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Final Report

Financial and Economic Viability of Kalpasar Project

Volume I

Submitted by:

Grant Thornton Bharat LLP

&

G Tech Infrastructure Pvt. Ltd.

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List of Abbreviations

ADB	Asian Development Bank
AIIB	Asian Infrastructure Investment Bank
BC	Benefit Cost
BOT	Build-Operate-Transfer
CAPEX	Capital Expenditure
CERC	Central Electricity Regulatory Commission
CPI	Consumer Price Index
CRZ	Coastal Regulation Zone
CSIR	Council of Scientific & Industrial Research
CSMCRI	Central Salt and Marine Chemicals Research Institute
CUF	Capacity Utilisation Factor
CVP	Cost Profit Volume
CWPRS	Central Water and Power Research Station
DBFOT	Design-Build-Finance-Operate-Transfer
DMIC	Delhi-Mumbai Industrial Corridor
DPR	Detailed Project Report
DSCR	Debt Service Coverage Ratio
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortisation
EC	Environmental Clearance
ECA	Essential commodities Act
ECB	External Commercial Borrowing.
EF	Escalation factor
MoEFCC	Ministry of Environment, Forest, and Climate Change
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
ENPV	Economic Net Present Value
EPC	Engineering, Procurement and Construction
FI	Financial Institution
FIRR	Financial internal rate of return
FRL	Full Reservoir Level
FSI	Floor Space Index
GACL	Gujarat Alkalis and Chemicals Limited
GCZMA	Gujarat Coastal Zone Management Authority
GDP	Gross Domestic Product
GST	Goods and Services Tax
HAM	Hybrid Annuity Model
HAT	Highest Astronomical Tide
HTL	High Tide Lines
ICR	Interest Coverage Ratio
IDC	Interest During Construction
IIT	Indian Institutes of Technology
IMF	International Monetary Fund
IRR	Internal rate of return
ITC	Input Tax Credit

ITS	Intelligent Transport System
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
JJM	Jal Jeevan Mission
KFW	The KfW Bankengruppe ("banking group")
LCV	Light commercial vehicle
LIBOR	London Inter-Bank Offered Rate
LLTL	Lowest Low Tide Level
LOA	Letter of Acceptance
LTL	Low Tide Lines
MAV	Micro Air vehicle
MCLR	Marginal Cost of Funds based
MCM	Million Cubic Meter
MDDL	Minimum Draw-down Level
MFA	Multilateral Funding Agency
MFI	Multilateral Financial Institutions
MIS	Micro-Irrigation system
MoES	Ministry of Earth Sciences
MSL	Mean Sea Level
MWL	Maximum Water level
NCA	Narmada Control Authority
NCCR	National Centre for Coastal Research
NGT	National Green Tribunal
NH	National Highway
NHAI	National Highway Authority of India
NIWE	National Institute of Wind Energy
NPV	Net Present Value
NQE	Non-Quantifiable Externalities
OPEX	Operating Expense
PCPIR	Petrochemical Petroleum Investment Region
PMF	Probability Mass function
PMU	Project Management Unit
PPP	Public-Private Partnership
PSU	Public Sector Undertaking
RBI	Reserve Bank of India
RORO	Roll-on/roll-off
RTL	Rupee term Loan
SBM	Swachh Bharat Mission
SC/ST	Scheduled Castes/Scheduled Tribes
SCFE	Shadow Cost Factor Estimation
SGST	State Goods and Services Tax
SH	State Highway
SIA	Social Impact Assessment
SIR	Special Investment Region
SPV	Special Purpose Vehicle
STP	Sewage Treatment Plant
TRA	Trust Retention Agreement
TS	Transaction Structure

VFM	Value-for-Money
VGF	Viability Gap Funding
VOC	Vehicle Operating Costs
VOT	Vehicle Operating Time
WACC	Weighted Average Cost of Capital
WPI	Wholesale Price index
WTG	Wind Turbine Generators

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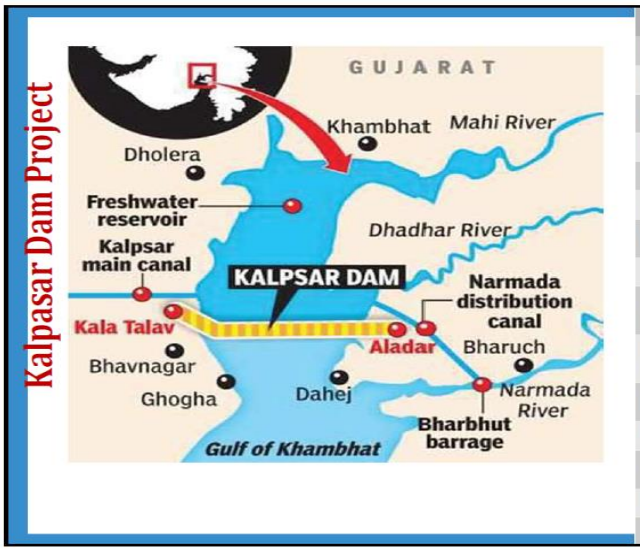
Financial and Economic Viability Analysis

32.1 Introduction

The Ministry of Earth Sciences (MoES) has taken up the task of preparing a Detailed Project Report (DPR) for the construction of a dyke across the Gulf of Khambhat, which is influenced by a higher tidal range (~9m) at the gulf's head. The project entails building a 30 km earthen dyke across the Gulf of Khambhat to create a freshwater coastal reservoir for irrigation, drinking, and industrial purposes, as well as a 2 km concrete spillway, to flush out saltwater or flood water. A 16-lane road and 4-lane rail network are planned to be built over the dyke, reducing travel distance from 350 Km to 50 Km. The project site is in the moderate seismic zone (Zone III) and about 700 km from the Makran fault. Kalpasar Project aims to create a freshwater coastal reservoir in the Gulf of Khambhat by construction of about 30 km dyke connecting the east and west banks of the gulf. It will be the world's largest freshwater lake in the marine environment to create huge fresh water of about 10,000 million cubic meters for irrigation, drinking and industrial purposes. It will be the world's largest freshwater lake in the marine environment.



Description	Details
Length of dam (in sea)	30 km
Top width of dam	100m, 10 lane
Reservoir :	
Full Reservoir Level (FRL)	(+) 3.0m
Maximum Water Level (MWL)	(+) 5.0m
Minimum Draw Down Level (MDDL)	(-) 4.0m
Irrigation command	
Water envisaged for irrigation	6500 mcm
Ground water improvement in periphery of reservoir	7.0 lakh ha
Extra land to be recovered (Availability of new fresh land)	1.2 lakh ha
Reduction in distance	
Bhavnagar – South Gujarat	136 km
Proposed Power Generation	
Wind Power	1470 MW
Solar Power	1000 MW

Figure 32. 1: Kalpasar Project Overview

The project is expected to create the world's largest man-made freshwater reservoir. The proposed project will generate resources pertaining to irrigation and drinking water for Saurashtra and Central Gujarat regions. The proposed reservoir will have the storage that is two times the storage of the Sardar Sarovar (Narmada Reservoir) capacity. It is expected that approximately 10.54-lakh hectare of land in 37 talukas of nine districts of Saurashtra region will get irrigation benefit facilities, including rejuvenation of rivers. More than 60 existing dams will get permanently filled up with water. Wind and solar energy will be generated, which can also be used for lifting fresh water from the reservoir to the canal. Bhavnagar port will get revived, resulting into the speedy development of the region. There will be large savings in travel time and fuel due to reduction in the distance by about 136 km between Bhavnagar to Surat/Mumbai. Saline ground water of coastal area of Saurashtra & Central Gujarat will get converted into freshwater with reduction in soil salinity. Substantial improvement in ground water quality as well as soil salinity of coastal area of Saurashtra & Central Gujarat. About 1.2 lakh hectare land along the periphery of the reservoir will be opened up for development towards value-based land utilisation. An enhanced benefit of world-class industrial estates like Dahej and Dholera will be available to Bhavnagar/Saurashtra region.

32.1.1 Project highlights including project components

Kalpasar is a multi-purpose project consisting of various components such as the reservoir for storing freshwater, an Earthen Dyke for acting as barrier between seawater and reservoir, a flood regulator for regulation of water levels, a Transportation corridor for connecting Bharuch and Bhavnagar, and renewable energy farms to produce energy for operation of the entire system.

Reservoir

The proposed reservoir has a water spread area of about 2,000 sq. km. Area-capacity table is developed based on the topography and bathymetry for the reservoir. Based on estimated inflow into the reservoir and outflow for irrigation, drinking and industrial water, the Full Reservoir Level (FRL), Maximum Water level (MWL) and Minimum Draw-down Level (MDDL) are determined.

Earthen Dyke and Approach Embankment

The total length of the dyke including the intertidal regions is about 61.3 km. The total length of dyke is divided into three zones based on the bathymetry and soil profile in the project area. The three zones are (i) Intertidal zone at Bhavnagar, (ii) Gulf region and (iii) Intertidal zone at Dahej. The length of the intertidal zone at Bhavnagar is 19.83 km and the seabed level in this zone is around +4.0 m to 4.5m MSL. The gulf region is about 26.7 km and extending till -27 m below MSL with predominantly silty sand. The length of intertidal zone at Dahej is 13.6 km and the seabed level in this region is +3.0 to +5.0 m MSL. The water level in intertidal zone depth varies from 0.25 to 2.0m during high tides and mainly consists of clay.

The water level post-construction of dyke is estimated to be +6.5m MSL Highest Astronomical Tide (HAT) and -6.0 m MSL Lowest Low Tide Level (LLTL). Based on the study carried out by CWPRS, the significant wave height in the location is estimated to be 8.1m and the design water level is estimated to be 8.765m w.r.t. MSL. The dyke section on the seaside is designed as breakwater using the Hudson Formula and model studies.

The crest level of the breakwater is designed based on the allowable overtopping rate for safety and structural design as per the specification given in Euro top manual. The entire design is based on the desk and wave flume studies carried out by CWPRS.

The crest level for sections below -5.0m seabed is +19.0m MSL. The crest levels in the shallow regions with seabed levels at 0m, +2.0m and +5.0m are +16.5m, +15.0m, and +12.0m respectively. The crest levels of the breakwater in intertidal zones will be gradually reduced to connect the existing road at Bhavnagar and Dahej, which is at +10.0m level.

