economy (ENPV) is sero. The EIRR should be compared with the socially required rate of return. Projects that are found to have an EIRR that is higher than the socially required rate of return would be said to be feasible economic investments. These may then proceed for a detailed analysis of their viability as PPPs.

FIRR and EIRR give different sorts of information about a project. FIRR provides a decision criterion on whether the project generates enough return to cover the cost of funds (or in other words generates a positive Net Present Value of Net Cash Flow during the project period) On the other hand, the EIRR is better suited to being a decision criterion from the socially beneficial purpose. By allowing a project to be compared against a required rate of return it gives a yes or no answer about whether it is economically feasible. EIRR includes aspects such as socio-economic perspective and positive and negative externalities of the project to society.

Methodology adopted for Economic Feasibility of Kalpasar Project

a) Net Economic Benefit

Economic appraisal is done by estimating net project gains by comparing the 'With Kalpasar' scenario and 'Without Kalpasar' scenario. Stream of costs and benefits, as estimated in market values are then converted into economic values by using appropriate shadow cost factors.

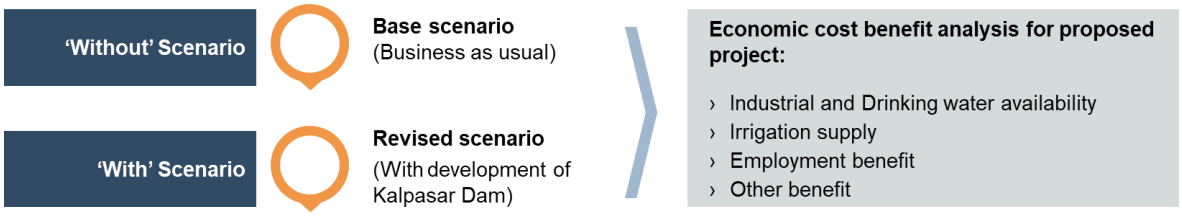
The annual stream of project costs and benefits are compared over the entire analysis period for estimating the net benefit and economic viability of the project. These benefits are presented in terms of the Economic Internal Rate of Return (EIRR).

EIRR represents the discount rate at which ENPV of the project is equal to zero; in other terms where the Net Present Value of all economic cash flows is equal to zero. The higher the value of EIRR, the greater the net economic returns from the project.

b) Economic assessment – Approach and framework

As highlighted, economic cost-benefit analysis analyses overall costs and benefits from the development of the Kalpasar Dyke. The assessment includes monetizing non-market benefits from the development of the dyke, such as availability of water drinking, industrial, and irrigational purposes, hydropower generation, employment generation, travel time savings, decongestion benefits, environmental impact savings, etc.

Figure 32.2: Economic Analysis:Without and With Scenarios



Economic appraisal of this project evaluates social cost-benefit and compares project benefit and costs under "With" and "Without" project cases.

"With" case considers the possible benefits achieved with the development of Kalpasar Dyke whereas "Without project" case considers the existing base case. The Economic Internal Rate of Return (EIRR) would be calculated as-

EIRR = Private Returns + Cost Gains

Where, Private Returns = Actual Revenues – Actual Costs

Cost Gains = Actual Cost – Opportunity Cost

All taxes and subsidies are excluded from the computation of EIRR

The financial analysis only looks at the project from the perspective of the implementing agency. Also, financial analysis is only concerned with line items that entail monetary outlays. Economic analysis, on the other hand, considers cost and associated benefits to the economy.

Economic analysis requires quantification of various costs and benefits converted to 'economic equivalent' terms. EIRR also requires identification of 'externalities and valuation of inputs and outputs at their true economic prices, or the 'opportunity costs'. These externalities would be estimated as the Shadow Cost Factor, as explained in the following Section.

c) Shadow Cost Factor Estimation

In order to estimate the economic benefits of the Kalpasar Dyke, the actual financial value of construction and operational costs would be estimated including the Shadow Cost Factor. The Shadow Prices are adjusted financial prices, which discount the effects of government taxation and subsidies, the opportunity cost of resources, environmental externalities, and market distortions.

The Shadow Exchange Rate Factor determines the domestic currency value converted at the official exchange rate, and as per the Asian Development Bank's (ADB) guidelines it is determined as per the formula below.

SERF = RER / OER * (1 + T – S)

Where, SERF = Shadow Cost Factor,

RER = Long-run Real Exchange Rate for the Economy,

OER = Original Exchange Rate (Actual) of the economy,

T = Average rate of tax on infrastructure investment, and

S = Average rate of subsidy on infrastructure investment

Shadow Wage Rate Factor (SWRF) determines the opportunity cost of labour. For skilled labour, SWRF is considered equal to 1, whereas, for unskilled labour, SWRF varies between 0-0.75 implying a loss of output.

The relevant shadow factors for the economic assessment of Kalpasar Dyke would be derived using the ADB or similar Guidelines.

Benchmark EIRR

For all investment projects such as transportation, energy, urban development, and agriculture, Multilateral Funding Agencies use a discount rate of between 9% to 12% as the minimum required EIRR to accept or reject a project and to choose the least-cost (or most efficient) project choice. This rate serves as a rationing rate to maintain resource efficiency and as a stand-in for the opportunity cost of capital in each of the member countries that are developing (DMCs). However, lower discount rates of about 6% can be used as the minimum required EIRR for social sector projects, specific poverty-targeting projects (like rural roads and rural electrification), and projects that primarily generate environmental benefits (like pollution control, ecosystem protection, flood control, control of deforestation, and disaster risk management).

These projects can be justified by using a lower social discount rate for the following reasons: Numerous environmental protection and conservation initiatives have very long-term effects that justify a lower discount rate, and many social sector and poverty-targeting projects frequently have many advantages that cannot be quantified.

Understanding the Socio-Economic Impact of the Project

Given the scale of the project, we understand that substantial socio-economic benefits, both tangible (revenue generation, income from assets likely to be generated, increase in Gross Domestic Product i.e. GDP, improvement in groundwater quality etc.) and intangible (improved quality of life, improvement in flora and fauna etc.) are expected to accrue to the project. In order to carry out the economic feasibility analysis, we shall strive to understand these and categorise them in to tangible and intangible benefits. The tangible benefits shall then be quantified to conduct the feasibility analysis and the intangible benefits shall be mentioned separately.

Following are some of the likely benefits expected to accrue, divided into two broad categories:

(1) Direct benefits, and
(2) Indirect benefits

Table 32.7: Direct and Indirect Benefits

Direct Benefits	Reduction in passenger transport and freight haulage cost
	Generation of Sustainable Energy
	Land Reclamation and Development
	Water availability for industry, agriculture (irrigation), and domestic/municipal applications
	Tourism and recreation
Indirect Benefits	Increase in Agri Gross Regional Product
	Reduction in siltation along the coastal shipping route
	Reduction in air pollution and Consequent Carbon Credit
	Additional Employment Generation
	Improved navigation for coastal shipping
	Negative Impact on Fauna

Most of these benefits are briefly discussed below. Few of the indirect benefits have been directly covered in the Section on Methodology for Estimation of the respective benefits

a. Reduction in passenger transport cost and freight haulage cost

Direct connectivity between the Saurashtra region and South Gujarat (Bharuch, Surat) has been a long-felt requirement of Gujarat. Construction of dyke road across the Gulf of Khambhat will fulfill that requirement by connecting the Saurashtra region with South Gujarat; thus, transport distance will be reduced significantly, thereby reducing the transport costs. The road transport benefits will accrue largely through the diverted and generated traffic. While the traffic will be diverted to the dyke road from other modes of transport or other routes in view of the differences between the transport costs incurred in the dyke; the generated traffic will be consequential to the new road connection and the reduced costs between the Saurashtra region and South Gujarat, and to the demand of transport on account of various projects in the region, viz Petrochemical and Petroleum Investment Region (PCPIR), Delhi-Mumbai Industrial Corridor (DMIC), Dholera Special Investment Region (Dholera SIR), Fedra (Dholera) International Airport, Port activities, etc. Moreover the transport component within the project will stimulate the regional economic development.

Presently, we have estimates of major district connectivity with and without dyke (details in TAS Table 1) and therefore savings in distances. For example, savings in distance from Bhavnagar to Bharuch is 137 km. As per the savings matrix Table, across different districts, the savings range from 50-150 kms. Moreover, the expected travel time savings is estimated to be between 30-minutes to more than 6 hours. Estimates of traffic volumes and traffic composition for different vehicle movements in the project influence area (heavy and light commercial vehicles, passenger cars, auto rickshaws etc.,) are similar to those provided in TAS (Oct, 2013). [The corresponding train traffic volume details are provided in Table 5&6 (CEPT)]. These estimates of cost and time (road user benefits) are categorised as Savings in Vehicle Operation Costs (VOC) and Savings in Value of Passenger Time (VOT) and are provided in Table 5-6 (TAS).

The overall benefits (both quantifiable and non-quantifiable) can be summarised as under-

(1) Reduction in operating expenses, both for the users of the new highway on the dyke, but equally for traffic that continues to use the existing routes, which may become less congested;
(2) Time savings for both passengers and freight;
(3) Reduction in accidents;
(4) Increased comfort and convenience;
(5) Secondary benefits like savings in foreign exchange as consequence of reduction in transport timing of fuel imports.

b. Generation of Sustainable Energy

Owing to environmental concerns and rapidly depleting fossil fuel reserves, renewable sources of energy like Wind, Solar etc. have been the preferred option. Wind power is non polluting and causes no ecological imbalance, no throughput fuel. It has low gestation periods and is having rapid technological advancements.

One of the objectives of Gulf of Khambhat Development Project is to explore the possibility of power generation through renewable energy sources like Wind and Solar to meet the power requirement for pumping of water into canals.

Under the ambit of the Gulf of Khambhat Development Project, the power requirement for pumping of water from the proposed freshwater reservoir is planned to be achieved through renewable energy sources by setting up wind power farms along the periphery of the reservoir.

The annual power requirement for water pumping of the project would be approximately 2500 Million Units (TEFR). As per TEFR and Suzlon study (pre-feasibility survey), the wind energy potential is the estimated energy assessment of 700 turbines each of 2.1 MW capacity, aggregating to a total of 1470 MW capacity.

Along with wind power, solar power is planned to be developed collaterally. Basic parameters for the feasibility of solar power development are aligned to wind-farm are provided as follows: 4500 ha land area is proposed to be made available for wind park, of which 3000 ha land area (without any shadow effect) can be available for solar power development.

c. Land Reclamation and Development

Consequent to the construction of the dyke across the Gulf and creation of the fresh water reservoir, the presently tidal affected land between EL + 5.0 m MSL and EL + 8.0 m MSL in the periphery of the proposed reservoir will open up for reclamation and development. Based on a reconnaissance field survey of the peripheral areas reinforced with computer-based estimation, such land areas are 2,38,464 ha, which are mostly governmental lands. Because of the project-induced development in the region as well as several upcoming developments in the neighboring areas, like Dholera Special Investment Region (SIR), Petrochemical Petroleum Investment Region (PCPIR), etc., there is a high value-additive setting for these lands to be appropriately reclaimed and developed towards value-based land utilisation.

d. Water availability for industry, agriculture (irrigation), and domestic/municipal applications

Total water available for storage in Kalpasar reservoir is 10,000 MCM at 50% dependability, of which 6568 MCM water is proposed to be allocated for irrigation in Saurashtra region covering 39 talukas in six coastal districts viz. Bhavnagar (7 talukas), Amreli (3 talukas), Junagadh (12 talukas), Porbandar (3 talukas), Jamnagar (10 talukas) and Rajkot (4 talukas). Details of net-water availability (after accounting for losses) for these three major causes (industry, agriculture, and domestic) are provided in Table 9.2 (DPR). For drinking water a reservation of 1000 MCM from proposed Kalpasar Reservoir has been planned. It will be provided to Water Supply Department of GoG to cover deficit of drinking water in the entire Kalpasar command area. Also, 100 Mm3 of water for industrial use from the freshwater Kalpasar lake. A good part of this can be reused for irrigation after proper treatment. Appropriate water tariffs can be employed to value the additional water resource generated by the project. Moreover, surface irrigation would recharge the ground water in the command area, as a result of which the additional irrigation has been planned using the groundwater.

e. Tourism and Recreation

Tourism will be one of the relatively new economic activities in the region. The Kalpasar lake will offer avenues of recreation along the waterfront. Hence recreation has been proposed as a separate land use zone in the Final Structure Plan of the Gulf of Khambat Development Project Report prepared by CEPT University in January 2019, which includes tourism and recreation-based activities depending on the location and environmental sensitivity. To promote tourism activities, riverfront is proposed at strategic locations to create Entertainment for heterogeneous group of people, it will also increase the degree of tourism development in the area.

Benefits from tourism shall be estimated basis a certain percentage of the average expected per capita expenses incurred by the estimated tourist volume on fooding, lodging

etc. basis comparable per capita expenses incurred by tourists in similar or near similar tourism projects.

Apart from revenue generation potential, this will also create new jobs in the form of hotel management, guides, drivers, hotel staff, craftsmen, agents, trade and commerce, transport and logistics, locals etc. This includes a mix of skilled, semi-skilled, and daily wage earners.

f. Increase in Agri Gross Regional Product

It is expected that the reservoir developed in Kalpasar Project will irrigate approximately 10.50 lakh hectare land, benefiting 9 to 10 districts of Gujarat where the present agriculture is dependent solely on monsoon. With an increase in water supply for irrigation due to the development of dyke, the Agricultural output of the state would likely increase, thus, increasing the Agri Gross Regional Product.

As per the DPR (June 2022 Section 2.7.20), the gross value of crops proposed to be grown under irrigation at current prices works out at Rs.10,366.9 Crore as against the present realisation of Rs, 2,110.7 Crore, thereby implying an additional gross value of Rs.8,256.2 Crore per year. Among the proposed crops/crop groups, groundnut turns out to be the main crop with a share of 23% of irrigated area and providing highest return of additional production worth Rs.2,338.2 Crore. Though wheat accounts for 30.8% and cotton 6.4% of irrigated area, the return from wheat is just 50% of that from cotton. The highest return after groundnut is from onion and wheat. These two cash crops taken together constitute the major source of income to the farming community of Saurashtra region. An increase of 8.38 million tonnes is envisaged in the overall production of crops due to the proposed Kalpasar Project.

From available information, it seems that due to dependency on monsoon mostly single crops are roped. With creation of irrigation facilities, the farmers will be able to harvest two to three crops in a year. The availability of water will help in reclamation of degraded soils due to which more land will be converted from barren to fertile. This will bring prosperity to rural households depending mainly on agriculture. The farmers of the area need to be guided to adopt integrated farming through which they can generate more income even from small holdings. With respect to hydrological properties, majority of the soils in the Kalpasar Command Area have high available water capacity suggesting that crops like cotton, sugarcane and paddy, can be safely grown.

Insofar as the fisheries sector is concerned, the proposed Kalpasar Project may not bring in any appreciable loss of fisheries yield (DPR Section 2.7.19). On the contrary, the proposed Kalpasar reservoir would add at least 2,000 tonnes of reservoir fish, valued about Rs.15 Crore through its 2,000 km2 reservoir. Thus, the creation of fresh-water reservoir is likely to result in excess reservoir fish yield. Apart from value realisation from the fish yield, the working population ratio is also expected to increase significantly with a substantial number getting involved in pisciculture.

The fishing in the Ghogha area of the Bhavnagar district may profit from the rise in water level. Additionally, prospects for aquaculture near the villages of Ghogha and Kuda may arise due to the rising sea level. Many Ghogha families rely on marine fishing for their livelihood. The years-long decline in fish catches was one of the main complaints. The increase in saltwater could help the local fishing industry.

Families from the SC and ST communities in the Bharuch district, particularly in the Dahej area, have historically relied heavily on fishing as a source of income. But the extensive industrialisation in the Dahej region has had a negative impact on the quality of the seawater, which has decreased the availability of fish and other aquatic life.

The projected Kalpasar dyke is expected to raise the water level, which should help to flush away or diluted the level of pollutants in the sea water in this area. This would have a

favourable effect since it would make it easier for fish and other aquatic animals to move about, which would be extremely beneficial for households in the underprivileged groups of society in the villages of Dahej, Luvara, Ambetha, Koliyad, Vengni, Suva, and Mahegam.

With the rise in water level, fishing—another important occupation for the locals in the Hansot-Ankleswar region might benefit. The majority of the households from the Rathore and Vasava villages depend on fishing and day labour in agricultural areas for a living. According to preliminary findings, these communities' way of life will remain mostly untouched or enhanced. Due to the scarcity of Narmada water following the Sardar Sarovar Dam and the incursion of tidal saline water deep into the river, the yield of hilsa fish has decreased in the Bharbhut region near Bharuch. Freshwater fishing may flourish close to Bharbhut while seawater fishing may flourish in the villages of Katpor and Vamleswar further downstream as a result of the construction of the dyke.

g. Improvement in Groundwater

Due to availability of fresh water from canal system around 10 Lakh ha of area would be under irrigation. With the availability of 4500 MCM/year for irrigation, pressure on groundwater will reduce. Considering infiltration rate of 30 to 35% there would be additional ground water recharge between 1400-1600 MCM/year. This will improve the ground water condition both in terms of increase in water table and reduction in salinity. There are plans to promote drip and sprinkler irrigation to reduce overuse of water in the region, with arid conditions and prevent sodicity of soils. The canals will also firm up existing reservoir in the command area and in turn benefit in prevention of salinity ingress along the sea coast of Saurashtra region. Amreli, Jamnagar, Junagadh, Bhavnagar and Porbandar districts would benefit from the salinity projects already in operation from the Kalpasar canals. This in turn would benefit the ground water resources of the region.

h. Reduction in siltation along coastal shipping route

The region towards the east of the Gulf of Khambat around Dahej is exposed to siltation due to the discharge of water from Sardar Sarovar Dam which brings a huge volume of silt, impacting the ferry route in the region. With the development of the Kalpasar Dyke the siltation would likely reduce, thus, reviving the ferry route and reducing the cost of dredging along the route.

i. Reduction in Air Pollution and Consequent Carbon Credits

Emission estimates depending on vehicle types are provided in Table 5 (TAS). Reduction in emissions due to distance savings via the Kalpasar Project road will result in Carbon Credits accruing due to the project. Trading of Carbon Credits is therefore, another benefit that is likely to accrue due to the project.

A carbon credit is a generic term for any tradable certificate or permits representing the right to emit one tonne of carbon dioxide or carbon dioxide equivalent. Carbon Credit is maintained in the form of an Electronic Certificate, similar to that of a De-Materialised (Demat) Share Certificate. One carbon credit is equal to one ton of carbon dioxide, or in some markets, carbon dioxide equivalent gases. Emission trading (also known as cap and trade) is a market-based approach used to control pollution by providing economic incentives for achieving reductions in the emissions of pollutants.

Estimation of Various Benefits

This section explains various direct and indirect benefits to be considered for the assessment.

a) Estimation of Direct Benefits

i. Reduction in passenger transport and freight haulage cost

Estimates of traffic volumes and traffic composition for different vehicle movements in the project influence area (heavy and light commercial vehicles, passenger cars, auto rickshaws etc.,) are similar to those provided in the L&T Report submitted in November 2022. These estimates of cost and time (road user benefits) are categorised as Savings in Vehicle Operation Costs (VOC) and Savings in Value of Passenger Time (VOT) and are provided in Table 5-6 (TAS). Initial assumptions and estimates are provided in section 32.8 (d & e).

Sources for Calculation: Conceptual Report for Road, Rail, and Bridge Designs, L&T Infra Engineering, June 2022; L&T Report of November, 2022; Stakeholders' consultations

ii. Generation of Sustainable Energy

As per the Narmada, Water Resources, Water Supply, and Kalpasar Department, the Kalpasar Dyke is proposed to generate 1,470 MW of Wind Energy and 1,000 MW of Solar Energy.

A 25 MW Solar Grid-connected power plant at Sardar Sarovar Dam generated ~183.8 Million units of electricity in May 2022. GT shall estimate the economic benefit due to sustainable energy generation based on benchmarking of unit cost/MW of energy generated in similar projects.

While it may not directly be related to the present project, the benefit of increased consumption resulting from a generation project will also depend on the presence of transmission and distribution surplus capacity. Additional investment in transmission and distribution will be needed if there is insufficient capacity to support increased usage. When this occurs, a system approach should be used to combine the transmission and distribution components with the generation project such that their investment and operation costs are added to the project cost to derive net gain.

Sources for Calculation: Benchmarking from similar projects/studies

iii. Land Reclamation and Development

A maximum water level (MWL) of about 5.0 m in the reservoir will result in recovery of land between 5.0 m to 8.0 m surrounding the reservoir. As per the DPR and the CEPT University reports, it is expected that approximately 1 lakh hectare of land will be reclaimed upon implementation of the project.

GT has estimated the additional revenue generated from the reclaimed land as per the method stipulated in Section under the sub heading "Land Reclamation and Development"

Sources for Calculation: Jantri estimates provided by authorities for land value appreciation in Dholera SIR are employed to compute the escalation factor. These estimates are applied on the proposed reclaimable land jantri rates provided by the authorities. In addition, benchmarking from prevalent land rates in the areas surrounding the project area.

iv. Increase in availability of Industrial and Drinking water

Total water available for storage in Kalpasar reservoir is 10,000 MCM at 50% dependability, of which 6568 MCM water is proposed to be allocated for irrigation in the Saurashtra region covering 39 talukas in six coastal districts viz. Bhavnagar (7 talukas), Amreli (3 talukas), Junagadh (12 talukas), Porbandar (3 talukas), Jamnagar (10 talukas) and Rajkot (4 talukas). Details of net-water availability (after accounting for losses) for these three major causes (industry, agriculture, and domestic) are provided in the reports. GT shall estimate the economic benefit generated due to the provision of water for domestic and industrial purposes based on benchmarking of unit cost/MCM of water supply in similar projects. Initial assumptions and estimates provided in section 32.8 (b).

Sources for Calculation: Data provided by the authorities and conceptual structural plan report (CEPT University).Benchmarking from similar projects/studies

v. Increase in revenue due to tourism and recreation

Estimation of revenue generation from tourism and recreation is based on assessment of and benchmarking against similar development work in Gujarat (Statue of Unity etc.) and elsewhere.

The computation of employment generation potential would require an estimate of full capacity employment at steady state and annual incremental phasing of the same. Assuming three categories of employment, skilled ($wage = w_1$), semi-skilled ($wage = w_2$), and daily wage earners ($wage = w_3$). Moreover, these comprise x_1%, x_2%, x_3% of the overall employment generation. Here, $w = w_1 * x_1 + w_2 x_2 + w_3 * x_3$. If 'N' jobs are created in a phase-wise manner over 'n' years, and after that steady state is achieved. Also, the increase in average wage rate to be 'y%' per year. Again the risk of tourism related employment generation can be take as the risk of the project (discount rate of 'r%'). The value created in terms of tourism employment generation can be obtained as follows.

$$PV_{tourism} = N * w[\frac{1}{n} * \frac{(1+y)}{1+r} + \frac{2}{n} * \frac{(1+y)^2}{(1+r)^2} + \cdots + \frac{(1+y)^n}{(1+r)^n} + \frac{(1+y)^n}{(1+r)^n * (r-y)}]$$

The above method is developed based on the inputs from CEPT report (Sec 5).

Any other source of job creation (e.g., industrial and urban development or proposed special investment region) can be suitably considered as per the respective development plans. The discounted cash flow valuation method can be suitably adopted thereafter.

Alternatively, a top-down approach can be followed by examining the new tourists' potential and average spending ot these tourists. This can be achieved by benchmarking with other tourism related projects. Inputs from Kalpasar authorities, in-house consultants, and secondary public information for similar project/studies are also being pursued. For example, a cost-benefit analysis for tourism campaigns run by the government may provide a reasonably comparable benchmark.

Because of its interdependence with other sectors of the economy, it is difficult to analyse and plan for tourism. The lack of reliable statistical data hampers the identification of the mechanisms by which tourism generates growth, as well as its potential for development.

However, in an attempt to quantify the tourism benefits that are likely to be created with the development of the Kalpasar dyke, especially the recreational avenues along the waterfront, a study of a similar tourism project – the State of Unity has been done to identify potential economic benefits to the economy. Initial assumptions and estimates provided in section 32.8 (i).

Sources for Calculation: Data provided by the authorities and conceptual structural plan report (CEPT University).Benchmarking from similar projects/studies, inputs from Kalpasar authorities, in-house experts with the consultant

Developments at the Statue of Unity

The Statue of Unity, the tallest statue in the world, was built to accelerate tourism within the region and the surrounding 2,200-acre preserve along the Narmada River, where it is located. In addition to the Statue, which stands on an island in the river, there is an exhibit hall and memorial garden at the base. The project includes a canopied bridge to the island, a visitor's center, a hotel with a conference center, a transit center, and a 3.5 km road from the nearby town of Kevadia.

It was envisaged that the building of the iconic structure, shall become a catalyst for accelerated development in the project area benefitting a large number of the local tribal population. It was anticipated that development will be based on several stimuli such as tourism infrastructure, entertainment, and educational infrastructure, research activity in facets of biotechnology, clean energy, water resources, environmental management, and tribal development. The overall area surrounding the project site was expected to grow and support all of the above activities and more.

Post-Development Impact of Statue of Unity

As per the information received from Gujarat State Government, recreational places have been developed around the Statue of Unity to increase employment and tourism in the surrounding area. Moreover, local people were employed during the construction of different projects undertaken by various Departments including the Tourism Department of the State Government, Sardar Sarovar Narmada Nigam, Sardar Vallabhbhai Patel Rashtriya Ekta Trust, etc. At present approximately 3000 persons have been employed as tourist guides, security guards, animal keepers, operations, maintenance & repair staff, drivers, photographers, etc.

The table below shows the increase in the no. of tourists with the development of the Statue of Unity.

Table 32.8 : Details of Tourists before and after the Statue of Unity

Status	Year	Total no. of tourists visited	Monthly Average
Before the Statue of Unity	2018 (from January to October 2018)	5,81,255	58,125
After the Statue of Unity	November 2018 to February 2020	42,58,060	2,66,129

Source: Rajya Sabha Discussion; Ministry of Tourism, GOI

In terms of revenue generation, as per tourism details shared by Gujarat Tourism Department, a tourist footfall of 2.6 million at the Statue of Unity generated an earning of RS. 570 million through selling tickets and RS. 1160 million including tickets and parking between 1st November 2018 to 12th September 2019.

The Statue of Unity is spread over an area of 0.02 sqkm project area, i.e the revenue generated per sqm of the project area land in a year was RS. 58,000.

Using the same benchmark, the economic benefits of the tourism sector shall be evaluated for the Kalpasar Dyke Project. However, due consideration shall also be given to the change in the annual footfall of the facility with time which has an impact on the revenue collection at the facility as well as the application of shadow factor for economic revenue estimates.

b. Estimation of Indirect Benefits

The approach for estimating the indirect benefits is highlighted below.

Increase in Agri Gross Regional Product (including Fisheries)-

The Agri Gross Regional Product would be estimated by benchmarking the unit yield per Hectare in the state and the nation. As per the Social Economic Review of Gujarat 2019-20, the average yield of food grains in 2019-20 was ~2.2 tonnes/hectare.

Depending on information obtained on the current yield, variance from mean yield mentioned above and other necessary limiting factors, the same yield with suitable variations are being used to estimate the output of the single-yield Agricultural activities.

Output from multi crop yield would be based on available market estimates of the proposed (less water intensive) crops to be introduced, adjusted for local conditions. In case market estimates are not available, GT's agri expert is in the process of identifying the likely crops that can be introduced through proactive Government Action. To that effect, the increase in Agri GRP is contingent upon GoG's efforts as suggested in the Agri Action Plan.

Sources for Calculation: Social Economic Review of Gujarat 2021-22; Socio-Economic Survey Report of India 2021-22.

The following assumptions are required to value the incremental cash flow benefits from fishing activity.

The creation of fresh-water reservoir may result in excess reservoir fish yield. (a) The max-yield full development scenario and the number of years in which this full capacity scenario is obtained. (b) Yearly incremental phasing of increase in reservoir fish. For example, assume total reservoir fish capacity to be 'C' tonnes.

This is to be achieved in 'n' years with C/n incremental phasing. After n year onwards the capacity will achieve its steady state value C. (c) Assume per tone reservoir value of fish to be 'R' and a steady growth of g_R year on year in this rate. Again the risk of reservoir fishing can be taken as the risk of the dyke project. Then the present value (PV) of reservoir fish at the end of the year can be computed as

$$PV_{fish} = \frac{C}{n} * \frac{R*(1+g_R)}{1+r} + \frac{2C}{n} * \frac{R*(1+g_R)^2}{(1+r)^2} + \cdots + \frac{C}{1} * \frac{R*(1+g_R)^n}{(1+r)^n} + \frac{C}{1} * \frac{R*(1+g_R)^n}{(1+r)^n*(R-G)}\text{; or}$$

$$PV_{fish} = C * R\left(\frac{1}{n} * \frac{(1+g_R)}{1+r} + \frac{2}{n} * \frac{(1+g_R)^2}{(1+r)^2} + \cdots + \frac{(1+g_R)^n}{(1+r)^n} + \frac{(1+g_R)^n}{(1+r)^n * (R-G)}\right)$$

Initial assumptions and estimates provided in section 32.8 (h).

Sources for Calculation: Data provided by the authorities and conceptual structural plan report (CEPT University).Benchmarking from similar projects/studies

Reduction in siltation along coastal shipping route

As per the approved rates by Superintendent Engineer, Port and Inland Water Department, vide letter dated 01/08/2019, the rate for dredging all types of soils, pebbles, soft rocks, etc. is RS. 234 per cum. The same would be considered for the estimation of saving in dredging cost. While the reduction in siltation for coastal shipping routes is indeed a benefit, the cost of desilting the reservoir will be included in the operating costs for the project.

Sources for Calculation: Approved rates by Superintendent Engineer, Port, and Inland Water Department, vide letter dated 01/08/2019 (S. No. 4)

Reduction in air pollution and Consequent Carbon Credit

Emissions from the transport sector depend mainly on type of transport and fuel apart from type of combustion engine, emission mitigation techniques, maintenance procedures, and vehicle age. The major pollutants emitted from transport are Carbon dioxide (CO2), Methane (CH4), Carbon monoxide (CO), Nitrogen oxides (NOx), Nitrous oxide (N2O), Sulphur dioxide (SO2), Non-methane volatile organic compounds (NMVOC), Particulate matter (PM) and Hydrocarbon (HC). Diesel is used in public passenger and cargo vehicles, while private two-wheelers, light motor vehicles (passenger), cars, and jeeps use gasoline. Emission estimates depending on vehicle types are provided in Table 5 (TAS). Reduction in emissions due to distance savings via the Kalpasar Project road are quantified based on the number of vehicles and distance saved in a year per different vehicle type, as follows

$$E_i = 365 * \left(\sum_{j=1}^{J} Veh_{j,wihout\ GKDP} - \sum_{j=1}^{J} Veh_{j,wih\ GKDP} \right) * E_{ijkm}$$

Here, E_i= emission of GHG (i) in tons;

E_{ijkm} = emission of GHG(i) in tons from vehicle type (j) per driven kilometer.

Estimates for the project are provided in Table 5-5 (TAS).

As per the research paper on Freight Transportation and Value Chains by Rodrigue J. in 2020, a conventional truck carrying 35 tonnes emits ~0.1 kg/tonne-km of CO2. The average cost of CO2 per tonne-km is ~RS. 6.7/kg. The same may be used to estimate the reduction in CO2 emissions in the region.

Sources for Calculation: Rodrigue, J. P., & Slack, B. (n.d.). Freight Transportation and Value Chains. Retrieved January 2021, from The Geography of Transport Systems.

Improved navigation for coastal shipping

The development of the Kalpasar Dyke would likely provide efficient navigational lights and sound signals for Ro-PAX movements between Ghogha and Hazira during the night. This would lead to increased revenue due to a longer navigation period. The consultant would review the available information to understand the possibility of night navigation for the Ro-PAX movement between Ghogha and Hazira and estimate the additional revenue generated due to the extended service time of the ferries. Quantification of the benefit is possible once the proposed investment (CAPEX and OPEX) and mode (including frequency) of operations are known and it would be limited to the likely impact of incremental coastal shipping due to the proposed development. In case no such information can be made available and no similar projects can be identified, this will have to classified as a Non Quantifiable Externalities.

Sources for Calculation: Review of available information

Negative Impact on Fauna

The development of the Kalpasar Dyke would likely change the composition of the water and negatively transform the ecosystem. According to the National Oceanic and Atmospheric Administration, rising temperatures in dammed waters limit the ability of species of cold-water fish to inhabit them.

In a similar case, in Columbia, the construction of the Grand Coulee Dam eliminated a fishery worth USD 0.25 million annually. Almost 30-50% of the anadromous fish habitat in the Columbia basin has submerged due to reservoirs and blocked by dams.

Report from GUIDE is proposed to be used as the basis for such calculations. As on date, the latest estimates have not been received yet.

Sources for Calculation: Secondary Research

c. Shadow Price Approach: Indicative Methodology pertinent to the Kalpasar Project

The key concept is the use of shadow prices to reflect the social opportunity cost of goods and services, instead of prices observed in the market, which may be distorted. Sources of market distortions are manifold.

Non-efficient markets where the public sector and/or operators exercise their power (e.g., subsidies for energy generation from renewable sources, prices including a mark-up over the marginal cost in the case of monopoly, etc.).

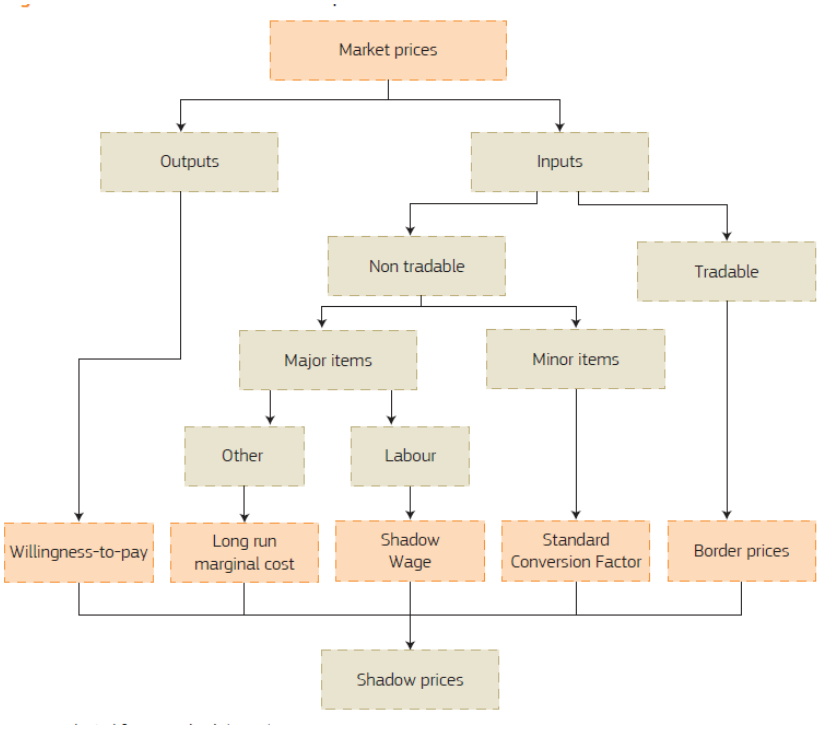
Administered tariffs for utilities may fail to reflect the opportunity cost of inputs due to affordability and equity reasons.

Some prices include fiscal requirements (e.g. duties on import, excises, VAT and other indirect taxes, income taxation on wages, etc.).

For some effects, no market (and prices) are available (e.g. reduction of air pollution, time savings).

In such cases, the standard approach to economic analysis is the conversion from market prices to shadow prices. A simplified operational approach for the estimation of the shadow prices is presented in the schematic below:

Figure 32.3: Estimation of Shadow Prices



Source: Guide to Cost-Benefit Analysis of Investment Projects (Economic appraisal tool for Cohesion Policy 2014-2020; adapted from Saerback (1990).

The approach can be adapted in the Kalpasar project as discussed in the subsequent section.

Shadow Cost Factor Estimation

In order to estimate the economic benefits of the Kalpasar Dyke, the actual financial value of construction and operational costs would be estimated including the Shadow Cost Factor. The Shadow Prices are adjusted financial prices, which discount the effects of government taxation and subsidies, the opportunity cost of resources, environmental externalities, and market distortions.

The Shadow Exchange Rate Factor determines the domestic currency value converted at the official exchange rate, and as per the Asian Development Bank's (ADB) guidelines, it is determined as per the formula below.

SERF = RER / OER * (1 + T – S)

Where, SERF = Shadow Cost Factor

RER = Long-run Real Exchange Rate for the economy

OER = Original Exchange Rate (Actual) of the economy

T = Average rate of tax on infrastructure investment, and

S = Average rate of subsidy on infrastructure investment

Shadow Wage Rate Factor (SWRF) determines the opportunity cost of labour. For skilled labour, SWRF is considered equal to 1, whereas, for unskilled labour, SWRF varies between 0-0.75 implying a loss of output.

The relevant shadow factors for the economic assessment of Kalpasar Dyke would be derived using the ADB or similar Guidelines.

Methodology for Identifying Non-Quantifiable Externalities

Large infrastructure projects generally have numerous benefits, both direct and indirect. That apart, some of these direct / indirect projects can be quantified and others cannot, or, are not quantified.

Generally, quantifiable benefits are those where:

- Investments are required to be made to reap the eventual benefits

- The benefits, so identified, can be quantified in terms of market estimates, or close economic approximations and the net of benefits less the required investments are considered for economic analysis.

For the other benefits, it might be challenging to quantify the financial value. These are considered as externalities that can create both positive benefits as well as have negative consequences. Cost-effectiveness analysis should be used in these situations. It is also likely that some benefits, especially external consequences, may not be measurable outside of the social sectors. Where such effects are significant but impossible to quantify, they should be noted and a qualitative explanation offered.

In so far as the Kalpasar Project is concerned, preliminary analysis outlines the following as externalities that are unlikely to be quantified:

a) Projects under the Conceptual Structure Planning of Kalpasar Project

A Conceptual Structure Plan For Gulf of Khambhat Development Project has been submitted by the CEPT University in 2019.

The proposed Structure Plan for Kalpasar Region has the following objectives:

(1) To delineate the area under the influence of Kalpasar Project for the purpose of the comprehensive development;
(2) About 122386 ha (public land between 5-6 and 6-7 contour intervals) of area is likely to be created through the Kalpasar Project, by stabilizing the difference between high and low tide. Suitable utilisation of these new/reclaimed/created lands is crucial;
(3) To induce optimum development for the improvement of regional economy as well as environmental protection;
(4) Region as a Global Hub of Eco Centric development;
(5) To create balanced physical and social infrastructure for sustainable development;
(6) Capitalise on the proposed investments in the study area, through the development of suitable forward and backward linkages;
(7) To enhance the infrastructure facilities for better connectivity of the region in order to achieve faster growth of the study area;
(8) Propose for an institutional structure and legal backing for the Structure Plan;
(9) The concept development bases on structuring growth, linking the growth centres, economic development and environmental protection. A detailed analysis of existing trends of growth, infrastructure levels, development hotspots, environmental hotspots were used to understand and design the future growth trends in the region;
(10) Lakefront zone detailing;
(11) Health city;

(12) Waterfront real estate;
(13) Logistic hub;
(14) Education city;
(15) Green energy research and development center;
(16) Riverfront and tourism development and
(17) Ghogha port redevelopment

We understand that, while these are part of the overall development plans, these projects would entail CAPEX for each of the sub components mentioned above. Therefore, considering economic benefits accruing due to these projects would not be a true and fair representation of quantifiable benefits. Much of the benefits may eventually have to be classified as non-quantifiable externalities.

b) Impact on Social & Cultural Practices

It's possible that social and cultural behaviours in some of the villages in the Bhavnagar district won't alter significantly. However, due to changes in road connectivity and future industrialisation, a significant influx of migrant workers may occur in the villages. Barwada Mosque, Jain Derasars in Ghogha, and Nishkalank Mahadev in Koliyad, among others, could be impacted. A significant part in the social and cultural lives of the villagers is represented by the numerous temples and ashrams found in some villages of the Bhavnagar district. These religious sites are not anticipated to be negatively impacted by the project.