The placement of the transportation corridor on the dyke is based on the storm surge and sieches study carried out by IIT Delhi. The results indicate that there will be an increase in water level of 2.5m in the reservoir during a hypothetical cyclone track. Therefore, the transportation corridor is located on the crest of sand fill embankment on the reservoir side at an elevation of +9.0m MSL elevation (4m above MWL). The sand fill embankment on the reservoir side is protected by providing the rock toe protection and filter layer.

Geotechnical investigations carried out indicate that the analyses for both static and pseudo-static conditions for the cross-section are sufficient for stability, settlement, bearing capacity and prevention of seepage. The liquefaction assessment carried out indicates the liquefiable layers where ground improvement is proposed.

Flood Regulator

Unlike other cases, the flood regulator here satisfies two purposes. Not only will it let off the excess flood water into the sea, but it will also prevent the flow of sea water when water level rises during storm surge, thus preventing any increase in the salinity of the reservoir. The tidal variations on the seaside are estimated to be +6.5m and -6.0m MSL post-implementation. The volume available between levels +3.0m MSL (FRL) and +5.0m MSL (MWL) is 4104 Mm3, which is the storage space available for flood absorption. Here, it is pointed out that the summation PMF of all the contributing rivers comes to 1,38,858 m3/s. Considering channel routing up to Kalpasar reservoir, the net routed inflow for the reservoir will be 1,07,299 m3/s. The flood inflow of 1,07,299 m3/s is required to be absorbed for a duration of 6 hours which is the duration of the tidal event by which time the tide from its highest level (+4.40m MSL) recedes to its lowest level (-4.40m MSL), and the flood regulator comes in full operation. The volume of the possible maximum water quantum that will be required to be retained in the reservoir for 6-hour duration is 2318 Mm3. Since the additional volume available is 4104 Mm3, it is apparent that the maximum flood can be retained for about 10 hours to take care of the ever-likely maximum flood as the flood regulator comes to full operation after the tidal event of 6 hours. The flood regulator will be required to be closed whenever the downstream water levels, governed by tidal range, exceed the reservoir level.

The capacity of the flood regulator is therefore designed to have a larger discharge to compensate the deficiency in operation time. Based on the PMF study carried out excluding discharge from river Narmada, the inflow flood considered is 1,10,000 cumecs taking into consideration the allowance of water level to rise till +5m on the reservoir side during any event of flood. The capacity of flood regulator is designed to be 1,10,000 cumecs, with a gross width is 2,196 meters and net width is 1,800 meters having 100 spans of 18 meters width and 99 no. of 4m thick piers. The levels of structural elements such as downstream apron level is -10.0m MSL, upstream apron level is -7.1m MSL, level of ogee crest is -3.5m MSL.

Roadways

Construction of dyke road across the Gulf of Khambhat will fulfil the requirement of connecting the Saurashtra region with South Gujarat as a result of which transport distance will be reduced significantly thereby reducing the transport costs. At present one can reach

Bhavnagar to Surat through Vataman-Vadodara-Bharuch-Surat network. Once the Gulf of Khambhat dyke (60 km long) is constructed, Bhavnagar will be directly connected to Dahej. There is extended length of road on both Bhavnagar side (22km) and Bharuch side (23 Km) for dispersal of traffic. On the Bhavnagar side it starts from Sonegadh on NH-8E, passes through Ghangalia on SH-36 and Bhavnagar on NH-751. On the Dahej side it passes through Panjadara/Aladar on SH-6, Pipaliya/Pakhajan, Sadathala connecting NH-64 (under construction) Keshrol on SH-6.

On construction of the road, the distance between Saurashtra and South Gujarat would be reduced by about 150 km and time saving ranging from 6 hours to 1.5 hours.

Most of the heavy vehicles (goods movement) heading for Saurashtra and Kutch coming from South Gujarat will be able to utilise this route once the road is provided over the proposed dyke. Also, there is going to be significant development activities in the study area in view of the DMIC corridor, Dholera SIR Projects, Federa International Airport, Port activities, Tourism Development, Agriculture activities, and other related activities.

Railways

Technically, it is envisaged to extend the Bhavnagar railway line onto the Kalpasar dyke, while on the east side, the Dahej-Bharuch broad gauge line is in operation. Hence, on top of dyke, the railway connectivity will be useful for goods as well as passenger traffic between Saurashtra and Surat/Mumbai. There will be a great reduction in distance between Saurashtra and Mumbai.

The prospects of regional development potential consequential to Kalpasar Project as well as the proposed DMIC, Dholera SIR, PCPIR, Fedra International Airport, etc. warrant a detailed study to assess the future railway traffic flow and pattern as well as the requirement for 10m wide utility corridor on the dyke top.

The provision of a railway on the top of the dyke will, on the one hand, enhance the development potential of the Kalpasar Project due to saving in transport cost consequential to shortened route and on the other hand, it will be beneficial to railway also in terms of increased revenue from passenger and goods traffic. Being an attractive proposition both for the Kalpasar Project and the Railway Ministry, the development of the railway transport system on the Kalpasar dyke top can be explored for adopting it as a joint venture of the Government of Gujarat- Kalpasar Department and the Railway Ministry.

Renewable Energy

The power required for pumping 6,500 Mm3 of water from the Kalpasar reservoir to the Saurashtra region, which is at higher elevation, requires about 2500 million Units/year. To meet this power requirement, about 1,470 MW capacity wind turbine generators are proposed in three locations. These wind farms consist of 700 wind turbine generators (WTGs) of 2.1 MW capacity. Out of 700 wind turbine generators, 341 WTGs will be placed in Wind Farm 1 (Vadgam I), 186 WTGs will be placed in Wind Farm 2 (Vadgam II) and 173 WTGs will be placed in Wind Farm 3 (Jambusar Nada). The proposed windfarms require about 4500 ha land; 3000 ha land area (without shadow effect) will be available for development of solar power. Solar isolation in this area is 5.8 KWh/m2/day and this can yield about 174 million units and a capacity of about 1000 MW.

32.1.2 Objective and Scope of Work

The objective of the current assignment is to conduct a 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'.

The scope of the current assignment is as under:

Tier 1: 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.
8. Suggesting at least two project financing structures based on experience, market intelligence and other relevant information.
    - The project financing structure to 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, the Consultant is not expected to approach any of the Funding Agencies.
    - To analyse the feasibility of each financing structure suggested. The feasibility analysis to 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.

Tier 2: 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. 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.

5. Conducting an economic analysis of the Present Value of Economic Benefits and Economic Return from the project.

Note i. Sequencing of economic benefits which are likely to accrue –to make an informed estimate of commencement of the economic benefits aligned with the Construction and Implementation Schedules

Tier 3: Non-Quantifiable Externalities

1. Identification of non-quantifiable economic benefits accruing to the project area and surrounding population, ecology, biodiversity etc.

2. Highlight trade-offs if any

Exclusions

1 Cost phasing to be based on the Project Structure (Capital Budgeting structure) as suggested by the Authorities. Effort estimates do not include the same (project structuring except as already mentioned by the Authorities).

2 The Project Cost Estimate will be as per the Detailed Project Report of the various components, to be shared with the Consultant by NCCR.

3 Opex, as mentioned in the DPR, shall form the basis of calculating the Operational Cash Outflow. In case of any gross mismatch from established standards, the

Consultant shall discuss the same with the Authorities. The authorities in turn shall make necessary changes and share it with the Consultant.

4 For the purpose of conducting economic analysis, the Consultant shall rely on data to be made available by the Authorities in the form the EIA and the SIA. Apart from physical inspection of the project site and project-benefit area, the Consultant shall not conduct any primary data collection activities. (Refer ***Note ii*** below)

5 Unless due to reasons arising out of errors in calculation, the present assignment shall remain restricted to one-stage revision of the Analysis Model based on changes in Cost/Revenue/Benefit estimates. (Refer ***Note iii*** below)

6 Revisions in the model due to changes in the project structure/capital budgeting structure (except changes in ratios of Equity, Debt and/or Grant)/Implementation Scheduling (except postponement/preponement of the existing project phasing)/any other changes requiring complete overhaul of the analysis model are outside the purview of the current scope.

Note ii. ***The Consultant shall rely on data provided by the Authorities (e.g., Demographic, Socio-Economic etc.). Basis the data/information provided, the Consultant shall conduct further analysis and develop new quantifiable measures to be used in the Financial and Economic Analysis mentioned under Tier 1 and Tier 2 Analyses.***

Note iii. ***At each deliverable stage, once the Draft Report has been submitted, the Consultant shall make necessary revisions basis the inputs and observations received from the Authorities and submit the Report incorporating such inputs and observations.***

However, basis the current effort estimates, once the Final Report has been submitted, the Consultant agrees to conduct a maximum one revision of the Financial (and Economic) Analysis Model based on changes in Cost/Revenue/Benefit estimates.

32.2 Methodology

This section discusses important considerations employed in the analysis, including the data sources employed in the study, a detailed discussion about the two approaches employed in the study, that is financial and economic analysis, and the contrast between both the approaches. The section also discusses non-quantifiable externalities (NQEs). It also provides for the key assumptions related to sub-projects (rail, road, renewable, and dyke project) that are part of cash flow analysis.

32.2.1 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 outside the purview of the Financial and Economic Analysts, no primary data collection has been undertaken. As an when felt necessary, the team 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, necessary parameters have been 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) are 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.

32.2.2 Methodology for Conducting Financial Analysis

The overall methodology followed in conducting the Financial Analysis follows from the Scope of Work and involves the following:

(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 projections 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.

Based on the estimated cash flows, the following coverage ratios are estimated.

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

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 IRR and NPV indicators are calculated considering 30-, 40-, and 50-year cash flows. For NPV computation, 6%, 8%, 10%, and 12% discount rates have been considered to indicate the robustness of the results and sensitivities to various scenarios (discussed later). Customary to such large-scale projects government bodies often advise a discount rate of 12% (taken from various benchmark projects as Chennai Metro, Silverline metro project, Bengaluru rail corridor).

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 does not directly accrue to government. To make such projects financially feasible, government support may be required in the initial stages, in the form of viability gap funding. The NPV analysis and IRR analysis will highlight the VGF support which might be necessary to be provided to the project by the government to make it sustainable.