The Barwada Mosque, a mosque built in the seventh century, is in poor shape. The Mosque may need protection measures in the unlikely event of seawater intrusion to preserve this important historical relic. Similar to this, the neighbouring villagers have religious significance for the Nishkalank Mahadev temple, which is submerged in the water near Koliyad beach. To prevent full submersion, the place that is submerged during high tide may need protection.

Similar to this, there are numerous ashrams and temples situated along the Narmada River in the villages on the Bharuch side. The majority of these temples and ashrams are part of the Narmada Parikrama, an annual pilgrimage that includes Ambetha, Jageswar, Luvara, and Vamleswar. The Narmada River's diversion may have an impact on Narmada Parikrama. Religious and cultural customs may shift in the nearby villages of Ambetha and Vamleswar, which are strongly linked to the Parikrama. Depending on how much of an impact these proposed changes would have on religious monuments and cultural customs, alternative alternatives might be taken into consideration.

c) Impact on Water Bodies

From the initial analysis, it is expected that there would be certain unquantifiable externalities arising out of the following:

(1) River Boundaries will change, presently rivers in catchment area are not perennial rivers.
(2) High Tide Lines and Low Tide Lines (HTL & LTL) will change, the demarcation of CRZ Boundaries and permissible activities under various CRZ Zones requires to be confirmed by GCZMA.
(3) Red and Blue Line demarcation of Rivers in catchment area required to be redefined.
(4) Total Water disposal through rivers in catchment area (including monthly pattern thereof) is required to be estimated.
(5) Total Sewage Generation in Catchment area, Quantity of Treated Sewage (with quality of Treated Sewage) and Quantity of untreated Sewage disposal in catchment area is required to be compiled. Presently all treated and untreated Sewage leading to

Bay of Khambhat/Cambay get diluted through Esturine / Marine Disposal system, after the project becomes operational the treated/untreated sewage will get dissipated in the reservoir.

(6) Total Trade Effluent (Industrial Wastewater) Generation in Catchment area, Quantity of Treated Effluent (with quality of Treated Effluent) and Quantity of untreated Effluent, if any and its disposal in the catchment area is required to be compiled.

(7) This aspect is also required to be looked into in the context of Final Orders passed by Hon'ble NGT in the case of 673/2018 (AKA Polluted Rivers of India).

d) Impact on Institutions & Sociology

(1) **CSMCRI**: A CSIR Institute having excellent infrastructure, research capabilities and Naval Vessels might become irrelevant on implementation of the proposed project. Its relocation is required to be looked into. Details on similar institutions working on marine and other research and the impact of the proposed project is required to be assessed.

(2) **Businesses**: Dahej and Vadodara, two of the biggest Industrial hubs of Gujarat thrives on Chlor-Alkali Production by Industries such as GACL (GoG PSU), Reliance, Nirma etc. are dependent on Salt production from the coastal region spread from north of Dahej to Bhavnagar. The industries producing Chlor-Alkali Products, which are essential for Chemicals and other industries, might face short supplies and find challenges to continue their industrial production activities (contributing substantially to GDP).

Note:

- There are no wildlife sanctuaries or national parks in 15 km radius as listed in wildlife protection act (WPA) of India. Blackbuck National Park is located at 37.7 km from the dyke alignment. Also, the proposed project site does not involve any forest land.

- Mangroves are falling within the dyke corridor. Exact no. of trees and girth details are currently not available; it is expected that details would be available in the EIA study.

- The project falls in CRZ area, CRZ map will be prepared by one of the authorised agencies and details will be furnished in EIA report.

32.8 Project Related Assumptions

Dyke Project related Assumptions

Key Assumptions

The following key assumptions have been made in carrying out the computations:

Project cost and means of financing related assumptions

Total project cost of Rs. 88,143.15 crores has been assumed for the Dyke project. This also includes the interest during the construction of Rs 8,634.13 crores. For computation purposes, a debt-to-equity ratio of 70:30 is assumed which is the same as other large public infrastructure projects being executed in the country (details as provided by the authorities). This cost is considered as the most realistic scenario. In addition, the model provides flexibility of ±5% and ±10% change in project cost. Since O&M expenses are directly linked to project cost, accordingly the O&M expense profile changes with the assumptions pertaining to capex.

Table 32.9: Project cost details

Project Cost	**Rs Crore**	**Specification**
Total Hard Cost	79,405.14	
Pre-Opex	103.88	
Soft Cost(IDC)	8,634.13	
Total Cost	**88,143.15**	
Means of Financing (70:30)		
Debt	61,700.21	Debt profile: Door to door tenor of 30 years and 6 years of moratorium with interest @4% p.a.
Equity	26,442.95	
Total cost	**88,143.15**	

The construction period of project is estimated as 6 years. The capex is phased-out over the 6-year period in the following manner (details as provided by the authorities).

Table 32.10: Other Preliminary expenses

Year	**2022**	**2023**	**2024**	**Total**
One-time Rehabilitation and Resettlement costs (%)			**5%**	**5%**
One-time Preliminary and Pre-operative expenses (Rs crore)	246	63	41	350

These assumptions are taken from comparable Dam projects in India (Daudhan Dam) and other countries (e.g Niger from Africa and Lesotho from South Africa)

In addition to the most optimum scenario, the following four project cost escalation/reduction scenarios are considered: ±5% and ±10% change in project cost.

Table 32.11: Capex phasing

Year	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
Percentage	17.60%	25.40%	23.23%	15.11%	10.12%	8.53%
Cost in crores	15,558.37	22,404.10	20,453.86	13,305.34	8,909.80	7,511.68
10% Reduction	13,852.55	19,947.23	18,210.49	11,846.02	7,932.58	6,687.81
5% Reduction	14,700.87	21,169.04	19,326.11	12,571.74	8,418.54	7,097.52
5% Escalation	16,425.22	23,652.64	21,593.93	14,046.97	9,406.42	7,930.37
10% Escalation	17,301.55	24,914.88	22,746.53	14,796.74	9,908.49	8,353.66

*With cost escalation, minor differences in phasing % are on account of preliminary expenses

Dyke operating expense related assumptions

The O&M expenses are considered as 1% of the project cost, escalated at a rate of 5% per annum. With reference to reports provided by authorities, the operation and maintenance costs are estimated to be about Rs. 881.43 crores (Year 2029). This results in the following annual O&M expense profile. Since the O&M expense profile is linked to the project cost, the following four scenarios in O&M expenses are worked out corresponding to the following four project cost scenarios: ±5% and ±10% change in project cost. These four scenarios are in addition to the most optimum scenario (or base case scenario)

Table 32.12: O&M Expense Profile

Year	2029	2034	2039	2044	2049
Cost in crores	881.43	1,124.95	1,435.76	1,832.43	2,338.70
10% Reduction	784.77	1,001.58	1,278.30	1,631.47	2,082.22
5% Reduction	832.84	1,062.94	1,356.61	1,731.41	2,209.77
5% Escalation	930.56	1,187.65	1,515.78	1,934.56	2,469.04
10% Escalation	980.22	1,251.03	1,596.67	2,037.80	2,600.81

Due to the development of project, mangroves will no longer exist near freshwater reservoir. MoEFCC at their discretion, may impose condition in Environment Clearance for compensatory mangrove plantation in the tune of 200% to 500% of present mangrove area. The cost of new mangrove plantation and maintenance for 8 to 10 years requires to be considered.

Usually, MoEFCC mandates project proponents to allocate 2% or Project Cost towards Environment Preservation etc over the span of the project. Depending on the impacts, MoEFCC may impose conditions for additional Environmental Compensation Cost in Environment Clearance. The exact financial implications of all such cost can become clear once the EC is obtained from MoEFCC.

MoEFCC, in CRZ Clearance, may impose additional conditions impacting on various components of project. Such costs are also required to be considered for overall cost benefit analysis. Exact conditions related to such standard and extra-ordinary costs can become clear only after receiving CRZ Clearance.

There will be collateral cost to GoG for developing / upgrading infrastructure of Industrial wastewater treatment and disposal and Sewage Treatment and disposal in the catchment area of reservoir. Since a lot of Nagarpalikas, Villages etc are yet to have STPs, and also present infrastructure might require substantial upgradation, this substantial cost had also required to be considered, since the water quality in reservoir requires to be maintained as “irrigation water”. This cost will not be borne by the project / project proponent, but it will become a major and substantial cost head for GoG.

Fresh Water Availability For Various Applications

The following key assumptions have been made in carrying out the computations:

For cash inflow projection from fresh water availability, we consider availability for irrigation, drinking, and industrial consumption have been considered with following rates (As provided by Kalpasar authorities). Furthermore, three scenarios 1-3 (adverse, most optimum, and favourable) have been considered for cash flow projections, along with the escalation rates for each application. Here, only the most optimum scenario has been presented.

Table 32.13: Application wise rate of freshwater

Application Type	Rate	Unit
Seasonal irrigation	330.93	Rs/Ha
Perennial irrigation	620.49	Rs/Ha
Drinking water	5.05	Rs /1000Ltr
Industrial use	41.77	Rs /1000Ltr

Table 32.14: Application wise consumption scenarios

Scenario 1 (Adverse)	Scenario 2 (Most Optimum)	Scenario 3 (Favorable)	Unit	Escalation (Per annum)
4487490	4986100	5484710	Ha	2.5%
84770	96880	108990	Ha	2.5%
750	800	850	(MM3*10^6)	10.0%
75	80	85	(MM3*10^6)	10.0%

Assumptions related to availability of fresh water are provided by the authorities. These include the type of applications, rate of water, consumption in the respective applications and annual escalation rates for the price in each application. Three scenarios are employed: (a) Adverse scenario (1) with 4.5 times seasonal irrigation, 3.5 times perennial irrigation, and 750 MM^3*10^6 drinking water and 75 MM^3*10^6 industrial use water. (b) Base case scenario (2) with 5.0 times seasonal irrigation, 4.0 times perennial irrigation, and 800 MM^3*10^6 drinking water and 80 MM^3*10^6 industrial use water. (c) Favorable scenario (2) with 5.5 times seasonal irrigation, 4.5 times perennial irrigation, and 850 MM^3*10^6 drinking water and 85 MM^3*10^6 industrial use water. Based on these assumptions, the following revenue profile is obtained from fresh water availability (as shown in Table 32.15).

Table 32.15: Cash inflow profile from Fresh Water Availability

Year (Rs Crore)	*2029*	*2034*	*2039*	*2044*	*2049*	*2054*	*2059*
Scenario 1: Adverse							
Seasonal irrigation	148.50	168.02	190.10	215.08	243.34	275.32	311.50
Perennial irrigation	5.26	5.95	6.73	7.62	8.62	9.75	11.03
Drinking water	378.75	609.98	982.38	1582.13	2548.04	4103.64	6608.96
Industrial use	313.28	504.53	812.55	1308.63	2107.56	3394.24	5466.46
Total	***845.79***	***1288.48***	***1991.77***	***3113.46***	***4907.56***	***7782.96***	***12397.95***
Scenario 2: Base case (Most optimum)							
Seasonal irrigation	165.01	186.69	211.22	238.98	270.38	305.91	346.11
Perennial irrigation	6.01	6.80	7.69	8.71	9.85	11.14	12.61
Drinking water	404.00	650.65	1047.87	1687.61	2717.91	4377.22	7049.56
Industrial use	334.16	538.17	866.72	1395.87	2248.06	3620.53	5830.89
Total	***909.18***	***1382.30***	***2133.51***	***3331.16***	***5246.20***	***8314.80***	***13239.17***
Scenario 3: Favorable							
Seasonal irrigation	181.51	205.36	232.34	262.87	297.42	336.50	380.72
Perennial irrigation	6.76	7.65	8.66	9.79	11.08	12.54	14.19
Drinking water	429.25	691.31	1113.36	1793.08	2887.78	4650.80	7490.16
Industrial use	355.05	571.80	920.90	1483.11	2388.57	3846.81	6195.32
Total	***972.56***	***1476.12***	***2275.26***	***3548.86***	***5584.84***	***8846.64***	***14080.38***

Land Reclamation and Development

The following are the assumptions pertaining to land monetization from the Kalpasar project. To compute escalation factor EF, we use the data provided by Kalpasar authorities for the Dholera SIR region for residential, commercial, and industrial region. This includes pre-development and post-development Jantri rates (Rs per Sq Mts). We consider three

scenarions, base rate scenario, and average rate and maximum rate scenarios for higher FSI rates provided by Kalpasar authorities.

Table 32.16: Land Sale Rate in Dholera SIR

Rates (Rs per Sq Mts)	Pre-Development	Post-Development		
		Base Rate	Average	Maximum
Residential	350	4125	4641	5156
Commercial	550	5500	7288	9625
Industrial	480	2750	2979	3163

Using these base, average, and maximum rates, we compute the escalation factor $EF = \left(\frac{I_{Post}}{I_{Pre}}\right) - 1$. This includes rates for residential, commercial, and industrial area.

Table 32.17: Escalation factor (EF) based on Dholera SIR land sale rate

$EF = \left(\frac{I_{Post}}{I_{Pre}}\right) - 1$	Base Rate	Average	Maximum
Residential	10.8	12.3	13.7
Commercial	9.0	12.3	16.5
Industrial	4.7	5.2	5.6

Next, we consider the pre-development rates for the Kalapasar project area reclaimable land. These rates are multiplied by EF to obtain the estimated post development rate. To this end we assume the break of Kalpasar project reclaimable area into residential, commercial, and industrial regions as 20%, 40%, and 40% respectively. These valuations include all the three scenarios base, average, and maximum.

Table 32.18: Distribution of reclaimable land around Kalpasar project area

Reclaimable Land (Pre-Dev Jantri Rates)	Area Lakh Sq Mts.	Average Rate Rs per Sq. Mts.	Total Land Valuation Based on Average Rate (Rs crores)
District			
Bhavnagar	3528.2	128.0	4516.1
Ahmedabad	2033.8	49.0	996.6
Anand	922.8	213.7	1972.0
Vadodara	0.6	65.0	0.4
Bharuch	3349.9	201.3	6741.7
Total	**9835.3**	**144.6**	**14226.7**

Table 32.19: Post development Jantri rates

Application Type	Area share (%)	Area share Lakhs Sq Mts	Post development (EF incorporated)		
			Base	Average	Maximum
Residential	20%	2845	30689	34881	39071
Commercial	40%	5691	51216	69712	93897
Industrial	40%	5691	26912	29631	31809
Total	**100%**	**14227**	**108818**	**134225**	**164776**

Lastly, we project the land monetization phasing and cash inflow schedule, as shown in the table below. A gradual land phasing, which results in monetization of 63% on land by end of the year 2059. Escalation in land value over the years is assumed to be 1%. This results in cumulative inflow of Rs 67,688 crore, which may be persued to support project capital and operation expenditures.

Table 32.20: Cash inflow from land monetization (base case)

Year	**2029**	**2034**	**2039**	**2044**	**2049**	**2054**	**2059**
Land Monetization Phasing	5%	3%	2%	1%	1%	0.5%	0.5%
Cumulative Phasing	5.0%	28.0%	42.0%	51.0%	56.0%	60.5%	63.0%
Scenario 1: Base Rate							
Cash Inflow	5331	2628	1589	759	758	380	389
Cumulative Inflows	**5331**	**27208**	**38786**	**45742**	**49535**	**52947**	**54875**
Scenario 2: Average Rate							
Cash Inflow	6575	3242	1960	936	935	469	480
Cumulative Inflows	**6575**	**33561**	**47842**	**56422**	**61100**	**65309**	**67688**
Scenario 3: Maximum Rate							
Cash Inflow	8072	3979	2407	1149	1148	575	590
Cumulative Inflows	**8072**	**41200**	**58732**	**69264**	**75007**	**80175**	**83095**

Development of Roadways Project

Key Assumptions

The following key assumptions have been made in carrying out the computations.

Project cost and means of financing related assumptions

A total project cost of Rs. 10615.18 crore has been estimated to construct the roadways over dam. This also includes the interest during construction of Rs. 1273.82 crore. For computation purposes, a debt-to-equity ratio of 60:40 is assumed which is similar to other roadways projects.

Table 32.21: Project cost details

Project Cost	**Rs. (cr.)**	
Highway Civil cost	5,660.24	
Road Structural cost	3,548.78	
Intelligent Transport System (ITS) cost	75.74	
Environmental Charges due to Road @ 1% of Civil cost	56.60	
Interest during construction	1273.82	
Total cost	**10615.18**	
Means of Financing (60:40)		**Debt profile**
Debt	6369.11	Debt profile: Door to door tenor of 30 years and 8 years of moratorium with interest @5%p.a.
Equity	4246.07	
Total cost	**10615.18**	

The construction period of project is assumed to be equal to moratorium period, i.e., 8 years. It is assumed that capex is phased out in equal amount over construction period, i.e., 12.5% over 8 years.

Table 32.22: Capex Phasing

Year	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Percentage	**12.5%**	**12.5%**	**12.5%**	**12.5%**	**12.5%**	**12.5%**	**12.5%**	**12.5%**
Cost in crores	1326.90	1326.90	1326.90	1326.90	1326.90	1326.90	1326.90	1326.90

Revenue and expense related assumptions

To compute the projected revenue, which is the sum of toll revenues and non-fare box revenues the following assumptions are considered.

Assumptions related to toll revenue

To compute the projected revenues from Tolls, the following important assumptions have been made based on inputs provided and similar roadways projects. Traffic forecast for different vehicles is provided for by technical team from the year 2031 to 2071. Traffic forecast for the mini bus assumed to be 4.5% of the number of buses for each year. Along with traffic forecast, toll rates are also provided by technical team, escalated at a rate of 5% between 2022-41 which gradually decreases at each 20 years interval.

Table 32.23: Revenue profile

Traffic forecast							
Year	**Car**	**Bus**	**Mini Bus**	**LCV**	**2A**	**3A**	**MAV**
2031	1642	348	16	4437	2267	1125	7281
2041	5491	434	20	5673	2135	1635	11768
2051	10944	524	24	6687	2323	2369	18103
2061	17748	581	26	7842	2403	2655	25072
2071	25097	630	28	9056	2590	2962	31417
Toll Rates							
Rates	**Car**	**Bus**	**M. Bus**	**LCV**	**2A**	**3A**	**MAV**
Toll rates	860	2,175	355	1,015	1,915	2,250	2,725

Annual Toll escalation rate	
Year	**Escalation rate**
2022-2041	5.0%
2042-2061	3.5%
2062-2081	2.5%
2082-2101	1.5%

Non-Fare box revenue		
Revenue Source	**Rate**	**Escalation Rate**
Revenue from marketing and other expenses	10%	3%

Assumptions related to non-fare box revenue

Non-fare revenue is assumed to be generated from two sources, i.e., Revenue from (a) Marketing and other commercial charges and (b) Revenue from registration fees and stamp duty. Revenue from marketing & other commercial charges is considered to be 10% of revenue from passenger trains with a yearly escalation of 3% per annum. Whereas, revenue from registration fees & stamp duty is considered to be 15% of revenue from passenger train with a yearly escalation of 3% per annum.

Assumptions related to expenses

Operation and maintenance cost is assumed as 1% of total project cost each year with an annual escalation of 3% whereas periodical maintenance cost assumed as 5% of total project cost at every five years with escalation rate of 3%. Operation and maintenance cost rate is estimated as per inputs provided by Kalpasar authorities.

Table 32.24: O&M Expense Profile

Cost Profile	**Percentage of total cost**		**Escalation rate**
Operation and maintenance (O&M) cost	1%	Each year	3%
Periodic O&M cost	5%	At each 5 years	3%

Key Results pertaining to Project IRR/NPV

With the above mentioned assumptions, we forecast the project cash flows and estimate coverage ratios, project IRR/Equity IRR and project NPV (NPV computations assume four cost of capital scenarios: 8%, 10%, 12%, and 14%). The results are reported for 30 years, 40 years, and 50 years for five scenarios.

The details for different scenarios are mentioned below.

Scenario 1 – Normal scenario:

- No change is revenue and costs (Most realistic revenue and costs).

Scenario 2 – Good scenario:

- Increase in revenue by 5%
- Decrease in capital cost and operation & maintenance cost by 5%.

Scenario 3 – Favorable scenario:

- Increase in revenue by 10%
- Decrease in capital cost and operation & maintenance cost by 10%.

Scenario 4 – Bad scenario:

- Decrease in revenue by 5%
- Increase in capital cost and operation & maintenance cost by 5%.

Scenario 5 – Worst scenario:

- Decrease in revenue by 10%
- Increase in capital cost and operation & maintenance cost by 10%.

Normal Scenario

We compute these results under the normal scenario where the most realistic revenue and cost are considered . The results suggest that the road project offers a reasonable IRR (15%-16%) when computed for 30-50 years. The results from NPV computation also provide similar inferences. We also estimate the debt service coverage ratio and interest coverage ratio. DSCR and ICR remain more than 3 and 6, respectively, indicating comfortable debt servicing profile over the currency of the loan. The projected cash flows corresponding to the normal scenario are provided in Annexure A.1. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.25: Results under Normal Scenario

			Year	**30**		**40**		**50**
Project IRR				15.0%		16.1%		16.4%
Equity IRR				21.6%		22.2%		22.4%
NPV @ Cost of capital								
NPV @ 14%				777.90		1978.12		2579.77
NPV @ 12%				2860.35		5093.18		6426.26
NPV @ 10%				6045.75		10257.35		13261.60
NPV @ 8%				10960.81		19019.91		25910.84
Coverage ratios								
Year	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**
DSCR (Debt Coverage)	3.33	3.80	4.33	4.93	4.46	6.36	7.21	8.16
ICR (Interest Coverage)	6.42	7.51	8.78	10.27	9.55	14.07	16.51	19.41
Average DSCR	3.33	3.56	3.81	4.08	4.15	4.50	4.85	5.23
Average ICR	6.42	6.95	7.53	8.16	8.41	9.23	10.10	11.04

Good Scenario

We compute these results under the good scenario: (a) increase in revenue by 5% and decrease in capex and opex by 5%. As expected, The results suggest that the road project offers a reasonable IRR when computed for 30-50 years. The results from NPV computation also provide similar inferences. We also estimate the debt service coverage ratio and interest coverage ratio. Results for both the ratios are well with in comfortable limits. The projected cash flows corresponding to the good scenario are provided in Annexure A.2. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.26: Results under Good Scenario

			Year	**30**		**40**		**50**
Project IRR				15.92%		16.88%		17.18%
Equity IRR				22.89%		23.39%		23.49%
NPV @ Cost of capital								
NPV @ 14%				1424.78		2688.65		3321.72
NPV @ 12%				3650.86		6002.06		7404.79
NPV @ 10%				7040.45		11475.28		14636.46
NPV @ 8%				12253.41		20739.59		27990.43
Coverage ratios								
Year	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**
DSCR (Debt Coverage)	3.73	4.26	4.85	5.52	5.12	7.11	8.06	9.12
ICR (Interest Coverage)	7.20	8.41	9.83	11.49	10.98	15.73	18.45	21.69
Average DSCR	3.73	3.99	4.27	4.57	4.68	5.06	5.45	5.87
Average ICR	7.20	7.79	8.44	9.14	9.47	10.38	11.34	12.39

Favorable Scenario

We compute the results under the favorable scenario: (a) an increase in revenue by 10% and a decrease in capex and opex by 10%. Under this scenario, the results suggest that the road project offers a very comfortable IRR when computed for 30-50 years. The results from NPV computation also provide similar inferences. We also estimate the debt service coverage ratio and interest coverage ratio. As expected, the DSCR and ICR remain above 4 and 8 respectively, which suggests comfortable debt servicing. The projected cash flows corresponding to the favorable scenario are provided in Annexure A.3. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.27: Results under Favourable Scenario

			Year	**30**		**40**		**50**
Project IRR				16.84%		17.71%		17.97%
Equity IRR				24.16%		24.59%		24.67%
NPV @ Cost of capital								
NPV @ 14%				2067.32		3394.81		4059.31
NPV @ 12%				4436.75		6906.29		8378.63
NPV @ 10%				8030.20		12688.19		16006.25
NPV @ 8%				13540.71		22453.79		30064.42
Coverage ratios								
Year	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**
DSCR (Debt Coverage)	4.18	4.77	5.43	6.18	5.87	7.95	9.01	10.19
ICR (Interest Coverage)	8.07	9.42	11.00	12.85	12.57	17.59	20.63	24.24
Average DSCR	4.18	4.47	4.78	5.12	5.26	5.68	6.12	6.58
Average ICR	8.07	8.72	9.45	10.23	10.65	11.66	12.73	13.89

Bad Scenario

We compute stress test our results under the bad scenario: (a) a decrease in revenue by 5% and an increase in capex and opex by 5%. Even with bad scenario, the results suggest that the road project offers a reasonable IRR (14%-15%) when computed for 30-50 years. The results from NPV computation also provide similar inferences. NPV remains positive for all the discount rates employed. We also estimate the debt service coverage ratio and interest coverage ratio. The DSCR and ICR ratios remain comfortably above 3 and 5, indicating comfortable debt servicing even during stressed situations. The projected cash flows corresponding to the bad scenario are provided in Annexure A.4. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.28: Results under Bad Scenario

			Year	**30**		**40**		**50**
Project IRR				14.16%		15.31%		15.69%
Equity IRR				20.42%		21.10%		21.26%
NPV @ Cost of capital								
NPV @ 14%				124.91		1261.46		1831.66
NPV @ 12%				2063.40		4177.80		5441.21
NPV @ 10%				5044.29		9032.55		11879.83
NPV @ 8%				9661.12		17292.97		23823.88
Coverage ratios								
Year	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**
DSCR (Debt Coverage)	2.97	3.39	3.87	4.41	3.86	5.68	6.44	7.30
ICR (Interest Coverage)	5.73	6.70	7.84	9.17	8.27	12.57	14.76	17.36
Average DSCR	2.97	3.18	3.40	3.64	3.68	4.00	4.32	4.66
Average ICR	5.73	6.20	6.72	7.29	7.46	8.20	8.99	9.83

Worst Scenario

We further stress test these results under the worst scenario: (a) a decrease in revenue by 10% and an increase in capex and opex by 10%. The results suggest that the road project still offers a reasonable IRR when computed for 30-50 years (13%-15%). The results from NPV computation also provide similar inferences. Except one scenario (30-year at 14%), NPV remains positive for all the other cases. We also estimate the debt service coverage ratio and interest coverage ratio. The DSCR and ICR ratios remain well above 2 and 5, indicating comfortable debt servicing even during such extreme stress. The projected cash flows corresponding to the normal scenario are provided in Annexure A.5. Other scenarios can be obtained by selecting the appropriate option in the excel model. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.29: Results under Worst Scenario

			Year	**30**		**40**		**50**
Project IRR				13.31%		14.55%		14.97%
Equity IRR				19.19%		19.99%		20.18%
NPV @ Cost of capital								
NPV @ 14%				-536.43		536.42		1075.16
NPV @ 12%				1257.67		3253.59		4447.32
NPV @ 10%				4033.68		7798.52		10488.76
NPV @ 8%				8352.01		15556.43		21727.21
Coverage ratios								
Year	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**
DSCR (Debt Coverage)	2.64	3.02	3.45	3.93	3.32	5.07	5.75	6.52
ICR (Interest Coverage)	5.10	5.97	6.98	8.18	7.11	11.22	13.18	15.51
Average DSCR	2.64	2.83	3.03	3.25	3.26	3.54	3.83	4.14
Average ICR	5.10	5.52	5.99	6.49	6.60	7.27	7.98	8.74

Development of Railways Project

Key Assumptions

The following key assumptions have been made in carrying out the computations.

Project cost and means of financing related assumptions

Total project cost of Rs. 8462.27 crore has been assumed to construct the railway track between Bhavnagar and Dahej-Bharuch. This also includes the interest during construction Rs. 1015.47 crore. For computation purposes, a debt-to-equity ratio of 60:40 is assumed which is similar to other semi-high-speed railway projects.

Table 32.30: Project cost details

Project Cost	**Rs Crore**	
Railway Civil cost	4424.84	
Railway Signaling, telecommunication and Electrification cost	1221.68	
Railway Mechanical cost	1.16	
Railway Structural cost	1754.87	
Environmental Charges due to Rail @ 1% of Civil cost	44.25	
Interest during construction	1015.47	
Total cost	**8462.27**	
Means of Financing (60:40)		**Debt profile**
Debt	5077.36	Door to door tenor of 30 years and 8 years of moratorium with interest @5% p.a.
Equity	3384.91	
Total cost	**8462.27**	

The construction period of project is estimated as 8 years. It is assumed that capex is phased out in equal amount over construction period, i.e., 12.5% over 8 years.

Table 32.31: Capex Phasing

Year	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Percentage	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%
Cost in crores	1057.784	1057.784	1057.784	1057.784	1057.784	1057.784	1057.784	1057.784

Revenue and expense related assumptions

To compute the projected revenue, which is the sum of revenue from passenger trains, revenue from freight trains, and non-fare revenues, following assumptions are considered.

Assumptions related to passenger train

To compute the projected revenues from passenger train, the following important assumptions have been made on the basis of reports provided by authorities and similar semi high speed rail projects. Total distance is estimated as 97.5 km. With reference to Silverline semi-high speed rail project, fare per passenger is considered to be Rs 2.75 as per year 2019 with an escalation of 6% per annum. Phasing of passenger train per day is done as per report provided by technical team. Number of passenger trains per day is estimated to be 63 for 2023 and which gradually increase to 167 in 2071. Referring to similar semi high-speed rail project of Vande Bharat, number of daily passengers per train per day are considered as 1300.

Table 32.32: Revenue profile

Number of trains per day						
Year	**2023**	**2032**	**2042**	**2052**	**2062**	**2072**
Passenger trains per day	63	78	119	139	155	167
Freight trains Per day	10	25	47	65	77	84
Capacity utilization rates						
Passenger trains	_	0.55	0.97	0.97	0.97	0.97
Freight trains	_	0.55	0.97	0.97	0.97	0.97
Revenue profile	**Price**	**Unit**	**Escalation (per annum)**			
Passenger Fare	2.75	per km	6%			
Wagon rate (with RORO)	8100	Per wagon	3%			
Wagon rate (without RORO)	180	Per wagon	3%			
Distance	97.5	KM				
Passengers	1300	Passengers per day				
Wagons	30	Wagons per train				
Capacity per wagon (without RORO)	50	Ton per wagon				

Non-fare revenue		
Revenue Source	**Rate**	**Escalation rate**
Revenue from Marketing and other expenses	**10%**	**3%**
Revenue from registration fees and stamp duty	**15%**	**3%**

To compute the revenue from passenger train, Capacity utilization rate for passenger train is considered as 55% for 2032 and gradually increased to 97% in year 2072. Capacity utilization rates are estimated with reference to Silverline, Bangalore suburban semi high speed rail projects.

Assumptions related to freight train

To further compute the projected revenues from freight trains, separate assumptions are made for freight train without RORO services and freight train with RORO services. The number of freight trains without RORO and with RORO is considered to be in equal ratio. The number of freight trains per day are considered as 10 in 2023 and gradually increase to 84 in 2072.

To compute the revenue from freight trains with RORO services, total number of wagons per train are assumed to be 60, whereas rates per wagon is considered as Rs 8100 with an escalation of 3% per annum.

Further to compute the revenue from freight trains without RORO services, number of wagons per trains remains same, i.e., 60. Tonne capacity per wagon is 50 and rate per wagon per tonne is considered to be Rs.180, which is referred from tariff rate circular from Ministry from railways. Capacity utilization rates computed for freight trains are similar to passenger trains.

Assumptions related to non-fare box revenue

Non-fare revenue is assumed to be generated from two sources, i.e., Revenue from Marketing, and other expenses and Revenue from registration fees and stamp duty. Revenue from marketing& other expenses is expected to be 10% of revenue from passenger trains with a yearly escalation of 3% per annum. Whereas, revenue from registration fees &

stamp duty is expected to be 15% of revenue from passenger train with a yearly escalation of 3% per annum.

Assumptions related to expenses

With reference to reports provided by authorities, operation and maintenance cost are estimated to be incurred Rs. 506 crores each year. However, periodical replacement cost will be incurred instead of annual cost after every 10 years starting from 2032 to 2062.

Table 32.33: O&M Expense Profile

Cost Profile	Price	Unit	
Operation and maintenance cost	506	crores	Each year
Periodical replacement cost	9715 23643 9715	crores	2032 2042 2052

Key Results pertaining to Project IRR/NPV

Based on the assumptions noted, we forecast the project cash flows and estimate coverage ratios, project IRR/Equity IRR and project NPV (NPV computations assume four cost of capital scenarios: 8%, 10%, 12%, and 14%). The results are shown for 30 years, 40 years, and 50 years for five scenarios.

The details of scenarios are mentioned below.

Scenario 1 – Normal scenario:

- No change is revenue and costs

Scenario 2 – Good scenario:

- Increase in revenue by 5%
- Decrease in capital cost and operation & maintenance cost by 5%.

Scenario 3 – Favorable scenario:

- Increase in revenue by 10%
- Decrease in capital cost and operation & maintenance cost by 10%.

Scenario 4 – Bad scenario:

- Decrease in revenue by 5%
- Increase in capital cost and operation & maintenance cost by 5%.

Scenario 5 – Worst scenario:

- Decrease in revenue by 10%
- Increase in capital cost and operation & maintenance cost by 10%.

Normal Scenario

These computations assume normal scenario where revenue and cost figures are most realistic based on the assumptions made. The results suggest that the rail project offers a reasonable project IRR and equity IRR when computed for 30-50 years. The results from NPV computation also offer similar inferences. Except for one case (30 Year, 14% discount rate), all the NPV figures are positive. Railway projects are expected to significantly contribute to socio-economic benefits, which may not appear in simple IRR and NPV analyses of this kind. We also estimate the debt service coverage ratio and interest coverage ratio. Except for initial two years, the DSCR and ICR remain well above 2 and 4, respectively, indicating comfortable debt servicing. The projected cash flows corresponding to the normal scenario are provided in Annexure B.1. Detailed results corresponding to this

scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.34: Results under Normal Scenario

	Year	30	40	50
Project IRR		13.49%	15.41%	16.06%
Equity IRR		18.48%	19.93%	20.32%
NPV @ Cost of capital				
NPV @ 14%		-320.92	1,269.95	2,271.17
NPV @ 12%		1,191.93	4,153.95	6,380.29
NPV @ 10%		3,587.45	9,179.43	14,215.07
NPV @ 8%		7,395.30	18,106.02	29,699.53

Coverage ratios								
Year	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**
DSCR (Debt Coverage)	1.07	1.57	2.17	2.88	3.76	4.81	6.06	7.43
ICR (Interest Coverage)	2.07	3.11	4.39	5.99	8.06	10.64	13.87	17.67
Average DSCR	1.07	1.32	1.60	1.90	2.26	2.65	3.10	3.59
Average ICR	2.07	2.58	3.15	3.81	4.57	5.45	6.46	7.59

Good Scenario

We compute these results under the good scenario: (a) an increase in revenue by 5% and a decrease in capex and opex by 5%. The results suggest that the project offers a reasonable IRR (14%-16%) when computed for 30-50 years. The results from NPV computation also provide similar inferences. We also estimate the debt service coverage ratio and interest coverage ratio. Except for the initial few years, both the DSCR and ICR ratios remain above 2 and 5, respectively, indicating comfortable debt servicing conditions. The projected cash flows corresponding to the good scenario are provided in Annexure B.2. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.35: Results under Good Scenario

	Year	30	40	50
Project IRR		14.54%	16.26%	16.83%
Equity IRR		19.94%	21.16%	21.47%
NPV @ Cost of capital				
NPV @ 14%		337.51	2,015.57	3,067.76
NPV @ 12%		2,023.12	5,147.79	7,487.43
NPV @ 10%		4,669.74	10,569.35	15,861.21
NPV @ 8%		8,851.64	20,152.62	32,335.91

Coverage ratios								
Year	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**
DSCR (Debt Coverage)	1.31	1.87	2.53	3.32	4.31	5.48	6.87	8.40
ICR (Interest Coverage)	2.52	3.69	5.12	6.91	9.23	12.13	15.73	19.99
Average DSCR	1.31	1.58	1.89	2.23	2.63	3.07	3.57	4.12
Average ICR	2.52	3.09	3.73	4.47	5.32	6.31	7.44	8.70

Favorable Scenario

We compute these results under the favorable scenario: (a) an increase in revenue by 10% and a decrease in capex and opex by 10%. The results suggest that the project offers a very comfortable IRR (15%-18%) when computed for 30-50 years. The results from NPV computation also provide similar inferences. We also estimate the debt service coverage ratio and interest coverage ratio. Except for the initial few years, both the DSCR and ICR ratios remain above 2 and 5, respectively, indicating comfortable debt servicing conditions. The projected cash flows corresponding to the favorable scenario are provided in Annexure

B.3. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.36: Results under Favourable Scenario

			Year	**30**		**40**		**50**
Project IRR				15.58%		17.13%		17.62%
Equity IRR				21.39%		22.41%		22.66%
NPV @ Cost of capital								
NPV @ 14%				985.14		2,750.40		3,853.55
NPV @ 12%				2,842.15		6,129.47		8,582.43
NPV @ 10%				5,738.53		11,945.76		17,493.85
NPV @ 8%				10,293.33		22,184.57		34,957.64
Coverage ratios								
Year	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**
DSCR (Debt Coverage)	1.57	2.19	2.93	3.82	4.92	6.23	7.78	9.49
ICR (Interest Coverage)	3.03	4.33	5.94	7.95	10.55	13.79	17.82	22.58
Average DSCR	1.57	1.88	2.22	2.61	3.05	3.54	4.10	4.71
Average ICR	3.03	3.66	4.39	5.21	6.17	7.27	8.53	9.95

Bad Scenario

We compute stress test our results under the bad scenario: (a) a decrease in revenue by 5% and an increase in capex and opex by 5%. Even with bad scenario, the results suggest that the project offers a reasonable IRR (12%-15%) when computed for 30-50 years. The results from NPV computation also provide similar inferences. Except for one case (30 Year, 14% discount rate), all the NPV figures are positive. We also estimate the debt service coverage ratio and interest coverage ratio. Except for the initial few years, both the DSCR and ICR ratios remain above 2 and 5, respectively, indicating comfortable debt servicing conditions. The projected cash flows corresponding to the bad scenario are provided in Annexure B.4. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.37: Results under Bad Scenario

			Year	**30**		**40**		**50**
Project IRR				12.44%		14.57%		15.31%
Equity IRR				17.00%		18.72%		19.20%
NPV @ Cost of capital								
NPV @ 14%				-986.57		517.10		1,467.36
NPV @ 12%				352.85		3,152.22		5,265.26
NPV @ 10%				2,496.66		7,781.02		12,560.43
NPV @ 8%				5,930.02		16,050.48		27,054.21
Coverage ratios								
Year	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**
DSCR (Debt Coverage)	0.86	1.31	1.84	2.48	3.27	4.21	5.32	6.55
ICR (Interest Coverage)	1.67	2.59	3.73	5.15	7.01	9.31	12.19	15.60
Average DSCR	0.86	1.09	1.33	1.61	1.92	2.28	2.68	3.12
Average ICR	1.67	2.12	2.63	3.21	3.89	4.68	5.58	6.59

Worst Scenario

We further stress test these results under the worst scenario: (a) a decrease in revenue by 10% and an increase in capex and opex by 10%. The results suggest that the project still offers a reasonable IRR when computed for 30-50 years (11%-15%). The results from NPV computation also provide similar inferences. Except for two scenarios (30-year and 40-year at 14%), NPV remains positive for all the other cases. We also estimate the debt service coverage ratio and interest coverage ratio. Except for the initial few years, both the DSCR and ICR ratios remain above 2 and 4, respectively, indicating comfortable debt

servicing conditions.The projected cash flows corresponding to the normal scenario are provided in Annexure B.5. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.38: Results under Worst Scenario

			Year	**30**	**40**		**50**	
Project IRR				11.36%	13.73%		14.58%	
Equity IRR				15.48%	17.52%		18.11%	
NPV @ Cost of capital								
NPV @ 14%				-830.77	-244.16		2,584.67	
NPV @ 12%				764.08	4,649.20		7,602.09	
NPV @ 10%				3,328.82	10,660.18		17,339.41	
NPV @ 8%				7,454.39	21,489.83		36,867.90	
Coverage ratios								
Year	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**
DSCR (Debt Coverage)	0.68	1.08	1.55	2.12	2.83	3.67	4.67	5.77
ICR (Interest Coverage)	1.31	2.12	3.14	4.41	6.05	8.11	10.69	13.72
Average DSCR	0.68	0.87	1.09	1.34	1.62	1.94	2.30	2.69
Average ICR	1.31	1.71	2.16	2.68	3.29	3.98	4.79	5.69

Development of Wind Project

Key Assumptions

The following key assumptions have been made in carrying out the computations.