Sensitivity Analysis

Sensitivity Analysis is conducted considering four different scenarios apart from the Base Case scenario. The four other scenarios considered are as under:

Scenario 1- Optimistic scenario: 5% revenue is increased and both capital cost and operation and maintenance cost is reduced by 5%

Scenario 2 – Best-case scenario: 10% revenue is increased and both capital cost and operation and maintenance cost is reduced by 10%

Scenario 3- Pessimistic scenario: 5% revenue is decreased and both capital cost and operation and maintenance cost is increased by 5%

Scenario 4- Worst-case scenario: 10% revenue is decreased and both capital cost and operation and maintenance cost is increased by 10%

32.2.3 Methodology for Conducting Economic Analysis

While financial feasibility is crucial for project sustainability, project economic analysis (also known as Cost-Benefit Analysis) recognises the limitations of a purely financial perspective. It advocates for a broader lens that captures the project's impact on societal well-being, necessitating the quantification of both economic costs and benefits.

Financial appraisals remain important, assessing the project's attractiveness to participants and ensuring financial viability. However, they can be misleading indicators of social welfare improvements. Many project outputs either lack market prices (e.g., non-toll roads, pollution reduction) or face distorted market dynamics (e.g., subsidised utilities). Even in commercial settings, large projects can distort pricing, meaning social benefits exceed project revenues.

Therefore, economic analysis moves beyond financial metrics to encompass the wider economic and social impacts, providing a more comprehensive and accurate assessment of a project's true value.

The overall methodology followed in conducting the Economic Analysis follows from the Scope of Work and involves the following:

(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 conduct the necessary analysis.

Methodology specific to the current analysis can be seen in further details along with the relevant conversion factors in Section 32.5.1 of the report. Further details can be seen in Annexure F, Volume II of the Report.

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 Non-incremental outputs. Similarly,

inputs or project (and associated) costs can be classified as Traded/Non-Traded, further classified into Incremental and Non-incremental 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 appraisal of the 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.

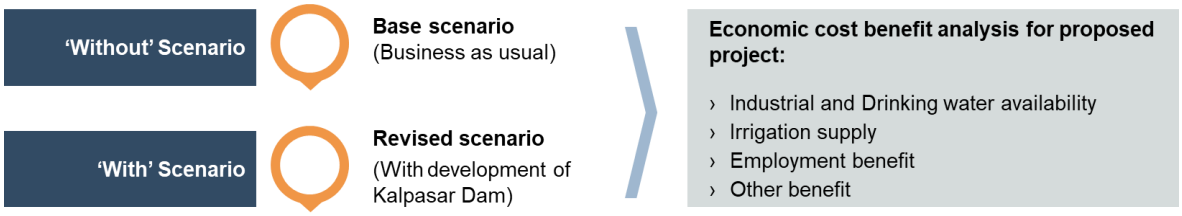


Figure 32. 2: Overview of Economic Analysis

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 using the Shadow Cost Factor as and where necessary. A detailed note on Shadow Cost Factor Estimation (SCFE) is provided in Annexure F

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 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.

32.2.4 Methodology for identification of Non-Quantifiable Externalities

Large infrastructure projects 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.

32.3 Project Cost

The overall project cost is Rs. 1,32,455.00 Cr, and comprises of components such as dyke, flood regulators, road alignment, rail alignment, solar and wind plant, and other components. The total cost also includes preliminary expenses (Survey and Investigation, Planning, Design, and Engineering Works). Further other variable costs include 1% contingency charges, 1% quality control, 1% work charge establishment, and 18% GST.

Table 32. 1: Total Project Cost before considering IDC (in Rs. Crore)

S. No	Component	Total
A	Dyke	54,117.30
B	Flood Regulator	20,677.80
C	Road Alignment	7,689.00
D	Rail Alignment	8,783.48
E	Solar Plant	4,000.00
F	Wind Farm	10,500.00
G	Other Components (Decantation, Instrumentation, Desalination, Flood Protection, Electrical)	1,868.00
	Summation (A+B+C+D+E+F+G)	1,07,635.58
	Survey and Investigation	538.00
	Planning, Design and Engineering Works	807.00
	Sub-total	1,08,980.58
	1% Contingency Charges	1,089.81
	1% Quality Control	1,089.81
	1% Work Charge Establishment	1,089.81
	Sub Total	1,12,250.00
	18% GST	20,205.00
Grand Total		**1,32,455.00**

32.3.1 Assumptions specific to the calculation of IDC

The assumptions related to the calculation of IDC are provided in the table below. The interest rate for all projects (except dyke with 6%) is 10%. The total door-to-door tenure is 30 years, including 8 years of moratorium for all the components.

Table 32. 2: Assumptions specific to the calculation of IDC

Assumptions	Dyke	Road	Rail	Renewable Energy
Interest rate	6.00%	10.00%	10.00%	10.00%
Total door to door Tenor	30	30	30	30
Moratorium Period	8	8	8	8
Construction Period	8	8	8	8

The total project cost after considering IDC (Interest During Construction), calculated as per the assumptions stated regarding the same is as under:

Table 32. 3: Total Project Cost after considering IDC (in Rs. Crore)

S. No	Component	Total
A	Dyke	54,117.30
B	Flood Regulator	20,677.80
C	Road Alignment	7,689.00
D	Rail Alignment	8,783.48
E	Solar Plant	4,000.00
F	Wind Farm	10,500.00
G	Other Components (Decantation, Instrumentation, Desalination, Flood Protection, Electrical)	1,868.00
	Summation (A+B+C+D+E+F+G)	1,07,635.58
	Survey and Investigation	538.00
	Planning, Design and Engineering Works	807.00
	Sub-total	1,08,980.58
	1% Contingency Charges	1,089.81
	1% Quality Control	1,089.81
	1% Work Charge Establishment	1,089.81
	Sub Total	1,12,250.00
	18% GST	20,205.00
H	**Interest During Construction**	24,042.67
Grand Total		**1,56,497.68**

The total cost is phased for investment over 8 years, starting from 2027 to 2034 as shown in the following table.

32.3.2 Phasing of Project Cost (Year – Wise Capex incurred)

Table 32. 4: Phasing of Project Cost (in Rs. Crore)

	2027	2028	2029	2030	2031	2032	2033	2034	Aggregate
PROJECTS									
DYKE (incl. Water Supply)									
Hard cost									93667
Soft cost									16010
Total	**2,872**	**8,096**	**13,061**	**20,283**	**17,660**	**17,776**	**22,702**	**7,228**	**109677**
ROAD									
Hard cost									9630
Soft cost									2330
Total	**453**	**751**	**697**	**697**	**1449**	**2819**	**3382**	**1713**	**11959**
RAIL									
Hard cost									10999
Soft cost									2612
Total	**485**	**796**	**734**	**734**	**1746**	**3331**	**3842**	**1946**	**13612**
RENEWABLE ENERGY									
WIND									
Hard cost									13149
Soft cost									2238
SUB-TOTAL	141	85	15	15	2504	5048	5034	2545	15387
SOLAR									
Hard cost									5009
Soft cost									852
SUB-TOTAL	54	32	6	6	954	1923	1918	970	5862
TOTAL	**195**	**118**	**20**	**20**	**3458**	**6971**	**6952**	**3515**	**21249**
GRAND TOTAL	**4146**	**9846**	**14527**	**21749**	**26817**	**35945**	**41912**	**16947**	**156497**

32.3.3 Operation and Maintenance Cost for a Ten-Year Period

Operation and Maintenance (O&M) Cost has been considered as per the Industry Standards while conducting the Financial Analysis for the project period.

As per the present procedures followed for procurement of infrastructure projects, the Government of India mandates the requirement of stipulating O&M for a minimum period of 5 years for all tenders. The project components being significantly large, the tendering authorities may like to consider a 10-year O&M period. Accordingly, the O&M Cost for ten years is presented below.

Table 32. 5: Operation and Maintenance Cost for first ten years (in Rs. Crore)

Year	Dyke Project	Road	Railways*	Solar	Wind	Year-wise Total
2035	4779.20	156.04	506.00	135.43	355.51	5932.2
2036	5018.15	160.72	506.00	140.63	369.16	6194.7
2037	5269.06	165.55	506.00	146.03	383.34	6470
2038	5532.52	170.51	506.00	151.64	398.06	6758.7
2039	5809.14	878.14	506.00	157.46	413.34	7764.1
2040	6099.60	180.90	506.00	163.51	429.22	7379.2
2041	6404.58	186.32	506.00	169.79	445.70	7712.4
2042	6724.81	191.91	506.00	176.31	462.81	8061.8
2043	7061.05	197.67	506.00	183.08	480.58	8428.4
2044	7414.10	1,018.00	9,715.22	190.11	499.04	18836
Total	**60,112.20**	**3,305.76**	**14,269.22**	**1,613.99**	**4,236.76**	**83538.00**

* *As provided by L&T in their report on the Railways project*

32.4 Financial Analysis of the Project

The section on financial analysis comprises discussion about each sub-project (or component) at individual level (e.g., rail, road, dyke, renewable, etc.). This includes methodology and assumptions pertaining to revenues and costs. Based on these assumptions, a component level base case discussion is provided along with component level NPV and IRR analysis. Subsequently, a component level scenario analysis is provided along with NPV and IRR analysis. Further considering these component level base case and scenario analysis, aggregate analysis is built-up.

32.4.1 Dyke Project

This section deals with the discussion on financial analysis related to dyke, water supply and other related sub-projects. This includes methodology and assumptions pertaining to various sources of revenues and costs.

32.4.1.1 Methodology for Revenue Estimation

A. Land Reclamation and Development

Consequent to the construction of the dyke across the Gulf and creation of the freshwater reservoir, the presently tidal affected land between EL +5.0m MSL and EL +8.0m 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 neighbouring 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 based on 12% phasing. In other words, the phasing of land monetisation is done based on expected return of 12%, considering the current market rates of land for 30 years with a tentative schedule. The schedule is considered perusing other comparable similar projects.

B. Water Supply for Irrigation, Drinking Water, and Industrial Use

Water is proposed for bulk supply with the ultimate purpose of supply being Irrigation, Drinking Water supply and supply of water for Industrial use. The present proposal envisages that a designated agency of the Government of Gujarat shall take up the project for laying necessary infrastructure to lift water from the fresh water source and shall thereafter arrange for segmental supply to the end-user.

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. The direct financial benefits 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 are estimated.

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

C. 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). The above benefits occur in a phase wise manner over a period of 30-50 years (standard PPP concession period) with a tentative schedule. The schedule is considered perusing other comparable similar projects.

32.4.1.2 Assumptions

A) Dyke Project related Assumptions

This is arguably the central component of overall project and entails building a 30 km earthen dyke across the Gulf of Khambhat to create a freshwater coastal reservoir for irrigation, drinking, and industrial purposes, as well as a 2 km concrete spillway, to flush out saltwater or flood water.