Project cost and means of financing related assumptions

Total project cost of Rs. 12,268.48 crores has been assumed to create wind farms at four different sites (Vadgam, Motibaru, Proposed P1 region and Proposed P2 region). This also includes the interest during the construction of 1,717.59 crores. For computation purposes, a debt-to-equity ratio of 70:30 is assumed which is similar to other wind farm projects across the country. For computation purposes, a debt-to-equity ratio of 70:30 (as per the CERC order 2021-22) is assumed which is similar to other wind power plant projects. As per the CERC order this cost is expected to be in the range of Rs 6.23-7.68 crore per MW (> 150MW; NIWE report considers Rs 7.00 crore per MW). We have considered a cost of Rs 7.00 per MW crore for wind projects.

Table 32.39: Project cost details

Project Cost	**Rs Crore**	
WEGs	7,301.22	
Concrete tower	1,308.31	
Distribution transformer	548.65	
Civil work	357.68	
Erection, commissioning, insurance	357.68	
Land and Transportation	263.77	
Transfer of development rights charges, contingency, etc.	413.59	
IDC	1,717.59	
Total cost	**12,268.48**	
Means of Financing (70:30)		**Debt profile**
Debt	8,587.93	Door to door tenor of 30 years and 5 years of moratorium with interest @8% p.a.
Equity	3,680.54	
Total cost	**12,268.48**	

The construction period of project is estimated as 5 years. It is assumed that capex is phased out in equal amount over construction period, i.e., 20% over 5 years.

Table 32.40: Capex phasing

Year	2023	2024	2025	2026	2027
Percentage	20.0%	20.0%	20.0%	20.0%	20.0%
Cost in crores	2,453.70	2,453.70	2,453.70	2,453.70	2,453.70

Revenue and expense related assumptions

To compute the projected revenue, the following assumptions are considered.

Assumptions related to tariff and capacity utilization factor

Tariff rate of Rs. 8.07 kWH (2028) and CUF of 35% has been assumed for estimating the revenue from the energy generation. [As per the latest CERC tariff order available the current total, i.e., fix+variable tariff rates are provided in the range of Rs 6-7.5 kWH (2022) along with an escalation rate of 3.84% . We consider an average tariff of Rs 6.68 kWH (2022)].

Table 32.41: Revenue Profile

Revenue					
Year	**2028**	**2034**	**2040**	**2046**	**2052**
Tariff (Rs kWH)	8.07	8.07	8.07	8.07	8.07
Electricity generation (kWh)	13203685200	13203685200	13203685200	13203685200	13203685200
CUF	35.00%	35.00%	35.00%	35.00%	35.00%
Revenue in Cr (Tariff*Electricity generation)	3728.43	3728.43	3728.43	3728.43	3728.43

Assumptions related to expenses

With reference to reports provided by authorities, Operation and maintenance cost is considered at Rs 14.00 lakhs per MW with an escalation of 3.8% per year. This works out to Rs. 211.02 crores per year (~2% of the project cost). CERC (2022) observes that O&M expenses range from Rs 6-15 Lakh per MW. However for projects > 150 MW the costs are closer to Rs 7-8 Lakh per MW. As per the NIWE report, the O&M cost for a wind project is considered as Rs 1.5 Lakhs per MW.

Table 32.42: O&M Expense Profile

Cost Profile	Price	Unit	
Operation and maintenance cost	211.02	crores	Annually

Key Results pertaining to Project IRR/NPV

Based on the assumptions noted, we forecast the project cash flows and estimate coverage ratios, project IRR/Equity IRR and project NPV (NPV computations assume four cost of capital scenarios: 8%, 10%, 12%, and 14%). The results are shown for 20 years, 25 years, and 30 years for five scenarios. The details of scenarios are mentioned below.

- **Scenario 1**- Normal scenario: No change is revenue and cost is assumed.

- **Scenario 2**- Good scenario: 5% revenue is increased and both capital cost and operation and maintenance cost is reduced by 5%

- **Scenario 3** – Favorable scenario: 10% revenue is increased and both capital cost and operation and maintenance cost is reduced by 10%

- **Scenario 4**- Bad scenario: 5% revenue is decreased and both capital cost and operation and maintenance cost is increased by 5%

- **Scenario 5**- Worst scenario: 10% revenue is decreased and both capital cost and operation and maintenance cost is increased by 10%

Normal Scenario

These computations assume normal scenario where revenue and cost figures are most realistic based on the assumptions made. The results suggest that the wind project offers a reasonable IRR (14%-16%) when computed for 20-30 years. The results from NPV computation also offer similar inferences. We also estimate the debt service coverage ratio and interest coverage ratio. For all the years of the project life, the average debt coverage ratio and average interest coverage ratio are above 3 and 5, indicating comfortable debt servicing. The projected cash flows corresponding to the normal scenario are provided in Annexure C.1. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.43: Results under Normal Scenario

			Year	**20**		**25**		**30**
Project IRR				14.31%		15.16%		15.49%
Equity IRR				27.95%		28.26%		28.35%
NPV @ Cost of capital								
NPV @ 14%				179.45		744.22		1,018.97
NPV @ 12%				1,531.05		2,375.56		2,824.41
NPV @ 10%				3,318.65		4,591.47		5,331.71
NPV @ 8%				5,692.19		7,626.29		8,859.19
Coverage ratios								
Year	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
DSCR (Debt Coverage)	3.42	3.50	3.59	3.69	3.78	3.89	4.00	4.12
ICR (Interest Coverage)	5.16	5.36	5.59	5.83	6.09	6.38	6.71	7.06
Average DSCR	3.42	3.46	3.50	3.55	3.59	3.64	3.68	3.73
Average ICR	5.16	5.26	5.36	5.47	5.58	5.70	5.83	5.95

Good Scenario

We compute these results under the good scenario: (a) an increase in revenue by 5% and a decrease in capex and opex by 5%. As expected, The results suggest that the project offers a reasonable IRR (15%-17%) when computed for 20-30 years. The results from NPV computation also provide similar inferences. We also estimate the debt service coverage ratio and interest coverage ratio. As expected, the DSCR and ICR remain above 3 and 5, respectively, which suggests comfortable debt servicing. The projected cash flows corresponding to the good scenario are provided in Annexure C.2. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.44: Results under Good Scenario

			Year	20	25	30		
Project IRR				15.78%	16.55%	16.84%		
Equity IRR				30.73%	30.98%	31.05%		
NPV @ Cost of capital								
NPV @ 14%				996.61	1,593.39	1,885.77		
NPV @ 12%				2,445.19	3,337.62	3,815.30		
NPV @ 10%				4,352.20	5,697.29	6,485.13		
NPV @ 8%				6,874.74	8,918.77	10,231.00		
Coverage ratios								
Year	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
DSCR (Debt Coverage)	3.83	3.93	4.03	4.14	4.25	4.37	4.50	4.63
ICR (Interest Coverage)	5.79	6.02	6.27	6.54	6.84	7.17	7.54	7.94
Average DSCR	3.83	3.88	3.93	3.98	4.03	4.08	4.14	4.19
Average ICR	5.79	5.90	6.02	6.14	6.27	6.40	6.54	6.69

Favourable Scenario

We compute the results under the favorable scenario: (a) an increase in revenue by 10% and a decrease in capex and opex by 10%. Under this scenario, the results suggest that the project offers a very comfortable IRR (17%-18%) when computed for 20-30 years. The results from NPV computation also provide similar inferences. We also estimate the debt service coverage ratio and interest coverage ratio. As expected, the DSCR and ICR remain above 4 and 6, respectively, which suggests comfortable debt servicing. The projected cash flows corresponding to the favorable scenario are provided in Annexure C.3. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.45: Results under Favourable Scenario

			Year	20	25	30		
Project IRR				17.31%	18.00%	18.26%		
Equity IRR				33.57%	33.77%	33.81%		
NPV @ Cost of capital								
NPV @ 14%				1,807.38	2,436.21	2,746.23		
NPV @ 12%				3,352.82	4,293.21	4,799.74		
NPV @ 10%				5,379.13	6,796.58	7,632.03		
NPV @ 8%				8,050.61	10,204.69	11,596.30		
Coverage ratios								
Year	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
DSCR (Debt Coverage)	4.30	4.41	4.52	4.65	4.77	4.91	5.06	5.21
ICR (Interest Coverage)	6.49	6.75	7.04	7.35	7.69	8.06	8.47	8.93
Average DSCR	4.30	4.35	4.41	4.47	4.52	4.58	4.65	4.71
Average ICR	6.49	6.62	6.75	6.89	7.04	7.19	7.35	7.51

Bad Scenario

We further stress test our results under the bad scenario: (a) a decrease in revenue by 5% and an increase in capex and opex by 5%. Even with the bad scenario, the results suggest that the project offers a reasonable IRR (12%-14%) when computed for 20-30 years. The results from NPV computation also provide similar inferences. Except for two cases (14% discount rate, 20-year and 25-year period), NPV remains positive for all the discount rates employed. We also estimate the debt service coverage ratio and interest coverage ratio. The DSCR and ICR ratios remain comfortably above 3 and 5, indicating comfortable debt servicing even during stressed situations. The projected cash flows corresponding to the bad scenario are provided in Annexure C.4. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.46: Results under Bad Scenario

			Year	20	25	30
Project IRR				12.90%	13.83%	14.21%
Equity IRR				25.20%	25.59%	25.71%
NPV @ Cost of capital						
NPV @ 14%				-644.25	-111.46	145.66
NPV @ 12%				610.23	1,406.88	1,826.91
NPV @ 10%				2,278.33	3,478.94	4,171.62
NPV @ 8%				4,502.81	6,327.10	7,480.70
Coverage ratios						
Year	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
DSCR (Debt Coverage)	3.04	3.12	3.20	3.28	3.37	3.46	3.56	3.66
ICR (Interest Coverage)	4.59	4.77	4.97	5.18	5.42	5.67	5.96	6.27
Average DSCR	3.04	3.08	3.12	3.16	3.19	3.24	3.28	3.32
Average ICR	4.59	4.68	4.77	4.87	4.97	5.07	5.18	5.30

Worst Scenario

We further stress test these results under the worst scenario: (a) a decrease in revenue by 10% and an increase in capex and opex by 10%. The results suggest that the project still offers a reasonable IRR when computed for 20-30 years (11%-13%). The results from NPV computation also provide similar inferences. Except for few scenarios (14% and 12% discount rate), NPV remains positive for all the other cases. We also estimate the debt service coverage ratio and interest coverage ratio. Except for the initial few years, both the DSCR and ICR ratios remain above 2 and 4, respectively, indicating comfortable debt servicing conditions. The projected cash flows corresponding to the worst scenario are provided in Annexure C.5. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.47: Results under Worst Scenario

			Year	20	25	30
Project IRR				11.54%	12.55%	12.97%
Equity IRR				22.45%	22.94%	23.10%
NPV @ Cost of capital						
NPV @ 14%				-1,474.66	-973.81	-734.31
NPV @ 12%				-317.43	431.42	822.64
NPV @ 10%				1,231.05	2,359.55	3,004.69
NPV @ 8%				3,306.43	5,021.03	6,095.37
Coverage ratios						
Year	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
DSCR (Debt Coverage)	2.70	2.77	2.84	2.91	2.99	3.07	3.15	3.24
ICR (Interest Coverage)	4.08	4.24	4.42	4.60	4.81	5.04	5.28	5.56
Average DSCR	2.70	2.74	2.77	2.80	2.84	2.87	2.91	2.95
Average ICR	4.08	4.16	4.24	4.33	4.42	4.51	4.60	4.70

Development of Solar Project

Key Assumptions

The following key assumptions have been made in carrying out the computations.

Project cost and means of financing related assumptions

Total project cost of Rs. 8,139.53 crore has been assumed to construct the solar power plant. This also includes the interest during construction Rs. 1,139.53 crore. For computation purposes, a debt-to-equity ratio of 70:30 (as per the CERC order 2021-22) is

assumed which is similar to other solar power plant projects. As per the CERC order this cost is expected to be in the range of Rs 3.75-6.43 crore per MW (> 150MW; NIWE report considers Rs 4.00 crore per MW). We have considered a cost of Rs 7.00 per MW crore for Solar projects.

Table 32.48: Project cost details

Project Cost	**Rs Crore**	
Land Development & Civil	105.88	
Equipments	415.04	
Solar Module (PV, Thin Film, CVP)	5,320.48	
Solar Inverters & Mounting	574.76	
Installation	21.18	
Electrical	445.89	
Preoperative Cost	45.38	
Contingency	71.39	
Interest during construction	1,139.53	
Total cost	**8,139.53**	
Means of Financing (70:30)		**Debt profile**
Debt	5,697.67	Door to door tenor of 30 years and 5 years of moratorium with interest @8% (as per the CERC order) p.a.
Equity	2,441.86	
Total cost	**8,139.53**	

The construction period of project is estimated as 5 years. It is assumed that capex is phased out in equal amount over construction period, i.e., 20% over 5 years.

Table 32.49: Capex phasing

Year	**2023**	**2024**	**2025**	**2026**	**2027**
Percentage	20%	20%	20%	20%	20%
Cost in crores	1,627.91	1,627.91	1,627.91	1,627.91	1,627.91

Revenue and expense related assumptions

Tariff rate of Rs. 8.07 kWH (2028) and CUF of 35% has been assumed for estimating the revenue from the energy generation. [As per the latest CERC tariff order available the current total, i.e., fix+variable tariff rates are provided in the range of Rs 6-7.5 kWH (2022) along with an escalation rate of 3.84% . We consider an average tariff of Rs 6.68 kWH (2022)]. Also, as per the CERC report CUF has been provided in the range of 30%-45%.

Table 32.50: Revenue Profile

Revenue						
Year	**2023**	**2028**	**2034**	**2040**	**2046**	**2052**
Tariff (Rs kWH)	8.07	8.07	8.07	8.07	8.07	8.07
Electricity generation (kWh)	8760000000	8760000000	8760000000	8760000000	8760000000	8760000000
CUF	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%
Revenue in crore (Tariff*Electricity generation)	0.00	2473.63	2473.63	2473.63	2473.63	2473.63

Assumptions related to expenses

With reference to reports provided by authorities, Operation and maintenance cost is considered at Rs 7.00 lakhs per MW with an escalation of 3.8% per year. This works out to Rs. 100 crores (at 2022 rates) at about 1.5% of the project cost. CERC (2022) observes that O&M expenses range from Rs 3-8.5 Lakh per MW. However for projects > 150 MW the

costs are closer to Rs 3 Lakh per MW. As per the NIWE report, the O&M cost for a solar project is considered as Rs 8 Lakhs per MW.

Table 32.51: O&M Expense Profile

Cost Profile	Price	Unit	
Operation and maintenance cost	100	crores	Annually

Key Results pertaining to Project IRR/NPV

Based on the assumptions noted, we forecast the project cash flows and estimate coverage ratios, project IRR/Equity IRR and project NPV (NPV computations assume four cost of capital scenarios: 8%, 10%, 12%, and 14%). The results are shown for 20 years, 25 years, and 30 years for five scenarios. The details of scenarios are mentioned below.

- **Scenario 1**- Normal scenario: No change is revenue and cost is assumed.
- **Scenario 2**- Good scenario: 5% revenue is increased and both capital cost and operation and maintenance cost is reduced by 5%
- **Scenario 3** – Favorable scenario: 10% revenue is increased and both capital cost and operation and maintenance cost is reduced by 10%
- **Scenario 4**- Bad scenario: 5% revenue is decreased and both capital cost and operation and maintenance cost is increased by 5%
- **Scenario 5**- Worst scenario: 10% revenue is decreased and both capital cost and operation and maintenance cost is increased by 10%

Normal Scenario

These computations assume normal scenario where revenue and cost figures are most realistic based on the assumptions made. The results suggest that the solar project offers a reasonable IRR (14%-16%) when computed for 20-30 years. The results from NPV computation also offer similar inferences. We also estimate the debt service coverage ratio and interest coverage ratio. For all the years of the project life, the average debt coverage ratio and average interest coverage ratio are above 3 and 5, indicating comfortable debt servicing. The projected cash flows corresponding to the normal scenario are provided in Annexure D.1. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.52: Results under Normal Scenario

			Year	**20**	**25**	**30**		
Project IRR				14.62%	15.46%	15.79%		
Equity IRR				28.52%	28.82%	28.90%		
NPV @ Cost of capital								
NPV @ 14%				239.96	629.41	820.94		
NPV @ 12%				1,163.88	1,746.27	2,059.20		
NPV @ 10%				2,384.87	3,262.70	3,778.83		
NPV @ 8%				4,005.14	5,339.12	6,198.83		
Coverage ratios								
Year	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
DSCR (Debt Coverage)	3.49	3.58	3.67	3.77	3.88	3.99	4.11	4.24
ICR (Interest Coverage)	5.27	5.48	5.71	5.97	6.24	6.55	6.88	7.26
Average DSCR	3.49	3.53	3.58	3.62	3.67	3.72	3.77	3.82
Average ICR	5.27	5.37	5.48	5.59	5.71	5.84	5.96	6.10

Good Scenario

We compute these results under the good scenario: (a) an increase in revenue by 5% and a decrease in capex and opex by 5%. As expected, The results suggest that the project offers a reasonable IRR (16%-17%) when computed for 20-30 years. The results from NPV computation also provide similar inferences. We also estimate the debt service coverage ratio and interest coverage ratio. As expected, the DSCR and ICR remain above 3 and 5, respectively, which suggests comfortable debt servicing. The projected cash flows corresponding to the good scenario are provided in Annexure D.2. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.53: Results under Good Scenario

			Year	**20**		**25**		**30**
Project IRR				16.07%		16.83%		17.12%
Equity IRR				31.25%		31.49%		31.55%
NPV @ Cost of capital								
NPV @ 14%				776.06		1,186.01		1,388.78
NPV @ 12%				1,762.96		2,376.04		2,707.34
NPV @ 10%				3,061.43		3,985.53		4,531.99
NPV @ 8%				4,778.27		6,182.65		7,092.90
Coverage ratios								
Year	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
DSCR (Debt Coverage)	3.91	4.01	4.11	4.23	4.35	4.47	4.61	4.75
ICR (Interest Coverage)	5.90	6.14	6.40	6.68	7.00	7.34	7.72	8.14
Average DSCR	3.91	3.96	4.01	4.06	4.11	4.17	4.23	4.28
Average ICR	5.90	6.02	6.14	6.27	6.40	6.54	6.68	6.83

Favourable Scenario

We compute the results under the favorable scenario: (a) an increase in revenue by 10% and a decrease in capex and opex by 10%. Under this scenario, the results suggest that the project offers a very comfortable IRR (17%-19%) when computed for 20-30 years. The results from NPV computation also provide similar inferences. We also estimate the debt service coverage ratio and interest coverage ratio. As expected, the DSCR and ICR remain above 4 and 6, respectively, which suggests comfortable debt servicing. The projected cash flows corresponding to the favorable scenario are provided in Annexure D.3. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.54: Results under Favorable Scenario

			Year	**20**		**25**		**30**
Project IRR				17.58%		18.27%		18.52%
Equity IRR				34.04%		34.23%		34.27%
NPV @ Cost of capital								
NPV @ 14%				1,307.92		1,738.40		1,952.41
NPV @ 12%				2,357.72		3,001.52		3,351.20
NPV @ 10%				3,733.59		4,704.03		5,280.83
NPV @ 8%				5,546.97		7,021.82		7,982.65
Coverage ratios								
Year	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
DSCR (Debt Coverage)	4.37	4.49	4.61	4.73	4.87	5.01	5.16	5.33
ICR (Interest Coverage)	6.60	6.87	7.17	7.49	7.84	8.23	8.65	9.13
Average DSCR	4.37	4.43	4.49	4.55	4.61	4.67	4.73	4.80
Average ICR	6.60	6.74	6.87	7.02	7.17	7.32	7.49	7.66

Bad Scenario

We further stress test our results under the bad scenario: (a) a decrease in revenue by 5% and an increase in capex and opex by 5%. Even with the bad scenario, the results suggest that the project offers a reasonable IRR (13%-15%) when computed for 20-30 years. The results from NPV computation also provide similar inferences. Except for one case (14% discount rate 20-year period), NPV remains positive for all the discount rates employed. We also estimate the debt service coverage ratio and interest coverage ratio. The DSCR and ICR ratios remain comfortably above 3 and 5, indicating comfortable debt servicing even during stressed situations. The projected cash flows corresponding to the bad scenario are provided in Annexure D.4. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.55: Results under Bad Scenario

			Year	**20**		**25**		**30**
Project IRR				13.24%		14.16%		14.53%
Equity IRR				25.82%		26.20%		26.31%
NPV @ Cost of capital								
NPV @ 14%				-300.48		68.49		248.79
NPV @ 12%				560.36		1,112.11		1,406.68
NPV @ 10%				1,703.82		2,535.41		3,021.24
NPV @ 8%				3,227.48		4,491.15		5,300.33
Coverage ratios								
Year	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
DSCR (Debt Coverage)	3.11	3.19	3.28	3.36	3.46	3.56	3.66	3.77
ICR (Interest Coverage)	4.70	4.89	5.10	5.32	5.57	5.84	6.14	6.47
Average DSCR	3.11	3.15	3.19	3.23	3.28	3.32	3.36	3.41
Average ICR	4.70	4.79	4.89	4.99	5.10	5.21	5.32	5.44

Worst Scenario

We further stress test these results under the worst scenario: (a) a decrease in revenue by 10% and an increase in capex and opex by 10%. The results suggest that the project still offers a reasonable IRR when computed for 20-30 years (11%-13%). The results from NPV computation also provide similar inferences. Except for few scenarios (14% and 12% discount rate), NPV remains positive for all the other cases. We also estimate the debt service coverage ratio and interest coverage ratio. Except for the initial few years, both the DSCR and ICR ratios remain above 2 and 4, respectively, indicating comfortable debt servicing conditions. The projected cash flows corresponding to the worst scenario are provided in Annexure D.5. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.56: Results under worst Scenario

			Year	**20**		**25**		**30**
Project IRR				11.90%		12.90%		13.32%
Equity IRR				23.14%		23.61%		23.76%
NPV @ Cost of capital								
NPV @ 14%				-845.37		-496.85		-327.78
NPV @ 12%				-47.69		473.45		749.66
NPV @ 10%				1,018.17		1,803.58		2,259.11
NPV @ 8%				2,445.17		3,638.61		4,397.29
Coverage ratios								
Year	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
DSCR (Debt Coverage)	2.78	2.85	2.92	3.00	3.08	3.17	3.26	3.36

ICR (Interest Coverage)	4.19	4.36	4.54	4.74	4.96	5.20	5.46	5.76
Average DSCR	2.78	2.81	2.85	2.88	2.92	2.96	3.00	3.04
Average ICR	4.19	4.27	4.36	4.45	4.54	4.64	4.74	4.84

Benefits to Fisheries due to Kalpasar Dyke

To estimate the potential of fisheries in the region, we consider three scenarios of maximum potential (Base, Scenario-1, and Scenario-2) along with the respective prices (in Rs per tonnes). These figures are based on the conceptual structure plan prepared by CEPT university and submitted to Kalpasar authorities. Perusing these figures and the phasing schedule of fishery development in the region (as provided in the table), we compute the value of fishery potential over the years in a phased wise manner. Price escalation of 3% per year is considered which is customary and aligned to the average inflation rates (2%-4% as per the inflation targeting policy of RBI).

Table 32.57: Potential of Fisheries

	Potential (Tonnes)	**Price (Rs/Tonnes)**
Base Case	20000	75000
Scenario -1	15000	60000
Scenario-2	25000	90000

These assumptions coupled with the phasing of fishery development (as shown in Table 32.57), the following projections are made regarding revenues from Fisheries.

Table 32.58: Reservoir Fish Yield (Base Case Scenario)

Year	**2029**	**2030**	**2031**	**2032**	**2034**	**2044**
Phasing of Fishery Development	15%	20%	20%	20%	5%	0%
Cumulative Development	15%	35%	55%	75%	100%	100%
Value of Fisheries (Rs crores)						
Base Case	23.18	55.70	90.15	126.62	179.11	240.71
Scenario -1	13.91	33.42	54.09	75.97	107.46	144.42
Scenario-2	34.76	83.55	135.22	189.93	268.66	361.06

Employment Generation from Agricultural, Industrial, Tourism, Special Investment Region (SIR), and Urban development

Assumptions related to agricultural employment

We use inputs provided in the concept structure plan report (CEPT university), submitted to Kalpasar authorities to estimate the monetary potential of employment opportunities from the development in the region. This includes two scenarios with Rs 250 per day and Rs 300 per day wage rates. Other assumptions related to work force in agricultural area and the related job opportunities are provided in the table below.

Table 32.59: Agricultural Employment

Particulars	**Value**	**Unit**
Area under agriculture	3066.06	Sq.km
Total Workforce Dependent on Agriculture	3.2	Lakhs
Workforce Participation	1.6	Lakhs
Man Land Ratio for Direct Jobs	1.377	Ha per person
Total Direct Job Opportunities	4.22	Lakhs
Incremental Direct Job Opportunities (by 2030)	2.62	Lakhs

Indirect Jobs in Agriculture (@30% of Direct Jobs)	0.79	30% of direct jobs
Total Agricultural Jobs	3.41	Lakhs
Average daily wage rate (RBI)(250* *20 Days a month*12)	60000	Rs per person per annum
Maximum average daily wage rate (RBI)(300* *20 Days a month*12)	72000	Rs per person per annum
Escalation in wages	1%	Per Annum

Using the information related to employment generation potential, we project the cash inflows from the agricultural employment. The assumptions related to phasing and the resulting cash flows for both the scenarios are provided below.

Table 32.60: Phasing of potential inflows from agricultural employment phasing

Year	2029	2034	2039	2044
Phasing of Jobs	5%	10%	10%	0%
Cumulative phasing	5%	40%	90%	100%
Base Case (Rs crore): Rs 250 Daily wage	103	868	2054	2398
Scenario 1 (Rs crore): Rs 300 Daily age	124	1042	2464	2878

Assumptions related to industrial employment

We use inputs provided in the concept structure plan report (CEPT university), submitted to Kalpasar authorities to estimate the monetary potential of industrial related employment opportunities from the development in the region. This includes two scenarios with Rs 10,000 per day and Rs 15,000 per month salaried jobs. Other assumptions related to work force in the industrial area and the related job opportunities are provided in the table below.

Table 32.61: Industrial Employment

Particulars	Value	Unit
Industrial area to be created	615	sq.km
Jobs per unit area	500	Jobs per Sq. Km
Total Number of Direct Jobs	307500	
Indirect Jobs	61,500	20% of direct jobs
Total Industrial Jobs	3.69	Lakhs
Salary (@10000 per month)	120000	Rs per person per annum
Salary (@15000 per month)	180000	Rs per person per annum
Escalation in Salary	1%	Per Annum

Using the information related to employment generation potential, we project the cash inflows from the industrial employment. The assumptions related to phasing and the resulting cash flows for both the scenarios are provided below.

Table 32.62: Phasing of potential inflows from industrial employment phasing

Year	2029	2034	2039	2044
Phasing of Jobs	5%	10%	10%	0%
Cumulative phasing	5%	40%	90%	100%
Base Case (Rs crore): (@ Rs 10000 per month)	224	1880	4446	5192
Scenario 1 (Rs crore): (@ Rs 15000 per month)	335	2820	6669	7788

Assumptions related to tourism employment

We use inputs provided in the concept structure plan report (CEPT university), submitted to Kalpasar authorities to estimate the monetary potential of tourism related employment opportunities from the development in the region. This includes two scenarios with Rs 5,000 per day and Rs 10,000 per month salaried jobs. Other assumptions related to work force in the tourism area and the related job opportunities are provided in the table below.

Table 32.63: Tourism Employment

Particulars	Value	Unit
Tourism area to be created	235	Sq.km
Jobs per unit area	200	Jobs per Sq. Km
Total Number of Direct Jobs	47000	
Indirect Jobs	32,900	70% of direct jobs
Total Jobs	0.80	Lakhs
Salary (@5000 per month)	60000	Rs per person per annum
Salary (@10000 per month)	120000	Rs per person per annum
Escalation in Salary	1%	Per Annum

Using the information related to employment generation potential, we project the cash inflows from the tourism employment. The assumptions related to phasing and the resulting cash flows for both the scenarios are provided below.

Table 32.64: Phasing of potential inflows from tourism employment phasing

Year	2029	2034	2039	2044
Phasing of Jobs	5%	10%	10%	0%
Cumulative phasing	5%	40%	90%	100%
Base Case (Rs crore): (@ Rs 5000 per month)	24	204	481	562
Scenario 1 (Rs crore): (@ Rs 10000 per month)	48	407	963	1124

Assumptions related to urbanization/urban-agglomeration employment

We use inputs provided in the concept structure plan report (CEPT university), submitted to Kalpasar authorities to estimate the monetary potential of urbanization related employment opportunities from the development in the region. This includes two scenarios with Rs 5,000 per day and Rs 10,000 per month salaried jobs. Other assumptions related to work force in the urbanization and the related job opportunities are provided in the table below.

Table 32.65: Urbanization/Urban-agglomeration Employment

Particulars	Value	Unit
Urban area to be created	690	Sq.km
Jobs per unit area	1200	Jobs per Sq. Km
Total Number of Direct Jobs	828000	
Indirect Jobs due to urban agglomeration	99,360	12% of direct jobs
Total Jobs	9.27	Lakhs
Salary (@5000 per month)	60000	Rs per person per annum
Salary (@10000 per month)	120000	Rs per person per annum
Escalation in Salary	1%	Per Annum

Using the information related to employment generation potential, we project the cash inflows from the urbanization/urban-agglomeration related employment. The assumptions related to phasing and the resulting cash flows for both the scenarios are provided below.

Table 32.66: Phasing of potential inflows from Urbanization/Urban-agglomeration employment phasing

Year	2029	2034	2039	2044
Phasing of Jobs	5%	10%	10%	0%
Cumulative phasing	5%	40%	90%	100%
Base Case (Rs crore): (@ Rs 5000 per month)	281	2363	5587	6524
Scenario 1 (Rs crore): (@ Rs 10000 per month)	562	4725	11174	13049

Assumptions related to Dholera SIR related employment

We use inputs provided in the concept structure plan report (CEPT university), submitted to Kalpasar authorities to estimate the monetary potential of Dholera SIR related employment opportunities from the development in the region. This includes two scenarios with Rs 5,000 per day and Rs 10,000 per month salaried jobs. Other assumptions related to work force in Dholera SIR and the related job opportunities are provided in the table below.

Table 32.67: Dholera SIR related Employment

Particulars	Value	Unit
Total SIR Jobs	14.35	Lakhs
Salary (@5000 per month)	60000	Rs per person per annum
Salary (@10000 per month)	120000	Rs per person per annum
Escalation in Salary	1%	Per Annum

Using the information related to employment generation potential, we project the cash inflows from the Dholera SIR related employment. The assumptions related to phasing and the resulting cash flows for both the scenarios are provided below.

Table 32.68: Phasing of potential inflows from Dholera SIR employment phasing

Year	2029	2034	2039	2044
Phasing of Jobs	5%	10%	10%	0%
Cumulative phasing	5%	40%	90%	100%
Base Case (Rs crore): (@ Rs 5000 per month)	435	3657	8648	10099
Scenario 1 (Rs crore): (@ Rs 10000 per month)	870	7314	17295	20197

Consolidated cash flow profile from employment generation

Based on these individual components of employment generation, the overall employment generation potential due to Kalpasar project is provided below (for both the scenarios: (a) Base case and (b) Scenario (1).

Table 32.69: Total value add from employment generation in the region

Year	2029	2034	2039	2044	2049	2054	2059
Base Case (Rs crore)	1,067	8,972	21,216	24,775	26,039	27,367	28,763
Scenario 1 (Rs crore)	1,940	16,308	38,565	45,036	47,334	49,748	52,286

32.9 Secondary Data Points

Table 32.70: Secondary Data points to be employed for Financial Modelling

Information taken from secondary sources		
1. Roadways		
S. No.	**Assumptions major head**	**Referred sources**

1	Related to funding pattern (Debt-Equity ratio)	ADB report (Tamil Nadu Industrial Connectivity Project) -(Project Number: 51337-001, March 2021)
2	Related to interest rate	ADB report (Tamil Nadu Industrial Connectivity Project) -(Project Number: 51337-001, March 2021)
3	Related to loan repayment and moratorium period	Bangalore suburban railway DPR

2. Railways

S.No.	Information	Source
1	Opex rate as a percentage of total project cost, escalation rate for operation and maintenance, fare per passenger, and Escalation rate on fare	Silverline railway DPR
2	Debt - Equity Ratio, Interest Rate The total door-to-door period, and Moratorium period	Bangalore suburban railway DPR
3	No of daily passengers per train per day	Vande Bharat semi-high-speed train circular
4	Rate per wagon (Assuming loaded vehicles with the rigid body)	Report RORO charges per wagon from the rate circular on RORO operations
5	Ton capacity per wagon for freight trains without RORO	Indian railways report on the carrying capacity of different types of wagons
6	Rate per wagon (per ton) for freight trains without RORO	Rate circular for different classes of commodity, the rate is taken as the average of high and low

3. Wind Project

S.no.	Referred Source	Name of public source	Details	Particulars
1	CERC RE Tariff Order for FY 2021-22	CERC	Life of the project	25 years
			CPEX	467 lakh/MW
			OPEX	25.46 lakh/MW/yr.
			Escalation OPEX	3.84%
			Financing pattern	Debt - 70%, Equity - 30%
			Interest rate	0.09
2	NIWE(National Institute of Wind Energy)	Kalapsar PPT solar_wind hybrid NIWE	Tariff	3.63 Rs/kWh
			Depreciation rate	4.67%
3	CWET(Center for Wind Energy Testing)	CWET	PLF base	25.71%
4	Indian IT Act for FY11-12	IT act	Tax rate	33.22%

4. Dyke Project

S.no.	Referred Source	Name of public source

1	Cost of capital/WACC	Daudhan dam Appraisal Report
2	Annual O&M Charges	Daudhan dam
3	Escalation cost	Ken Dam
4	Land rehabilitation and resettlement	Gonda Dam

32.10 Financial Analysis

The Kalpasar project being analysed involves various sub-projects, including the construction of rail and roadways, solar & wind projects, development of freshwater reservoir and fisheries harvesting, tourism, land reclamation, availability fresh water for drinking, agriculture, industrial and commercial purposes. The financial model accounts for the incremental cash flows associated with these sub-projects along with the main dyke project. The individual project details are discussed in great detail in the previous sections along with their assumptions and cash flow projections.

Financial analysis here involves analyzing cash flows from all the sub-projects on nominal cost basis as per the current prices (Year 2022). For each sub-project (e.g., rail, road, wind, solar, etc), we compute project and equity IRR and NPV measures. In addition we also project debt servicing coverage indicators (DSCR, ICR, etc.). The analysis is being conduct for 30, 40, and 50 years. For cash flow discounting, we have employed discount rates of 8%, 10%, 12%, and 14%. All the models have built-in sensitivity scenarios. The model for road, rail, wind, and solar, each includes 5 scenarios for revenues, capex, and opex. These include The most optimum scenario, along with 5% and 10% increase and decrease respectively. Models for Dyke, Freshwater availability, Land monetization, Fisheries, and Employment generation also include different scenarios and the corresponding built-in flexibility. The cash flows from individual models are consolidated in the final consolidated model projections. The consolidated analysis includes project and equity IRRs for the consolidated cash flows from 30, 40, and 50 years. For discounting the consolidated cash flows, we employ 8%, 10%, 12%, and 14% discount rates. The data employed in financial modeling is predominantly provided by Kalpasar authorities. The remaining gaps have been filled using the data from comparable infrastructure projects of similar nature in India and across the world. Such assumptions, wherever taken, have been explicitly developed.

Key Results pertaining to Project IRR/NPV

The cash flows from all the individual projects are consolidated, and similar to individual projects, 5-scenarios (as discussed below) are constructed.

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- **Scenario 1**- Normal scenario: No change is revenue and cost is assumed.
- **Scenario 2**- Good scenario: 5% revenue is increased and both capital cost and operation and maintenance cost is reduced by 5%
- **Scenario 3** – Favorable scenario: 10% revenue is increased and both capital cost and operation and maintenance cost is reduced by 10%
- **Scenario 4**- Bad scenario: 5% revenue is decreased and both capital cost and operation and maintenance cost is increased by 5%
- **Scenario 5**- Worst scenario: 10% revenue is decreased and both capital cost and operation and maintenance cost is increased by 10%

Normal Scenario

Based on the cash flows estimated in the previous sections, we estimate the following coverage ratios.

1. $$Cash\ DSCR = \frac{Principal+Interest}{Cash\ inflows\ from\ operations\ before\ financing\ expenses}$$

2. $$Cash\ ICR = \frac{Interest}{Cash\ inflows\ from\ operations\ before\ financing\ expenses}$$

3. $$Average\ Cash\ DSCR = \frac{Cumulative\ Principal+Interest\ till\ date}{Cumulative\ Cash\ inflows\ from\ operations\ before\ financing\ expenses\ till\ date}$$

4. $$Average\ Cash\ ICR = \frac{Cumulative\ Interest\ till\ date}{Cumulative\ Cash\ inflows\ from\ operations\ before\ financing\ expenses\ till\ date}$$

The minimum value for cash DSCR, cash ICR, average cash DSCR, average cash ICR, are 2.04, 3.87, 2.28, 4.370, respectively. For most of the years, the coverage ratios are sufficiently large indicating comfortable debt servicing.

Table 32.71: Coverage Ratios

Coverage Ratios	Min	2029	2034	2039	2044	2049	2054
DSCR (Debt Coverage)	2.04	2.04	3.25	6.26	9.05	13.51	0.00
ICR (Interest Coverage)	3.87	3.87	6.94	15.99	31.38	94.48	0.00
Average DSCR	2.28	2.32	2.65	3.62	4.71	5.94	7.59
Average ICR	4.37	4.41	5.31	7.76	10.92	15.24	20.99

Next, we calculate project IRR and NPV indicators. We compute these measures for considering 30-, 40-, and 50-year cash flows. The consolidated project IRR falls in the comfortable range of 11%-13%. Customarily for such large scale government projects an IRR of 10%-12%[1] is desirable. This is ascribed to the fact that a major objective of such projects is to create benefits related to externalities (e.g., employment generation, socio-economic development, etc.), which may not be captured in direct financial cash flows. These aspects are discussed in more detail in the economic analysis section. Thus, to summarize, the project IRR levels are substantially comfortable.

For NPV computation, we consider 8%, 10%, 12%, and 14% discount rates to indicate the robustness of the results and sensitivities to various scenarios. Customary to such large scale projects government bodies often advise a discount rate of 12% (taken from various bench mark projects as Chennai Metro, Silverline metro project, Bengaluru rail corridor). Except those scenarios where IRRs are less than opportunity costs, for many scenarios, the consolidated NPV turns out to be positive and considerably large. The negative NPV for some of the scenarios indicates a very high level of hurdle rate or opportunity costs, which do not capture the positive externalities related to the project. This aspect is captured in a more comprehensive manner in the economic benefits analysis section. Nonetheless, the project remains substantially viable at opportunity costs above 10%. In fact for operating periods of more than 40 years, it is even profitable at opportunity costs of 12%,

Table 32.72: Project IRR and NPV (Rs crores)

Project IRR	**%**		
30-Years	11.81%		
40-Years	12.70%		
50-Years	13.04%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	-18,584.59	-12,837.68	-10,265.19
NPV@12%	-1,988.57	8,638.90	14,348.92
NPV@10%	22,944.90	42,866.73	55,758.24
NPV@8%	60,628.06	98,505.96	128,130.78

[1] https://www.mohua.gov.in/upload/whatsnew/59a3f7f130eecMetro_Rail_Policy_2017.pdf

In addition to project IRR and project NPV, we also compute equity IRR and equity NPVs. As expected, the equity IRRs are considerably large. Conventionally, an equity IRR of 14%-18% is desirable from the large infrastructure projects of this nature. We observe equity IRRs of about 19%-20% on consolidated cash flows basis. This indicates considerable profitability of the project.

Table 32.73: Equity IRR and NPV (Rs crores)

Equity IRR	**%**		
30-Years	19.00%		
40-Years	19.50%		
50-Years	19.62%		
Equity NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	19,480.80	25,227.71	27,800.21
NPV@12%	34,008.39	44,635.86	50,345.87
NPV@10%	55,443.68	75,365.52	88,257.03
NPV@8%	87,504.21	125,382.12	155,006.94

In addition to the above analysis, we also consider the fact that such projects result in considerable direct taxes that are part of exchequer. These inflows essentially result in socioeconomic development of the region. Since these cash flows can be directly estimated from the model, we consider another set of optional analysis where tax is considered while computing the project and equity IRR and NPV analyses. As expected, the figures improve further indicating the benefits from the project. The project IRR is in the range of 12%-14% and equity IRR is in the range of 20%-22%.

Table 32.74: Project IRR and NPV (Rs crores): Considering taxes as inflows

Project IRR	**%**		
30-Years	12.86%		
40-Years	13.72%		
50-Years	14.04%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	-10,190.21	-12,837.68	435.25
NPV@12%	9,378.10	22,731.59	30,309.89
NPV@10%	38,659.40	63,725.39	80,836.80
NPV@8%	82,831.58	130,557.62	169,884.15

Table 32.75: Equity IRR and NPV (Rs crores): Considering taxes as inflows

Project IRR	**%**		
30-Years	20.69%		
40-Years	21.11%		
50-Years	21.21%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	27,875.19	25,227.71	38,500.65
NPV@12%	45,375.05	58,728.55	66,306.84
NPV@10%	71,158.18	96,224.17	113,335.59
NPV@8%	109,707.73	157,433.77	196,760.30

For other scenarios, flexibility is provided in the financial model (as discussed in this chapter) to generate the results for different scenarios. In the interest of brevity, the same is not produced here and can be generated in the model by selecting the desired scenario. All the scenario indicate that the project overall adds value to the exchequer and also contributes to the socioeconomic development. The projected cash flows corresponding to the Normal scenario presented here are provided in Annexure E.1. Detailed results

corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Good Scenario

Based on the cash flows estimated in the previous sections, we estimate the following coverage ratios for the good scenario.

The minimum value for cash DSCR, cash ICR, average cash DSCR, average cash ICR, are 2.61, 4.95, 2.86, 5.41, respectively. For most of the years, the coverage ratios are sufficiently large indicating comfortable debt servicing.

Table 32.76: Coverage Ratios

Coverage Ratios	Min	2029	2034	2039	2044	2049	2054
DSCR (Debt Coverage)	2.61	2.61	4.81	9.96	14.11	20.17	0.00
ICR (Interest Coverage)	4.95	4.95	10.28	25.45	48.96	141.09	0.00
Average DSCR	2.86	2.86	3.63	5.36	7.22	9.08	11.55
Average ICR	5.41	5.41	7.26	11.46	16.73	23.26	31.87

Next, we calculate project IRR and NPV indicators. We compute these measures for considering 30-, 40-, and 50-year cash flows. The project IRR falls in the comfortable range of 15%-17%. This improvement is on account of the favourable conditions considered in the model. That is, increase in revenues by 5%, and decrease in capital expenditure and O&M related costs by 5%. To summarize, the project IRR levels for this scenario are substantially comfortable.

For NPV computation, we consider 8%, 10%, 12%, and 14% discount rates to indicate the robustness of the results and sensitivities to various scenarios. Customary to such large scale projects government bodies often advise a discount rate of 12% (taken from various bench mark projects as Chennai Metro, Silverline metro project, Bengaluru rail corridor). For different discount rates, the consolidated NPV turns out to be positive and considerably large. This again is due to the favourable conditions assumed in this scenario.

Table 32.77: Project IRR and NPV (Rs crores)

Project IRR	%		
30-Years	15.96%		
40-Years	16.48%		
50-Years	16.62%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	19,203.54	27,514.35	30,814.58
NPV@12%	47,667.41	63,017.43	70,332.77
NPV@10%	89,601.17	118,339.23	134,832.01
NPV@8%	152,099.63	206,668.14	244,514.51

In addition to project IRR and project NPV, we also compute equity IRR and equity NPVs. As expected, the equity IRRs are considerably large. Conventionally, an equity IRR of 14%-18% is desirable from the large infrastructure projects of this nature. We observe equity IRRs of about 25%-26% on consolidated cash flows basis. The equity NPVs also reflect the favourable conditions assumed in the model, and are considerably higher as compared to the previous scenario.

Table 32.78: Equity IRR and NPV (Rs crores)

Equity IRR	**%**		
30-Years	25.50%		
40-Years	25.68%		
50-Years	25.71%		
Equity NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	55,152.52	63,463.33	66,763.56
NPV@12%	81,663.77	97,013.79	104,329.13
NPV@10%	120,295.01	149,033.07	165,525.85
NPV@8%	177,485.06	232,053.57	269,899.94

In addition to the above analysis, we also consider the fact that such projects result in considerable direct taxes that are part of exchequer. These inflows essentially result in socioeconomic development of the region. Since these cash flows can be directly estimated from the model, we consider another set of optional analysis where tax is considered while computing the project and equity IRR and NPV analyses. As expected, the figures improve further indicating the benefits from the project. The project IRR is in the range of 16%-18% and equity IRR is in the range of 26%-28%. The NPV values computed for this scenario also reflect the improvement in project profitability indicators as taxes are considered part of revenues to exchequer.

Table 32.79: Project IRR and NPV (Rs crores): Considering taxes as inflows

Project IRR	**%**		
30-Years	16.82%		
40-Years	17.31%		
50-Years	17.45%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	28,602.30	27,514.35	42,642.16
NPV@12%	60,339.78	78,563.89	87,843.64
NPV@10%	107,046.52	141,208.44	162,138.20
NPV@8%	176,647.09	241,599.76	289,646.81

Table 32.80: Equity IRR and NPV (Rs crores): Considering taxes as inflows

Project IRR	**%**		
30-Years	26.89%		
40-Years	27.05%		
50-Years	27.07%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	64,551.28	63,463.33	78,591.14
NPV@12%	94,336.14	112,560.26	121,840.01
NPV@10%	137,740.36	171,902.28	192,832.04
NPV@8%	202,032.52	266,985.20	315,032.24

For other scenarios, flexibility is provided in the financial model (as discussed in this chapter) to generate the results for different scenarios. In the interest of brevity, the same is not produced here and can be generated in the model by selecting the desired scenario. All the scenario indicate that the project overall adds value to the exchequer and also contributes to the socioeconomic development. The projected cash flows corresponding to the Good scenario presented here are provided in Annexure E.2. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Favourable Scenario

Based on the cash flows estimated in the previous sections, we estimate the following coverage ratios for the Favourable scenario.

The minimum value for cash DSCR, cash ICR, average cash DSCR, average cash ICR, are 2.83, 5.38, 3.14, 5.92, respectively. For most of the years, the coverage ratios are sufficiently large indicating comfortable debt servicing.

Table 32.81: Coverage Ratios

Coverage Ratios	Min	2029	2034	2039	2044	2049	2054
DSCR (Debt Coverage)	2.83	2.83	5.22	10.74	15.25	21.85	0.00
ICR (Interest Coverage)	5.38	5.38	11.15	27.45	52.91	152.93	0.00
Average DSCR	3.14	3.14	3.94	5.81	7.82	9.83	12.52
Average ICR	5.92	5.92	7.90	12.42	18.11	25.18	34.56

Next, we calculate project IRR and NPV indicators. We compute these measures for considering 30-, 40-, and 50-year cash flows. The project IRR falls in the comfortable range of 16%-18%. The indicators suggest very high profitability of the project. This is ascribed to the favourable conditions assumed in this scenario. That is 10% increase in revenues, and 10% decrease in capital expenditure and O&M related costs. Customarily for such large scale government projects an IRR of 10%-12%[2] is desirable. This is ascribed to the fact that a major objective of such projects is to create benefits related to externalities (e.g., employment generation, socio-economic development, etc.), which may not be captured in direct financial cash flows. These aspects are discussed in more detail in the economic analysis section. Thus, to summarize, the project IRR levels are substantially comfortable.

For NPV computation, we consider 8%, 10%, 12%, and 14% discount rates to indicate the robustness of the results and sensitivities to various scenarios. Customary to such large scale projects government bodies often advise a discount rate of 12% (taken from various bench mark projects as Chennai Metro, Silverline metro project, Bengaluru rail corridor). For different discount rates, the consolidated NPV turns out to be positive and considerably large. The project attains extreme large and significant positive NPV levels. This is again ascribed to the favourable conditions assumed in this particular scenario.

Table 32.82: Project IRR and NPV (Rs crores)

Project IRR	%		
30-Years	16.73%		
40-Years	17.20%		
50-Years	17.32%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	25,867.40	34,372.16	37,771.22
NPV@12%	55,223.50	70,934.80	78,469.43
NPV@10%	98,355.83	127,776.18	144,763.88
NPV@8%	162,515.69	218,391.44	257,374.67

In addition to project IRR and project NPV, we also compute equity IRR and equity NPVs. As expected, the equity IRRs are considerably large. Conventionally, an equity IRR of 14%-18% is desirable from the large infrastructure projects of this nature. We observe equity IRRs of about 26%-27% on consolidated cash flows basis. The equity NPVs are also considerably high as shown in the Table below.

[2] https://www.mohua.gov.in/upload/whatsnew/59a3f7f130eecMetro_Rail_Policy_2017.pdf

Table 32.83: Equity IRR and NPV (Rs crores)

Equity IRR	**%**		
30-Years	26.78%		
40-Years	26.93%		
50-Years	26.95%		
Equity NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	59,724.82	68,229.59	71,628.65
NPV@12%	87,242.68	102,953.98	110,488.61
NPV@10%	127,265.70	156,686.05	173,673.74
NPV@8%	186,427.48	242,303.24	281,286.47

In addition to the above analysis, we also consider the fact that such projects result in considerable direct taxes that are part of exchequer. These inflows essentially result in socioeconomic development of the region. Since these cash flows can be directly estimated from the model, we consider another set of optional analysis where tax is considered while computing the project and equity IRR and NPV analyses. As expected, the figures improve further indicating the benefits from the project. The project IRR is in the range of 17%-19% and equity IRR is in the range of 28%-29%. NPV values also follow the suit and indicate the higher profitability of the project, when taxes are also considered as inflows to the government and provide another source of revenue.

Table 32.84: Project IRR and NPV (Rs crores): Considering taxes as inflows

Project IRR	**%**		
30-Years	17.68%		
40-Years	18.12%		
50-Years	18.24%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	36,275.37	34,372.16	50,730.76
NPV@12%	69,206.83	87,940.25	97,535.40
NPV@10%	117,537.40	152,661.25	174,302.98
NPV@8%	189,411.99	256,207.84	305,890.65

Table 32.85: Equity IRR and NPV (Rs crores): Considering taxes as inflows

Project IRR	**%**		
30-Years	28.35%		
40-Years	28.48%		
50-Years	28.49%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	70,132.79	68,229.59	84,588.18
NPV@12%	101,226.01	119,959.43	129,554.58
NPV@10%	146,447.26	181,571.11	203,212.84
NPV@8%	213,323.79	280,119.63	329,802.45

For other scenarios, flexibility is provided in the financial model (as discussed in this chapter) to generate the results for different scenarios. In the interest of brevity, the same is not produced here and can be generated in the model by selecting the desired scenario. All the scenario indicate that the project overall adds value to the exchequer and also contributes to the socioeconomic development. The projected cash flows corresponding to the Favourable scenario presented here are provided in Annexure E.3. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Bad Scenario

Based on the cash flows estimated in the previous sections, we estimate the following coverage ratios.

The minimum value for cash DSCR, cash ICR, average cash DSCR, average cash ICR, are 1.69, 3.20, 1.92, 3.69, respectively. For most of the years, the coverage ratios are sufficiently large indicating comfortable debt servicing.

Table 32.86: Coverage Ratios

Coverage Ratios	Min	2029	2034	2039	2044	2049	2054
DSCR (Debt Coverage)	1.69	1.69	2.88	5.69	8.25	12.28	0.00
ICR (Interest Coverage)	3.20	3.20	6.14	14.54	28.62	85.85	0.00
Average DSCR	1.92	1.97	2.27	3.20	4.21	5.34	6.83
Average ICR	3.69	3.74	4.56	6.85	9.76	13.70	18.88

Next, we calculate project IRR and NPV indicators. We compute these measures for considering 30-, 40-, and 50-year cash flows. The project IRR falls in the range of 10%-12%. Relatively lower levels of project IRR are due to the bad conditions considered in this particular scenario. That is a decrease in project revenues of 5% and increase in capital expenditure and O&M expenses of 5%. Notwithstanding the poor conditions assumed in the model, the coverage indicators appear to be relatively comfortable. Also, the project IRR and NPV values are adequate to the project of this nature. Customarily for such large scale government projects an IRR of 10%-12%[3] is desirable. This is ascribed to the fact that a major objective of such projects is to create benefits related to externalities (e.g., employment generation, socio-economic development, etc.), which may not be captured in direct financial cash flows. These aspects are discussed in more detail in the economic analysis section. Thus, to summarize, the project IRR levels are comfortable.

For NPV computation, we consider 8%, 10%, 12%, and 14% discount rates to indicate the robustness of the results and sensitivities to various scenarios. The negative NPV values are on account of the bad conditions considered in this scenario. Nonetheless at discount rates of 10% the project has positive NPV values. Moreover, for a life of 50 year, the project NPV is positive for discount rate of 12% as well. Customary to such large scale projects government bodies often advise a discount rate of 12% (taken from various bench mark projects as Chennai Metro, Silverline metro project, Bengaluru rail corridor). For different discount rates, the consolidated NPV turns out to be adequate to the project of this scale and size, despite the poor conditions assumed in this model.

Table 32.87: Project IRR and NPV (Rs crores)

Project IRR	%		
30-Years	10.72%		
40-Years	11.74%		
50-Years	12.14%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	-28,436.82	-22,978.63	-20,558.61
NPV@12%	-13,454.06	-3,363.83	2,007.45
NPV@10%	9,332.87	28,241.10	40,367.25
NPV@8%	44,084.38	80,022.22	107,886.81

In addition to project IRR and project NPV, we also compute equity IRR and equity NPVs. As expected, the equity IRRs are considerably large. Conventionally, an equity IRR of 14%-18% is desirable from the large infrastructure projects of this nature. We observe equity IRRs of about 16%-18% on consolidated cash flows basis. Equity NPVs also follow the suit and indicate comfortable levels.

[3] https://www.mohua.gov.in/upload/whatsnew/59a3f7f130eecMetro_Rail_Policy_2017.pdf

Table 32.88: Equity IRR and NPV (Rs crores)

Equity IRR	**%**		
30-Years	16.96%		
40-Years	17.63%		
50-Years	17.81%		
Equity NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	11,770.31	17,228.51	19,648.52
NPV@12%	24,567.31	34,657.54	40,028.82
NPV@10%	43,657.95	62,566.17	74,692.33
NPV@8%	72,468.64	108,406.48	136,271.07

In addition to the above analysis, we also consider the fact that such projects result in considerable direct taxes that are part of exchequer. These inflows essentially result in socioeconomic development of the region. Since these cash flows can be directly estimated from the model, we consider another set of optional analysis where tax is considered while computing the project and equity IRR and NPV analyses. As expected, the figures improve further indicating the benefits from the project. The project IRR is in the range of 11%-13% and equity IRR is in the range of 18%-20%. The project and equity NPVs also agree with the IRR figures. That is, wherever the IRR levels are more than discount rates, project offers positive NPV.

Table 32.89: Project IRR and NPV (Rs crores): Considering taxes as inflows

Project IRR	**%**		
30-Years	11.70%		
40-Years	12.68%		
50-Years	13.07%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	-21,044.50	-22,978.63	-10,983.03
NPV@12%	-3,391.09	9,277.07	16,420.50
NPV@10%	23,317.88	47,090.50	63,219.46
NPV@8%	63,944.11	109,193.94	146,261.22

Table 32.90: Equity IRR and NPV (Rs crores): Considering taxes as inflows

Project IRR	**%**		
30-Years	18.51%		
40-Years	19.10%		
50-Years	19.25%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	19,162.64	17,228.51	29,224.10
NPV@12%	34,630.28	47,298.44	54,441.87
NPV@10%	57,642.95	81,415.58	97,544.53
NPV@8%	92,328.37	137,578.20	174,645.48

For other scenarios, flexibility is provided in the financial model (as discussed in this chapter) to generate the results for different scenarios. In the interest of brevity, the same is not produced here and can be generated in the model by selecting the desired scenario. All the scenario indicate that the project overall adds value to the exchequer and also contributes to the socioeconomic development. The projected cash flows corresponding to the Bad scenario presented here are provided in Annexure E.4. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Worst Scenario

Based on the cash flows estimated in the previous sections, we estimate the following coverage ratios.

The minimum value for cash DSCR, cash ICR, average cash DSCR, average cash ICR, are 1.55, 2.941.75, 3.38, respectively. For most of the years, the coverage ratios are sufficiently large indicating comfortable debt servicing.

Table 32.91: Coverage Ratios

Coverage Ratios	Min	2029	2034	2039	2044	2049	2054
DSCR (Debt Coverage)	1.55	1.55	2.64	5.27	7.62	11.30	0.00
ICR (Interest Coverage)	2.94	2.94	5.64	13.45	26.42	78.98	0.00
Average DSCR	1.75	1.79	2.08	2.95	3.87	4.92	6.27
Average ICR	3.38	3.41	4.18	6.31	8.98	12.61	17.34

Next, we calculate project IRR and NPV indicators. We compute these measures for considering 30-, 40-, and 50-year cash flows. The project IRR falls in the range of 10%-12%. The relatively lower IRR levels are ascribed to the worst conditions considered in this scenario, that is increase in project capital expenditure and O&M expenses by 10% and decrease in project revenues by 10%. Notwithstanding the extremely adverse conditions Customarily for such large scale government projects an IRR of 10%-12%[4] is desirable. This is ascribed to the fact that a major objective of such projects is to create benefits related to externalities (e.g., employment generation, socio-economic development, etc.), which may not be captured in direct financial cash flows. These aspects are discussed in more detail in the economic analysis section. Thus, to summarize, the project IRR levels are appropriate in the worst of the scenario.

For NPV computation, we consider 8%, 10%, 12%, and 14% discount rates to indicate the robustness of the results and sensitivities to various scenarios. Customary to such large scale projects government bodies often advise a discount rate of 12% (taken from various bench mark projects as Chennai Metro, Silverline metro project, Bengaluru rail corridor). For discount rates less than project IRR turnout out to be negative. However, for discount rates 10% and lower, the consolidated NPV values are positive.

Table 32.92: Project IRR and NPV (Rs crores)

Project IRR	%		
30-Years	10.03%		
40-Years	11.12%		
50-Years	11.56%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	-35,305.27	-30,042.48	-27,721.92
NPV@12%	-21,229.66	-11,503.40	-6,352.79
NPV@10%	341.66	18,562.51	30,190.63
NPV@8%	33,412.10	68,033.00	94,753.58

In addition to project IRR and project NPV, we also compute equity IRR and equity NPVs. As expected, the equity IRRs are considerably large. Conventionally, an equity IRR of 14%-18% is desirable from the large infrastructure projects of this nature. We observe equity IRRs of about 15%-17% on consolidated cash flows basis. Equity NPVs are also substantial, indicating the project viability levels. Overall the IRR and NPV results are

[4] https://www.mohua.gov.in/upload/whatsnew/59a3f7f130eecMetro_Rail_Policy_2017.pdf

comfortable and suggest that even in the worst of the scenarios, the project remains reasonably viable. This is also supported by the coverage ratios observed.

Table 32.93: Equity IRR and NPV (Rs crores)

Equity IRR	**%**		
30-Years	15.75%		
40-Years	16.54%		
50-Years	16.76%		
Equity NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	7,069.39	12,332.17	14,652.73
NPV@12%	18,840.40	28,566.66	33,717.26
NPV@10%	36,514.77	54,735.61	66,363.74
NPV@8%	63,322.17	97,943.07	124,663.65

In addition to the above analysis, we also consider the fact that such projects result in considerable direct taxes that are part of exchequer. These inflows essentially result in socioeconomic development of the region. Since these cash flows can be directly estimated from the model, we consider another set of optional analysis where tax is considered while computing the project and equity IRR and NPV analyses. As expected, the figures improve further indicating the benefits from the project. The project IRR is in the range of 10%-13% and equity IRR is in the range of 17%-19%. Project and equity NPVs also follow the suit and show improving financial viability. This is on expected lines as taxes contribute to the pocket of exchequer providing additional sources of revenues that can be employed in the economic development of the region.

Table 32.94: Project IRR and NPV (Rs crores): Considering taxes as inflows

Project IRR	**%**		
30-Years	10.90%		
40-Years	11.98%		
50-Years	12.41%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	-28,909.39	-30,042.48	-19,265.60
NPV@12%	-12,464.50	-308.44	6,518.16
NPV@10%	12,603.06	35,408.50	50,822.29
NPV@8%	50,933.43	94,330.08	129,754.25

Table 32.95: Equity IRR and NPV (Rs crores): Considering taxes as inflows

Project IRR	**%**		
30-Years	17.12%		
40-Years	17.83%		
50-Years	18.03%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	13,465.27	12,332.17	23,109.05
NPV@12%	27,605.55	39,761.62	46,588.22
NPV@10%	48,776.17	71,581.60	86,995.40
NPV@8%	80,843.50	124,240.15	159,664.33

For other scenarios, flexibility is provided in the financial model (as discussed in this chapter) to generate the results for different scenarios. In the interest of brevity, the same is not produced here and can be generated in the model by selecting the desired scenario. All the scenarios indicate that the project overall adds value to the exchequer and also contributes to the socioeconomic development. The projected cash flows corresponding to the Bad scenario presented here are provided in Annexure E.5. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

32.11 Economic Analysis

Large infrastructure projects of this nature comprise several economic benefits that may not get captured in financial analysis of the nature discussed in the previous section. These are often referred to as project externalities. While there are various such externalities that can be quantified, many of them cannot be quantified. The quantifiable benefits are those where the benefits can be identified and quantified in terms of market value estimates or close economic approximations can be computed. Such benefits, net of investments are employed for conducting the economic analyses, such as economic IRR (EIRR) and economic NPV (ENPV). Indian government has prescribed an EIRR of 14% from policy perspective. [5] One widely employed approach to estimate such economic benefits and carry out the analysis is called Shadow Cost Factor Estimation (SCFE approach). A brief summary of the approach is provided below.

Shadow Cost Factor Estimation (SCFE) approach to economic analysis

This approach entails the following steps. (1) Conversion of Financial Project Cost Estimates into economic costs; (2) Conversion of Opex estimates into economic costs; (3) Identification of tangible economic benefits accruing due to the project; (4) Quantification of the tangible economic benefits based on sound economic principles; and finally (5) Conducting an economic analysis of the Present Value of Economic Benefits and Economic Return from the project.

The socio-economic impact of the project can be classified into tangible and intangible benefits. The tangible benefits (or tangible outputs) can be further classified as Traded and Non Traded Outputs in the nature of Incremental and Nonincremental outputs. Similarly, inputs or project (and associated) costs can be classified as Traded/Non Traded, further classified into Incremental and Nonincremental inputs.

Economic cost-benefit analysis establishes the overall economic merit of the project. Economic assessment includes monetizing benefits, such as time savings, decongestion benefits, environmental impact, accident cost savings, etc. This analysis is the central tool for measuring the net economic gain that can be achieved through the development of the project.

Economic valuation of project benefits and costs involves converting their financial values into economic values, also known as “shadow pricing.” This conversion requires economic prices of project outputs and inputs to be estimated. Economic prices reflect values of goods, services, and other project effects on the national economy. The basis for estimating economic prices differs between internationally traded and nontraded goods and services, between project outputs and inputs, and between incremental and non-incremental outputs and inputs.

Based on the above principles, input costs and outputs shall be converted into shadow prices. Further analysis and calculation of EIRR / ENPV follows the same method as is used for the calculation of FIRR.

Economic Internal Rate of Return (EIRR) will be computed based on sound economic principles and globally accepted norms of conducting Economic Analysis of the Project (also known as Social Cost Benefit Analysis) to arrive at the economic feasibility of the project. The EIRR indicates the rate of return at which the present value of the economic costs and benefits of the project are equal. In other words, it is the discount rate for which the net present value of the net effect on the economy (ENPV) is zero. The EIRR

[5] https://www.mohua.gov.in/upload/whatsnew/59a3f7f130eecMetro_Rail_Policy_2017.pdf

should be compared with the socially required rate of return. Projects that are found to have an EIRR that is higher than the socially required rate of return would be said to be feasible economic investments. These may then proceed for a detailed analysis of their viability as PPPs.

FIRR and EIRR give different sorts of information about a project. FIRR provides a decision criterion on whether the project generates enough return to cover the cost of funds (or in other words generates a positive Net Present Value of Net Cash Flow during the project period) On the other hand, the EIRR is better suited to being a decision criterion from the socially beneficial purpose. By allowing a project to be compared against a required rate of return it gives a yes or no answer about whether it is economically feasible. EIRR includes aspects such as socio-economic perspective and positive and negative externalities of the project to society.

Shadow Cost Factor Estimation

In order to estimate the economic benefits of the Kalpasar Dyke, the actual financial value of construction and operational costs would be estimated including the Shadow Cost Factor. The Shadow Prices are adjusted financial prices, which discount the effects of government taxation and subsidies, the opportunity cost of resources, environmental externalities, and market distortions.

The Shadow Exchange Rate Factor determines the domestic currency value converted at the official exchange rate, and as per the Asian Development Bank's (ADB) guidelines it is determined as per the formula below.

SERF = RER / OER * (1 + T – S)

Where, SERF = Shadow Cost Factor,

RER = Long-run Real Exchange Rate for the Economy,

OER = Original Exchange Rate (Actual) of the economy,

T = Average rate of tax on infrastructure investment, and

S = Average rate of subsidy on infrastructure investment

Shadow Wage Rate Factor (SWRF) determines the opportunity cost of labour. For skilled labour, SWRF is considered equal to 1, whereas, for unskilled labour, SWRF varies between 0-0.75 implying a loss of output.

The relevant shadow factors for the economic assessment of Kalpasar Dyke would be derived using the ADB or similar Guidelines.

Conversion of financial costs into economic costs

In order to convert the capital and O&M costs into economic costs shadow factors as prescribed by the Indian government in appraising such large scale infrastructure projects, are considered. [6] These guidelines suggest a shadow cost factor of 0.83 and 0.87 for capital and O&M costs respectively.

[6] https://mohua.gov.in/upload/uploadfiles/files/Appraisal%20Guidelines%20for%20Metro%20Rail.pdf

Table 32.96: Conversion factors

Particulars	Conversion Factor
Capital Costs	0.83
O&M Cost Conversion Factor	0.87

In addition, the following economic benefits (based on the inputs provided by Kalpasar authorities and other consultants) are considered. These include savings in vehicle operating time (VOT), vehicle operating costs (VOC), and savings in environment in the form of carbon credits. Overall the quantification and phasing of these benefits is provided below.

Table 32.97 Quantification of economic benefits from the project (Rs crores)

Year	2032	2042	2052	2062	2072
Economic benefits from the Road project					
VOT Savings	4083.50	7174.00	11270.20	15857.30	20156.70
VOC Savings	1523.7	2282.6	3321.5	4416.6	5374.8
Economic benefits from Rail project					
VOT Savings	6196.56	9431.98	11210.56	12564.41	13460.22
VOC Savings	1116.6	1920.7	2514.8	2917.2	3147
Carbon Credits	39.2	58.2	83.5	110.3	134.2
Total Benefits	**12959.56**	**20867.48**	**28400.56**	**35865.81**	**42272.92**

Results from Economic analysis

Normal Scenario

Based on the economic value of project cost and benefits, we calculate project Economic IRR and NPV indicators for the Normal scenario (as described earlier). We compute these measures for considering 30-, 40-, and 50-year cash flows. The Economic IRR falls in the comfortable range of 17%-19%. Morover, the economic NPV value ranges from Rs 33,754.92 crore to Rs 278,497.17 crore. This strongly indicates the viability of the project. Customarily for such large scale government projects an economic IRR of 14%[7] is desirable.

For economic NPV computation, we consider 8%, 10%, 12%, and 14% discount rates to indicate the robustness of the results and sensitivities to various scenarios. Customary to such large scale projects government bodies often advise a discount rate of 14% (taken from various bench mark projects as Chennai Metro, Silverline metro project, Bengaluru rail corridor). For different discount rates, the consolidated NPV turns out to be positive and considerably large. In addition, we also show the results corresponding to the analysis where tax revenues are also considered as inflows. The project economic IRR remains in the range of 18%-19%. Morover, the economic NPV value ranges from Rs 42,149.30 crore to Rs 278,497.17 crore.

Both the results strongly convey the financial and economic viability of the Kalpasar project on overall basis. In the interest of brevity, other scenarios are not presented. These scenarios (As discussed in the financial analyses section) can be easily generated be checking the suitable options in the financial model. The projected economic benefits corresponding to the Normal scenario presented here are provided in Annexure F.1. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

[7] https://www.mohua.gov.in/upload/whatsnew/59a3f7f130eecMetro_Rail_Policy_2017.pdf

Table 32.98: Economic IRR and NPV (Rs crores)

Economic IRR	**%**		
30-Years	17.65%		
40-Years	18.08%		
50-Years	18.19%		
Economic NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	33,754.92	42,871.87	46,566.38
NPV@12%	64,475.24	81,333.56	89,517.05
NPV@10%	109,445.09	141,045.19	159,481.70
NPV@8%	176,143.10	236,222.47	278,497.17

Table 32.99: Economic IRR and NPV (Rs crores): taxes as inflows

Economic IRR	**%**		
30-Years	18.40%		
40-Years	18.82%		
50-Years	18.92%		
Economic NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	42,149.30	42,871.87	57,266.82
NPV@12%	75,841.91	95,426.25	105,478.02
NPV@10%	125,159.59	161,903.84	184,560.26
NPV@8%	198,346.62	268,274.12	320,250.54

Good Scenario

Based on the economic value of project cost and benefits, we calculate project Economic IRR and NPV indicators for the Good scenario (as described earlier). We compute these measures considering 30-, 40-, and 50-year cash flows. The Economic IRR falls in the comfortable range of 21%-22%. Morover, the economic NPV value ranges from Rs 77,923.73 crore to Rs 416,595.35crore. This strongly indicates the viability of the project. Customarily for such large scale government projects an IRR of 14%[8] is desirable.

For NPV computation, we consider 8%, 10%, 12%, and 14% discount rates to indicate the robustness of the results and sensitivities to various scenarios. Customary to such large scale projects government bodies often advise a discount rate of 14% (taken from various bench mark projects as Chennai Metro, Silverline metro project, Bengaluru rail corridor). For different discount rates, the consolidated NPV turns out to be positive and considerably large. In addition, we also show the results corresponding to the analysis where tax revenues are also considered as inflows. The project economic IRR remains in the range of 22%-23%. Morover, the economic NPV value ranges from Rs 87,322.49 crore to Rs 461,727.65 crore.

Both the results strongly convey the financial and economic viability of the Kalpasar project on overall basis. In the interest of brevity, other scenarios are not presented. These scenarios (As discussed in the financial analyses section) can be easily generated be checking the suitable options in the financial model. The projected economic benefits corresponding to the Good scenario presented here are provided in Annexure F.2. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.100: Economic IRR and NPV (Rs crores)

Economic IRR	**%**
30-Years	21.51%

[8] https://www.mohua.gov.in/upload/whatsnew/59a3f7f130eecMetro_Rail_Policy_2017.pdf

40-Years	21.76%		
50-Years	21.80%		
Economic NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	77,923.73	90,022.59	94,595.36
NPV@12%	122,867.11	145,228.02	155,349.83
NPV@10%	188,242.77	230,134.93	252,921.97
NPV@8%	284,780.72	364,383.39	416,595.35

Table 32.101: Economic IRR and NPV (Rs crores): taxes as inflows

Economic IRR	**%**		
30-Years	22.19%		
40-Years	22.43%		
50-Years	22.48%		
Economic NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	87,322.49	90,022.59	106,422.93
NPV@12%	135,539.48	160,774.48	172,860.70
NPV@10%	205,688.12	253,004.14	280,228.16
NPV@8%	309,328.18	399,315.01	461,727.65

Favorable Scenario

Based on the economic value of project cost and benefits, we calculate project Economic IRR and NPV indicators for the Favorable scenario (as described earlier). We compute these measures for considering 30-, 40-, and 50-year cash flows. The Economic IRR falls in the comfortable range of 22%-23%. Morover, the economic NPV value ranges from Rs 83,260.47 crore to Rs 426,853.35 crore. This strongly indicates the viability of the project. Customarily for such large scale government projects an economic IRR of 14%[9] is desirable.

For economic NPV computation, we consider 8%, 10%, 12%, and 14% discount rates to indicate the robustness of the results and sensitivities to various scenarios. Customary to such large scale projects government bodies often advise a discount rate of 14% (taken from various bench mark projects as Chennai Metro, Silverline metro project, Bengaluru rail corridor). For different discount rates, the consolidated NPV turns out to be positive and considerably large. In addition, we also show the results corresponding to the analysis where tax revenues are also considered as inflows. The project economic IRR remains in the range of 23%-24%. Morover, the NPV value ranges from Rs 93,668.45 crore to Rs 475,369.34 crore.

Both the results strongly convey the financial and economic viability of the Kalpasar project on overall basis. In the interest of brevity, other scenarios are not presented. These scenarios (As discussed in the financial analyses section) can be easily generated be checking the suitable options in the financial model. The projected economic benefits corresponding to the Favourable scenario presented here are provided in Annexure F.3. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.102: Economic IRR and NPV (Rs crores)

Economic IRR	**%**		
30-Years	22.28%		
40-Years	22.51%		
50-Years	22.55%		
Economic NPV	**30-Years**	**40-Years**	**50-Years**

[9] https://www.mohua.gov.in/upload/whatsnew/59a3f7f130eecMetro_Rail_Policy_2017.pdf

NPV@14%	83,260.47	95,521.96	100,182.12
NPV@12%	128,879.43	151,543.17	161,858.98
NPV@10%	195,156.67	237,620.62	260,845.64
NPV@8%	292,936.98	373,634.88	426,853.35

Table 32.103: Economic IRR and NPV (Rs crores): taxes as inflows

Economic IRR	**%**		
30-Years	23.06%		
40-Years	23.27%		
50-Years	23.31%		
Economic NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	93,668.45	95,521.96	113,141.66
NPV@12%	142,862.75	168,548.62	180,924.95
NPV@10%	214,338.23	262,505.68	290,384.74
NPV@8%	319,833.28	411,451.28	475,369.34

Bad Scenario

Based on the economic value of project cost and benefits, we calculate project Economic IRR and NPV indicators for the Bad scenario (as described earlier). We compute these measures for considering 30-, 40-, and 50-year cash flows. The Economic IRR falls in the comfortable range of 17%-18%. Morover, the economic NPV value ranges from Rs 32,976.39 crore to Rs 285,238.72 crore. The relatively poor profitability measures are ascribed to the adverse conditions assumed in the model. This strongly indicates the viability of the project. Customarily for such large scale government projects an economic IRR of 14%[10] is desirable.

For economic NPV computation, we consider 8%, 10%, 12%, and 14% discount rates to indicate the robustness of the results and sensitivities to various scenarios. Customary to such large scale projects government bodies often advise a discount rate of 14% (taken from various bench mark projects as Chennai Metro, Silverline metro project, Bengaluru rail corridor). For different discount rates, the consolidated NPV turns out to be positive, despite the adverse conditions assumed in this scenario. In addition, we also show the results corresponding to the analysis where tax revenues are also considered as inflows. The project economic IRR remains in the range of 18%-19%. Morover, the NPV value ranges from Rs 40,368.72 crore to Rs 323,613.12 crore.

Both the results strongly convey the financial and economic viability of the Kalpasar project on overall basis. In the interest of brevity, other scenarios are not presented. These scenarios (As discussed in the financial analyses section) can be easily generated be checking the suitable options in the financial model. The projected economic benefits corresponding to the Bad scenario presented here are provided in Annexure F.4. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.104: Economic IRR and NPV (Rs crores)

Economic IRR	**%**		
30-Years	17.37%		
40-Years	17.81%		
50-Years	17.92%		
Economic NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	32,976.39	42,286.14	46,001.91
NPV@12%	64,876.50	82,096.04	90,325.19

[10] https://www.mohua.gov.in/upload/whatsnew/59a3f7f130eecMetro_Rail_Policy_2017.pdf

NPV@10%	111,705.18	143,991.45	162,527.49
NPV@8%	181,342.14	242,743.74	285,238.72

Table 32.105: Economic IRR and NPV (Rs crores): taxes as inflows

Economic IRR	**%**		
30-Years	18.00%		
40-Years	18.43%		
50-Years	18.54%		
Economic NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	40,368.72	42,286.14	55,577.49
NPV@12%	74,939.47	94,736.94	104,738.23
NPV@10%	125,690.18	162,840.86	185,379.70
NPV@8%	201,201.87	271,915.45	323,613.12

Worst Scenario

Based on the economic value of project cost and benefits, we calculate project Economic IRR and NPV indicators for the Worst scenario (as described earlier). We compute these measures for considering 30-, 40-, and 50-year cash flows. The Economic IRR falls in the comfortable range of 15%-17%. Morover, the economic NPV value ranges from Rs 7,069.39 crore to Rs 124,663.65 crore. The relatively poor profitability measures are ascribed to the adverse conditions assumed in the model. This strongly indicates the viability of the project. Customarily for such large scale government projects an economic IRR of 14%[11] is desirable.