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. 1,09,677[1] Crore have been assumed for the Dyke project. This also includes the interest during the construction of Rs 16,010 Crore. 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 linked to project cost, accordingly the O&M expense profile changes with the assumptions pertaining to capex.

Table 32. 6: Project cost details (Dyke Project)

Project Cost	**Rs Crore**	**Specification**
Total Hard Cost	93,667	
Soft Cost (IDC)	16,010	
Total Cost	**1,09,677**	
Means of Financing (70:30)		
Debt	76,774	Debt profile: Door to door tenor of 30 years and 8 years of moratorium with interest @6% p.a.
Equity	32,903	

[1] The overall dyke cost varies over different transaction structures due to variation in soft cost (e.g., IDC). However, the hard cost of dyke remains same for all the transaction structures, i.e., Rs. 93667 crore.

Total cost	**1,09,677**	

The construction period of project is estimated as 8 years. The capex is phased-out over the 8-year period in the following manner (details as provided by the authorities).

Table 32. 7: Other Preliminary expenses (Dyke Project)

Year	**2026**	**2027**	**2028**	**Total**
One-time Rehabilitation and Resettlement costs (%)		**3%**	**2%**	**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. 8: Capex phasing (Dyke Project)

Year	***2027***	***2028***	***2029***	***2030***	***2031***	***2032***	***2033***	***2034***
Cost in Crore	2,872	8,096	13,061	20,283	17,660	17,776	22,702	7,228
10% Reduction	2,541	7,164	11,558	17,948	15,627	15,729	20,088	6,395
5% Reduction	2,705	7,626	12,303	19,106	16,635	16,744	21,384	6,808
5% Escalation	3,041	8,574	13,833	21,481	18,703	18,826	24,042	7,654
10% Escalation	3,214	9,060	14,617	22,699	19,764	19,894	25,406	8,089

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

Dyke operating expense related assumptions

Kalpasar water would be very precious, and Govt. intends to implement a policy to adopt 100% Micro-irrigation system (MIS), in Kalpasar command area. Minimum head of 14m is proposed at sub-chak level (i.e., 5 to 8 ha) and power cost for the complete system has been calculated accordingly in operation and maintenance cost.

Taking the above into account, the O&M expenses are considered as 4.15% of the project cost, escalated at a rate of 5% per annum. This accounts for the information provided by the authorities and the operation and maintenance costs are estimated to be about Rs. 4,779 Crore for the first year of operations (Year 2035). 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. 9: O&M Expense Profile (Dyke Project)

Year	2035	2045	2055	2065	2076
Cost in Crore	4,779	7,785	12,681	20,655	35,328
10% Reduction	4,229	6,889	11,221	18,277	31,261
5% Reduction	4,502	7,333	11,945	19,456	33,277
5% Escalation	5,061	8,245	13,429	21,875	37,414
10% Escalation	5,349	8,712	14,191	23,116	39,536

Due to the development of project, mangroves will no longer exist near freshwater reservoir. MoEFCC at their discretion, may impose conditions 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% of 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 costs 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 extraordinary costs can become clear only after receiving CRZ Clearance.

There will be collateral cost to GoG (Government of Gujarat) 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 present infrastructure might require substantial upgradation, this substantial cost is also required to be considered, since the water quality in reservoir requires to be maintained as “irrigation water.” The project/project proponent will not bear this cost, but it will become a major and substantial cost head for GoG.

B) Fresh Water Availability for Various Applications

Kalpasar Project aims to create a freshwater coastal reservoir in the Gulf of Khambhat by construction of about 30 km dyke connecting the east and west banks of the gulf. It will be the world’s largest freshwater lake in the marine environment to create huge fresh water of about 10,000 million cubic meters for irrigation, drinking and industrial purposes. It will be the world’s largest freshwater lake in the marine environment.

Key Assumptions

The following key assumptions have been made in carrying out the computations. For cash inflow projection from freshwater availability, availability for irrigation, drinking, and industrial consumption have been considered with following rates (existing Government of Gujarat water supply 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. The cash flows for each of the scenarios is presented in Annexure A.

Table 32. 10: Application wise rate of freshwater

Application Type	Rate	Unit
Seasonal irrigation	662	Rs/Ha
Perennial irrigation	620.49	Rs/Ha
Drinking water	5.05	Rs /1000Ltr
Industrial use	41.77	Rs /1000Ltr

Table 32. 11: Application wise consumption scenarios

Scenario 1 (Adverse)	Scenario 2 (Most Optimum)	Scenario 3 (Favourable)	Unit	Escalation (Per annum)
4487490	4986100	5484710	Ha	2.5%
84770	96880	108990	Ha	2.5%
750	800	850	(MM3*10^6)	10.0%
400	450	500	(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 400 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 450 MM^3*10^6 industrial use water. (c) Best-case scenario (3) with 5.5 times seasonal irrigation, 4.5 times perennial irrigation, and 850 MM^3*10^6 drinking water and 500 MM^3*10^6 industrial use water. Based on these assumptions, the revenue profile is obtained from freshwater availability (as shown in Table 32.12).

Table 32. 12: Cash inflow profile from Fresh Water Availability (Base-Case Scenario)

Year (Rs Crore)	*2037*	*2045*	*2055*	*2065*	*2076*
Scenario 1: Base case (Most optimum)					
Seasonal irrigation	422.53	514.81	659.00	843.58	1106.85
Perennial irrigation	7.69	9.38	12.00	15.36	20.16
Drinking water	1047.87	2246.21	5826.08	15111.35	43114.46
Industrial use	4875.33	10450.70	27106.42	70307.07	200594.29
Total	***6353.43***	***13221.09***	***33603.51***	***86277.37***	***244835.75***

C) Land Reclamation and Development

Consequent to the construction of the dyke across the Gulf and creation of the freshwater reservoir, the presently tidal affected land between EL +5.0m MSL and EL +8.0m MSL in the periphery of the proposed reservoir will open 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.

Key Assumptions

Unlike in other places, the land available in the project is reclaimed land for which a substantial amount of infrastructure expenses needs to be incurred by the Project Authorities. Owing to this, the Project Authorities (through the Project Development Agencies as decided appropriately) should look to monetise the land in a manner which is both economically feasible as well as financially profitable to the overall sustainability of the project. This, combined with the existing rates for land available in the vicinity of the project influence area have been taken together to arrive at a reference rate for consideration. Further, it may also be noted that the rates assumed are currently available rates. Actual monetisation of land shall happen almost a decade later, by which time it can be reasonably expected that land rates for even the existing areas would have almost doubled, provided sufficient value-addition in terms of economic activity continues to take place in the respective regions.

Basis the above discussion, following are the assumptions pertaining to land monetisation from the Kalpasar project. To compute escalation factor EF (Escalation Factor), data provided by Kalpasar authorities for the Dholera SIR region for residential, commercial, and industrial region has been used. This includes pre-development and post-development Jantri rates (Rs per Sq. Mts). Three scenarios, base rate scenario, and average rate and maximum rate scenarios for higher FSI rates provided by Kalpasar authorities are considered.

Table 32. 13: 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. 14: 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, the pre-development rates for the Kalpasar project area reclaimable land are considered. These rates are multiplied by EF to obtain the estimated post development rate. To this end the break of Kalpasar project reclaimable area into residential, commercial, and industrial regions as 20%, 40%, and 40% respectively have been assumed. These valuations include all the three scenarios base, average, and maximum.

Table 32. 15: 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 Crore)**
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. 16: 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, land monetisation phasing and cash inflow schedule are projected, as shown in the table below. The phasing of land monetisation is done based on expected return of 12% on considering the current market rates of land for 30 years. The 30-year period is considered in this case as a benchmark since it is assumed that the Project Authorities will be looking to monetise the land through projects developed in the PPP Mode and/or through sale/lease of land at a suitable rate commensurate with the expected returns from the land. It is therefore expected that 100% of land will be monetised by the year 2064.

Table 32. 17:Phasing Assumption and Cash inflow from land monetisation (Base Case Scenario)

Year	**2035**	**2045**	**2055**	**2065**	**2076**
Scenario 1: Base Rate					
Cash Inflow	16663	16663	16663	0	0
Cumulative Inflows	16663	183294	349926	499894	499894

D) Assumptions related to Fisheries

To estimate the potential of fisheries in the region, three scenarios of maximum potential (Base, Scenario-1, and Scenario-2) along with the respective prices (in Rs per tonnes) have been considered. 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), the value of fishery potential over the years in a phased wise manner has been computed. 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. 18: Potential of Fisheries

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

The assumptions regarding fisheries phasing are shown in Table 32. 18. The following projections (shown in Table 32. 19) are made regarding revenues from Fisheries.

Table 32. 19: Reservoir Fish Yield (Phasing Assumption and Base Case Scenario)

Year	**2035**	**2045**	**2055**	**2065**	**2076**
Phasing of Fishery Development	15%	0%	0%	0%	0%
Cumulative Development	15%	100%	100%	100%	100%
Value of Fisheries (Rs Crore)					
Base Case	22.50	201.59	270.92	364.09	503.98

32.4.1.3 Results of Financial Analysis

The Dyke project being analysed involves various sub-projects, including the development of freshwater reservoir, fisheries harvesting, tourism and related employment, land reclamation, availability fresh water for drinking, agriculture, industrial and commercial purposes. The financial model accounts for the incremental cash flows associated with the project. With the assumptions mentioned in the previous section, project cash flows and estimate coverage ratios, project IRR/Equity IRR and project NPV (NPV computations assume four cost of capital scenarios: 6%, 8%, 10%, and 12%) have been forecasted. The results are reported for 30 years, 40 years, and 50 years for the Base-case scenario.

Base-case scenario

Results have been computed under the Base-case scenario where the most realistic revenue and cost are considered. The results suggests that the Equity IRR ranges between 17%-18% for the dyke and allied projects. Furthermore, the NPV values at 6%, 8%, and 10%, are positive as shown in the table below. The results from NPV computation provide inferences regarding higher cash inflows than the outflows due to which dyke as a standalone

project is profitable. Debt service coverage ratio (DSCR) and interest coverage ratio (ICR) have been estimated. The average DSCR and ICR are over 1.49 and 2.64, respectively, indicating a reasonable debt servicing profile over the currency of the loan. The projected cash flows, balance sheets and profit and loss statements corresponding to the Base-case scenario are provided in Annexure A.1, A.2, A.3, respectively. 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. 20: Results under Base-case scenario (Dyke Project)

			Year	**30**		**40**		**50**
Project IRR				10.36%		11.72%		12.36%
Equity IRR				16.92%		17.87%		18.17%
NPV @ Cost of capital								
NPV @ 12%				(10,334.56)		(2,243.11)		3,433.76
NPV @ 10%				2,860.22		18,103.51		30,991.15
NPV @ 8%				23,750.77		52,879.89		82,662.60
NPV @ 6%				56,777.94		113,275.55		183,386.95
Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	1.49	1.50	2.36	2.47	2.60	2.75	2.91	3.09
ICR (Interest Coverage)	2.64	2.73	4.37	4.70	5.09	5.52	6.03	6.64
Average DSCR	1.49	1.50	1.78	1.94	2.07	2.17	2.27	2.36
Average ICR	2.64	2.68	3.22	3.56	3.83	4.08	4.31	4.55

32.4.1.4 Sensitivity Analysis

This section deals with the financial analysis results for the other scenarios, except Base-case scenario (the results of which are discussed above in the Financial Analysis results section).

Key Results pertaining to Project IRR/NPV

A) Optimistic Scenario

Based on the cash flows estimated in the previous sections, all the coverage ratios are estimated for the Optimistic scenario. The optimistic scenario considers the increase in revenue by 5% and decrease in capital cost by 5%. For all the years, the coverage ratios are good, indicating comfortable debt servicing. For NPV computation, 6%, 8%, 10%, and 12% discount rates are considered to indicate the robustness of the results and sensitivities to various scenarios. In addition to project IRR and project NPV, equity IRR is computed.

Next, project IRR and NPV indicators are computed considering 30-, 40-, and 50-year cash flows. The project IRR is 12.79%, 13.82%, and 14.25% for 30-, 40-, and 50- year period. The results further suggests that the Equity IRR are in comfortable range between 21%-22% approximately, for the dyke and allied projects. This is due to the increase revenue streams in the dyke project which affect the profitability of the dyke and allied components. This is also reflected in the positive NPV values at 12%, 10%, 8% and 6% in the table below. The results from NPV computation also reflect that cash inflows are greater than the outflows due to which dyke as a standalone project is profitable at high cost of capital of 10% and 12%. Debt service coverage ratio (DSCR) and interest coverage ratio (ICR) have improved. 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 summarise, the project IRR levels for this scenario are comfortable.

Table 32. 21: Results under Optimistic-case scenario (Dyke Project)

			Year	30		40		50
Project IRR				12.79%		13.82%		14.25%
Equity IRR				21.47%		21.96%		22.08%
NPV @ Cost of capital								
NPV @ 12%				5,153.69		14,726.01		21,191.61
NPV @ 10%				22,811.60		40,833.06		55,507.41
NPV @ 8%				50,049.07		84,464.27		118,366.91
NPV @ 6%				92,310.00		159,014.63		238,803.22
Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	2.12	2.16	3.17	3.33	3.51	3.70	3.91	4.14
ICR (Interest Coverage)	3.77	3.91	5.88	6.33	6.84	7.43	8.10	8.90
Average DSCR	2.12	2.14	2.47	2.68	2.84	2.97	3.09	3.21
Average ICR	3.77	3.84	4.49	4.91	5.26	5.57	5.88	6.18

B) Best-Case Scenario

Based on the cash flows estimated in the previous sections, all the coverage ratios are estimated for the Best-case scenario. The best-case scenario considers the increase in revenue by 10% and decrease in capital cost by 10%. For most of the years, the coverage ratios are large, indicating comfortable debt servicing. For NPV computation, 6%, 8%, 10%, and 12% discount rates are considered to indicate the robustness of the results and sensitivities to various scenarios. In addition to project IRR and project NPV, equity IRR is computed.

Next, project IRR and NPV indicators are computed considering 30-, 40-, and 50-year cash flows. The project IRR is 13.48 %, 14.43%, and 14.81% for 30-, 40-, and 50- year period. The results further suggests that the Equity IRR are in between 22% to 23% approximately for the dyke and allied projects. This is due to the increase of revenue streams in the dyke project which affect the profitability of the dyke and allied components. This is also reflected in the positive NPV values at 6%, 8%, 10%, and 12% in the table below. The results from NPV computation also reflect that cash inflows are greater than the outflows due to which dyke as a standalone project is profitable at all levels of cost of capital. Debt service coverage ratio (DSCR) and interest coverage ratio (ICR) have improved considerably. This improvement is on account of the favourable conditions considered in the model. That is, increase in revenues by 10%, and decrease in capital expenditure and O&M related costs by 10%. To summarise, the project IRR levels for this scenario are better than optimistic scenario and are extremely comfortable.

Table 32. 22: Results under Best-case scenario (Dyke Project)

			Year	30		40		50
Project IRR				13.48%		14.43%		14.81%
Equity IRR				22.67%		23.08%		23.18%
NPV @ Cost of capital								
NPV @ 12%				9,238.76		18,944.38		25,480.75
NPV @ 10%				27,426.64		45,698.83		60,532.54
NPV @ 8%				55,346.13		90,239.73		124,507.58
NPV @ 6%				98,515.34		166,146.51		246,787.57
Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	2.30	2.34	3.42	3.59	3.78	3.99	4.22	4.47
ICR (Interest Coverage)	4.08	4.24	6.35	6.83	7.39	8.02	8.75	9.62
Average DSCR	2.30	2.32	2.68	2.90	3.06	3.21	3.34	3.47
Average ICR	4.08	4.16	4.85	5.31	5.68	6.02	6.35	6.68

C) Pessimistic Scenario

Based on the cash flows estimated in the previous sections, all the coverage ratios are estimated for the pessimistic scenario. The pessimistic scenario considers the decrease in revenue by 5% and increase in capital cost by 5%. For most of the years, the coverage ratios are good, indicating normal debt servicing. For NPV computation, 6%, 8%, 10%, and 12% discount rates are considered to indicate the robustness of the results and sensitivities to various scenarios. In addition to project IRR and project NPV, equity IRR is computed.

Next, project IRR and NPV indicators are computed considering 30-, 40-, and 50-year cash flows. The project IRR is 7.97%, 9.72%, 10.62% for 30-, 40-, and 50- year period. The results further suggests that the Equity IRR and Project IRR are positive but have reduced for the dyke and allied projects. This is due to the decrease in revenue streams and increase in opex for the dyke project which affect the profitability of the dyke and allied components. This is also reflected in the negative NPV values in the table below. The results from NPV computation also provide similar inferences that cash outflows are greater than the inflows due to which dyke as a standalone project is not profitable at higher cost of capital of 12%, 10% (for 40 years), and 8% (for 30 years). Debt service coverage ratio (DSCR) and interest coverage ratio (ICR) have declined. This reduction is on account of the unfavourable conditions considered in the model. That is, decrease in revenues by 5%, and increase in capital expenditure and O&M related costs by 5%. To summarise, the project IRR levels for this scenario are still comfortable at lower cost of capital of 6% and 8%.

Table 32. 23: Results under Pessimistic-case scenario (Dyke Project)

			Year	**30**		**40**		**50**
Project IRR				7.97%		9.72%		10.62%
Equity IRR				12.20%		13.97%		14.64%
NPV @ Cost of capital								
NPV @ 12%				(24,709.75)		(18,017.74)		(13,128.88)
NPV @ 10%				(15,511.32)		(2,896.02)		8,206.52
NPV @ 8%				(287.40)		23,836.31		49,502.73
NPV @ 6%				24,510.78		71,333.00		131,775.64
Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	1.00	1.00	1.71	1.79	1.89	1.99	2.11	2.24
ICR (Interest Coverage)	1.77	1.81	3.16	3.40	3.68	4.00	4.38	4.82
Average DSCR	1.00	1.00	1.23	1.36	1.46	1.54	1.62	1.69
Average ICR	1.77	1.79	2.23	2.50	2.71	2.90	3.08	3.25

D) Worst-Case Scenario

Based on the cash flows estimated in the previous sections, all the coverage ratios are estimated for the worst-case scenario. The worst-case scenario considers the decrease in revenue by 10% and increase in capital cost by 10%. For most of the years, the coverage ratios are good, indicating normal debt servicing. For NPV computation, 6%, 8%, 10%, and 12% discount rates are considered to indicate the robustness of the results and sensitivities to various scenarios. In addition to project IRR and project NPV, equity IRR is computed.

Next, project IRR and NPV indicators are computed considering 30-, 40-, and 50-year cash flows. The project IRRs are 7.39%, 9.23%, 10.20% for 30-, 40-, and 50- year period. The equity IRRs are 11.03%, 13.05%, 13.84% for 30-, 40-, and 50- year period. The results further suggest that both Project IRR and Equity IRR are positive. However, the NPV values are negative at 12%, 10% (for 40 years), and 8% (for 30 years) cost of capital as shown in the table below. This is due to the lack of revenue streams in the dyke project which affect the profitability of the dyke and allied components. The results from NPV computation also

provide similar inferences that cash outflows are greater than the inflows due to which dyke as a standalone project is not profitable a higher cost of capital under this scenario. Debt service coverage ratio (DSCR) and interest coverage ratio (ICR) have declined considerably. This is on account of the unfavourable conditions considered in the model. That is, decrease in revenues by 10%, and increase in capital expenditure and O&M related costs by 10%. To summarise, the project IRR levels for this scenario are comfortable but at lower cost of capital.

Table 32. 24: Results under Worst-case scenario (Dyke Project)

			Year	30		40		50
Project IRR				7.39%		9.23%		10.20%
Equity IRR				11.03%		13.05%		13.84%
NPV @ Cost of capital								
NPV @ 12%				(29,217.82)		(22,666.13)		(17,851.76)
NPV @ 10%				(20,591.47)		(8,240.09)		2,694.71
NPV @ 8%				(6,092.47)		17,527.66		42,809.65
NPV @ 6%				17,755.84		63,602.76		123,148.07
Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	0.91	0.91	1.58	1.65	1.74	1.84	1.94	2.07
ICR (Interest Coverage)	1.62	1.65	2.93	3.15	3.40	3.69	4.04	4.44
Average DSCR	0.91	0.91	1.13	1.25	1.35	1.42	1.49	1.56
Average ICR	1.62	1.64	2.04	2.30	2.50	2.67	2.83	3.00

32.4.2 Development of Roadways Project

A ~30 km earth dyke has been planned to be constructed across the Gulf of Khambhat to create a massive freshwater coastal reservoir for irrigation, drinking and industrial purposes, with about 2 km concrete spillway for emptying saltwater or flood water. A road (Multilane highway) has also been planned to be built over the dyke. This road over the dam will reduce the distance and travel time by about 110 km and 2 hours respectively between South Gujarat and Saurashtra.