For economic NPV computation, we consider 8%, 10%, 12%, and 14% discount rates to indicate the robustness of the results and sensitivities to various scenarios. Notwithstanding the extremely advserse conditions considered in the model, economic NPV remains positive for all the specifications of the model. Customary to such large scale projects government bodies often advise a discount rate of 14% (taken from various bench mark projects as Chennai Metro, Silverline metro project, Bengaluru rail corridor). For different discount rates, the consolidated NPV turns out to be positive, despite the adverse conditions assumed in this scenario. In addition, we also show the results corresponding to the analysis where tax revenues are also considered as inflows. The project economic IRR remains in the range of 17%-19%. Morover, the NPV value ranges from Rs 13,465.27 crore to Rs 159,664.33crore.

Both the results strongly convey the financial and economic viability of the Kalpasar project on overall basis. In the interest of brevity, other scenarios are not presented. These scenarios (As discussed in the financial analyses section) can be easily generated be checking the suitable options in the financial model. The projected economic benefits corresponding to the Worst scenario presented here are provided in Annexure F.5. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the excel model (not shown here in the interest of brevity).

Table 32.106: Economic IRR and NPV (Rs crores)

Economic IRR	**%**		
30-Years	15.75%		
40-Years	16.54%		
50-Years	16.76%		
Economic NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	7,069.39	12,332.17	14,652.73

[11] https://www.mohua.gov.in/upload/whatsnew/59a3f7f130eecMetro_Rail_Policy_2017.pdf

NPV@12%	18,840.40	28,566.66	33,717.26
NPV@10%	36,514.77	54,735.61	66,363.74
NPV@8%	63,322.17	97,943.07	124,663.65

Table 32.107: Economic IRR and NPV (Rs crores): taxes as inflows

Economic IRR	**%**		
30-Years	17.12%		
40-Years	17.83%		
50-Years	18.03%		
Economic NPV	**30-Years**	**40-Years**	**50-Years**
NPV@14%	13,465.27	12,332.17	23,109.05
NPV@12%	27,605.55	39,761.62	46,588.22
NPV@10%	48,776.17	71,581.60	86,995.40
NPV@8%	80,843.50	124,240.15	159,664.33

32.12 Transaction Structure and Financing Options

(a) Objectives of Financing

Large infrastructure projects like Kalpasar are financed to guarantee the following in addition to timely financial closure of the project: (a) To ensure low project cost; (b) To avail long-term, low-cost debt with a repayment period that matches the project cash flow profile; (c) To create a self-sustainable system in the long run by ensuring low infrastructure maintenance costs (d) To secure feasible utility charges (rentals) that minimize the dependence on subsidies; (e) To recover returns from both the direct and indirect beneficiaries, among others.

Such massive infrastructure projects are capital-intensive, have long gestation periods, and have poor financial returns despite providing significant social benefits. Often such large initiatives frequently produce externalities that are difficult to quantify financially. Thus, experience worldwide reveals that the government highly subsidizes the construction and operation of such projects. As a result, government involvement and a substantial share in the ownership of such projects is a foregone conclusion, ranging from complete government ownership (100%), known as the "Public Procurement Model," to a range of Public-Private Partnership (PPP) models with varying degrees of private party involvement. Complete privatization in large infrastructure projects with considerable socioeconomic benefits is undesirable.

Public-Private Partnerships (PPPs) are viewed as a means of attracting additional investment for public infrastructure and as a tool for enhancing infrastructure planning and project selection. Additionally, PPPs provide a means of improving project management and ensuring proper maintenance, thereby avoiding cycles of construction followed by persistent neglect and high-cost reconstruction. Well-designed PPPs bring the private investment money, private-sector know-how, and commercial management incentives necessary to improve service delivery to users. Given the significance of the PPP model, a thorough discussion is needed to demonstrate the significance of this innovative project funding model. Thus, private sector funding serves two crucial purposes in a PPP. Firstly, it supplements public sector financing and enables projects to proceed that would have been abandoned due to fiscal limitations. Secondly, it establishes an incentive mechanism that aligns private and public interests.

(b) Introduction to PPP

A Public-Private Partnership (PPP) is a contractual agreement between public entities (national, state, provincial, or local) and private entities, where the skills, assets, and/or financial resources of both sectors are utilized in a complementary manner. This arrangement shares the risks and rewards, aiming to provide citizens with optimal service delivery and value.

PPP differs significantly from conventional public procurement as it places the burden of raising funds on the private entity. In the PPP structure, the private entity is primarily responsible for finding investors and creating the project's financing structure. However, the government is affected by the private party's participation in such important public initiatives. The following crucial components are a part of the PPP project implementation mode:

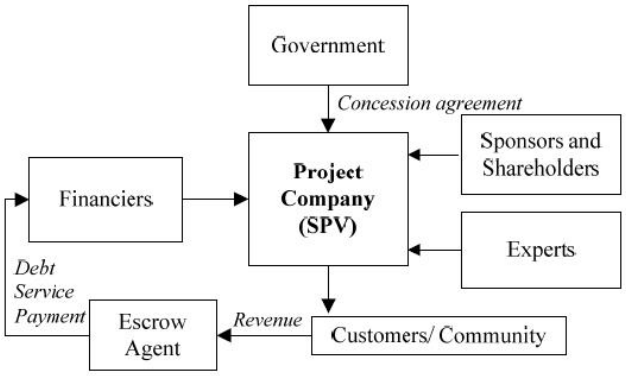
1. **Duration:** Typically, agreements between public and private sector partners are medium- to long-term and frequently span the entire life of the asset created under the PPP agreement.

2. **Financing, responsibilities, and ownership**. Asset financing by the public and/or private sector is often intricate and can involve earnings from the operation of the asset over a set period. The obligations of the private partner can often include the commodity's creation, management, and upkeep. Depending on the PPP arrangement, the ownership of the commodity varies. In some cases, the private sector operator owns the asset and transfers ownership to the public sector partner after a designated period. In other cases, ownership may be shared or retained by the public sector partner over the asset's life.

3. **Performance-based returns.** PPPs develop assets or projects to deliver ongoing services to the public, rather than the asset being the deliverable of the contract, with payment being contingent on the operator of the asset meeting performance standards. Typically, the public sector partner is in charge of keeping track of results throughout the contract.

4. **Output and quality specification.** The private sector collaborator participates in project phases defined by the public sector partner. (e.g., design, construction, operation, maintenance, and financing). The public sector partner specifies the desired general welfare, service excellence, and pricing structure results.

Figure 32.4: A typical structure of the PPP project



Source: ADB Guide to PPP Projects

Public infrastructure is the systems and facilities necessary for the functioning of the economy and society. They serve as a means of supporting a nation's socioeconomic progress rather than an end in themselves and include facilities that are auxiliary to this end.

A Special Purpose/Project Vehicle (SPV) is a legal entity created to execute a specific project. All contractual agreements between the various parties are negotiated between themselves and the SPV. The SPV is a commercial enterprise formed under the relevant Act of a country by the shareholders or sponsors through an agreement, commonly referred to as the memorandum of association. The shareholders' agreement outlines the company's foundation, including its name, ownership structure, management control, authorized share capital, and the members' liabilities.

Public infrastructure can be categorized in two ways.

Economic infrastructure: Infrastructure critical for everyday economic activities, such as transportation and utility networks (such as water, sewage, and electricity), falls under the category of economic infrastructure

Social infrastructure: Social infrastructure includes amenities such as schools, hospitals, libraries, prisons, etc.; that is, infrastructure considered essential for the structure of society.

It is universally acknowledged that the state must be involved in providing public infrastructure for the following reasons.

- Such projects present significant externalities that the commercial sector cannot account for, such as the socioeconomic advancement of the lower strata of society. To make initiatives with significant "externalities"—i.e., general economic and social benefits—easily accessible as "public goods" even to those who lack the financial means to pay for them, public-sector intervention is necessary. (medical, education, transportation, etc.).

- Additionally, private markets frequently result in the competitive delivery of infrastructure. This process is often deemed ineffective and necessitates some form of public oversight to ensure the fair distribution of benefits, which are critical for the holistic development of society and the economy. The objective is to guarantee that "Merit Goods" (such as education), which would be underprovided to vulnerable groups in a free competitive market, are offered at the lowest possible cost.

- In addition, considerable investments are necessary for large-scale infrastructure projects, and the returns are realized over an extended period. Consequently, raising private funds for such ventures without public-sector assistance is challenging.

- Building infrastructure needs a sizable upfront investment, on which only very long-term returns can be anticipated. Without some public-sector assistance, it might be challenging to raise private capital for this investment. In projects of such nature, competitive market pricing does not account for the socio-economic benefits and the externalities therein. Thus, it could be claimed that infrastructure should be provided by the government in cases where free market competition would cause behavior to change or result in the loss of socioeconomic advantages.

Finally, PPPs are also known as publicly-funded provisions for social service rendered by non-public sector organizations, including the voluntary (not-for-profit) sector and public funding of the private sector. It contains the following components.

- A long-term contract (a 'PPP Contract') between a public and a private sector party;
- Long-term involvement of private sector party; which mainly includes designing work, construction work, financing, and the operation of public infrastructure (the 'Facility');
- Payments under the PPP Contract to the private-sector party, made either by the public-sector party or by the users (the general public) as a fee or tax for using the Facility.
- The Facility remains in public-sector ownership or reverts to public-sector ownership at the end of the PPP Contract. In a few cases, the PPP Contracts may involve major upgrading of existing infrastructure rather than a 'greenfield' construction.

(c) Public Procurement vs PPP

The public-sector party to the PPP Contracts (the 'Public Authority'—also known by several other terms like the 'Public party', 'Public Entity', 'Government-owned Entity', 'Public Institution', 'Contracting Authority', or just the 'Authority') can be a central/state/regional government department, a local/municipal corporation, a government agency or any other institution which comes under the control of the public sector. At the same time, the private-sector party is generally a special-purpose-vehicle (SPV) company (also called the 'Project Company' or the 'Private Party') formed by the private parties explicitly to undertake the PPP Contracts. Here, it is notable that the relationship between the public and private parties cannot be a partnership in the legal sense. It is purely contractual and based on the PPP Contracts' terms and conditions.

Therefore, A PPP is thus an option to the public sector procuring the Facility ('public sector procurement'), which uses money from tax revenues or public borrowing. A typical public-sector procurement (known as 'design-bid-build,' the Public Authority specifies and designs the Facility, solicits bids on the basis of this detailed design, and pays for the Facility's construction by a private-sector contractor.

The Public Authority finances the entire construction cost, including any cost overruns. The Public Authority is solely responsible for the Facility's operation and maintenance, and the contractor assumes no responsibility for the Facility's long-term performance once the (a relatively short) construction warranty has ended.

On the other hand, in a PPP, the Public Authority outlines its needs in terms of "outputs", that is public services the facility is to offer. However, they do no details instructions on how to render these services. To further ensure that the Facility meets the long-term output requirements, the private sector must design, finance, build, and operate it. Over the course of the PPP Contract (perhaps 25 years on average), the Project Company receives payments (referred to as "Service Fees") on a pre-agreed basis. These payments are meant to pay back the financing expenses and provide investors with a return. In general, there is no additional allowance for cost overruns that happen during construction or operation of the Facility. Conversely, the Service Fees are subject to deductions for failing to fulfil output standards.

The result of this PPP approach is that significant risks relating to:

- The cost of designing and construction of the Facility
- Market demand for the Facility (usage)
- Service provided by the Facility (including its availability for use)
- The operation and maintenance expenditures of the Facility are handed over from the Public Authorities to the Project company.

In order to boost the project's viability and enable significant participation from the private sector, a variety of ownership and finance structures are constructed with the aid of the PPP mode of procurement. Here, a variety of these structures are discussed.

(d) BOO—BOT—BTO—DBFO-Franchise-Public Procurement

The figure below summarizes the various methods of providing public infrastructure outlined above, along with how PPPs fall on the spectrum from completely public-sector projects (and risk) to fully owned private-sector projects.

Figure 32.5: Structure of PPP projects: Public procurement-> Private Ownership

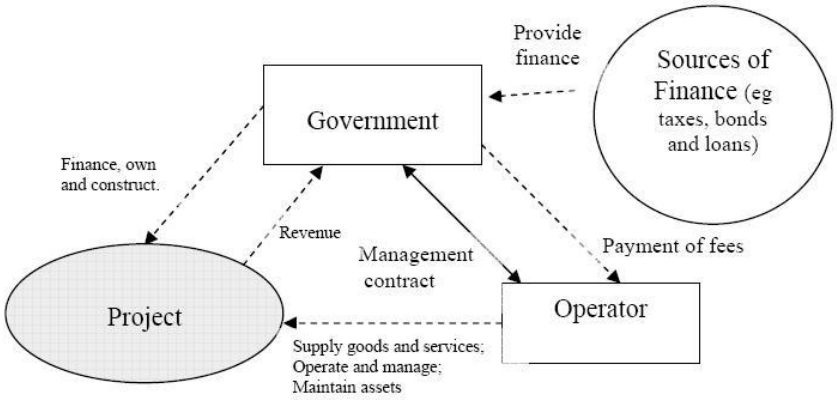
Public and private provision of infrastructure

	Public project ←					→ Private project
			← Public–Private Partnership →			
Contract Type	**Public-sector procurement**	**Franchise (*Affermage*)**	**Design-Build Finance-Operate (DBFO)***	**Build-Transfer-Operate (BTO)****	**Build-Operate-Transfer (BOT)*****	**Build-Own-Operate (BOO)**
Construction	Public sector[2]	Public sector[2]	Private sector	Private sector	Private sector	Private sector
Operation	Public sector[3]	Private sector	Private sector	Private sector	Private sector	Private sector
Ownership[1]	Public sector[4]	Public sector	Public sector	Private sector during construction, then public sector	Private sector during Contract, then public sector	Private sector
Who pays?	Public sector	Users	Public sector or users	Public sector or users	Public sector or users	Private-sector offtaker public sector[5], or users
Who is paid?	n/a	Private sector	Private sector	Private sector	Private sector	Private sector

Source: Y.R. Enscombe (2007, Ch 1)

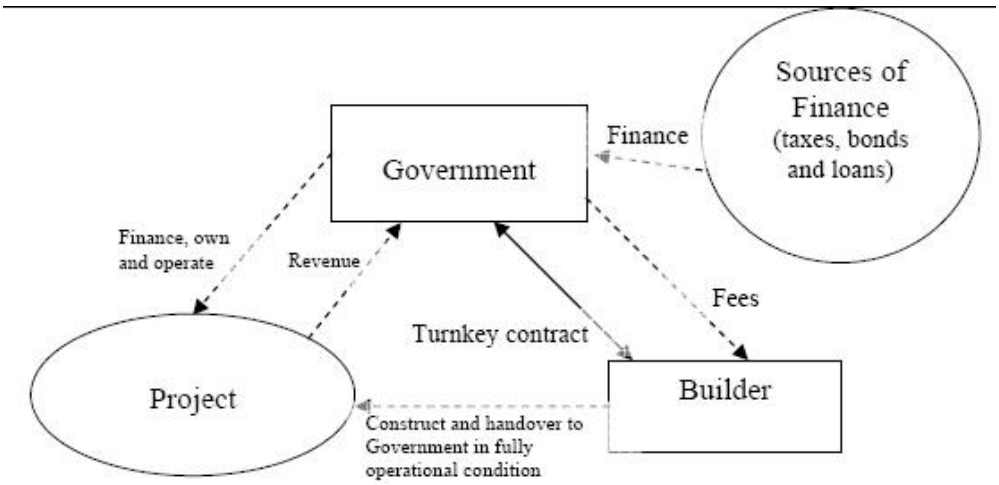
At one extreme we have the complete ownership and control of operations by the public sector often referred to as public procurement. Management and supply contracts, operations and maintenance management, and turnkey contracts are included in this. The contracts posits the following advantages: They are quick to put into practice. Compared to all other potential contract structures, they are the least complicated. Nonetheless, the following disadvantages exist. Efficiency gains are lower, and the private sector has fewer incentives to invest. Public sector is more likely to bear the majority of the risk. They don't work well for constructing greenfield assets.

Figure 32.6: Public Procurement: Management Contracts



Source: UN Primer to PPP projects

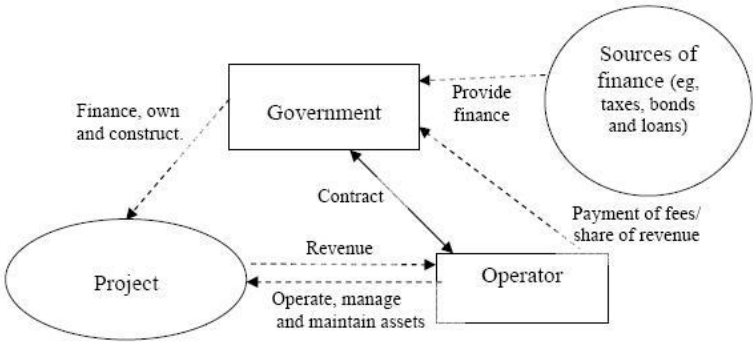
Figure 32.7: Public Procurement: Turnkey contract



Source: UN Primer to PPP projects

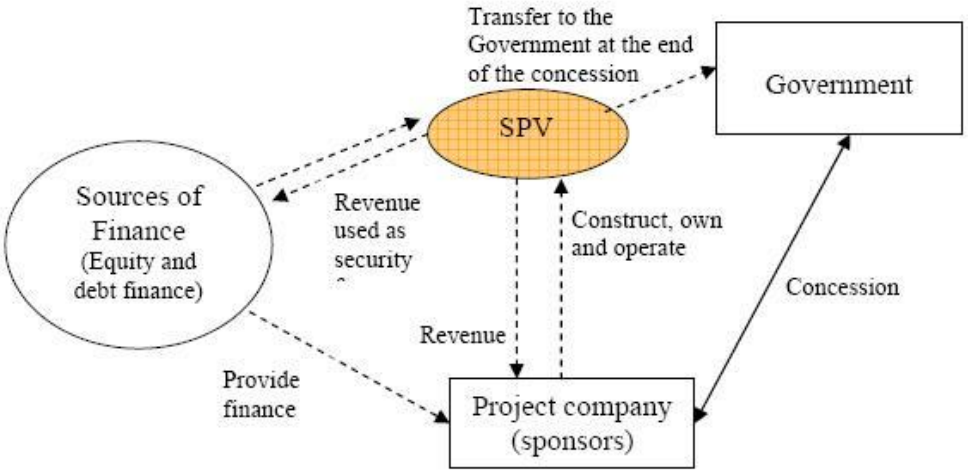
Next structure with significant control of public sector is affermage (or Franchise) which is blend of ownership by public sector and service management by private sector. Affermage (lease) contracts, as opposed to management contracts and turnkey contracts, give incentives to the private sector to invest in assets through long-term contracts.

Figure 32.8: Afterimage/Lease contract



Source: UN Primer to PPP projects

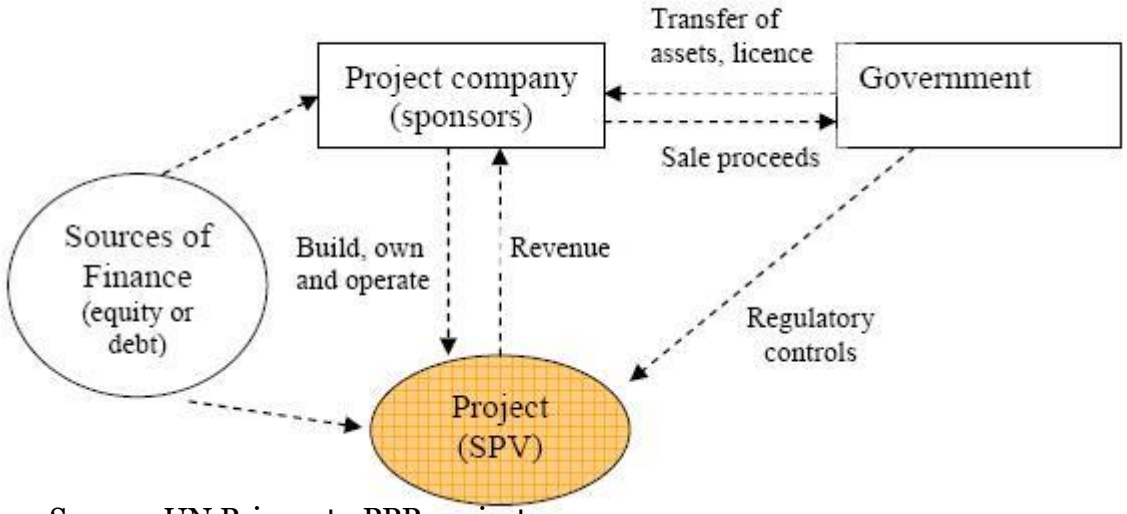
Figure 32.9: Concession Agreements



Source: UN Primer to PPP projects

Next, we have the BOT/BTO model, in which public parties bear the risk and are responsible for payments (rather than end-users). Then there is DBFOT/DBFO, which is prominent in developing nations. Under this the private sector takes charge of designing, investing, plans, building the infrastructure. It also collects fees from end users (or, in certain situations, from the public offtaker); assumes the risk associated with the demand; and ensures that the output requirements are met. The facility is handed to public-sector ownership at the end of the concession period.

Figure 32.10: Private Ownership of Assets



Source: UN Primer to PPP projects

At the opposite side of the spectrum, we have a comprehensive BOO structure which results in the facility's privatisation. The private firm controls the ownership structure. The public sector only serves as a regulator, policymaker, and monitoring authority to guarantee that a service or item is delivered to the public at a specific standard of quality and at prices that provide an acceptable (but not abnormal) return to the private party. As a result, an acceptable trade-off between competitive pricing and monitoring the provision of socioeconomic advantages to lower socioeconomic strata of society is ensured. Increasing private ownership provides the following advantages. First, The private sector carries

substantial risks and provides higher incentives for long-term investment. Second, involvement of private sector increase the probability of higher efficiency and innovation as compare to when public sector is involved. However, excess involvement of private sector also comes with certain disadvantages. These types of structures are difficult to establish contractually. Significant regulatory control is necessary. Government is projected to incur contingent liabilities in the medium to long term.

The PPP was first designed as a 'Build-Own-Operate' (BOO) contract between private-sector parties. Under this the possession of the Facility lies with the investors. With the time it was clear to use similar structure for the construction of public sector projects. The "Build-Operate-Transfer" (BOT) contract model was first developed in Turkey, but with the important distinctions that the offtaker (purchaser) would be a Public Authority, the state ownership. At contract end, possession of facility could be transferred to the offtaker, i.e., public sector from the investors. The possession could be passed usually for a nominal amount or no cost.

BTO contract and DBFO contract were only a short distance apart from BOT model. 'Build-Transfer-Operate' (BTO) contract, where possession is handed over to the public authority on contract completion and the 'Design-Build-Finance-Operate' (DBFO) contract, where possession of the facility is not transferred throughout the contract and remains with public authority only, Instead of owning physical assets, the private sector's stake in the project is purely dependent on its contractual rights to operate the Facility and earn money from the offtaker for doing so.

BOT, BTO, and DBFO contracts allowed cash-strapped state utilities in developing nations to invest in more efficient facilities without giving up control over the facility, how it was delivered to customers, or how much it cost. In other words, the private sector facilitates the service on behalf of the public sector, but it was still entirely under the umbrella of public-sector.

(e) PPP contract types

Most PPP projects have contractual duration of 20-30 years, some have shorter spans whereas few lasts for long than 30 years. The term should always be long enough for the private party to have the incentive to integrate service delivery costs considerations into the design phase of the project. in order to maximise the trade-offs between initial investment cost and future maintenance and operation expenses, this also incorporates maintenance considerations.

The "whole-life" approach maximises service delivery efficiency by taking into account whole-life costs and benefits. This is one of key reason for using PPPs to deliver public services. Project type and policies are key factors that determines the precise length of contract. Policymakers must be satisfied that the demand for the services delivered by the project will be sustained for the duration of the contract; the private party must accept responsibility for service delivery over the term of the contract; and the procuring authority must commit to the project for the duration of the contract. Finance availability and its terms and conditions to acquire may also have an impact on the term of the PPP contract.

Such contracts are built around three criteria. (a) The type of assets; (b) Functions of the private party; (c) How payments are made to the private party.

1. **Based on the Type of assets:** Construction of new – Greenfield assets can be included under PPP contracts. PPPs can also be used for brownfield projects, which involve handing over management and upkeep of existing assets to a private company. In any of the specified case, a crucial component of a PPP is that the assets

or services provided are specified in terms of outputs. That is, level and quality of output or service should be pre-determined.

2. **Functions of the private party:** The fact that a PPP contract combines distinct project phases or roles is one of its key characteristics. Yet, depending on the kind of asset and service being used, different duties are assigned to the private party. Some of key functions include Design (also known as engineering work) – includes project developed from the scratch, i.e., concept generation and output requirements to construction ready design specifications. **Build, or Rehabilitate –** However, using PPP for new infrastructure projects often requires private party to build the asset and setup and install the required equipment. In PPPs where existing assets are involved, the private party may oversee extending or rebuilding the asset. **Finance—**When a PPP calls for the construction or renovation of the asset, the private party is often also expected to fund all or a portion of the needed capital expenditure. **Maintain**—During the duration of the contract, the private party is responsible for maintaining an infrastructure asset to a stipulated standard. This is one of the key components of PPP contracts. **Operate**—Depending on the type of underlying asset and accompanying service, the private party's operating obligations under a PPP might vary greatly.

   For instance, the private party might be held accountable for: Asset's technical operation and offering bulk services to government off-taker; and (b) Asset's technical operation and offering end user services; (c)creation of PPP entity, special purpose vehicle (SPV). It is possible to separate all assets and liabilities related to the private provision of services via a specialized SPV.

3. **Payment Mechanism:** The third distinguishing characteristic is the PPP payment mechanism. The government may pay the private party directly, through the collection of fees from users of the services, or through a mix of the two— With the common, defining trait that payment is conditional on performance. The functions of the private party may affect the available payment mechanisms: In **user-pays public-private partnerships (PPPs)**, such as toll roads, a private party offers customers a service and makes money by charging users for that service. Government payments may be used to supplement these fees (or tariffs, or tolls), such as additional payments for services rendered to low-income consumers when the tariff is capped, or subsidies to investment after the completion of construction or at particular construction milestones. Payments might be subject to the service's accessibility at a specified level of quality. Government funding is the only source of income for the private party under **government-pays PPPs**. Government payments may be conditional upon the availability of an asset or service at a contractually stipulated quality (availability payments); an example would be a free highway for which the government makes periodic availability payments. Alternatively, they could be volume-based payments for the services that users receive; for instance, compensation for successfully delivered hospital care.

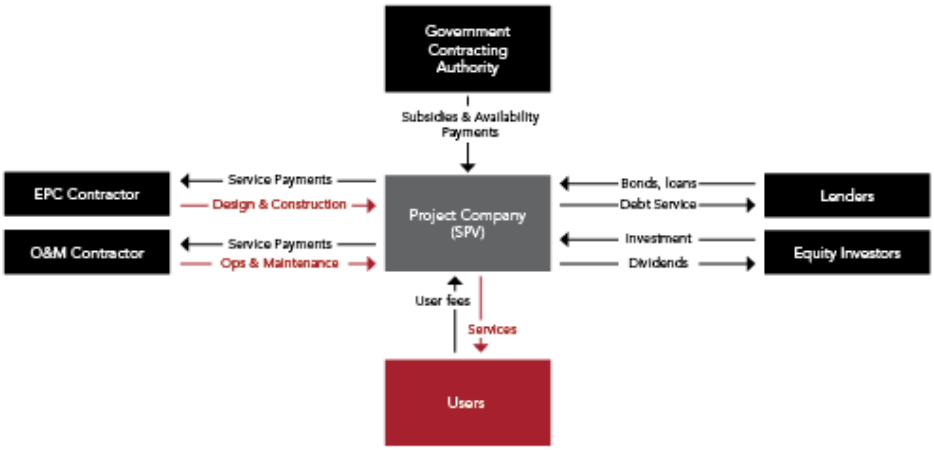
A variety of PPP contracts can be made by combining these traits in different ways. These contracts are viewed as a continuum between public and private provision of infrastructure, shifting increasing responsibilities and risk to the private sector. The payment method should be designed so that the private party's net compensation is related to performance. For the private party to have the right incentives to supply services at the performance levels envisaged by the procurement body, its remuneration, net-of-costs, should increase when reaching these levels. Also, contract cancellation should follow from persistently deviating significantly from the expected performance levels, with termination

payments made such that abandoning the project is never an easy option for the private party.

(f) Project Finance Transaction Structure of PPP Projects

Most PPP contracts have a private party that is a specific project company created for that purpose, often known as a Special Purpose Vehicle (SPV). This project company obtains funding by combining equity—provided by the project company's shareholders—and debt—provided by banks, or through bonds or other financial instruments. The financing structure consists of a mix of equity and debt as well as contractual arrangements between stock holders and lenders.

Figure 32.11: Typical Project Finance Structure with SPV Company



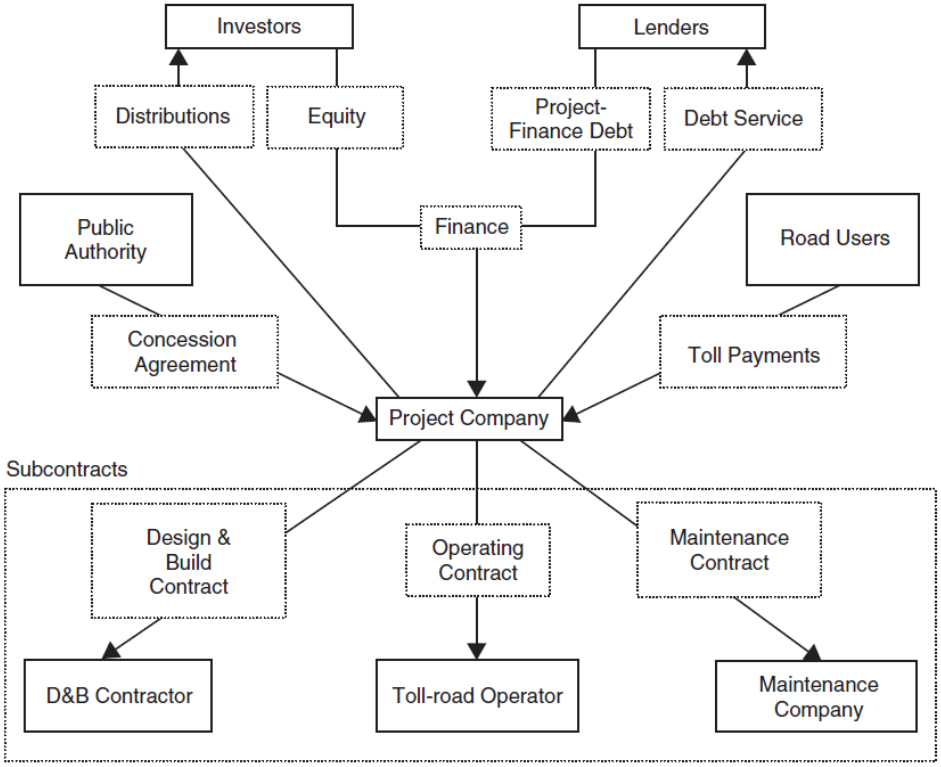
Source: World Bank primer on Project Finance

In Figure 32.11, a typical PPP project structure is shown. The project company is the main party under contract with the government. A direct agreement between the contracting authority and the lenders may supplement this, albeit this relationship is often restricted to the lending arrangements specified in the PPP agreement, such as step-in rights or senior debt repayment guarantees.

Project shareholders are the initial equity investors who create the PPP proposal. Project developers, engineering or construction companies, infrastructure management companies, and private equity funds are examples of typical equity investors. In case of developing nations, commercial banks, multilateral and bilateral development banks, financial institutions, and institutional investors like pension funds and insurance firms may all lend money to PPP projects.

The project company (as shown in the Typical PPP Project Structure), enters into agreements with firms to oversee the facility's design and construction (often referred to as an Engineering, Procurement and Construction, or EPC contract), as well as operations and maintenance (O&M). These subcontractors can have connections to equity investors.

Figure 32.12: A Comprehensive Project Finance Structure for a Road Project



Source: E R. Yescombe Chapter 2007, Ch 1

Fig. 32.12 displays a comprehensive road project financing arrangement. The following are the main components of this project finance structure. (a) A Project Company owned by investors from the private sector; (b) Financing for the project's capital costs (or "capex") through shareholder equity and project-finance debt; (c) A Design-and-Build contract ("D&B" contract), under which the contractor agrees to design and build the completed road and related works (such as toll booths) to the required specification, at a fixed price and schedule; and (d) An operating agreement, in which a toll operation company performs services like managing accidents, making minor repairs, and manning toll booths, etc.; (e) A maintenance agreement, through which a maintenance company maintains roads; (f) A concession agreement, which is the common name for this kind of PPP contract, with the public authority, that permits the collection of tolls from the users of roads but usually does not entail any payment from or to the Public Authority; (g) Cash flow after operating expenses (also known as "opex"), which mostly consists of payments made under operating and maintenance contracts and is used to pay distributions to the investors after paying for debt service.

The equity investment is "first in, last out," meaning that any project losses are first borne by the equity investors, and lenders only suffer if the equity investment is lost, as described in Farquharson et al's chapter on PPP financing (PPIAF 2001, 53). This implies that equity investors require a larger return on their investment because they incur a higher risk than debt lenders.

The project shareholders' and their advisors' primary concern when creating the finance structure is usually to keep the project's financing costs as low as possible. Project shareholders rely heavily on debt to finance the project because equity is more expensive than debt. This percentage may change from project to project based on the risks that the PPP operator assumes in each country.

The PPP project's financial modelling would adjust debt service and anticipated dividends in accordance with the anticipated flow of cash, which includes user fee and government payment revenue, building costs, and ongoing expenses, specifically for maintenance and operations.

(g) Hybrid Annuity Model (HAM) for PPP projects

The HAM concept has recently brought fresh innovation to the PPP market. By lowering the risk for project developers and banks, HAM is anticipated to quicken the pace of PPP project award and execution. This is due to the crucial variations in the flaws of the traditional toll and annuity-based DBFOT model, which HAM attempts to counter. The following are the key features of a HAM project.

1. **Bid Parameter:** The bid parameter is the project life cycle cost, which is calculated as the sum of the Net Present Value (NPV) of the quoted bid project cost and the NPV of the operations and maintenance (O&M) cost for the whole operating time. The developer submitting the lowest NPV for project life cycle cost wins the bid.

2. **Cash Construction Support:** The authority shall pay the concessionaire 40% of the bid project cost in five equal installments tied to the project's physical progress. 60% of the project's remaining costs must be initially covered by the concessionaire through a combination of debt and equity.

3. **Escalation clause in the project cost:** A Price Index Multiple (PIM), which is the weighted average of the Wholesale Price Index (WPI) and Consumer Price Index (CPI) (IW) in the ratio of 70:30, shall be used to index project costs for inflation. The bid project cost at the commencement of construction shall be the bid project cost adjusted for variation in the price index occurring between the reference index preceding the bid date and reference index date immediately preceding the appointed date. Bid project cost shall be changed to variation in PIM on monthly basis till the achievement of commercial operations date (COD).

4. **Stable cash flow of annuity payments:** After the project is completed, the Authority shall pay the concessionaire semi-annual annuity payments for the remaining 60% of the total project cost. The annuity payments are aligned with the normal revenue profile for highway projects. Interest on the reducing balance of the final construction cost shall be paid in annuity form in addition to the annuity payments. Interest will be charged at the bank rate plus 3%.

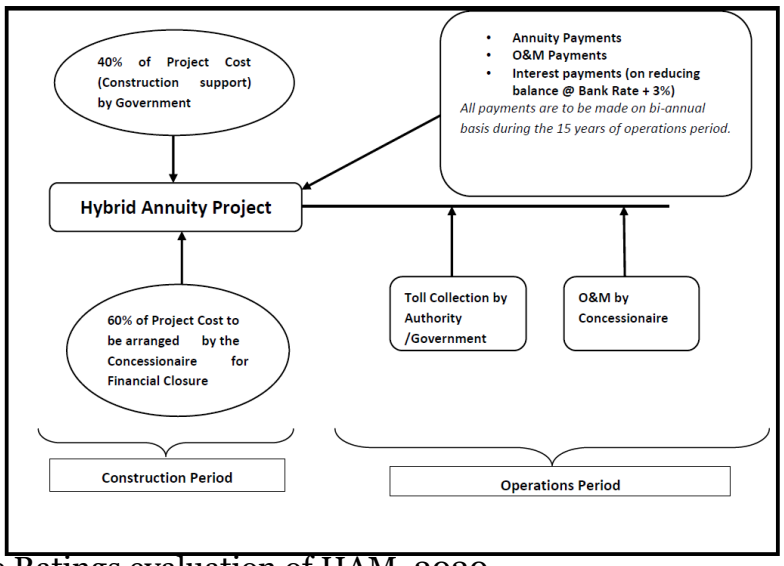
5. **Assured O&M payouts by authority:** The Authority shall make O&M payments and annuity payments to the concessionaire in accordance with the amount quoted, which will be inflation-indexed. Until the end of the concession period, the concessionaire is still in charge of project maintenance.

6. **Revenue for authority:** Toll collection shall be the responsibility and revenue of the authority.

7. **Concession Period:** It shall comprise construction period, which shall be project specific, with a fixed operations period of 15 years.

The following diagram provides an overview of HAM structure.

Figure 32.13: HAM model Block diagram



Source: Care Ratings evaluation of HAM, 2020

Compared to the traditional DBFOT model, this type of structure is anticipated to have the following benefits.

- **Concession period**: In HAM delinks annuities for operations and maintenance from the construction period. Hence, any delay in construction will not affect the stipulated O&M annuities. This is in contrast to typical DBFOT, where a fixed concession term results in lower annuities if construction is delayed.

- **Damages for Delays:** Concessionaire will be required to pay higher damages (0.2%-0.3%) in HAM than in DBFOT (0.1%) for project delay in commercial operation date (COD).

- **Project cost as bidding criteria:** Low possibilities of deviations in stipulated project cost because project cost is also a key bidding factor.

- **Construction grant** linked to the physical progress, which amounts to 40% of the project cost. This is expected to provide a significant funding cushion.

- In addition, other clauses, such as those relating to deemed termination for excessive delay in project award, project milestones linked to physical and financial progress, provision of mobilization advances up to 10% of bid project cost, bonus payment on early completion, termination payment under concessionaire event of default, among others, are anticipated to bring more transparency and visibility of the project scope and expected benefits and penalties and more certainty to implementation.

Thus, HAM structure is expected to reduce the following risks.

- **Funding risk**: HAM model eases developer funding requirements by taking into account 40% construction support from authority. Mobilization advances up to 10% of bid project cost are expected to provide further padding. Overall, this lowers the project's funding risk.
- **Project Implementation risk**: Clauses like 80% availability of project land before the appointed date, deemed termination, which is further supported by construction

grants and mobilization advances, are expected to lower the risk associated with implementing the project.

- **Cash flow risk**: Annuity payments from the authority and 60% of the project cost in the form of semi-annuities at a rate of Bank+3% are anticipated to somewhat alleviate the risk of cash flow during O&M.
- **O&M risk**: O&M risk is significantly countered by fixed annuity payments that are inflation-indexed.
- **Interest rate risk**: As per HAM, interest annuity is paid on reducing balance of bid-project cost at Bank+3%, thus reducing the interest rate risk to an extent.