32.4.2.1 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. 11959.34 Crore has been estimated for construction the roadways over dam. This also includes the interest during construction of Rs. 2330.25 Crore. For computation purposes, a debt-to-equity ratio of 70:30 is assumed which is similar to other roadways projects.

Table 32. 25: Project cost details (Road Development)

Project Cost	**Rs. (cr.)**	
Highway Civil cost	5,834.59	
Road Structural cost	3,658.09	
Intelligent Transport System (ITS) cost	78.07	
Environmental Charges due to Road @ 1% of Civil cost	58.35	
Interest during construction	2330.25	
Total cost	**11959.34**	
Means of Financing (70:30)		**Debt profile**
Debt	8371.54	Debt profile: Door to door tenor of 30 years and 8 years of moratorium with interest @10%p.a.
Equity	3587.80	
Total cost	**11959.34**	

The construction period of project is considered to be equal to moratorium period, i.e., 8 years. It is assumed that capex is phased out as 3.78%, 6.28%, 5.82%, 5.82%, 12.11%, 23.57%, 28.28%, 14.3% over construction period, i.e., 8 years.

Table 32. 26: Capex Phasing (Road Development)

Year	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
Percentage	**3.78%**	**6.28%**	**5.82%**	**5.82%**	**12.11%**	**23.57%**	**28.28%**	**14.32%**
Cost in Crore	452.60	751.21	696.52	696.52	1448.57	2818.72	3382.21	1712.98

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 have been 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 (conducted by L&T) for different vehicles has been provided for by Kalpasar technical team from the year 2031 to 2071. Traffic forecast for the minibus assumed to be 4.5% of the number of buses for each year. Along with traffic forecast, toll rates (reported by L&T) are also provided by Kalpasar technical team, escalated at a rate of 5% between 2022-41 which gradually decreases at each 20 years interval.

Table 32. 27: Revenue profile (Road Development)

Traffic forecast							
Year	**Car**	**Bus**	**Minibus**	**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 marketing and other commercial charges. Revenue from marketing & other commercial charges is considered to be 10% of toll revenue 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 is 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. 28: O&M Expense Profile (Road Development)

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%

32.4.2.2 Results of Financial Analysis

This section provides the key financial analysis results for the base case scenario.

Base-case scenario

These results are computed under the Base-case scenario where the most realistic revenue and cost have been considered. The results suggest that the road project offers a reasonable IRR (20%-21%) when computed for 30-50 years. The results from NPV computation also provide similar inferences. The debt service coverage ratio and interest coverage ratio are also estimated. Except for the initial few years, both the DSCR and ICR remain more than 3 and 4, respectively, indicating comfortable debt servicing profile over the currency of the loan. The projected cash flows corresponding to the Base-case 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). Balance sheet and profit and loss statement with respect to this scenario is provided in the Annexure B.2. and Annexure B.3.

Table 32. 29: Results under Base-case scenario (Road Development)

			Year	**30**		**40**		**50**
Project IRR				20.40%		21.02%		21.16%
Equity IRR				31.76%		31.95%		31.97%
NPV @ Cost of capital								
NPV @ 12%				8231.07		11493.13		13310.22
NPV @ 10%				13272.22		19417.48		23506.92
NPV @ 8%				20983.69		32727.74		42094.38
NPV @ 6%				32943.31		55724.96		77575.04
Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	2.50	2.85	3.25	3.70	3.53	4.78	5.44	6.19
ICR (Interest Coverage)	3.66	4.24	4.91	5.69	5.55	7.68	8.95	10.45
Average DSCR	2.50	2.67	2.86	3.06	3.15	3.40	3.66	3.93
Average ICR	3.66	3.95	4.25	4.59	4.76	5.18	5.63	6.12

32.4.2.3 Sensitivity Analysis

The project cash flows, estimated coverage ratios, project IRR/Equity IRR, and project NPV (NPV computations assume four cost of capital scenarios: 6%, 8%, 10%, and 12%) were computed with the above-mentioned assumptions. The results have been reported for 30 years, 40 years, and 50 years for five scenarios. The details for different scenarios are mentioned below.

Base-case scenario

Base-case scenario has been discussed in results of financial analysis section. Rest of the scenario are provided below.

Optimistic scenario

The results under the Optimistic scenario have been computed assuming: (a) an increase in revenue by 5% and (b) a decrease in CAPEX and OPEX by 5%. As expected, the results suggested that the road project offered a reasonable IRR when computed for 30-50 years. The results from NPV computation also provided similar inferences. The debt service coverage ratio and interest coverage ratio have also been estimated. Results for both the ratios were well within comfortable limits. The projected cash flows corresponding to the Optimistic scenario have been provided in Annexure B.4. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the Excel model (which is not shown here for the sake of brevity).

Table 32. 30: Results under Optimistic scenario (Road Development)

			Year	30		40		50
Project IRR				21.11%		21.67%		21.80%
Equity IRR				32.95%		33.12%		33.13%
NPV @ Cost of capital								
NPV @ 12%				8600.36		11867.50		13686.83
NPV @ 10%				13679.51		19834.34		23928.81
NPV @ 8%				21436.21		33198.48		42576.63
NPV @ 6%				33451.02		56267.88		78144.75
Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	2.67	3.05	3.47	3.95	3.82	5.11	5.81	6.61
ICR (Interest Coverage)	3.92	4.53	5.25	6.08	6.00	8.20	9.56	11.16
Average DSCR	2.67	2.86	3.05	3.27	3.37	3.63	3.91	4.21
Average ICR	3.92	4.22	4.54	4.90	5.10	5.55	6.03	6.54

Best-case scenario

The results under the Best-case scenario have been computed assuming: (a) an increase in revenue by 10% and (b) a decrease in CAPEX and OPEX by 10%. Under this scenario, the results suggested that the road project offered an extremely comfortable IRR when computed for 30-50 years. The results from NPV computation also provided similar inferences. The debt service coverage ratio and interest coverage ratio have also been estimated. As expected, the DSCR and ICR remained above 3 and 5, respectively, which suggested comfortable debt servicing, except for the initial few years. The projected cash flows corresponding to the Best-case scenario have been provided in Annexure B.5. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the Excel model (which is not shown here for the sake of brevity).

Table 32. 31: Results under Best-case scenario (Road Development)

			Year	**30**		**40**		**50**
Project IRR				21.85%		22.38%		22.48%
Equity IRR				34.21%		34.35%		34.36%
NPV @ Cost of capital								
NPV@12%				8960.91		12233.03		14054.55
NPV@10%				14077.19		20241.35		24340.73
NPV@8%				21878.05		33658.10		43047.47
NPV@6%				33946.74		56797.97		78700.99
Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	2.86	3.26	3.72	4.23	4.14	5.47	6.22	7.07
ICR (Interest Coverage)	4.20	4.86	5.62	6.51	6.50	8.78	10.23	11.95
Average DSCR	2.86	3.06	3.27	3.50	3.62	3.90	4.20	4.51
Average ICR	4.20	4.52	4.87	5.25	5.47	5.95	6.46	7.02

Pessimistic scenario

The results under the Pessimistic scenario have been computed by assuming: (a) a decrease in revenue by 5% and (b) an increase in CAPEX and OPEX by 5%. Even with the Pessimistic scenario, the results suggested that the road project offers a reasonable IRR (19%-21%) when computed for 30-50 years. The results from NPV computation also provided similar inferences. The NPV remained positive for all the discount rates employed. The debt service coverage ratio and interest coverage ratio have also been estimated. The DSCR and ICR ratios remained comfortably above 3 and 4, indicating comfortable debt servicing even during stressed situations, except for the initial few years. The projected cash flows corresponding to the Pessimistic scenario have been provided in Annexure B.6. Detailed results corresponding to this scenario can be obtained by selecting the appropriate option in the Excel model (which is not shown here for the sake of brevity).

Table 32. 32: Results under Pessimistic scenario (Road Development)

			Year	**30**		**40**		**50**
Project IRR				19.74%		20.40%		20.56%
Equity IRR				30.62%		30.85%		30.87%
NPV @ Cost of capital								
NPV@12%				7852.74		11109.58		12924.38
NPV@10%				12854.95		18990.40		23074.70
NPV@8%				20520.08		32245.46		41600.32
NPV@6%				32423.15		55168.74		76991.38
Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	2.34	2.67	3.05	3.47	3.28	4.49	5.11	5.81
ICR (Interest Coverage)	3.44	3.98	4.61	5.34	5.15	7.21	8.40	9.82
Average DSCR	2.34	2.51	2.68	2.87	2.94	3.18	3.43	3.69
Average ICR	3.44	3.70	3.99	4.30	4.45	4.85	5.28	5.73

Worst-case scenario

The results under the Worst-case scenario have been computed by assuming: (a) a decrease in revenue by 10% and (b) an increase in CAPEX and OPEX by 10%. The results suggested that the road project still offered a reasonable IRR when computed for 30-50 years (19%-20%). The results from NPV computation also provided similar inferences. The debt service coverage ratio and interest coverage ratio have also been estimated. The DSCR and

ICR ratios have been found to remain well above 2 and 3, indicating comfortable debt servicing even during such extreme stress. The projected cash flows corresponding to the Worst-case scenario have been provided in Annexure B.7. 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 (which is not shown here for the sake of brevity).

Table 32. 33: Results under Worst-case scenario (Road Development)

			Year	30		40		50
Project IRR				19.11%		19.82%		19.99%
Equity IRR				29.53%		29.80%		29.83%
NPV @ Cost of capital								
NPV@12%				7465.03		10716.52		12528.98
NPV@10%				12427.33		18552.74		22631.75
NPV@8%				20044.97		31751.23		41094.01
NPV@6%				31890.10		54598.73		76393.25
Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	2.20	2.51	2.86	3.26	3.04	4.22	4.81	5.47
ICR (Interest Coverage)	3.23	3.74	4.33	5.02	4.78	6.78	7.91	9.23
Average DSCR	2.20	2.36	2.52	2.70	2.76	2.98	3.22	3.46
Average ICR	3.23	3.48	3.75	4.04	4.18	4.55	4.95	5.39

32.4.3 Development of Railways Project

A ~30 km earth dyke has been planned to be constructed across the Gulf of Khambhat to create a massive freshwater coastal reservoir for irrigation, drinking and industrial purposes, with about 2 km concrete spillway for emptying saltwater or flood water. A railway line has also been planned to be built over the dyke. This includes a passenger train, a dedicated freight train with RO-RO facility, and a Semi-High-Speed Rail for the movement of passenger traffic.