(h) PPP Projects in India

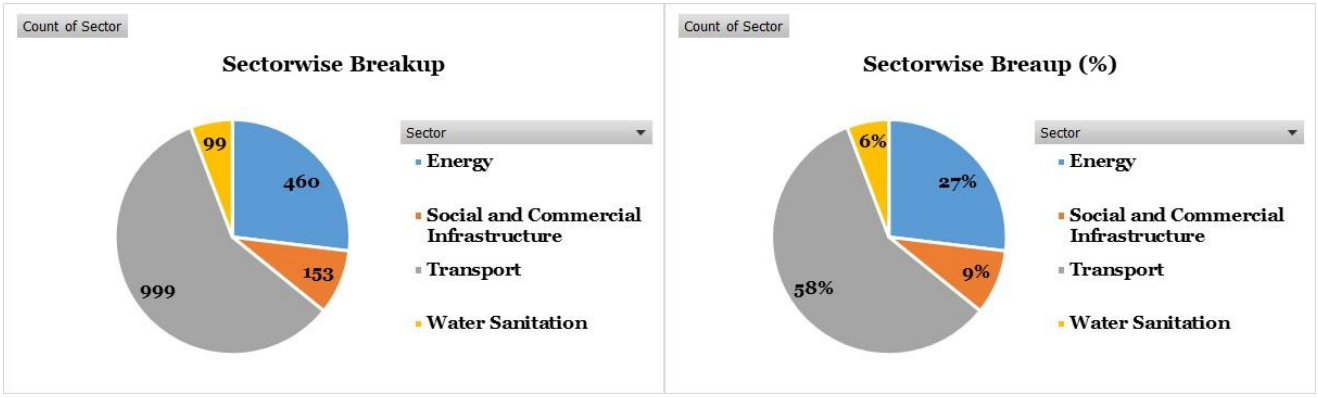
We survey more than 1700 projects from the Department of Economic Affairs (GoI) website on PPP infrastructure projects in India. This data includes the project PPP structure, location, and sector. The following analysis is obtained.

Table 32.108: Sector-wise distribution of projects

Sector	Count of Sector
Energy	460
Social and Commercial Infrastructure	153
Transport	999
Water Sanitation	99
Grand Total	**1711**

Sector-wise breakup suggests that majority of PPP project (~58%) are carried out in transport sector (railways and road). Other segment that have witnessed considerable growth in PPP projects, include Energy (27%), Water sanitation related projects (9%), and social and commercial infrastructure (6%).

Figure 32.14: Sector-wise break of PPP Projects



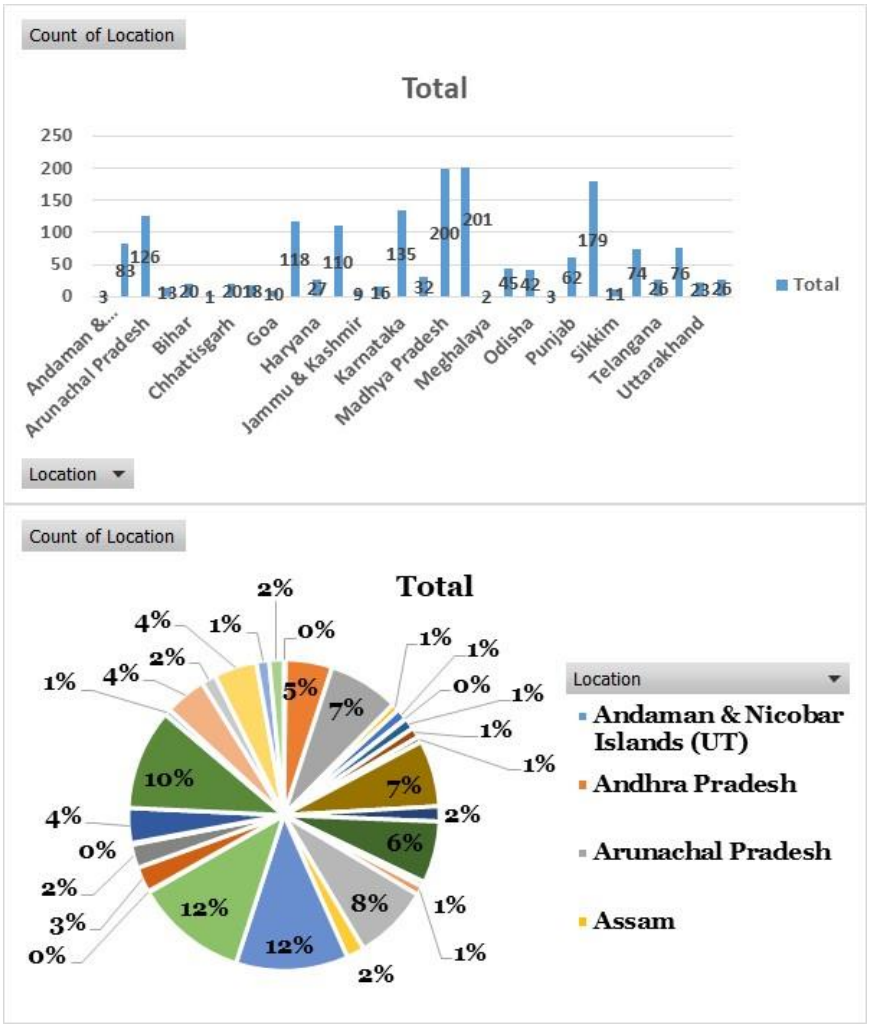
Source: Dept. of Economic Affairs (GoI)

Table 32.109: Geography-wise distribution of projects

State	Count
Andaman & Nicobar Islands (UT)	3
Andhra Pradesh	83
Arunachal Pradesh	126
Assam	13
Bihar	20
Chandigarh (UT)	1

Chhattisgarh	20
Delhi (UT)	18
Goa	10
Gujarat	118
Haryana	27
Himachal Pradesh	110
Jammu & Kashmir	9
Jharkhand	16
Karnataka	135
Kerala	32
Madhya Pradesh	200
Maharashtra	201
Meghalaya	2
Multi State/ Centre	45
Odisha	42
Puducherry (UT)	3
Punjab	62
Rajasthan	179
Sikkim	11
Tamil Nadu	74
Telangana	26
Uttar Pradesh	76
Uttarakhand	23
West Bengal	26
Grand Total	**1711**

Figure 32.15: Geography-wise break of PPP projects



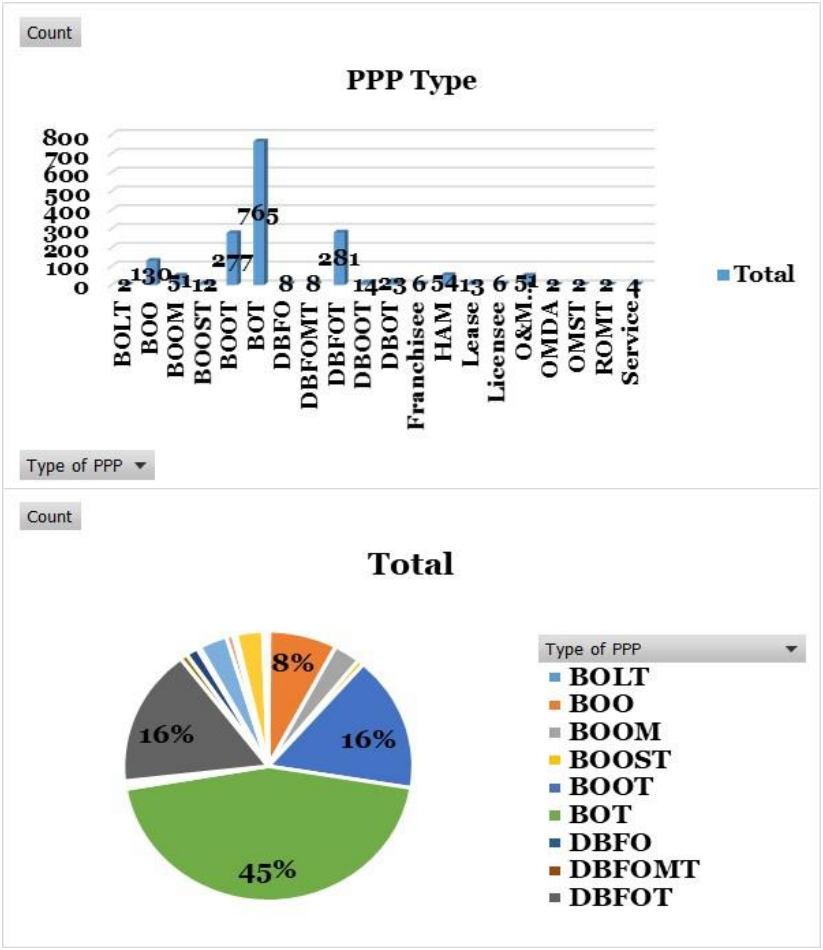
Source: Dept. of Economic Affairs (GoI)

Table 32.110: PPP-type wise distribution of projects

Project Type	Count
BOLT	2
BOO	130
BOOM	51
BOOST	12
BOOT	277
BOT	765
DBFO	8
DBFOMT	8
DBFOT	281
DBOOT	14
DBOT	23
Franchisee	6
HAM	54
Lease	13
Licensee	6
O&M Contract	51
OMDA	2
OMST	2
ROMT	2
Service Contract	4
Grand Total	**1711**

The PPP-type wise breakup suggests that most frequently employed PPP routes are BOT (~45%), DBFOT (~16%), BOOT (~16%), and BOO (7.60%).

Figure 32.16: PPP-type wise break of PPP projects



Source: Dept. of Economic Affairs (GoI)

(i) Proposed Transaction Structure

After reviewing different scenarios, we propose the following three structures for the consideration of Kalpasar Authorities.

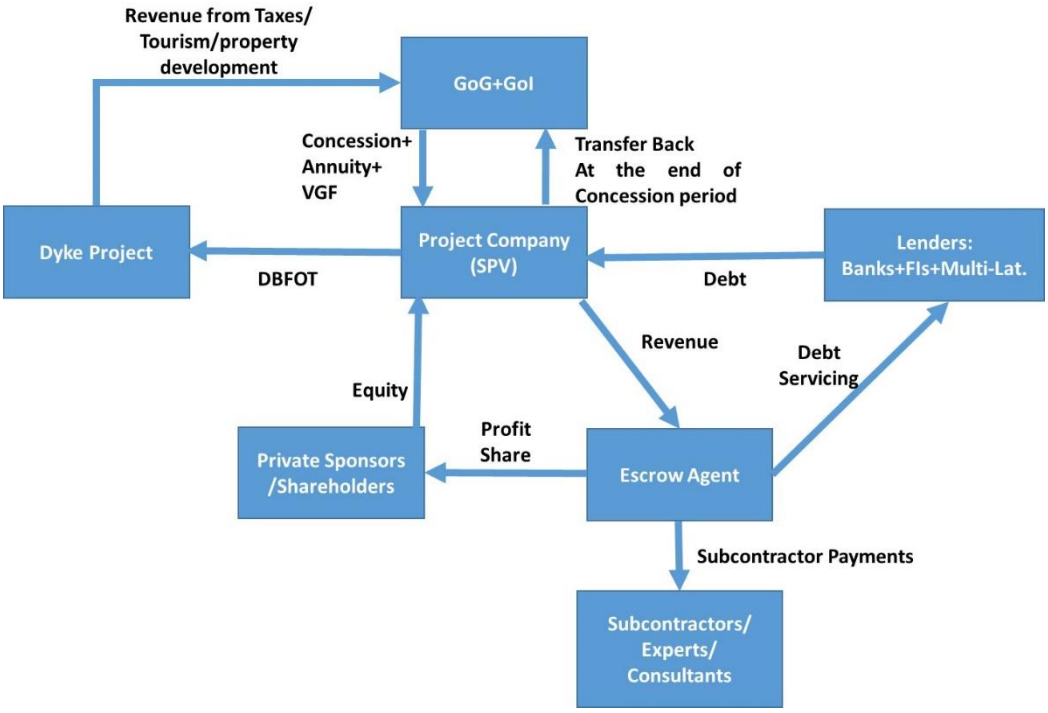
(1) Scenario 1 – Normal PPP

In this scenario, we consider the project as a bundle of four sub-projects (a) Dyke, (b) Road, (c) Railways, (d) Wind and Solar (RE Project). All these projects are stipulated to be offered on PPP (Design, Build, Finance, Operate Transfer: DBFOT+VGF) Basis. Description of financing structure for individual projects is provided here onwards.

(A) Dyke Project

The figure below provides an illustrative transaction structure of PPP approach to Dyke Construction

Figure 32.17: Dyke Construction DBFOT-PPP



The approach stipulates offering Dyke construction on Design, Build, Finance, Operate, and Transfer (DBFOT) model of PPP with an additional 20% as Viability Gap Funding (VGF) to make it viable for the private developer. The concessioning authority [Government of Gujarat (GoG) and Government of India (GoI)] is expected to sign a concession agreement with the private developer (the Concessionaire). The private developer is expected to design, build, finance, and operate (and maintain) the Dyke facility over the life of the concession agreement. In lieu of this, the concessioning authority will provide VGF (quasi equity) to the extent of 20% during the construction phase subject to achievement of milestones, which will reduce the funding risk. The project development will lead to the collection of additional taxes from the area in the project vicinity.

This VGF may not put additional burden on the state finances. For example, state development bonds (SDBs) or municipal bonds can be issued through securitization of expected future cash inflows from the taxes and property development charges from the Kalpasar development. These can be deep discount bonds (no coupon) with considerably

long-horizons (20-30 years) aligned to the development of the Kalpasar project. These immediate cash inflows from bond issuance can be employed to provide VGF to the project.

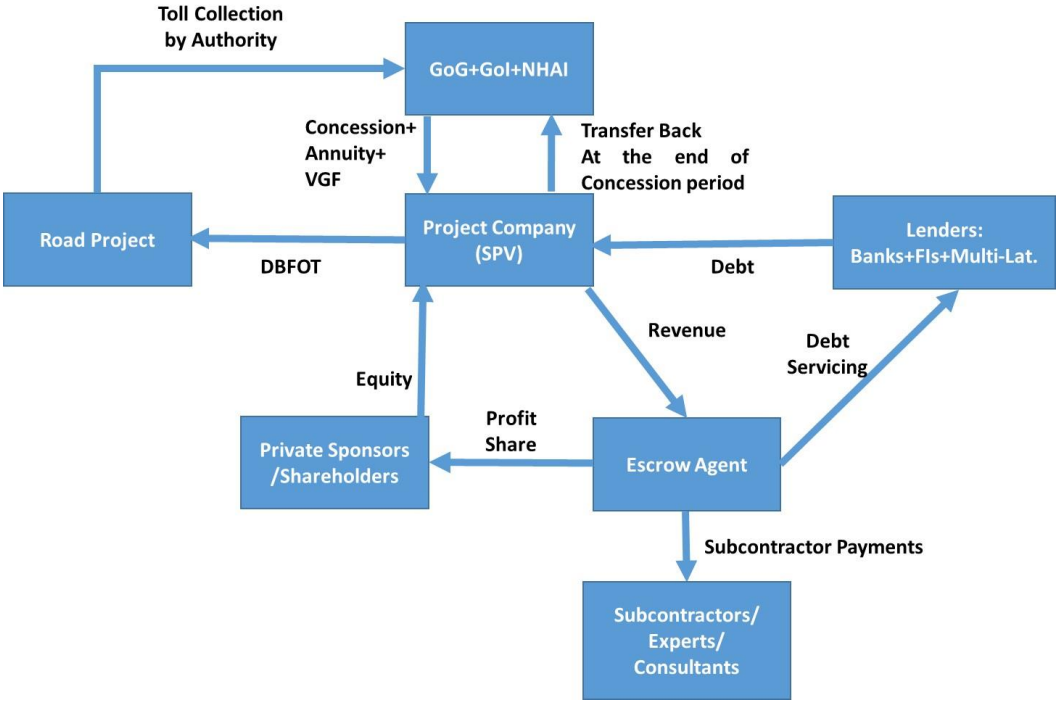
The remaining 80% is expected to be contributed by the private developer in the form of debt and equity capital. We stipulate that 20% equity will be raised by the private sponsor of the Special Purpose Vehicle (or SPV or Project Company) and the remaining 60% may be raised with Banks, Financial institutions, and Multilateral funding agencies. Given the socio-economic nature of the project (creation of fresh water reservoir with the Dyke project), it is expected that low-cost funding from multilateral institutions (e.g., World Bank, ADB, JBIC/JICA) may be available. Such soft loans are often provided at low cost (2-4%) and considerably long tenors (25-35 years) and help alleviate the debt servicing burden of the private developer. To provide easy access to debt capital markets, some credit enhancement to the debt facility availed by the private developer can be offered. Customarily, the government can support these borrowings by allowing the creation of charge on future receivables, that is, project annuities. This model is widely followed across the world, wherein the receivables by the private developer (in the form of annuity) are used as collateral (by creating an Escrow mechanism) to back the future repayment of lenders' debt obligations. Given the certainty of annuity inflows from the Government to private developer, this should alleviate the financing cost of the private developer and help avail funding at cheap costs. To ensure the comfort of lenders, the escrow mechanism may be employed to achieve the waterfall mechanism of cash flows (With adequate cushions such as cash sweep clauses). This will ensure that annuities received from the authority would be first utilized to repay the creditors (payment to subcontractors, financing charges, O&M expenses etc.) and only after that the residual profits are distributed to the sponsors of the SPV company. Any additional credit enhancement such as creation of infrastructure development fund (from the issuance of SDBs/Municipal bonds) can be employed to support any further gap in financing or increasing the viability of the project. This is ascribed to the fact that such projects often result in a considerable amount of positive externalities (socio-economic development of lower strata), which is not captured by financial IRR analysis.

In order to ensure adequate returns to private developer, post-construction the inflation adjusted (indexed to a combination of WPI and CPI) annuities should be offered to the private developer. This annuity comprises two components. First, it offers a certain reasonable returns over the capital investment in Dyke construction project, as mutually agreed between the private developer and authority. Customarily an assured financial IRR of 12% is considered adequate in such scenarios. Next, the O&M cost can be considered as pass-through with some incremental benefit margin of 5% reflecting the value addition by private developer in maintaining and operating the Dyke facility (e.g., O&M actuals+5%). This annuity (along with VGF) can be considered as the bid parameter in awarding the concession grant.

(B) Road Project

The figure below provides an illustrative transaction structure of PPP approach to Road project.

Figure 32.18: Road Project DBFOT-PPP

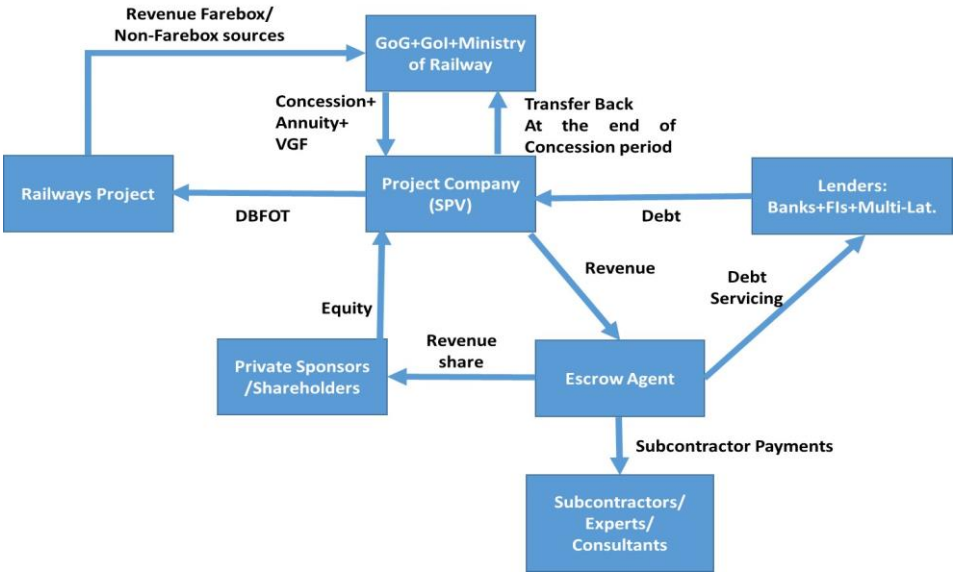


Similar to Dyke project, the road project can also be implemented with DBFOT mode of PPP operation. Here the concessioning authority [GoG, GoI, and National Highways Authority of India (NHAI)] will award the concession to the SPV company. At the end of the concession period, the SPV company will transfer the assets back to the authority. The authority is also expected to collect the toll and offer the annuity. Similar to the Dyke project, this annuity shall compensate the private developer on two accounts. First, a reasonable financial return on capital investment and project implementation. Second, inflation-indexed pass-through O&M expenses with some margins to reflect the opportunity cost of the SPV company. The discussion pertaining to VGF, issuance of bonds (through securitization of future toll revenues), credit enhancements, waterfall escrow mechanism, and project financing will remain the same.

(C) Rail Project

The figure below provides illustrative transaction structure of PPP approach to Railway project.

Figure 32.19: Railways Project DBFOT-PPP

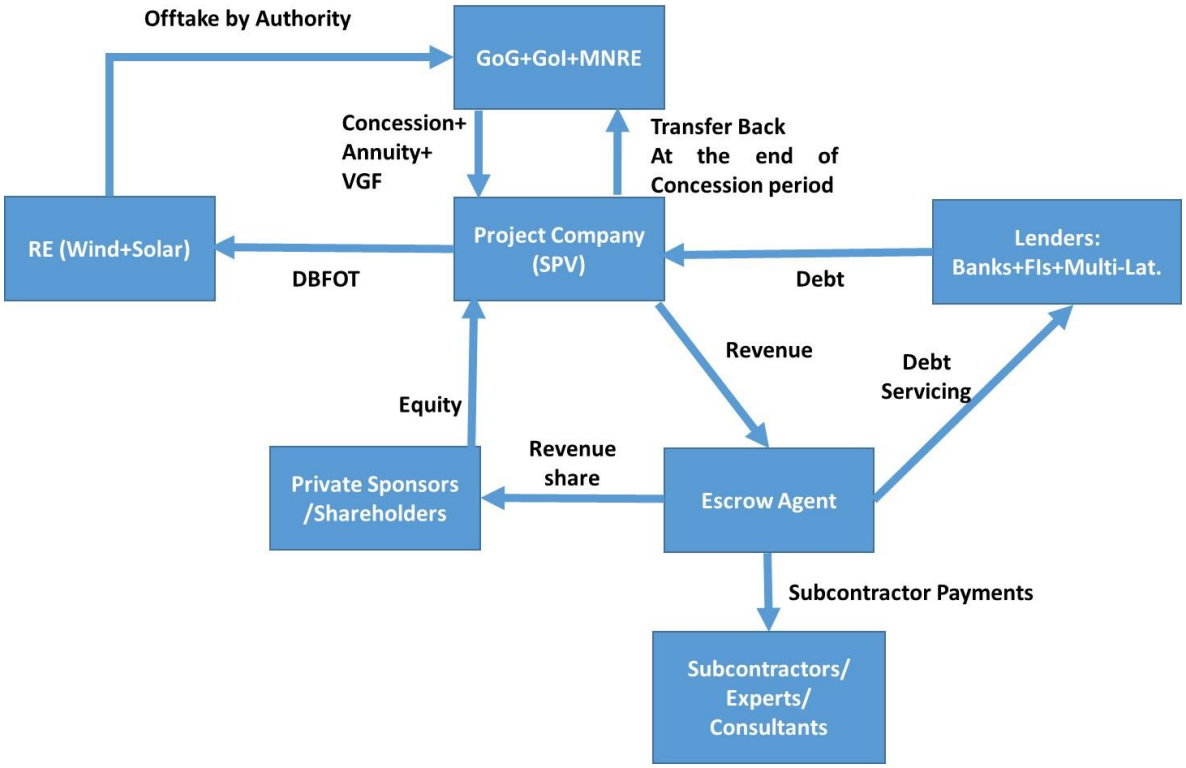


Again, the rail project can also be implemented with DBFOT mode of PPP operation. Here the concessioning authority [GoG, GoI, and Ministry of Railways] will award the concession to the SPV company. At the end of the concession period, the SPV company will transfer the assets back to the authority. The authority is also expected to collect the farebox (and non-farebox) revenues and offer the annuity to the SPV company. Similar to the road project, this annuity shall compensate the private developer on two accounts. First, a reasonable financial return on capital investment and project implementation. Second, inflation-indexed pass-through O&M expenses with some margins to reflect the opportunity cost of the SPV company. The discussion pertaining to VGF, issuance of bonds (through securitization of future toll revenues), credit enhancements, waterfall escrow mechanism, and project financing will remain the same.

(D) Renewable Energy (RE: Wind +Solar) Project

The figure below provides illustrative transaction structure of PPP approach to RE (Wind+Solar) project.

Figure 32.20: RE (Wind+Solar) Project DBFOT-PPP



The RE project (a bundle of solar and wind projects) can also be implemented with DBFOT mode of PPP operation. Here the concessioning authority [GoG, GoI, and Ministry of New and Renewable Energy (MNRE)] will award the concession to the SPV company. At the end of the concession period, the SPV company will transfer the assets back to the authority. The authority is also expected to offtake the power through long-term PPAs (at tariffs stipulated by the regulatory authority, e.g., CERC). These tariff payments can be in the form of annuities to the SPV company. Similar to the road project, this annuity shall compensate the private developer on two accounts. First, a reasonable financial return on capital investment and project implementation. Second, inflation-indexed pass-through O&M

expenses with some margins to reflect the opportunity cost of the SPV company. The discussion pertaining to VGF, issuance of bonds (through securitization of future toll revenues), credit enhancements, waterfall escrow mechanism, and project financing will remain the same.

Overall this mechanism is expected to result in the following means of finance, funding pattern, and financing costs.

Table 32.111: Cost of Funds: Scenario 1

Source of Funding	Share	Cost of Funds
VGF#	20%	0%
Equity from SPV Company (Private Sponsors)	20%	12%-16%
Funding from Banks, FIs, and Multilaterals (World Bank, ADB, etc.)*	60%	4%-6%
	WACC	4.8%-6.8%

*Backed by credit enhancements from State and Central Govt
#PPP Cell, Dept. of Economic Affairs, stipulates VGF of 20% for projects

The following are the strengths of this kind of structure.

- Suited to large infrastructure projects in attracting private capital
- Ensured annuity and VGF provide liquidity to private developer and reduces the funding risk
- Additional credit enhancements further reduce the cost of financing
- Escrow mechanism ensures discipline and payment of creditors
- Risk sharing through project finance structure mitigates various project implementation related risks
- Individual projects have flexibility in design of suitable implementation mode
- Annuity/VGF as bid parameter invite more competition and results in more efficiency

However, the following are some challenges

- Contractual structure may be complex and tendering process may be time consuming
- Elaborate structure of contract management and performance monitoring may be required
- Suited to large infrastructure projects in attracting private capital
- After the concession period, the assets are to be returned to the authority ; usually such government contracts stipulate an operation period of 15 years; however, longer tenor may be required to ensure the financial viability of the project for the private sector developer
- Limited upside for the private sector developer if the concession period is of short durations (10-20 years)
- Given the private party is the borrower, additional credit enhancements may be required
- For road and railway projects, involvement of private sector may be difficult to implement politically

- Given the less visibility of direct cash flows with Dyke project, it is difficult to find a private partner for the same. Considerable financial support from authorities may be required to make it viable to the private party.

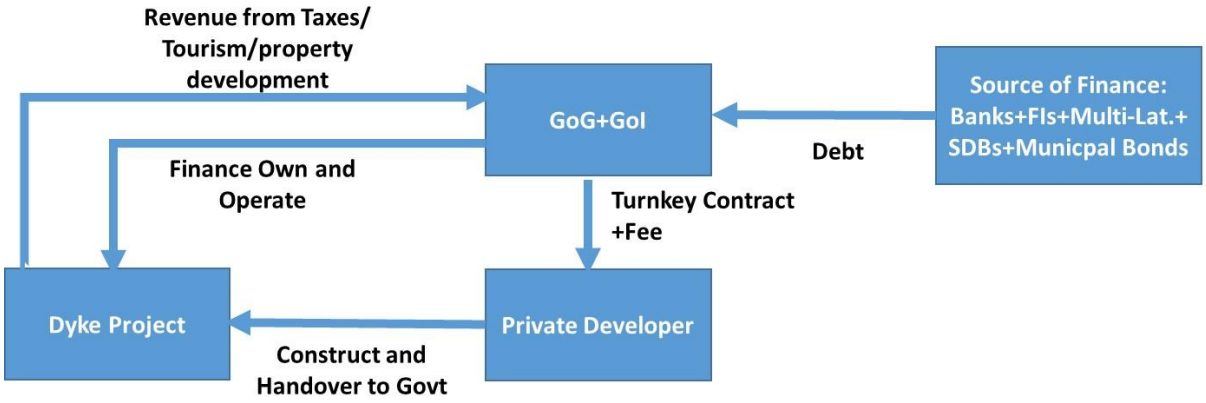
(2) Scenario 2 – Dyke EPC with Project (Rail+Road+RE) in DBFOT-PPP

In this scenario, we consider the execution of the complete project in two sets. First, the Dyke project through EPC contract. The remaining Road, Railways, Renewable energy to be executed with DBFOT annuity as a single project bundle. Description of the financing structure for individual projects is provided here onwards.

(A) Dyke Project

The figure below provides an illustrative transaction structure of EPC approach to Dyke Construction.

Figure 32.21: Dyke Project EPC

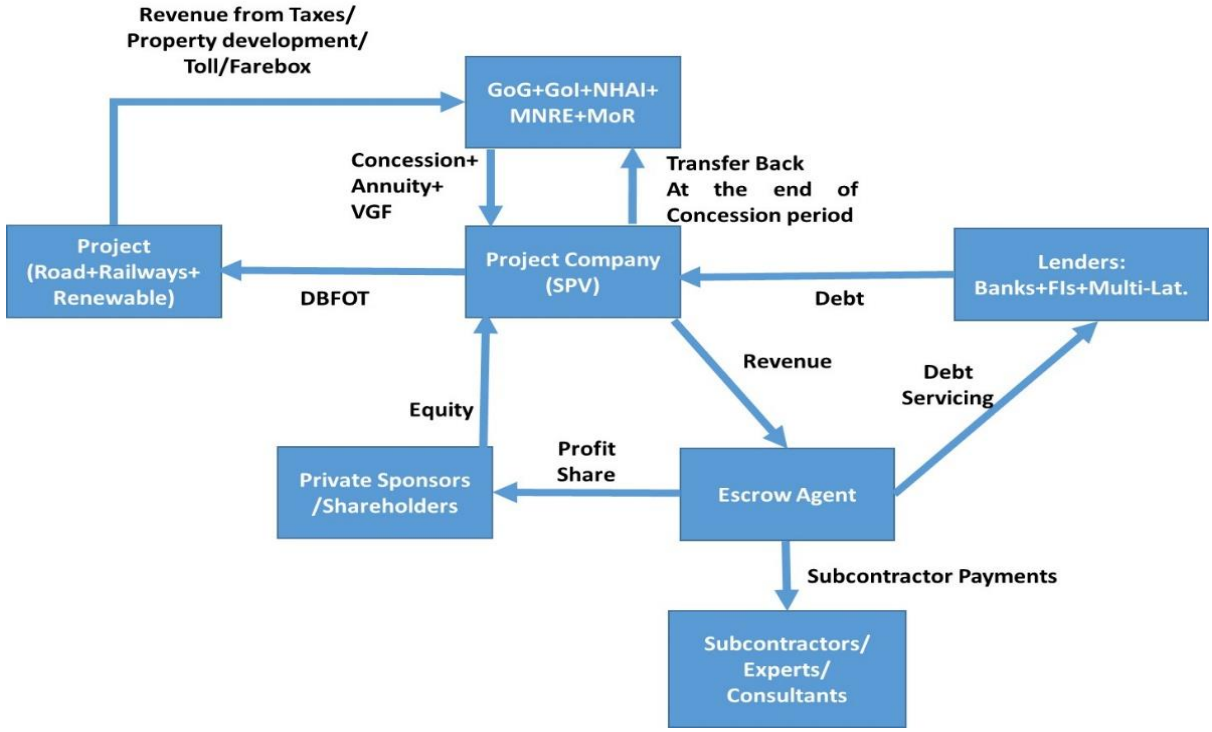


The approach stipulates offering Dyke construction on Engineering, Procurement, and Construction (EPC) contract. The authority (GoG and GoI) may finance the construction of the project through issuance of deep discount (no coupon bonds). These bonds can be created through securitization of two set of cash flows. (1) Expected incremental taxes from the development of Kalpasar Dyke project from the vicinity of the region (related to tourism and other economic activity). (2) Revenues from partial sale of land (valuation and monetization of the reclaimed land provided in financial model). Since these are deep discount bonds with no coupon payments, there is no pressure on the cash flows in the short-to-medium term. These bonds are expected to have a financing cost of 6%-8%. However, the cash outflows are expected to occur only after 10-15 years in the form of final principal payment only.

(B) Road +Railways+RE (Wind+Solar)

The figure below provides an illustrative transaction structure of PPP approach to the project bundle (Road, Railways, RE).

Figure 32.22: Project (Road+Railway+RE) DBFOT-PPP



The approach stipulates offering the project bundle (Railway+Road+Solar +Wind) through Design, Build, Finance, Operate, and Transfer (DBFOT) model of PPP with an additional 20% as Viability Gap Funding (VGF) to make it viable for the private developer. However, unlike the scenario 1, here all the four individual projects will be awarded together to a single concessionaire (not separately on PPP basis). Thus, the single consortium will be responsible for executing all the four project components, and will act as single point of contact.

The concessioning authorities [Government of Gujarat (GoG), Government of India (GoI), MNRE, NHAI, MoR] are expected to sign a concession agreement with the private developer (the Concessionaire). The private developer is expected to design, build, finance, and operate (and maintain) the all the four projects over the life of the concession agreement. Given the huge size of this project bundle, it is expected that a consortium of multiple members with expertise in different areas have to come together to finance and implement the project. Given the PPP nature of the project and considerable positive externalities associated with the project, the concessioning authority may consider providing VGF (quasi equity) to the extent of 20% during the construction phase subject to achievement of milestones, which will reduce the funding risk. The project development will lead to the collection of additional taxes from the area in the project vicinity.

This VGF may not put additional burden on the state and central finances. For example, state development bonds (SDBs) or municipal bonds can be issued through securitization of expected future cash inflows from the taxes and property development charges from the project development. These can be deep discount bonds (no coupon) with considerably long-horizons (20-30 years) aligned to the development of the Kalpasar project. These immediate cash inflows from bond issuance can be employed to provide VGF to the project.

The remaining 80% of the cost is expected to be contributed by the private developer in the form of debt and equity capital. We stipulate that 20% equity will be raised by the private sponsors of the Special Purpose Vehicle (or SPV or Project Company), and the

remaining 60% may be raised with Banks, Financial institutions, and Multilateral funding agencies. Given the socio-economic nature of the project (creation of fresh water reservoir, road and railways, and renewable energy), it is expected that low-cost funding from multilateral institutions (e.g., World Bank, ADB, JBIC/JICA) may be available. Such soft loans are often provided at low cost (2-4%) and considerably long tenors (25-35 years) and help alleviate the debt servicing burden of the private developer. To provide easy access to debt capital markets, some credit enhancement to provide additional cushion the debt facility availed by the private developer can be offered. Customarily, the government can support these borrowings by allowing the creation of charges on future receivables, that is, project annuities. This model is widely followed across the world, wherein the receivables by the private developer (in the form of annuities from authorities) are used as collateral (by creating an Escrow mechanism) to back the future repayment of lenders' debt obligations. Given the certainty of annuity inflows from the Government to private developer, this should alleviate the financing cost of the private developer and help avail funding at cheap costs. To ensure the comfort of lenders, the escrow mechanism may be employed to achieve the waterfall mechanism of cash flows (With adequate cushions such as cash sweep clauses). This will ensure that annuities received from the authority would be first utilized to repay the creditors (payment to subcontractors, financing charges, O&M expenses etc.) and only after that the residual profits are distributed to the sponsors of the SPV company. Any additional credit enhancement such as creation of infrastructure development fund (from the issuance of SDBs/Municipal bonds) can be employed to support any further gap in financing or increasing the viability of the project. This is ascribed to the fact that such projects often result in a considerable amount of positive externalities (socio-economic development of lower strata), which is not captured by financial IRR analysis.

In order to ensure adequate returns to private developer, post-construction the inflation adjusted (indexed to a combination of WPI and CPI) annuities should be offered to the private developer. This annuity comprises two components. First, it offers a certain reasonable returns over the capital investment in the project bundle (Road, Railways, and RE projects), as mutually agreed between the private developer and authority. Customarily an assured financial IRR of 12% is considered adequate in such scenarios. Next, the O&M cost can be considered as pass-through with some incremental benefit margin of 5% reflecting the value addition by private developer in maintaining and operating the Dyke facility (e.g., O&M actuals+5%). This annuity (along with VGF) can be considered as the bid parameter in awarding the concession grant.

Overall this mechanism is expected to result in the following means of finance, funding pattern, and financing costs.

Table 32.112: Cost of Funds: Scenario 2

Source of Funding	Share	Cost of Funds
Dyke Project		
SDBs/Municipal Bonds/Multilaterals ##		4%-6%
Project Bundle (Road+Railways+RE)		
VGF#	20%	0%
Equity from SPV Company (Private Sponsors)	20%	12%-16%
Funding from Banks, FIs, and Multilaterals (World Bank, ADB, etc.)*	60%	4%-6%
	WACC	4.8%-6.8%

*Backed by credit enhancements from State and Central Govt

#PPP Cell, Dept. of Economic Affairs, stipulates VGF of 20% for projects
##Soft loans raised by authorities

The following are the strengths of this kind of structure.

- Since the EPC project has no direct visibility of cash inflows, it may be difficult to get a private developer to finance the Dyke project on standalone basis; thus an EPC structure is more suitable for the Dyke project
- Suited to large infrastructure projects in attracting private capital
- Given the one-point contact structure, the contractual obligations are relatively easy of monitor and less complex as compared to scenario-1
- Ensured annuity and VGF provide liquidity to private developer and reduces the funding risk
- Additional credit enhancements further reduce the cost of financing
- Escrow mechanism ensures discipline and payment of creditors
- Risk sharing through project finance structure mitigates various project implementation related risks
- Annuity/VGF as bid parameter invite more competition and results in more efficiency

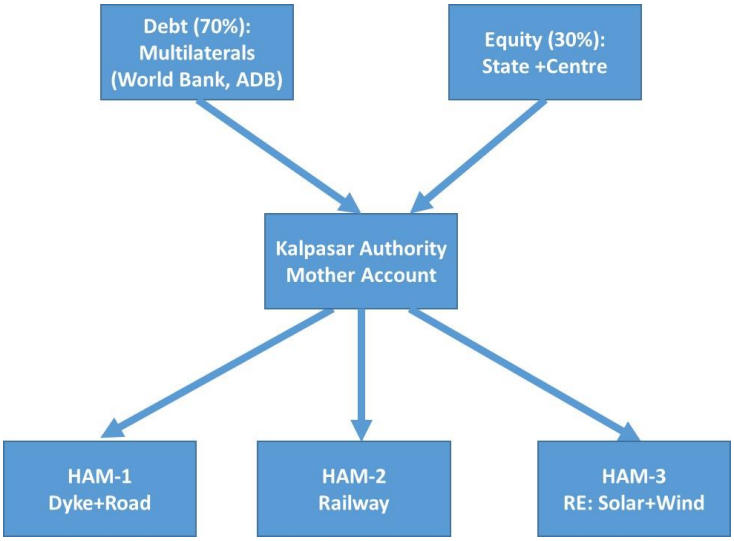
However, the following are some challenges:

- Difficult to find a consortium with the financial wherewithal to execute the complete bundle of the project under one umbrella
- Less flexibility to individual project implementation in a customized manner
- For road and railway projects, the involvement of private sector may be difficult to implement politically
- Given the private party is the borrower, additional credit enhancements may be required to reduce the financing costs (e.g., infrastructure development fund, creation of charge on annuity receivables through escrow, etc.)
- After the concession period, the assets are to be returned to the authority ; usually such government contracts stipulate an operation period of 15 years; however, longer tenor may be required to ensure the financial viability of the project for the private sector developer
- Limited upside for the private sector developer if the concession period is of short durations (10-20 years)

(3) Scenario 3 – HAM-PPP model

In this scenario, we consider the execution of the complete project in three project bundles with Hybrid Annuity Model (HAM-PPP) approach. All the three bundles (Child account: HAM-PPP projects) will be executed under Kalpasar Authority (Mother account). These three bundles include (1) Dyke+Road; (2) Railways; (3) Renewable Energy (Solar+Wind). The illustrative diagram is provided below.

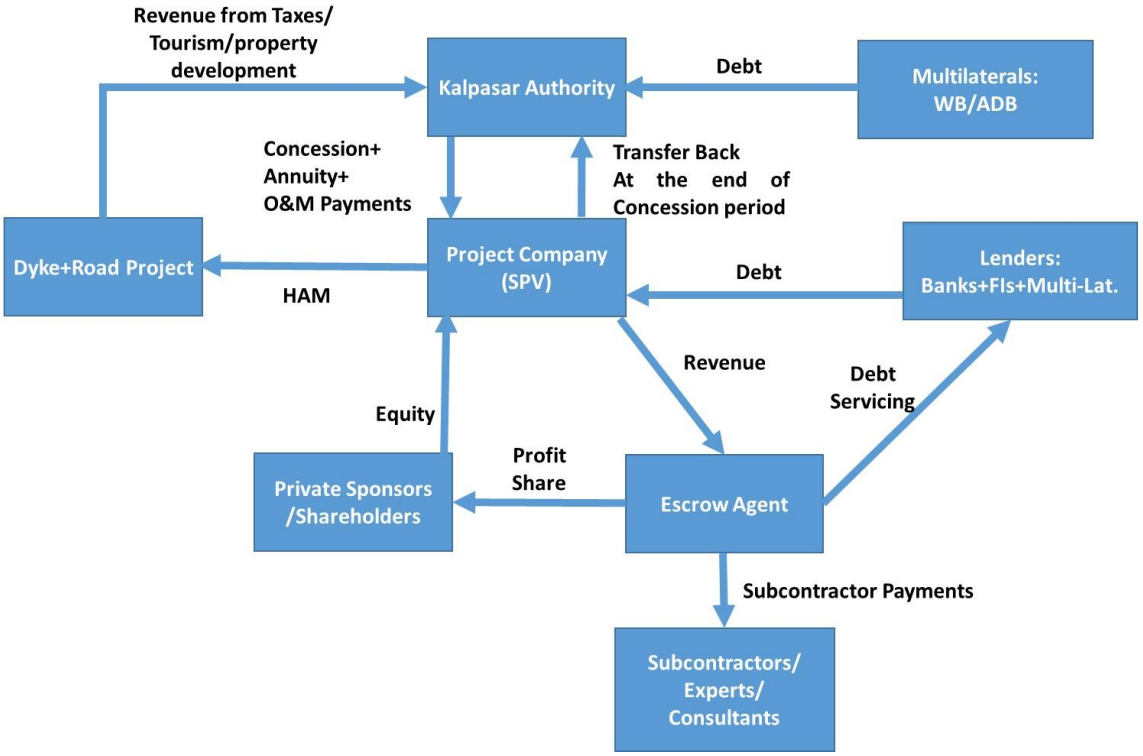
Figure 32.23: Scenario 3: HAM-PPP



(A) HAM1: Dyke+Road

A typical illustrative diagram for HAM1: Dyke+Road project bundle is shown here.

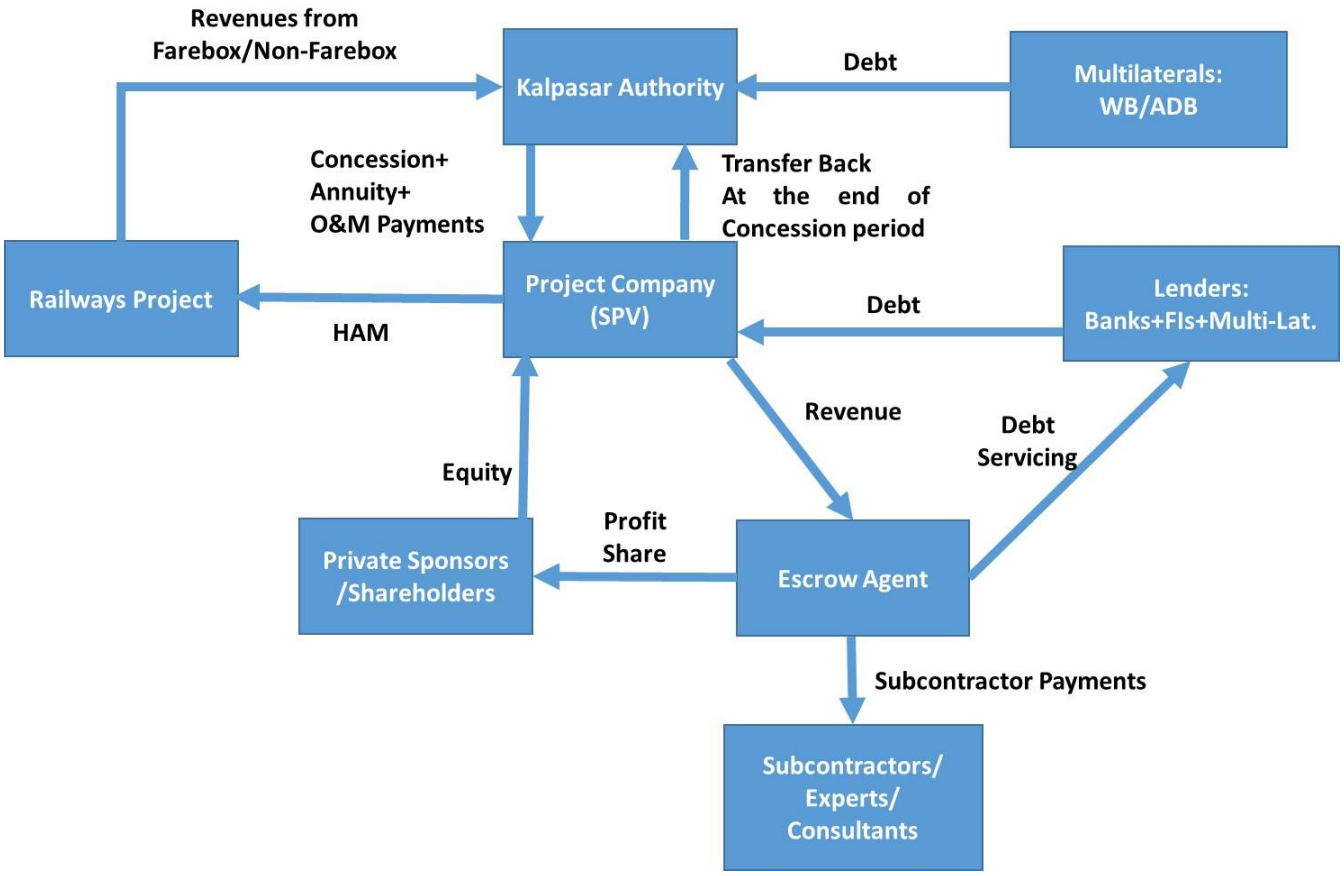
Figure 32.24: HAM1: Dyke+Road



(B) HAM2: Railways

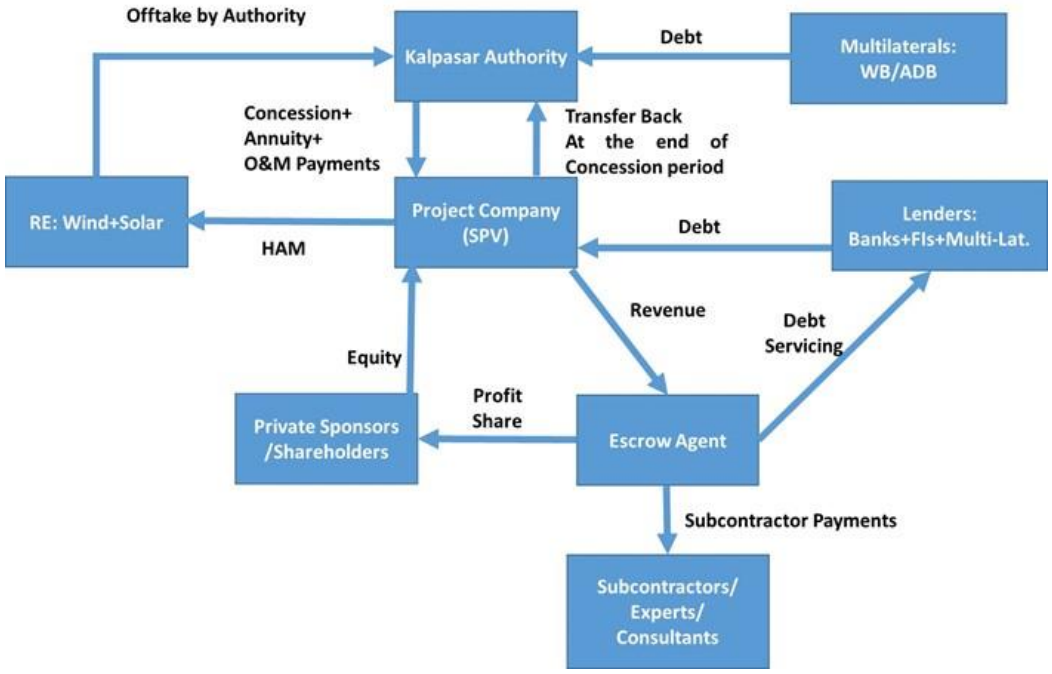
A typical illustrative diagram for HAM2: Railway project bundle is shown here.

Figure 32.25: HAM2: Railways



(C) HAM3: RE (Wind+Solar)

Figure 32.26: HAM3: RE (Wind+Solar)



The HAM model of PPP execution is novel and offers considerable flexibility and benefits over the conventional DBFOT/BOT structures. In this structure the Kalpasar authorities are proposed to tie-up financing from multilateral (70% of the cost). The remaining 30% is expected in the form of equity from state and central governments. The private developer will quote the NPV of the respective project bundle along with the O&M costs for the entire operation period as bid parameter. During the construction period 40% of the cost shall be payable to the concessionaire by the authority in five equal payments, linked to the physical progress of the project. The balance 60% will be borne by the concessionaire through a combination of equity and debt. This cost will be reimbursed in the form of inflation-indexed (weighted average of WPI and CPI) annuities post completion of the project. In addition to the cost, the concessionaire will also get interest that is bank rate+3% to account for the opportunity cost of the concessionaire. Moreover, the concessionaire will also get inflation indexed passthrough O&M payments, along with the annuity, till the end of the concession period. Collection of taxes, toll, fairbox, and other charges will be done by the authority. These revenues can be securitized to back the financing from multilaterals. Moreover, these revenues can also support the payments of annuities (project cost and O&M) that are the obligations of Kalpasar authorities (on behalf of state and central Governments).

Overall this mechanism is expected to result in the following means of finance, funding pattern, and financing costs.

Table 32.113: Cost of Funds: HAM

Source of Funding	Share	Cost of Funds
State + Central Equity	30%	12%
Funding from Banks, FIs, and Multilaterals (World Bank,	70%	4%-6%

ADB, etc.)*		
	WACC	6.4%-7.8%

*Backed by credit enhancements from State and Central Govt

The following are the strengths of this kind of structure.

- This kind of structure provides considerable visibility of revenues and lowers the funding risk for lenders
- More effective monitoring of contractual obligations that are binding on developers to complete the project in the stipulated time
- Project cost and O&M expenses being bidding criteria, the HAM model considerably improvise the competitive efficiency of the overall project pricing, that is whole-life cost of the project
- In addition, other clauses, such as those relating to deemed termination for excessive delay in project award, project milestones linked to physical and financial progress, provision of mobilization advances up to 10% of bid project cost, bonus payment on early completion, termination payment under concessionaire event of default, among others, are anticipated to bring more transparency and visibility of the project scope and expected benefits and penalties and more certainty to implementation.
- Funding risk: HAM model eases developer funding requirements by taking into account 40% construction support from authority. Mobilization advances up to 10% of bid project cost are expected to provide further padding. Overall, this lowers the project's funding risk.
- Project Implementation risk: Clauses like 80% availability of project land before the appointed date, deemed termination, which is further supported by construction grants and mobilization advances, are expected to lower the risk associated with implementing the project.
- Cash flow risk: Annuity payments from the authority and 60% of the project cost in the form of semi-annuities at a rate of Bank+3% are anticipated to somewhat alleviate the risk of cash flow during O&M.
- O&M risk: O&M risk is significantly countered by fixed annuity payments that are inflation-indexed.
- Interest rate risk: As per HAM, interest annuity is paid on reducing balance of bid-project cost at Bank+3%, thus reducing the interest rate risk to an extent.

However, the following are some challenges

- Less flexibility to individual project implementation in a customized manner
- For road and railway projects, the involvement of private sector may be difficult to implement politically
- After the concession period, the assets are to be returned to the authority ; usually such government contracts stipulate an operation period of 15 years; however, longer tenor may be required to ensure the financial viability of the project for the private sector developer
- Limited upside for the private sector developer if the concession period is of short durations (10-20 years)

It may be noted that such structures do not affect the project IRR (Modigliani–Miller). Since the value comes from the asset side of the project. Hence, given the project profitability, we do not anticipate any changes in project IRR on account of these structures pertaining to the financing of the project.

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ANNEXURES
Annexure A: Projections for Road Project

Table A.1 Project cash flow profile for (Normal scenario)

Year	2023	2028	2033	2038	2043	2048	2053	2058	2063	2068	2072
Cash Inflows											
Equity Inflow	530.76	530.76	-	-	-	-	-	-	-	-	-
Debt Inflow	796.14	796.14	-	-	-	-	-	-	-	-	-
Toll revenue	-	-	2,305.96	3,657.72	5,564.46	8,086.85	11,408.28	15,778.60	20,940.72	26,528.63	31,796.73
Non-Fare box revenue	-	-	319.20	586.96	1,035.15	1,744.00	2,852.16	4,573.08	7,035.87	10,333.02	13,939.39
Total Cash Inflows	**1,326.90**	**1,326.90**	**2,625.16**	**4,244.67**	**6,599.61**	**9,830.85**	**14,260.44**	**20,351.68**	**27,976.60**	**36,861.64**	**45,736.12**
Cash outflows											
Capex	1,326.90	1,326.90	-	-	-	-	-	-	-	-	-
Operation and maintenance cost	-	-	146.94	170.34	197.47	228.93	265.39	307.66	356.66	413.47	465.36
Principal repayment	-	-	289.51	289.51	289.51	289.51	-	-	-	-	-
Interest	-	-	282.27	209.89	137.51	65.14	-	-	-	-	-
Total cash outflow	**1,326.90**	**1,326.90**	**718.71**	**669.74**	**624.49**	**583.57**	**265.39**	**307.66**	**356.66**	**413.47**	**465.36**
Net cash flow before tax	**-**	**-**	**1,906.45**	**3,574.93**	**5,975.12**	**9,247.28**	**13,995.05**	**20,044.02**	**27,619.94**	**36,448.18**	**45,270.76**
Tax	-	-	365.94	1,173.90	2,113.35	3,302.70	4,882.66	7,008.48	9,663.91	12,755.50	15,844.05
Net cash flow after tax	**-**	**-**	**1,540.51**	**2,401.04**	**3,861.77**	**5,944.58**	**9,112.39**	**13,035.54**	**17,956.03**	**23,692.68**	**29,426.70**

Table A.2 Project cash flow profile (Good Scenario)

Year	2023	2028	2033	2038	2043	2048	2053	2058	2063	2068	2072
Cash Inflows											
Equity Inflow	500.81	500.81	-	-	-	-	-	-	-	-	-
Debt Inflow	751.21	751.21	-	-	-	-	-	-	-	-	-
Toll revenue	-	-	2,421.26	3,840.60	5,842.68	8,491.19	11,978.69	16,567.53	21,987.76	27,855.06	33,386.57
Non-Fare box revenue	-	-	335.16	616.30	1,086.91	1,831.20	2,994.77	4,801.73	7,387.67	10,849.67	14,636.36
Total Cash Inflows	**1,252.02**	**1,252.02**	**2,756.42**	**4,456.91**	**6,929.59**	**10,322.39**	**14,973.46**	**21,369.26**	**29,375.42**	**38,704.73**	**48,022.92**
Cash outflows											
Capex	1,252.02	1,252.02	-	-	-	-	-	-	-	-	-
Operation and maintenance cost	-	-	138.65	160.73	186.33	216.01	250.41	290.30	336.53	390.13	439.10
Principal repayment	-	-	273.17	273.17	273.17	273.17	-	-	-	-	-
Interest	-	-	266.34	198.05	129.75	61.46	-	-	-	-	-
Total cash outflow	**1,252.02**	**1,252.02**	**678.15**	**631.94**	**589.25**	**550.64**	**250.41**	**290.30**	**336.53**	**390.13**	**439.10**
Net cash flow before tax	**-**	**-**	**2,078.26**	**3,824.96**	**6,340.34**	**9,771.76**	**14,723.05**	**21,078.97**	**29,038.89**	**38,314.59**	**47,583.83**
Tax	-	-	443.08	1,265.77	2,239.93	3,482.54	5,138.34	7,371.11	10,160.71	13,408.82	16,653.67
Net cash flow after tax	**-**	**-**	**1,635.19**	**2,559.19**	**4,100.41**	**6,289.22**	**9,584.71**	**13,707.86**	**18,878.18**	**24,905.77**	**30,930.16**

Table A.3 Project cash flow profile (Favourable Scenario)

Year	2023	2028	2033	2038	2043	2048	2053	2058	2063	2068	2072
Cash Inflows											
Equity Inflow	471.26	471.26	-	-	-	-	-	-	-	-	-
Debt Inflow	706.89	706.89	-	-	-	-	-	-	-	-	-
Toll revenue	-	-	2,536.56	4,023.49	6,120.91	8,895.53	12,549.11	17,356.46	23,034.80	29,181.49	34,976.40
Non-Fare box revenue	-	-	351.12	645.65	1,138.67	1,918.40	3,137.38	5,030.39	7,739.46	11,366.32	15,333.33
Total Cash Inflows	**1,178.14**	**1,178.14**	**2,887.67**	**4,669.14**	**7,259.57**	**10,813.94**	**15,686.49**	**22,386.85**	**30,774.25**	**40,547.81**	**50,309.73**
Cash outflows											
Capex	1,178.14	1,178.14	-	-	-	-	-	-	-	-	-
Operation and maintenance cost	-	-	130.47	151.25	175.34	203.26	235.64	273.17	316.68	367.11	413.19
Principal repayment	-	-	257.05	257.05	257.05	257.05	-	-	-	-	-
Interest	-	-	250.62	186.36	122.10	57.84	-	-	-	-	-
Total cash outflow	**1,178.14**	**1,178.14**	**638.14**	**594.66**	**554.48**	**518.15**	**235.64**	**273.17**	**316.68**	**367.11**	**413.19**
Net cash flow before tax	**-**	**-**	**2,249.54**	**4,074.49**	**6,705.09**	**10,295.79**	**15,450.85**	**22,113.68**	**30,457.58**	**40,180.70**	**49,896.54**
Tax	-	-	519.80	1,357.41	2,366.37	3,662.26	5,393.94	7,733.64	10,657.42	14,062.03	17,463.16
Net cash flow after tax	**-**	**-**	**1,729.74**	**2,717.08**	**4,338.73**	**6,633.52**	**10,056.91**	**14,380.04**	**19,800.15**	**26,118.66**	**32,433.38**

Table A.4 Project cash flow profile (Bad Scenario)

Year	2023	2028	2033	2038	2043	2048	2053	2058	2063	2068	2072
Cash Inflows											
Equity Inflow	561.12	561.12	-	-	-	-	-	-	-	-	-
Debt Inflow	841.68	841.68	-	-	-	-	-	-	-	-	-
Toll revenue	-	-	2,190.66	3,474.83	5,286.24	7,682.51	10,837.87	14,989.67	19,893.69	25,202.20	30,206.89
Non-Fare box revenue	-	-	303.24	557.61	983.40	1,656.80	2,709.55	4,344.42	6,684.08	9,816.37	13,242.42
Total Cash Inflows	**1,402.81**	**1,402.81**	**2,493.90**	**4,032.44**	**6,269.63**	**9,339.31**	**13,547.42**	**19,334.10**	**26,577.77**	**35,018.56**	**43,449.31**
Cash outflows											
Capex	1,402.81	1,402.81	-	-	-	-	-	-	-	-	-
Operation and maintenance cost	-	-	155.35	180.09	208.77	242.02	280.57	325.26	377.06	437.12	491.98
Principal repayment	-	-	306.07	306.07	306.07	306.07	-	-	-	-	-
Interest	-	-	298.42	221.90	145.38	68.87	-	-	-	-	-
Total cash outflow	1,402.81	1,402.81	759.83	708.05	660.22	616.95	280.57	325.26	377.06	437.12	491.98
Net cash flow before tax	**-**	**-**	**1,734.07**	**3,324.39**	**5,609.41**	**8,722.35**	**13,266.85**	**19,008.84**	**26,200.70**	**34,581.44**	**42,957.33**
Tax	-	-	288.37	1,081.78	1,986.61	3,122.76	4,626.90	6,645.77	9,167.00	12,102.06	15,034.31
Net cash flow after tax	-	-	1,445.71	2,242.61	3,622.80	5,599.59	8,639.95	12,363.07	17,033.70	22,479.38	27,923.02

Table A.5 Project cash flow profile (Worst Scenario)

Cash Flow Statement											
Year	**2023**	**2028**	**2033**	**2038**	**2043**	**2048**	**2053**	**2058**	**2063**	**2068**	**2072**
Cash Inflows											
Equity Inflow	591.91	591.91	-	-	-	-	-	-	-	-	-
Debt Inflow	887.86	887.86	-	-	-	-	-	-	-	-	-
Toll revenue	-	-	2,075.36	3,291.95	5,008.01	7,278.16	10,267.45	14,200.74	18,846.65	23,875.76	28,617.06
Non-Fare box revenue	-	-	287.28	528.26	931.64	1,569.60	2,566.95	4,115.77	6,332.28	9,299.71	12,545.45
Total Cash Inflows	**1,479.77**	**1,479.77**	**2,362.64**	**3,820.21**	**5,939.65**	**8,847.77**	**12,834.40**	**18,316.51**	**25,178.94**	**33,175.48**	**41,162.51**
Cash outflows											
Capex	1,479.77	1,479.77	-	-	-	-	-	-	-	-	-
Operation and maintenance cost	-	-	163.87	189.97	220.22	255.30	295.96	343.10	397.75	461.10	518.97
Principal repayment	-	-	322.86	322.86	322.86	322.86	-	-	-	-	-
Interest	-	-	314.79	234.07	153.36	72.64	-	-	-	-	-
Total cash outflow	1,479.77	1,479.77	801.51	746.90	696.44	650.80	295.96	343.10	397.75	461.10	518.97
Net cash flow before tax	**-**	**-**	**1,561.13**	**3,073.31**	**5,243.21**	**8,196.96**	**12,538.43**	**17,973.41**	**24,781.19**	**32,714.38**	**40,643.53**
Tax	-	-	133.65	989.42	1,859.72	2,942.71	4,371.05	6,282.97	8,669.99	11,448.51	14,224.44
Net cash flow after tax	-	-	1,427.49	2,083.89	3,383.49	5,254.25	8,167.39	11,690.44	16,111.20	21,265.87	26,419.09

Annexure B: Projections for Railways

Table B.1 Project cash flow profile for 50 years (Normal scenario)

Year	2023	2028	2033	2038	2043	2048	2053	2058	2063	2068	2072
Cash Inflows											
Equity Inflow	423.11	423.11	-	-	-	-	-	-	-	-	-
Debt Inflow	634.67	634.67	-	-	-	-	-	-	-	-	-
Fare Box Revenue from Passenger Traffic	-	-	970.88	2,087.85	3,649.96	6,119.62	9,391.55	13,573.45	19,509.84	27,549.04	36,143.95
Freight revenue (with RORO)	-	-	88.40	241.96	480.15	742.16	1,075.46	1,496.11	1,965.65	2,479.79	2,941.89
Freight revenue (without RORO)	-	-	98.22	295.73	569.06	865.86	1,242.76	1,717.75	2,184.05	2,755.32	3,352.58
Non-Fare box revenue	-	-	335.98	837.60	1,697.50	3,299.38	5,869.90	9,834.91	16,387.77	26,826.18	39,612.92
Total Cash Inflows	**1,057.78**	**1,057.78**	**1,493.47**	**3,463.14**	**6,396.66**	**11,027.01**	**17,579.67**	**26,622.21**	**40,047.32**	**59,610.33**	**82,051.35**
Cash outflows											
Capex	1,057.78	1,057.78	-	-	-	-	-	-	-	-	-
Operation and maintenance cost	-	-	506.00	506.00	506.00	506.00	506.00	506.00	506.00	506.00	506.00
Principal repayment	-	-	230.79	230.79	230.79	230.79	-	-	-	-	-
Interest	-	-	225.02	167.32	109.62	51.93	-	-	-	-	-
Total cash outflow	**1,057.78**	**1,057.78**	**961.81**	**904.11**	**846.41**	**788.72**	**506.00**	**506.00**	**506.00**	**506.00**	**506.00**
Net cash flow before tax	**-**	**-**	**531.67**	**2,559.03**	**5,550.25**	**10,238.30**	**17,073.67**	**26,116.21**	**39,541.32**	**59,104.33**	**81,545.35**
Tax	-	-	-	834.01	1,960.17	3,636.14	5,963.34	9,135.15	13,837.01	20,685.43	28,540.31
Net cash flow after tax	**-**	**-**	**531.67**	**1,725.01**	**3,590.08**	**6,602.16**	**11,110.33**	**16,981.06**	**25,704.31**	**38,418.90**	**53,005.05**

Table B.2 Project cash flow profile for 50 years (Good scenario)

Year	2023	2028	2033	2038	2043	2048	2053	2058	2063	2068	2072
Cash Inflows											
Equity Inflow	399.24	399.24	-	-	-	-	-	-	-	-	-
Debt Inflow	598.85	598.85	-	-	-	-	-	-	-	-	-
Fare Box Revenue from Passenger Traffic	-	-	1,019.42	2,192.25	3,832.45	6,425.60	9,861.12	14,252.12	20,485.33	28,926.49	37,951.15
Freight revenue (with RORO)	-	-	92.82	254.06	504.15	779.27	1,129.23	1,570.91	2,063.93	2,603.78	3,088.99
Freight revenue (without RORO)	-	-	103.13	310.52	597.52	909.15	1,304.89	1,803.64	2,293.26	2,893.09	3,520.21
Non-Fare box revenue	-	-	352.78	879.48	1,782.37	3,464.35	6,163.40	10,326.65	17,207.16	28,167.49	41,593.57
Total Cash Inflows	**998.09**	**998.09**	**1,568.15**	**3,636.30**	**6,716.50**	**11,578.36**	**18,458.65**	**27,953.32**	**42,049.68**	**62,590.85**	**86,153.92**
Cash outflows											
Capex	998.09	998.09	-	-	-	-	-	-	-	-	-
Operation and maintenance cost	-	-	480.70	480.70	480.70	480.70	480.70	480.70	480.70	480.70	480.70
Principal repayment	-	-	217.77	217.77	217.77	217.77	-	-	-	-	-
Interest	-	-	212.32	157.88	103.44	49.00	-	-	-	-	-
Total cash outflow	**998.09**	**998.09**	**910.79**	**856.34**	**801.90**	**747.46**	**480.70**	**480.70**	**480.70**	**480.70**	**480.70**
Net cash flow before tax	**-**	**-**	**657.36**	**2,779.95**	**5,914.59**	**10,830.90**	**17,977.95**	**27,472.62**	**41,568.98**	**62,110.15**	**85,673.22**
Tax	-	-	0.00	914.82	2,086.70	3,840.58	6,280.54	9,610.21	14,546.83	21,737.53	29,985.09
Net cash flow after tax	**-**	**-**	**657.36**	**1,865.14**	**3,827.90**	**6,990.33**	**11,697.41**	**17,862.41**	**27,022.15**	**40,372.62**	**55,688.13**

Table B.3 Project cash flow profile for 50 years (Favourable scenario)

Year	2023	2028	2033	2038	2043	2048	2053	2058	2063	2068	2072
Cash Inflows											
Equity Inflow	375.68	375.68	-	-	-	-	-	-	-	-	-
Debt Inflow	563.52	563.52	-	-	-	-	-	-	-	-	-
Fare Box Revenue from Passenger Traffic	-	-	1,067.96	2,296.64	4,014.95	6,731.58	10,330.70	14,930.79	21,460.83	30,303.95	39,758.35
Freight revenue (with RORO)	-	-	97.24	266.16	528.16	816.38	1,183.01	1,645.72	2,162.21	2,727.77	3,236.08
Freight revenue (without RORO)	-	-	108.04	325.30	625.97	952.44	1,367.03	1,889.53	2,402.46	3,030.85	3,687.84
Non-Fare box revenue	-	-	369.58	921.36	1,867.25	3,629.32	6,456.90	10,818.40	18,026.55	29,508.80	43,574.22
Total Cash Inflows	**939.20**	**939.20**	**1,642.82**	**3,809.45**	**7,036.33**	**12,129.71**	**19,337.63**	**29,284.43**	**44,052.05**	**65,571.37**	**90,256.49**
Cash outflows											
Capex	939.20	939.20	-	-	-	-	-	-	-	-	-
Operation and maintenance cost	-	-	455.40	455.40	455.40	455.40	455.40	455.40	455.40	455.40	455.40
Principal repayment	-	-	204.92	204.92	204.92	204.92	-	-	-	-	-
Interest	-	-	199.79	148.56	97.34	46.11	-	-	-	-	-
Total cash outflow	**939.20**	**939.20**	**860.11**	**808.88**	**757.65**	**706.42**	**455.40**	**455.40**	**455.40**	**455.40**	**455.40**
Net cash flow before tax	**-**	**-**	**782.71**	**3,000.57**	**6,278.68**	**11,423.29**	**18,882.23**	**28,829.03**	**43,596.65**	**65,115.97**	**89,801.09**
Tax	-	-	0.00	995.47	2,213.15	4,044.98	6,597.74	10,085.26	15,256.65	22,789.62	31,429.88
Net cash flow after tax	**-**	**-**	**782.71**	**2,005.11**	**4,065.53**	**7,378.32**	**12,284.50**	**18,743.77**	**28,340.00**	**42,326.34**	**58,371.21**

Table B.4 Project cash flow profile for 50 years (Bad scenario)

Year	2023	2028	2033	2038	2043	2048	2053	2058	2063	2068	2072
Cash Inflows											
Equity Inflow	447.32	447.32	-	-	-	-	-	-	-	-	-
Debt Inflow	670.98	670.98	-	-	-	-	-	-	-	-	-
Fare Box Revenue from Passenger Traffic	-	-	922.33	1,983.46	3,467.46	5,813.64	8,921.97	12,894.78	18,534.35	26,171.59	34,336.76
Freight revenue (with RORO)	-	-	83.98	229.86	456.14	705.05	1,021.69	1,421.30	1,867.37	2,355.80	2,794.80
Freight revenue (without RORO)	-	-	93.31	280.94	540.61	822.56	1,180.62	1,631.86	2,074.85	2,617.56	3,184.95
Non-Fare box revenue	-	-	319.18	795.72	1,612.62	3,134.41	5,576.41	9,343.16	15,568.39	25,484.87	37,632.28
Total Cash Inflows	**1,118.30**	**1,118.30**	**1,418.80**	**3,289.98**	**6,076.83**	**10,475.66**	**16,700.68**	**25,291.10**	**38,044.95**	**56,629.82**	**77,948.78**
Cash outflows											
Capex	1,118.30	1,118.30	-	-	-	-	-	-	-	-	-
Operation and maintenance cost	-	-	531.30	531.30	531.30	531.30	531.30	531.30	531.30	531.30	531.30
Principal repayment	-	-	243.99	243.99	243.99	243.99	-	-	-	-	-
Interest	-	-	237.89	176.89	115.90	54.90	-	-	-	-	-
Total cash outflow	**1,118.30**	**1,118.30**	**1,013.18**	**952.19**	**891.19**	**830.19**	**531.30**	**531.30**	**531.30**	**531.30**	**531.30**
Net cash flow before tax	**-**	**-**	**405.62**	**2,337.80**	**5,185.64**	**9,645.47**	**16,169.38**	**24,759.80**	**37,513.65**	**56,098.52**	**77,417.48**
Tax	-	-	-	753.06	1,833.56	3,431.67	5,646.13	8,660.09	13,127.19	19,633.33	27,095.52
Net cash flow after tax	**-**	**-**	**405.62**	**1,584.74**	**3,352.08**	**6,213.80**	**10,523.25**	**16,099.71**	**24,386.46**	**36,465.19**	**50,321.96**

Table B.5 Project cash flow profile for 50 years (Worst scenario)

Year	2023	2028	2033	2038	2043	2048	2053	2058	2063	2068	2072
Cash Inflows											
Equity Inflow	471.86	471.86	-	-	-	-	-	-	-	-	-
Debt Inflow	707.79	707.79	-	-	-	-	-	-	-	-	-
Fare Box Revenue from Passenger Traffic	-	-	873.79	1,879.07	3,284.96	5,507.66	8,452.39	12,216.10	17,558.86	24,794.14	32,529.56
Freight revenue (with RORO)	-	-	79.56	217.76	432.13	667.95	967.92	1,346.49	1,769.08	2,231.81	2,647.70
Freight revenue (without RORO)	-	-	88.40	266.16	512.16	779.27	1,118.48	1,545.98	1,965.65	2,479.79	3,017.33
Non-Fare box revenue	-	-	302.38	753.84	1,527.75	2,969.44	5,282.91	8,851.42	14,749.00	24,143.56	35,651.63
Total Cash Inflows	**1,179.65**	**1,179.65**	**1,344.13**	**3,116.83**	**5,757.00**	**9,924.31**	**15,821.70**	**23,959.99**	**36,042.59**	**53,649.30**	**73,846.22**
Cash outflows											
Capex	1,179.65	1,179.65	-	-	-	-	-	-	-	-	-
Operation and maintenance cost	-	-	556.60	556.60	556.60	556.60	556.60	556.60	556.60	556.60	556.60
Principal repayment	-	-	257.38	257.38	257.38	257.38	-	-	-	-	-
Interest	-	-	250.94	186.60	122.25	57.91	-	-	-	-	-
Total cash outflow	**1,179.65**	**1,179.65**	**1,064.92**	**1,000.58**	**936.23**	**871.89**	**556.60**	**556.60**	**556.60**	**556.60**	**556.60**
Net cash flow before tax	**-**	**-**	**279.21**	**2,116.25**	**4,820.77**	**9,052.42**	**15,265.10**	**23,403.39**	**35,485.99**	**53,092.70**	**73,289.62**
Tax	-	-	-	636.14	1,706.88	3,227.16	5,328.91	8,185.03	12,417.36	18,581.23	25,650.73
Net cash flow after tax	**-**	**-**	**279.21**	**1,480.11**	**3,113.89**	**5,825.26**	**9,936.19**	**15,218.36**	**23,068.62**	**34,511.47**	**47,638.88**

Annexure C: Projections for Wind Project

Table C.1 Project cash flow profile for 30 years (Normal scenario)

Year	2023	2027	2031	2035	2039	2043	2047	2052
Cash Inflows								
Equity Inflow	736.11	736.11	-	-	-	-	-	-
Debt Inflow	1,717.59	1,717.59	-	-	-	-	-	-
Revenue in Cr (Tariff*Electricity generation)	-	-	3,728.43	3,728.43	3,728.43	3,728.43	3,728.43	3,728.43
Total Cash Inflows	**2,453.70**	**2,453.70**	**3,728.43**	**3,728.43**	**3,728.43**	**3,728.43**	**3,728.43**	**3,728.43**
Cash outflows								
Capex	2,453.70	2,453.70	-	-	-	-	-	-
Operation and maintenance cost	-	-	285.26	331.66	385.62	448.35	521.28	629.35
Principal repayment	-	-	343.52	343.52	343.52	343.52	343.52	343.52
Interest	-	-	590.85	480.92	371.00	261.07	151.15	13.74
Total cash outflow	**2,453.70**	**2,453.70**	**1,219.62**	**1,156.10**	**1,100.13**	**1,052.94**	**1,015.95**	**986.61**
Net cash flow before tax	**-**	**-**	**2,508.80**	**2,572.32**	**2,628.30**	**2,675.49**	**2,712.48**	**2,741.81**
Tax	-	-	685.28	815.17	905.39	968.24	1,011.59	1,045.61
Net cash flow after tax	**-**	**-**	**1,823.52**	**1,757.16**	**1,722.91**	**1,707.25**	**1,700.89**	**1,696.20**

Table C.2 Project cash flow profile for 30 years (Good scenario)

Year	2023	2027	2031	2035	2039	2043	2047	2052
Cash Inflows								
Equity Inflow	693.66	693.66	-	-	-	-	-	-
Debt Inflow	1,618.53	1,618.53	-	-	-	-	-	-
Revenue in Cr (Tariff*Electricity generation)	-	-	3,914.85	3,914.85	3,914.85	3,914.85	3,914.85	3,914.85
Total Cash Inflows	**2,312.19**	**2,312.19**	**3,914.85**	**3,914.85**	**3,914.85**	**3,914.85**	**3,914.85**	**3,914.85**
Cash outflows								
Capex	2,312.19	2,312.19	-	-	-	-	-	-
Operation and maintenance cost	-	-	270.99	315.08	366.33	425.93	495.22	597.89
Principal repayment	-	-	323.71	323.71	323.71	323.71	323.71	323.71
Interest	-	-	556.78	453.19	349.60	246.02	142.43	12.95
Total cash outflow	**2,312.19**	**2,312.19**	**1,151.48**	**1,091.97**	**1,039.64**	**995.65**	**961.35**	**934.54**
Net cash flow before tax	**-**	**-**	**2,763.37**	**2,822.87**	**2,875.20**	**2,919.20**	**2,953.49**	**2,980.31**
Tax	-	-	785.50	907.77	992.64	1,051.71	1,092.36	1,124.13
Net cash flow after tax	**-**	**-**	**1,977.87**	**1,915.11**	**1,882.56**	**1,867.49**	**1,861.13**	**1,856.18**

Table C.3 Project cash flow profile for 30 years (Favourable scenario)