32.4.3.1 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. 13612.15 Crore has been estimated for the construction of the railway track between Bhavnagar and Dahej-Bharuch. This also includes the interest during construction of Rs. 2612.41 Crore. A debt-to-equity ratio of 70:30 has been assumed for computation purposes, which is similar to other semi-high-speed railway projects.

Table 32. 34: Project cost details (Development of Railways)

Project Cost	**Rs Crore**	
Railway Civil cost	6,535.97	
Railway Signaling, telecommunication. and Electrification cost	1804.56	
Railway Mechanical cost	1.71	
Railway Structural cost	2592.14	
Environmental Charges due to Rail @ 1% of Civil cost	65.36	
Interest during construction	2612.41	
Total cost	**13612.15**	
Means of Financing (60:40)		**Debt profile**
Debt	9528.50	Door to door tenor of 30 years; and 8 years of moratorium with interest @10% p.a.
Equity	4083.64	
Total cost	**13612.15**	

The construction period of project is estimated as 8 years. It is assumed that capex is phased out as 3.6%, 5.8%, 5.4%, 5.4%, 12.8%, 24.5%, 28.2%, and 14.3% over construction period of 8 years.

Table 32. 35: Capex Phasing (Development of Railways)

Year	2027	2028	2029	2030	2031	2032	2033	2034
Percentage	3.6%	5.8%	5.4%	5.4%	12.8%	24.5%	28.2%	14.3%
Cost in Crore	485.13	795.77	733.53	733.53	1746.21	3330.76	3841.53	1945.67

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 have been considered.

Assumptions related to passenger train

To compute the projected revenues from passenger trains, the following important assumptions have been made on the basis of reports provided by authorities and similar semi high speed rail projects. Total distance has been 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. The number of passenger trains per day is estimated to be 63 for 2035 and which gradually increase to 159 in 2076. 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. 36: Revenue profile (Development of Railways)

Number of trains per day					
Year	**2035**	**2046**	**2056**	**2066**	**2076**
Passenger trains per day	63	84	123	143	159
Freight trains Per day	10	29	49	67	79
Capacity utilisation rates					
Passenger trains	0.5	0.97	0.97	0.97	0.97
Freight trains	0.5	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	60	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%**	**0%**
Revenue from registration fees and stamp duty	**15%**	**0%**

To compute the revenue from passenger trains, Capacity utilisation rate for passenger trains has been considered as 50% for 2035 and gradually increased to 97% in year 2076. Capacity utilisation rates are estimated with reference to Silverline, Bengaluru suburban semi high speed rail projects.

Assumptions related to freight train

Separate assumptions have been made to further compute the projected revenues from freight trains, for freight trains without RORO services and freight trains 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 is considered to be 10 in 2035 and gradually increases to 79 in 2076.

To compute the revenue from freight trains with RORO services, the total number of wagons per train has been assumed to be 60, whereas rate 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, the number of wagons per train 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 of Railways. Capacity utilisation rates computed for freight trains were kept 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 no yearly escalation. Whereas revenue from registration fees & stamp duty is expected to be 15% of revenue from passenger train with no yearly escalation.

Assumptions related to expenses

With reference to reports provided by Kalpasar authorities, operation and maintenance costs estimated to be incurred are Rs. 506 Crore each year. However, periodical replacement cost will be incurred instead of annual cost after every 10 years starting from 2035 to 2064.

Table 32. 37: O&M Expense Profile (Development of Railways)

Cost Profile	Price	Unit	
Operation and maintenance cost	506	Crore	Each year
Periodical replacement cost	9715 23643 9715	Crore	2044 2054 2064

32.4.3.2 Results of financial analysis

This section provides the key financial analysis results of base case scenario.

Base-case scenario

The Base-case scenario, where revenue and cost figures are most realistic based on the assumptions made, is used for these computations. 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. 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. The Debt Service Coverage Ratio (DSCR) and Interest Coverage Ratio (ICR) are also estimated. Except for the initial four years, the DSCR and ICR remain well above 2 and 3, respectively, indicating comfortable debt servicing.

The projected cash flows corresponding to the Base-case 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 (which is not shown here for the sake of brevity). The balance sheet and profit and loss statements with respect to this scenario are provided in Appendix C.2 and Appendix C.3, respectively.

Table 32. 38: Results under Base-case scenario (Development of Railways)

			Year	30	40	50		
Project IRR				13.90%	15.68%	16.24%		
Equity IRR				18.90%	20.45%	20.81%		
NPV @ Cost of capital								
NPV @ 12%				1,865.30	5,329.77	7,634.47		
NPV @ 10%				4,969.34	11,498.06	16,700.60		
NPV @ 8%				9,937.03	22,418.39	34,371.82		
NPV @ 6%				17,922.58	42,144.10	70,118.52		
Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	0.66	0.91	1.20	1.54	1.98	2.49	3.11	3.79
ICR (Interest Coverage)	0.97	1.35	1.81	2.38	3.11	4.00	5.11	6.41
Average DSCR	0.66	0.78	0.92	1.07	1.24	1.43	1.64	1.88
Average ICR	0.97	1.16	1.36	1.60	1.87	2.18	2.53	2.92

32.4.3.3 Sensitivity Analysis

Key Results pertaining to Project IRR/NPV

Based on the assumptions noted, the forecast of the project cash flows and estimated coverage ratios, project IRR/Equity IRR and project NPV (NPV computations assume four cost of capital scenarios: 6%, 8%, 10%, and 12%) have been done. The results are shown for 30 years, 40 years, and 50 years for five scenarios.

Base case scenario

Base case scenario is already discussed in results of financial analysis section. Rest of the scenarios are provided below.

Optimistic scenario

The following results have been computed under the Optimistic scenario- (a) an increase in revenue by 5% and (b) a decrease in CAPEX and OPEX by 5%. The results suggest that the project offers a reasonable IRR (15%-17%) when computed for 30-50 years. The results from NPV computation also provide similar inferences. We have also estimated 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 3, respectively, indicating comfortable debt servicing conditions. The projected cash flows corresponding to the Optimistic scenario have been 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. 39: Results under Optimistic scenario (Development of Railways)

			Year	**30**		**40**		**50**
Project IRR				15.06%		16.64%		17.12%
Equity IRR				20.86%		22.11%		22.38%
NPV @ Cost of capital								
NPV @ 12%				2,963.00		6,616.94		9,039.16
NPV @ 10%				6,392.52		13,279.09		18,746.87
NPV @ 8%				11,839.90		25,006.95		37,569.69
NPV @ 6%				20,551.26		46,106.48		75,506.58
Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	0.78	1.05	1.38	1.77	2.26	2.84	3.53	4.29
ICR (Interest Coverage)	1.14	1.57	2.09	2.73	3.55	4.55	5.80	7.25
Average DSCR	0.78	0.92	1.07	1.23	1.42	1.64	1.88	2.14
Average ICR	1.14	1.35	1.58	1.85	2.15	2.50	2.90	3.33

Best-case scenario

The following results have been computed under the Best-case scenario- (a) an increase in revenue by 10% and (b) a decrease in CAPEX and OPEX by 10%. The results suggest that the project offers an extremely comfortable IRR (16%-18%) when computed for 30-50 years. The results from NPV computation also provide similar inferences. We have also estimated the Debt Service Coverage Ratio and Interest Coverage Ratio. Except for the initial few years, both the DSCR and ICR ratios remain above 3 and 4, respectively, indicating comfortable debt servicing conditions. The projected cash flows corresponding to the Best-case scenario have been 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. 40: Results under Best-case scenario (Development of Railways)

			Year	**30**		**40**		**50**
Project IRR				16.22%		17.64%		18.05%
Equity IRR				22.84%		23.83%		24.03%
NPV @ Cost of capital								
NPV @ 12%				4,044.42		7,887.83		10,427.57
NPV @ 10%				7,797.98		15,042.41		20,775.42
NPV @ 8%				13,723.85		27,576.60		40,748.64
NPV @ 6%				23,160.37		50,049.30		80,875.09
Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	0.91	1.22	1.59	2.03	2.57	3.22	3.99	4.85
ICR (Interest Coverage)	1.34	1.82	2.40	3.12	4.04	5.17	6.57	8.20
Average DSCR	0.91	1.06	1.23	1.42	1.64	1.88	2.15	2.44
Average ICR	1.34	1.57	1.83	2.13	2.47	2.87	3.31	3.80

Pessimistic scenario

The following results have been computed under the Pessimistic scenario- (a) a decrease in revenue by 5% and (b) an increase in CAPEX and OPEX by 5%. Even with Pessimistic scenario, the results suggest that the project offers a reasonable IRR (12%-16%) when computed for 30-50 years. The results from NPV computation also provided similar inferences. All the NPV figures are positive. We have also estimated 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 3, respectively, indicating comfortable debt servicing conditions. The projected cash flows corresponding to the Pessimistic scenario have been provided in Annexure C.6. 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. 41: Results under Pessimistic scenario (Development of Railways)

			Year	**30**		**40**		**50**
Project IRR				12.76%		14.74%		15.38%
Equity IRR				16.94%		18.86%		19.33%
NPV @ Cost of capital								
NPV @ 12%				747.01		4,022.01		6,209.19
NPV @ 10%				3,523.29		9,694.15		14,631.45
NPV @ 8%				8,009.27		19,804.95		31,149.07
NPV @ 6%				15,267.81		38,155.65		64,704.39
Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	0.56	0.77	1.03	1.34	1.73	2.19	2.74	3.34
ICR (Interest Coverage)	0.82	1.15	1.56	2.07	2.71	3.51	4.50	5.65
Average DSCR	0.56	0.66	0.78	0.92	1.07	1.24	1.43	1.64
Average ICR	0.82	0.98	1.16	1.37	1.61	1.89	2.20	2.55

Worst-case scenario

The following results have been computed under the Worst-case scenario- (a) a decrease in revenue by 10% and (b) 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 provided similar inferences. Except for one scenario (30-year at 12%), NPV remained positive for all the other cases. We have also estimated the Debt Service Coverage Ratio and Interest Coverage Ratio. Except for the initial few years, both the DSCR and ICR ratios remained above 2 and 3, respectively, indicating comfortable debt servicing conditions. The projected cash flows corresponding to the Base-case scenario have been provided in Annexure C.7. 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. 42: Results under Worst-case scenario (Development of Railways)

			Year	**30**		**40**		**50**
Project IRR				11.60%		13.81%		14.55%
Equity IRR				14.96%		17.31%		17.92%
NPV @ Cost of capital								
NPV @ 12%				-394.70		2,690.84		4,760.49
NPV @ 10%				2,051.01		7,864.03		12,536.09
NPV @ 8%				6,052.79		17,162.80		27,897.61
NPV @ 6%				12,582.79		34,136.97		59,260.03
Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	0.46	0.66	0.89	1.16	1.50	1.91	2.40	2.94
ICR (Interest Coverage)	0.68	0.98	1.34	1.79	2.36	3.07	3.95	4.97
Average DSCR	0.46	0.56	0.66	0.78	0.92	1.07	1.24	1.43
Average ICR	0.68	0.82	0.99	1.17	1.39	1.63	1.91	2.22

32.4.4 Renewable Energy

The project also envisages the creation of a wind and solar hybrid system for renewable energy generation. Solar insolation in this area has been measured to be 5.8 kWh/m2/day. A wind park with a land area of 4500 hectares has been proposed, of which 3000 hectares (without any shadow effect) have been made available for solar power development. Solar plants can also be designed in the reclaimed area between 5m to 7m contour lines.