Year	2023	2027	2031	2035	2039	2043	2047	2052
Cash Inflows								
Equity Inflow	651.89	651.89	-	-	-	-	-	-
Debt Inflow	1,521.07	1,521.07	-	-	-	-	-	-
Revenue in Cr (Tariff*Electricity generation)	-	-	4,101.27	4,101.27	4,101.27	4,101.27	4,101.27	4,101.27
Total Cash Inflows	**2,172.95**	**2,172.95**	**4,101.27**	**4,101.27**	**4,101.27**	**4,101.27**	**4,101.27**	**4,101.27**
Cash outflows								
Capex	2,172.95	2,172.95	-	-	-	-	-	-
Operation and maintenance cost	-	-	256.73	298.50	347.05	403.51	469.15	566.42
Principal repayment	-	-	304.21	304.21	304.21	304.21	304.21	304.21
Interest	-	-	523.25	425.90	328.55	231.20	133.85	12.17
Total cash outflow	**2,172.95**	**2,172.95**	**1,084.19**	**1,028.61**	**979.82**	**938.93**	**907.22**	**882.80**
Net cash flow before tax	**-**	**-**	**3,017.08**	**3,072.66**	**3,121.45**	**3,162.34**	**3,194.05**	**3,218.47**
Tax	-	-	885.24	1,000.03	1,079.65	1,135.00	1,173.02	1,202.61
Net cash flow after tax	**-**	**-**	**2,131.84**	**2,072.64**	**2,041.80**	**2,027.34**	**2,021.03**	**2,015.86**

Table C.4 Project cash flow profile for 30 years (Bad scenario)

Year	2023	2027	2031	2035	2039	2043	2047	2052
Cash Inflows								
Equity Inflow	779.26	779.26	-	-	-	-	-	-
Debt Inflow	1,818.27	1,818.27	-	-	-	-	-	-
Revenue in Cr (Tariff*Electricity generation)	-	-	3,542.01	3,542.01	3,542.01	3,542.01	3,542.01	3,542.01
Total Cash Inflows	**2,597.52**	**2,597.52**	**3,542.01**	**3,542.01**	**3,542.01**	**3,542.01**	**3,542.01**	**3,542.01**
Cash outflows								
Capex	2,597.52	2,597.52	-	-	-	-	-	-
Operation and maintenance cost	-	-	299.52	348.24	404.90	470.76	547.34	660.82
Principal repayment	-	-	363.65	363.65	363.65	363.65	363.65	363.65
Interest	-	-	625.48	509.11	392.75	276.38	160.01	14.55
Total cash outflow	**2,597.52**	**2,597.52**	**1,288.66**	**1,221.01**	**1,161.29**	**1,110.79**	**1,071.01**	**1,039.02**
Net cash flow before tax	**-**	**-**	**2,253.35**	**2,320.99**	**2,380.71**	**2,431.21**	**2,471.00**	**2,502.98**
Tax	-	-	584.57	722.21	817.88	884.61	930.72	967.06
Net cash flow after tax	**-**	**-**	**1,668.78**	**1,598.78**	**1,562.83**	**1,546.60**	**1,540.28**	**1,535.92**

Table C.5 Project cash flow profile for 30 years (Worst scenario)

Year	2023	2027	2031	2035	2039	2043	2047	2052
Cash Inflows								
Equity Inflow	823.12	823.12	-	-	-	-	-	-
Debt Inflow	1,920.61	1,920.61	-	-	-	-	-	-
Revenue in Cr (Tariff*Electricity generation)	-	-	3,355.58	3,355.58	3,355.58	3,355.58	3,355.58	3,355.58
Total Cash Inflows	**2,743.73**	**2,743.73**	**3,355.58**	**3,355.58**	**3,355.58**	**3,355.58**	**3,355.58**	**3,355.58**
Cash outflows								
Capex	2,743.73	2,743.73	-	-	-	-	-	-
Operation and maintenance cost	-	-	313.78	364.83	424.18	493.18	573.41	692.29
Principal repayment	-	-	384.12	384.12	384.12	384.12	384.12	384.12
Interest	-	-	660.69	537.77	414.85	291.93	169.01	15.36
Total cash outflow	**2,743.73**	**2,743.73**	**1,358.60**	**1,286.72**	**1,223.15**	**1,169.24**	**1,126.54**	**1,091.78**
Net cash flow before tax	**-**	**-**	**1,996.99**	**2,068.86**	**2,132.43**	**2,186.35**	**2,229.04**	**2,263.81**
Tax	-	-	483.36	628.89	730.12	800.81	849.75	888.48
Net cash flow after tax	**-**	**-**	**1,513.63**	**1,439.97**	**1,402.32**	**1,385.54**	**1,379.29**	**1,375.33**

Annexure D: Projections for Solar Project

Table D.1 Project cash flow profile for 30 years (Normal scenario)

Year	2023	2027	2031	2035	2039	2043	2047	2052
Cash Inflows								
Equity Inflow	488.37	488.37	-	-	-	-	-	-
Debt Inflow	1,139.53	1,139.53	-	-	-	-	-	-
Revenue in Cr (Tariff*Electricity generation)	-	-	2,473.63	2,473.63	2,473.63	2,473.63	2,473.63	2,473.63
Total Cash Inflows	**1,627.91**	**1,627.91**	**2,473.63**	**2,473.63**	**2,473.63**	**2,473.63**	**2,473.63**	**2,473.63**
Cash outflows								
Capex	1,627.91	1,627.91	-	-	-	-	-	-
Operation and maintenance cost	-	-	135.18	157.17	182.74	212.47	247.03	298.25
Principal repayment	-	-	227.91	227.91	227.91	227.91	227.91	227.91
Interest	-	-	392.00	319.07	246.14	173.21	100.28	9.12
Total cash outflow	**1,627.91**	**1,627.91**	**755.09**	**704.15**	**656.79**	**613.58**	**575.22**	**535.27**
Net cash flow before tax	**-**	**-**	**1,718.54**	**1,769.48**	**1,816.84**	**1,860.04**	**1,898.41**	**1,938.36**
Tax	-	-	473.58	562.83	626.26	672.13	705.73	735.47
Net cash flow after tax	**-**	**-**	**1,244.96**	**1,206.65**	**1,190.58**	**1,187.92**	**1,192.68**	**1,202.89**

Table D.2 Project cash flow profile for 30 years (Good scenario)

Year	2023	2027	2031	2035	2039	2043	2047	2052
Cash Inflows								
Equity Inflow	460.21	460.21	-	-	-	-	-	-
Debt Inflow	1,073.82	1,073.82	-	-	-	-	-	-
Revenue in Cr (Tariff*Electricity generation)	-	-	2,597.31	2,597.31	2,597.31	2,597.31	2,597.31	2,597.31
Total Cash Inflows	**1,534.03**	**1,534.03**	**2,597.31**	**2,597.31**	**2,597.31**	**2,597.31**	**2,597.31**	**2,597.31**
Cash outflows								
Capex	1,534.03	1,534.03	-	-	-	-	-	-
Operation and maintenance cost	-	-	128.42	149.31	173.60	201.84	234.68	283.33
Principal repayment	-	-	214.76	214.76	214.76	214.76	214.76	214.76
Interest	-	-	369.39	300.67	231.94	163.22	94.50	8.59
Total cash outflow	**1,534.03**	**1,534.03**	**712.58**	**664.75**	**620.31**	**579.83**	**543.94**	**506.69**
Net cash flow before tax	**-**	**-**	**1,884.73**	**1,932.56**	**1,977.00**	**2,017.48**	**2,053.37**	**2,090.62**
Tax	-	-	539.12	623.16	682.87	726.01	757.58	785.47
Net cash flow after tax	**-**	**-**	**1,345.61**	**1,309.40**	**1,294.13**	**1,291.47**	**1,295.79**	**1,305.15**

Table D.3 Project cash flow profile for 30 years (Favourable scenario)

Year	2023	2027	2031	2035	2039	2043	2047	2052
Cash Inflows								
Equity Inflow	432.49	432.49	-	-	-	-	-	-
Debt Inflow	1,009.15	1,009.15	-	-	-	-	-	-
Revenue in Cr (Tariff*Electricity generation)	-	-	2,720.99	2,720.99	2,720.99	2,720.99	2,720.99	2,720.99
Total Cash Inflows	**1,441.65**	**1,441.65**	**2,720.99**	**2,720.99**	**2,720.99**	**2,720.99**	**2,720.99**	**2,720.99**
Cash outflows								
Capex	1,441.65	1,441.65	-	-	-	-	-	-
Operation and maintenance cost	-	-	121.66	141.46	164.47	191.22	222.33	268.42
Principal repayment	-	-	201.83	201.83	201.83	201.83	201.83	201.83
Interest	-	-	347.15	282.56	217.98	153.39	88.81	8.07
Total cash outflow	**1,441.65**	**1,441.65**	**670.64**	**625.85**	**584.27**	**546.44**	**512.96**	**478.33**
Net cash flow before tax	**-**	**-**	**2,050.35**	**2,095.14**	**2,136.72**	**2,174.55**	**2,208.03**	**2,242.67**
Tax	-	-	604.34	683.27	739.32	779.79	809.37	835.45
Net cash flow after tax	**-**	**-**	**1,446.00**	**1,411.87**	**1,397.40**	**1,394.76**	**1,398.66**	**1,407.22**

Table D.4 Project cash flow profile for 30 years (Bad scenario)

Year	2023	2027	2031	2035	2039	2043	2047	2052
Cash Inflows								
Equity Inflow	517.00	517.00	-	-	-	-	-	-
Debt Inflow	1,206.33	1,206.33	-	-	-	-	-	-
Revenue in Cr (Tariff*Electricity generation)	-	-	2,349.95	2,349.95	2,349.95	2,349.95	2,349.95	2,349.95
Total Cash Inflows	**1,723.33**	**1,723.33**	**2,349.95**	**2,349.95**	**2,349.95**	**2,349.95**	**2,349.95**	**2,349.95**
Cash outflows								
Capex	1,723.33	1,723.33	-	-	-	-	-	-
Operation and maintenance cost	-	-	141.94	165.03	191.88	223.09	259.38	313.16
Principal repayment	-	-	241.27	241.27	241.27	241.27	241.27	241.27
Interest	-	-	414.98	337.77	260.57	183.36	106.16	9.65
Total cash outflow	**1,723.33**	**1,723.33**	**798.18**	**744.07**	**693.71**	**647.72**	**606.81**	**564.08**
Net cash flow before tax	**-**	**-**	**1,551.76**	**1,605.88**	**1,656.24**	**1,702.23**	**1,743.14**	**1,785.87**
Tax	-	-	407.71	502.25	569.49	618.13	653.80	685.44
Net cash flow after tax	**-**	**-**	**1,144.06**	**1,103.62**	**1,086.75**	**1,084.10**	**1,089.34**	**1,100.43**

Table D.5 Project cash flow profile for 30 years (Worst scenario)

Year	2023	2027	2031	2035	2039	2043	2047	2052
Cash Inflows								
Equity Inflow	546.10	546.10	-	-	-	-	-	-
Debt Inflow	1,274.23	1,274.23	-	-	-	-	-	-
Revenue in Cr (Tariff*Electricity generation)	-	-	2,226.27	2,226.27	2,226.27	2,226.27	2,226.27	2,226.27
Total Cash Inflows	**1,820.33**	**1,820.33**	**2,226.27**	**2,226.27**	**2,226.27**	**2,226.27**	**2,226.27**	**2,226.27**
Cash outflows								
Capex	1,820.33	1,820.33	-	-	-	-	-	-
Operation and maintenance cost	-	-	148.70	172.89	201.01	233.71	271.73	328.07
Principal repayment	-	-	254.85	254.85	254.85	254.85	254.85	254.85
Interest	-	-	438.34	356.78	275.23	193.68	112.13	10.19
Total cash outflow	**1,820.33**	**1,820.33**	**841.88**	**784.52**	**731.09**	**682.24**	**638.71**	**593.11**
Net cash flow before tax	-	-	1,384.38	1,441.75	1,495.17	1,544.02	1,587.55	1,633.15
Tax	-	-	341.50	441.44	512.54	564.02	601.81	635.39
Net cash flow after tax	-	-	1,042.88	1,000.30	982.63	980.01	985.75	997.76

Annexure E: Consolidated Cash Flow

Table E.1 Consolidated cash flow profile (Normal scenario)

Year	2023	2030	2037	2044	2051	2058	2065	2072
Cash Inflows								
Equity Inflow	6,845.87	953.87	-	-	-	-	-	-
Debt Inflow	15,178.79	1,430.81	-	-	-	-	-	-
Inflow from Rail	-	-	2,986.61	7,135.67	14,912.18	26,622.21	47,131.45	82,051.35
Inflow from Road	-	-	3,869.07	7,169.81	12,293.04	20,351.68	31,273.97	45,736.12
Inflow from Solar	-	2,473.63	2,473.63	2,473.63	2,473.63	-	-	-
Inflow from Wind	-	3,728.43	3,728.43	3,728.43	3,728.43	-	-	-
Inflows from Indirect Sources	-	9,507.35	21,210.39	29,283.17	34,097.11	41,380.25	44,168.34	67,475.84
Total Cash Inflows	**22,024.66**	**18,094.09**	**34,268.12**	**49,790.70**	**67,504.39**	**88,354.14**	**122,573.75**	**195,263.31**
Cash outflows								
Capex	22,024.66	2,384.68	-	-	-	-	-	-
Operation and maintainence cost	-	1,330.39	2,500.75	3,228.02	4,227.87	4,441.75	7,502.99	8,154.73
Principal repayment	-	3,142.27	3,662.56	3,662.56	3,662.56	-	-	-
Interest	-	3,342.32	2,705.72	1,483.78	261.84	-	-	-
Total Cash Outflow	**22,024.66**	**10,199.66**	**8,869.03**	**8,374.36**	**8,152.27**	**4,441.75**	**7,502.99**	**8,154.73**
Net cash flow before tax	**-**	**7,894.43**	**25,399.09**	**41,416.34**	**59,352.12**	**83,912.39**	**115,070.76**	**187,108.58**
Tax	-	1,090.44	3,107.14	6,222.33	7,484.72	16,143.64	26,598.64	44,384.36
Net cash flow after tax	**-**	**6,803.98**	**22,291.95**	**35,194.01**	**51,867.40**	**67,768.76**	**88,472.12**	**142,724.22**

Table E.2 Consolidated cash flow profile (Good scenario)

Year	2023	2030	2037	2044	2051	2058	2065	2072
Cash Inflows								
Equity Inflow	6,464.17	900.04	-	-	-	-	-	-
Debt Inflow	14,333.02	1,350.06	-	-	-	-	-	-
Inflow from Rail	-	-	3,135.94	7,492.45	15,657.79	27,953.32	49,488.02	86,153.92
Inflow from Road	-	-	4,062.52	7,528.30	12,907.69	21,369.26	32,837.67	48,022.92
Inflow from Solar	-	2,597.31	2,597.31	2,597.31	2,597.31	-	-	-
Inflow from Wind	-	3,914.85	3,914.85	3,914.85	3,914.85	-	-	-
Inflows from Indirect Sources	-	12,802.27	35,350.30	50,095.09	56,585.62	65,727.56	66,346.40	92,544.08
Total Cash Inflows	**20,797.19**	**21,564.54**	**49,060.92**	**71,628.00**	**91,663.26**	**115,050.14**	**148,672.09**	**226,720.92**
Cash outflows								
Capex	20,797.19	2,250.11	-	-	-	-	-	-
Operation and maintainence cost	-	1,259.13	2,367.97	3,055.91	4,001.64	4,199.07	7,089.48	7,707.15
Principal repayment	-	2,967.58	3,458.51	3,458.51	3,458.51	-	-	-
Interest	-	3,155.45	2,554.22	1,400.70	247.18	-	-	-
Total Cash Outflow	**20,797.19**	**9,632.26**	**8,380.71**	**7,915.13**	**7,707.34**	**4,199.07**	**7,089.48**	**7,707.15**
Net cash flow before tax	**-**	**11,932.28**	**40,680.21**	**63,712.87**	**83,955.93**	**110,851.07**	**141,582.61**	**219,013.77**
Tax	-	1,260.19	3,416.54	6,632.77	8,762.96	16,981.31	28,017.18	46,638.76
Net cash flow after tax	**-**	**10,672.08**	**37,263.67**	**57,080.10**	**75,192.97**	**93,869.76**	**113,565.42**	**172,375.01**

Table E.3 Consolidated cash flow profile (Favorable scenario)

Year	2023	2030	2037	2044	2051	2058	2065	2072
Cash Inflows								
Equity Inflow	6,087.08	846.94	-	-	-	-	-	-
Debt Inflow	13,497.41	1,270.40	-	-	-	-	-	-
Inflow from Rail	-	-	3,285.27	7,849.23	16,403.40	29,284.43	51,844.59	90,256.49
Inflow from Road	-	-	4,255.98	7,886.79	13,522.34	22,386.85	34,401.36	50,309.73
Inflow from Solar	-	2,720.99	2,720.99	2,720.99	2,720.99	-	-	-
Inflow from Wind	-	4,101.27	4,101.27	4,101.27	4,101.27	-	-	-
Inflows from Indirect Sources	-	12,802.27	35,350.30	50,095.09	56,585.62	65,727.56	66,346.40	92,544.08
Total Cash Inflows	**19,584.49**	**21,741.87**	**49,713.81**	**72,653.37**	**93,333.63**	**117,398.84**	**152,592.36**	**233,110.29**
Cash outflows								
Capex	19,584.49	2,117.34	-	-	-	-	-	-
Operation and maintainence cost	-	1,188.41	2,236.09	2,885.04	3,777.13	3,958.77	6,680.43	7,264.18
Principal repayment	-	2,794.95	3,256.91	3,256.91	3,256.91	-	-	-
Interest	-	2,970.89	2,404.64	1,318.67	232.71	-	-	-
Total Cash Outflow	**19,584.49**	**9,071.59**	**7,897.64**	**7,460.62**	**7,266.74**	**3,958.77**	**6,680.43**	**7,264.18**
Net cash flow before tax	**-**	**12,670.29**	**41,816.17**	**65,192.75**	**86,066.88**	**113,440.06**	**145,911.93**	**225,846.12**
Tax	-	1,429.07	3,725.02	7,042.76	10,040.99	17,818.90	29,435.22	48,893.03
Net cash flow after tax	**-**	**11,241.21**	**38,091.15**	**58,149.99**	**76,025.89**	**95,621.16**	**116,476.71**	**176,953.08**

Table E.4 Consolidated cash flow profile (Bad scenario)

Year	2023	2030	2037	2044	2051	2058	2065	2072
Cash Inflows								
Equity Inflow	7,232.26	1,008.44	-	-	-	-	-	-
Debt Inflow	16,034.91	1,512.66	-	-	-	-	-	-
Inflow from Rail	-	-	2,837.28	6,778.88	14,166.57	25,291.10	44,774.87	77,948.78
Inflow from Road	-	-	3,675.62	6,811.32	11,678.39	19,334.10	29,710.27	43,449.31
Inflow from Solar	-	2,349.95	2,349.95	2,349.95	2,349.95	-	-	-
Inflow from Wind	-	3,542.01	3,542.01	3,542.01	3,542.01	-	-	-
Inflows from Indirect Sources	-	8,222.43	20,435.23	28,792.03	33,396.41	40,376.98	42,521.10	64,426.49
Total Cash Inflows	**23,267.17**	**16,635.49**	**32,840.08**	**48,274.18**	**65,133.33**	**85,002.18**	**117,006.25**	**185,824.59**
Cash outflows								
Capex	23,267.17	2,521.11	-	-	-	-	-	-
Operation and maintainence cost	-	1,402.22	2,634.45	3,401.39	4,455.84	4,686.85	7,921.04	8,607.00
Principal repayment	-	3,319.04	3,869.10	3,869.10	3,869.10	-	-	-
Interest	-	3,531.56	2,859.15	1,567.92	276.69	-	-	-
Total Cash Outflow	**23,267.17**	**10,773.93**	**9,362.70**	**8,838.41**	**8,601.64**	**4,686.85**	**7,921.04**	**8,607.00**
Net cash flow before tax	**-**	**5,861.57**	**23,477.38**	**39,435.77**	**56,531.69**	**80,315.33**	**109,085.21**	**177,217.59**
Tax	-	919.81	2,637.12	5,811.43	6,206.26	15,305.87	25,179.58	42,129.83
Net cash flow after tax	**-**	**4,941.76**	**20,840.26**	**33,624.34**	**50,325.43**	**65,009.46**	**83,905.63**	**135,087.76**

Table E.5 Consolidated cash flow profile (Worst scenario)

Year	2023	2030	2037	2044	2051	2058	2065	2072
Cash Inflows								
Equity Inflow	7,623.45	1,063.77	-	-	-	-	-	-
Debt Inflow	16,901.58	1,595.65	-	-	-	-	-	-
Inflow from Rail	-	-	2,687.94	6,422.10	13,420.96	23,959.99	42,418.30	73,846.22
Inflow from Road	-	-	3,482.16	6,452.83	11,063.73	18,316.51	28,146.57	41,162.51
Inflow from Solar	-	2,226.27	2,226.27	2,226.27	2,226.27	-	-	-
Inflow from Wind	-	3,355.58	3,355.58	3,355.58	3,355.58	-	-	-
Inflows from Indirect Sources	-	8,222.43	20,435.23	28,792.03	33,396.41	40,376.98	42,521.10	64,426.49
Total Cash Inflows	**24,525.03**	**16,463.70**	**32,187.19**	**47,248.81**	**63,462.96**	**82,653.49**	**113,085.98**	**179,435.22**
Cash outflows								
Capex	24,525.03	2,659.42	-	-	-	-	-	-
Operation and maintainence cost	-	1,474.61	2,769.07	3,576.04	4,685.60	4,934.41	8,343.71	9,064.03
Principal repayment	-	3,497.94	4,078.18	4,078.18	4,078.18	-	-	-
Interest	-	3,723.22	3,014.57	1,653.15	291.73	-	-	-
Total Cash Outflow	**24,525.03**	**11,355.18**	**9,861.81**	**9,307.37**	**9,055.50**	**4,934.41**	**8,343.71**	**9,064.03**
Net cash flow before tax	**-**	**5,108.52**	**22,325.38**	**37,941.44**	**54,407.46**	**77,719.07**	**104,742.27**	**170,371.19**
Tax	-	748.26	1,996.20	5,400.05	5,254.20	14,468.00	23,759.99	39,875.18
Net cash flow after tax	**-**	**4,360.26**	**20,329.18**	**32,541.38**	**49,153.26**	**63,251.07**	**80,982.27**	**130,496.01**

Annexure F: Economic Analysis

Table F.1 Consolidated cash flow profile (Normal Scenario)

Year	2023	2030	2037	2044	2051	2058	2065	2072
Economic Cash Flows								
Cash Inflows from Rail	0.00	0.00	2,986.61	7,135.67	14,912.18	26,622.21	47,131.45	82,051.35
Cash Inflows from Road	0.00	0.00	3,869.07	7,169.81	12,293.04	20,351.68	31,273.97	45,736.12
Cash Inflows from Solar	0.00	2,473.63	2,473.63	2,473.63	2,473.63	0.00	0.00	0.00
Cash Inflows from Wind	0.00	3,728.43	3,728.43	3,728.43	3,728.43	0.00	0.00	0.00
Cash Inflows from Fresh Water	0.00	987.27	1,790.68	3,331.16	6,303.24	12,059.47	23,234.51	44,961.31
Cash Inflows from Land	0.00	6,309.02	3,048.08	935.92	935.26	478.02	0.00	0.00
Cash Inflows from Fisheries	0.00	55.70	195.72	240.71	296.04	364.09	447.78	550.72
Cash Inflows from Employment	0.00	2,155.37	16,175.92	24,775.39	26,562.57	28,478.67	20,486.05	21,963.82
Economic Benefits	0.00	0.00	16,509.74	22,173.54	27,760.81	32,723.02	37,839.16	42,272.92
Total Operational Cash Inflows	**0.00**	**15,709.41**	**50,777.86**	**71,964.24**	**95,265.20**	**121,077.16**	**160,412.91**	**237,536.23**
Cash outflows								
Capital Expenditure Phasing								
Dyke Project	12,913.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Railway	877.96	877.96	0.00	0.00	0.00	0.00	0.00	0.00
Road	1,101.33	1,101.33	0.00	0.00	0.00	0.00	0.00	0.00
Solar	1,351.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wind	2,036.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cash outflows from Capex	**18,280.47**	**1,979.29**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Operation and maintainence cost								
Dyke Project	0.00	805.19	1,132.98	1,594.22	2,243.22	3,156.44	4,441.43	6,249.53
Railway	0.00	0.00	440.22	440.22	440.22	440.22	440.22	440.22
Road	0.00	0.00	143.88	176.96	217.63	267.66	1,645.95	404.86
Solar	0.00	113.26	147.44	191.95	249.88	0.00	0.00	0.00
Wind	0.00	239.00	311.13	405.04	527.29	0.00	0.00	0.00
Cash outflows from O&M Expenses	**0.00**	**1,157.44**	**2,175.66**	**2,808.38**	**3,678.25**	**3,864.32**	**6,527.60**	**7,094.62**
Net cash flow before tax	**-18,280.47**	**12,572.68**	**48,602.21**	**69,155.86**	**91,586.95**	**117,212.84**	**153,885.31**	**230,441.61**
Tax								
Railway	0.00	0.00	638.05	2,232.34	1,528.15	9,135.15	16,317.14	28,540.31
Road	0.00	0.00	1,007.58	2,327.80	4,185.81	7,008.48	10,281.50	15,844.05
Solar	0.00	445.87	597.17	681.52	730.42	0.00	0.00	0.00
Wind	0.00	644.57	864.34	980.68	1,040.34	0.00	0.00	0.00
Cash outflows from taxes	**0.00**	**1,090.44**	**3,107.14**	**6,222.33**	**7,484.72**	**16,143.64**	**26,598.64**	**44,384.36**
Net cash flow after tax	**-18,280.47**	**11,482.24**	**45,495.06**	**62,933.53**	**84,102.23**	**101,069.20**	**127,286.67**	**186,057.25**

Table F.2 Consolidated cash flow profile (Good Scenario)

Year	2023	2030	2037	2044	2051	2058	2065	2072
Economic Cash Flows								
Cash Inflows from Rail	0.00	0.00	3,135.94	7,492.45	15,657.79	27,953.32	49,488.02	86,153.92
Cash Inflows from Road	0.00	0.00	4,062.52	7,528.30	12,907.69	21,369.26	32,837.67	48,022.92
Cash Inflows from Solar	0.00	2,597.31	2,597.31	2,597.31	2,597.31	0.00	0.00	0.00
Cash Inflows from Wind	0.00	3,914.85	3,914.85	3,914.85	3,914.85	0.00	0.00	0.00
Cash Inflows from Fresh Water	0.00	1,055.70	1,910.59	3,548.86	6,708.49	12,826.62	24,702.63	47,790.37
Cash Inflows from Land	0.00	7,745.04	3,741.87	1,148.95	1,148.14	586.82	0.00	0.00
Cash Inflows from Fisheries	0.00	83.55	293.57	361.06	444.06	546.13	671.68	826.08
Cash Inflows from Employment	0.00	3,917.98	29,404.27	45,036.23	48,284.93	51,767.98	40,972.10	43,927.63
Economic Benefits	0.00	0.00	16,509.74	22,173.54	27,760.81	32,723.02	37,839.16	42,272.92
Total Operational Cash Inflows	**0.00**	**19,314.43**	**65,570.66**	**93,801.54**	**119,424.07**	**147,773.16**	**186,511.25**	**268,993.84**
Cash outflows								
Capital Expenditure Phasing								
Dyke Project	12,201.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Railway	828.41	828.41	0.00	0.00	0.00	0.00	0.00	0.00
Road	1,039.17	1,039.17	0.00	0.00	0.00	0.00	0.00	0.00
Solar	1,273.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wind	1,919.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cash outflows from Capex	**17,261.67**	**1,867.59**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Operation and maintainence cost								
Dyke Project	0.00	760.80	1,070.52	1,506.33	2,119.55	2,982.43	4,196.57	5,905.00
Railway	0.00	0.00	418.21	418.21	418.21	418.21	418.21	418.21
Road	0.00	0.00	135.76	166.97	205.35	252.56	1,553.07	382.02
Solar	0.00	107.60	140.07	182.35	237.39	0.00	0.00	0.00
Wind	0.00	227.05	295.57	384.79	500.93	0.00	0.00	0.00
Cash outflows from O&M Expenses	**0.00**	**1,095.44**	**2,060.14**	**2,658.64**	**3,481.43**	**3,653.19**	**6,167.85**	**6,705.22**
Net cash flow before tax	**-17,261.67**	**16,351.40**	**63,510.53**	**91,142.90**	**115,942.65**	**144,119.97**	**180,343.40**	**262,288.62**
Tax								
Railway	0.00	0.00	712.16	2,371.04	2,455.47	9,610.21	17,150.89	29,985.09
Road	0.00	0.00	1,094.85	2,463.52	4,407.53	7,371.11	10,866.29	16,653.67
Solar	0.00	513.02	655.50	734.84	780.75	0.00	0.00	0.00
Wind	0.00	747.17	954.04	1,063.38	1,119.22	0.00	0.00	0.00

Year	2023	2030	2037	2044	2051	2058	2065	2072
Cash outflows from taxes	0.00	1,260.19	3,416.54	6,632.77	8,762.96	16,981.31	28,017.18	46,638.76
Net cash flow after tax	-17,261.67	15,091.21	60,093.98	84,510.12	107,179.69	127,138.66	152,326.22	215,649.86

Table F.3 Consolidated cash flow profile (Favorable Scenario)

Year	2023	2030	2037	2044	2051	2058	2065	2072
Economic Cash Flows								
Cash Inflows from Rail	0.00	0.00	3,285.27	7,849.23	16,403.40	29,284.43	51,844.59	90,256.49
Cash Inflows from Road	0.00	0.00	4,255.98	7,886.79	13,522.34	22,386.85	34,401.36	50,309.73
Cash Inflows from Solar	0.00	2,720.99	2,720.99	2,720.99	2,720.99	0.00	0.00	0.00
Cash Inflows from Wind	0.00	4,101.27	4,101.27	4,101.27	4,101.27	0.00	0.00	0.00
Cash Inflows from Fresh Water	0.00	1,055.70	1,910.59	3,548.86	6,708.49	12,826.62	24,702.63	47,790.37
Cash Inflows from Land	0.00	7,745.04	3,741.87	1,148.95	1,148.14	586.82	0.00	0.00
Cash Inflows from Fisheries	0.00	83.55	293.57	361.06	444.06	546.13	671.68	826.08
Cash Inflows from Employment	0.00	3,917.98	29,404.27	45,036.23	48,284.93	51,767.98	40,972.10	43,927.63
Economic Benefits	0.00	0.00	16,509.74	22,173.54	27,760.81	32,723.02	37,839.16	42,272.92
Total Operational Cash Inflows	**0.00**	**19,624.53**	**66,223.55**	**94,826.91**	**121,094.44**	**150,121.86**	**190,431.52**	**275,383.21**
Cash outflows								
Capital Expenditure Phasing								
Dyke Project	11,497.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Railway	779.53	779.53	0.00	0.00	0.00	0.00	0.00	0.00
Road	977.86	977.86	0.00	0.00	0.00	0.00	0.00	0.00
Solar	1,196.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wind	1,803.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cash outflows from Capex	**16,255.13**	**1,757.39**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Operation and maintainence cost								
Dyke Project	0.00	716.88	1,008.73	1,419.38	1,997.21	2,810.28	3,954.35	5,564.16
Railway	0.00	0.00	396.20	396.20	396.20	396.20	396.20	396.20
Road	0.00	0.00	127.75	157.12	193.24	237.66	1,461.43	359.47
Solar	0.00	101.93	132.70	172.75	224.89	0.00	0.00	0.00
Wind	0.00	215.10	280.02	364.53	474.56	0.00	0.00	0.00
Cash outflows from O&M Expenses	**0.00**	**1,033.91**	**1,945.39**	**2,509.98**	**3,286.10**	**3,444.13**	**5,811.97**	**6,319.83**
Net cash flow before tax	**-16,255.13**	**16,833.23**	**64,278.15**	**92,316.93**	**117,808.34**	**146,677.73**	**184,619.54**	**269,063.38**
Tax								
Railway	0.00	0.00	786.10	2,509.67	3,382.75	10,085.26	17,984.65	31,429.88
Road	0.00	0.00	1,181.85	2,599.10	4,629.15	7,733.64	11,450.57	17,463.16
Solar	0.00	579.83	713.63	788.06	831.04	0.00	0.00	0.00
Wind	0.00	849.24	1,043.44	1,145.93	1,198.05	0.00	0.00	0.00

Year	2023	2030	2037	2044	2051	2058	2065	2072
Cash outflows from taxes	0.00	1,429.07	3,725.02	7,042.76	10,040.99	17,818.90	29,435.22	48,893.03
Net cash flow after tax	-16,255.13	15,404.15	60,553.14	85,274.17	107,767.35	128,858.82	155,184.32	220,170.34

Table F.4 Consolidated cash flow profile (Bad Scenario)

Year	2023	2030	2037	2044	2051	2058	2065	2072
Economic Cash Flows								
Cash Inflows from Rail	0.00	0.00	2,837.28	6,778.88	14,166.57	25,291.10	44,774.87	77,948.78
Cash Inflows from Road	0.00	0.00	3,675.62	6,811.32	11,678.39	19,334.10	29,710.27	43,449.31
Cash Inflows from Solar	0.00	2,349.95	2,349.95	2,349.95	2,349.95	0.00	0.00	0.00
Cash Inflows from Wind	0.00	3,542.01	3,542.01	3,542.01	3,542.01	0.00	0.00	0.00
Cash Inflows from Fresh Water	0.00	918.84	1,670.76	3,113.46	5,897.99	11,292.32	21,766.39	42,132.25
Cash Inflows from Land	0.00	5,114.81	2,471.12	758.76	758.23	387.54	0.00	0.00
Cash Inflows from Fisheries	0.00	33.42	117.43	144.42	177.62	218.45	268.67	330.43
Cash Inflows from Employment	0.00	2,155.37	16,175.92	24,775.39	26,562.57	28,478.67	20,486.05	21,963.82
Economic Benefits	0.00	0.00	16,509.74	22,173.54	27,760.81	32,723.02	37,839.16	42,272.92
Total Operational Cash Inflows	**0.00**	**14,114.39**	**49,349.82**	**70,447.72**	**92,894.14**	**117,725.20**	**154,845.41**	**228,097.51**
Cash outflows								
Capital Expenditure Phasing								
Dyke Project	13,632.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Railway	928.19	928.19	0.00	0.00	0.00	0.00	0.00	0.00
Road	1,164.33	1,164.33	0.00	0.00	0.00	0.00	0.00	0.00
Solar	1,430.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wind	2,155.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cash outflows from Capex	**19,311.75**	**2,092.52**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Operation and maintainence cost								
Dyke Project	0.00	850.06	1,196.12	1,683.07	2,368.24	3,332.35	4,688.96	6,597.83
Railway	0.00	0.00	462.23	462.23	462.23	462.23	462.23	462.23
Road	0.00	0.00	152.11	187.08	230.08	282.97	1,740.12	428.02
Solar	0.00	118.92	154.82	201.54	262.37	0.00	0.00	0.00
Wind	0.00	250.95	326.69	425.29	553.65	0.00	0.00	0.00
Cash outflows from O&M Expenses	**0.00**	**1,219.93**	**2,291.97**	**2,959.21**	**3,876.58**	**4,077.56**	**6,891.30**	**7,488.09**
Net cash flow before tax	**-19,311.75**	**10,801.94**	**47,057.85**	**67,488.51**	**89,017.55**	**113,647.64**	**147,954.10**	**220,609.42**
Tax								
Railway	0.00	0.00	404.08	2,093.57	600.79	8,660.09	15,483.38	27,095.52
Road	0.00	0.00	920.04	2,191.94	3,964.00	6,645.77	9,696.20	15,034.31
Solar	0.00	378.36	538.65	628.10	680.07	0.00	0.00	0.00
Wind	0.00	541.45	774.34	897.83	961.41	0.00	0.00	0.00

Year	2023	2030	2037	2044	2051	2058	2065	2072
Cash outflows from taxes	0.00	919.81	2,637.12	5,811.43	6,206.26	15,305.87	25,179.58	42,129.83
Net cash flow after tax	-19,311.75	9,882.13	44,420.73	61,677.08	82,811.29	98,341.77	122,774.52	178,479.59

Table F.5 Consolidated cash flow profile (Worst Scenario)

Year	2023	2030	2037	2044	2051	2058	2065	2072
Economic Cash Flows								
Cash Inflows from Rail	0.00	0.00	2,687.94	6,422.10	13,420.96	23,959.99	42,418.30	73,846.22
Cash Inflows from Road	0.00	0.00	3,482.16	6,452.83	11,063.73	18,316.51	28,146.57	41,162.51
Cash Inflows from Solar	0.00	2,226.27	2,226.27	2,226.27	2,226.27	0.00	0.00	0.00
Cash Inflows from Wind	0.00	3,355.58	3,355.58	3,355.58	3,355.58	0.00	0.00	0.00
Cash Inflows from Fresh Water	0.00	918.84	1,670.76	3,113.46	5,897.99	11,292.32	21,766.39	42,132.25
Cash Inflows from Land	0.00	5,114.81	2,471.12	758.76	758.23	387.54	0.00	0.00
Cash Inflows from Fisheries	0.00	33.42	117.43	144.42	177.62	218.45	268.67	330.43
Cash Inflows from Employment	0.00	2,155.37	16,175.92	24,775.39	26,562.57	28,478.67	20,486.05	21,963.82
Economic Benefits	0.00	0.00	16,509.74	22,173.54	27,760.81	32,723.02	37,839.16	42,272.92
Total Operational Cash Inflows	**0.00**	**13,804.28**	**48,696.93**	**69,422.35**	**91,223.77**	**115,376.51**	**150,925.14**	**221,708.14**
Cash outflows								
Capital Expenditure Phasing								
Dyke Project	14,360.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Railway	979.11	979.11	0.00	0.00	0.00	0.00	0.00	0.00
Road	1,228.21	1,228.21	0.00	0.00	0.00	0.00	0.00	0.00
Solar	1,510.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wind	2,277.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cash outflows from Capex	**20,355.77**	**2,207.31**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Operation and maintainence cost								
Dyke Project	0.00	895.43	1,259.96	1,772.89	2,494.63	3,510.20	4,939.20	6,949.96
Railway	0.00	0.00	484.24	484.24	484.24	484.24	484.24	484.24
Road	0.00	0.00	160.46	197.34	242.71	298.50	1,835.58	451.51
Solar	0.00	124.58	162.19	211.14	274.87	0.00	0.00	0.00
Wind	0.00	262.90	342.24	445.54	580.02	0.00	0.00	0.00
Cash outflows from O&M Expenses	**0.00**	**1,282.91**	**2,409.09**	**3,111.16**	**4,076.47**	**4,292.94**	**7,259.02**	**7,885.70**
Net cash flow before tax	**-20,355.77**	**10,314.06**	**46,287.84**	**66,311.19**	**87,147.30**	**111,083.57**	**143,666.11**	**213,822.43**
Tax								
Railway	0.00	0.00	0.00	1,954.74	0.00	8,185.03	14,649.62	25,650.73
Road	0.00	0.00	832.23	2,055.93	3,742.10	6,282.97	9,110.37	14,224.44
Solar	0.00	310.49	479.93	574.57	629.68	0.00	0.00	0.00
Wind	0.00	437.77	684.04	814.82	882.42	0.00	0.00	0.00

Year	2023	2030	2037	2044	2051	2058	2065	2072
Cash outflows from taxes	0.00	748.26	1,996.20	5,400.05	5,254.20	14,468.00	23,759.99	39,875.18
Net cash flow after tax	-20,355.77	9,565.80	44,291.64	60,911.13	81,893.10	96,615.56	119,906.12	173,947.26

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