Because the area required for solar PV power is 3.0 hectare/MW, 1000 MW of solar power installation has been found to be viable on 3000 ha of land. The wind and solar farms will supply power to a dedicated pooling substation with a voltage of 220/33 kV or 400/33 kV, depending on the voltage level at which the Gujarat state transmission utility grants connectivity. According to the power evacuation study, the pooling sub-station has been connected to the grid sub-station at 400 kV or 220 kV. The proposed 765 kV transmission corridor from Khavda- Halvad- Vataman- Kosamba is one of the viable options for evacuating power from the Kalpasar wind-solar farm.

Wind and solar energy generation are expected to meet the dam's power demand. Surplus energy, if any, shall be made available for supply to the power grid. Use of renewable energy sources shall enable mitigation of environmental imbalance and also shall be a major contributor as India takes further steps towards meeting its target of 500 GW of renewable energy by 2030.

32.4.4.1 Assumptions

(A) Wind

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. 15,387.00 Crore has been estimated to create wind farms at four different sites (Vadgam, Motibaru, Proposed P1 region and Proposed P2 region). This also included the interest during the construction of 2,237.63 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 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), therefore, cost at Rs 7.00 per MW Crore for wind projects has been considered.

Table 32. 43: Project cost details -Wind (Wind Energy Project)

Project Cost	**Rs Crore**	
WEGs	9,099.37	
Concrete tower	1,630.52	
Distribution transformer	683.77	
Civil work	445.76	
Erection, commissioning, insurance	445.76	
Land and Transportation	328.73	
Transfer of development rights charges, contingency, etc.	515.46	
IDC	2,237.63	
Total cost	**15,387.00**	
Means of Financing (70:30)		**Debt profile**
Debt	10,770.90	Door to door tenor of 30 years and 8 years of moratorium with interest @10% p.a.
Equity	4,616.10	
Total cost	**15,387.00**	

The construction period of project is estimated as 8 years. CAPEX is phased out as 0.9%, 0.6%, 0.1%, 0.1%, 16.3%, 32.8%, 32.7% and 16.5% over the period of 8 years.

Table 32. 44: Capex phasing (Wind Energy Project)

Year	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
Percentage	0.9%	0.6%	0.1%	0.1%	16.3%	32.8%	32.7%	16.5%
Cost in Crore	141.06	85.15	14.80	14.80	2,503.69	5,047.87	5,034.26	2,545.37

Revenue and expense related assumptions

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

Assumptions related to tariff and capacity utilisation factor

Tariff rate of Rs. 9.03 kWH (2035) and CUF of 35% has been assumed for estimating the revenue from energy generation. [As per the latest CERC tariff order available the current total, i.e., fixed + 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. 45: Revenue Profile (Wind Energy Project)

Revenue					
Year	**2038**	**2044**	**2050**	**2056**	**2062**
Tariff (Rs kWH)	9.03	9.03	9.03	9.03	9.03
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)	4174.65	4174.65	4174.65	4174.65	4174.65

Assumptions related to expenses

With reference to reports provided by the Kalpasar authorities, Operation and maintenance cost is considered at Rs 17.45 lakhs per MW with an escalation of 3.84% per year. This works out to Rs. 262.99 Crore 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. 46: O&M Expense Profile (Wind Energy Project)

Cost Profile	**Price**	**Unit**	
Operation and maintenance cost	262.99	Crore	Annually

(B) Solar

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. 5,861.71 Crore has been estimated for construction the solar power plant. This also includes the interest during construction Rs. 852.43 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. 47: Project cost details (Solar Energy Project)

Project Cost	**Rs Crore**	
Land Development & Civil	75.77	
Equipment	297.01	
Solar Module (PV, Thin Film, CVP)	3,807.40	
Solar Inverters & Mounting	411.31	
Installation	15.15	
Electrical	319.09	
Preoperative Cost	32.47	
Contingency	51.09	
Interest during construction	852.43	
Total cost	**5,861.71**	
Means of Financing (70:30)		**Debt profile**
Debt	4,103.20	Door to door tenor of 30 years and 8 years of moratorium with interest @10% (as per the CERC order) p.a.
Equity	1,758.51	
Total cost	**5,861.71**	

The construction period of the project is estimated as 8 years. CAPEX is phased out as 0.9%, 0.6%, 0.1%, 0.1%, 16.3%, 32.8%, 32.7% and 16.5% over the period of 8 years.

Table 32. 48: Capex phasing (Solar Energy Project)

Year	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
Percentage	0.9%	0.6%	0.1%	0.1%	16.3%	32.8%	32.7%	16.5%
Cost in Crore	53.74	32.44	5.64	5.64	953.83	1,922.95	1,917.77	969.71

Revenue and expense related assumptions

Tariff rate of Rs. 9.03 kWH (2035) and CUF of 35% has been assumed for estimating the revenue from energy generation. [As per the latest CERC tariff order available the current total, i.e., fixed + 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. 49: Revenue Profile (Solar Energy Project)

Revenue					
Year	**2038**	**2044**	**2050**	**2056**	**2062**
Tariff (Rs kWH)	9.03	9.03	9.03	9.03	9.03
Electricity generation (kWh)	8760000000	8760000000	8760000000	8760000000	8760000000
CUF	35.00%	35.00%	35.00%	35.00%	35.00%
Revenue in Cr (Tariff*Electricity generation)	2769.67	2769.67	2769.67	2769.67	2769.67

Assumptions related to expenses

With reference to reports provided by the Kalpasar 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 Crore (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. 50: O&M Expense Profile (Solar Energy Project)

Cost Profile	**Price**	**Unit**	
Operation and maintenance cost	100.19	Crore	Annually

32.4.4.2 Results of Financial Analysis

(A) Wind

Base-case scenario

The Base-case scenario, where revenue and cost figures are most realistic based on the assumptions made, is used for these computations. The results suggest that the wind project offers a reasonable IRR (13%-16%) when computed for 20-30 years. The results from NPV computation also offer similar inferences. We have also estimated 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 2 and 3, indicating comfortable debt servicing. The projected cash flows corresponding to the Base-case scenario have been provided in Annexure D1. 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. 51: Results under Base-case scenario (Wind Energy Project)

			Year	20	25	30		
Project IRR				13.56%	15.19%	15.78%		
Equity IRR				26.37%	27.25%	27.49%		
NPV @ Cost of capital								
NPV @ 12%				725.84	1,795.78	2,362.18		
NPV @ 10%				2,021.68	3,634.22	4,568.31		
NPV @ 8%				3,876.75	6,327.00	7,882.70		
NPV @ 6%				6,520.30	10,275.29	12,892.85		
Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	2.48	2.55	2.63	2.71	2.79	2.89	2.99	3.09
ICR (Interest Coverage)	3.63	3.79	3.97	4.17	4.39	4.64	4.91	5.23
Average DSCR	2.48	2.51	2.55	2.59	2.62	2.66	2.71	2.75
Average ICR	3.63	3.71	3.79	3.88	3.97	4.07	4.17	4.28

(B) Solar

Base-case scenario

The Base-case scenario, where revenue and cost figures are most realistic based on the assumptions made, is used for these computations. The results suggest that the solar project offers a reasonable IRR (23%-25%) when computed for 20-30 years. The results from NPV computation also offer similar inferences. We have also estimated 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 4 and 6, indicating comfortable debt servicing. The projected cash flows corresponding to the Base-case scenario have been provided in Annexure D8. 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 Base-case scenario (Solar Energy Project)

			Year	20	25	30		
Project IRR				23.47%	24.43%	24.70%		
Equity IRR				45.28%	45.54%	45.58%		
NPV @ Cost of capital								
NPV @ 12%				2,484.34	3,221.72	3,624.62		
NPV @ 10%				3,575.29	4,686.86	5,351.46		
NPV @ 8%				5,069.94	6,759.34	7,866.48		
NPV @ 6%				7,125.95	9,715.53	11,578.84		
Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	4.48	4.62	4.77	4.93	5.09	5.27	5.47	5.68
ICR (Interest Coverage)	6.57	6.88	7.21	7.59	8.00	8.47	8.99	9.59
Average DSCR	4.48	4.55	4.62	4.69	4.77	4.85	4.92	5.01
Average ICR	6.57	6.72	6.88	7.04	7.21	7.40	7.59	7.79

32.4.4.3 Results of Sensitivity Analysis

(A) Wind

Key Results pertaining to Project IRR/NPV

Based on the assumptions noted, we have forecasted the project cash flows and estimated coverage ratios, project IRR/Equity IRR and project NPV (NPV computations assume four cost of capital scenarios: 6%, 8%, 10%, and 12%). The results are shown for 20 years, 25 years, and 30 years for five scenarios.

Optimistic scenario

Following results have been computed under the Optimistic scenario: (a) an increase in revenue by 5% and (b) a decrease in CAPEX and OPEX by 5%. As expected, the results suggested that the project offers a reasonable IRR (15%-17%) when computed for 20-30 years. The results from NPV computation also provided similar inferences. We have also estimated the Debt Service Coverage Ratio and Interest Coverage Ratio. As expected, the DSCR and ICR remain above 2 and 5, respectively, which suggests comfortable debt servicing. The projected cash flows corresponding to the Optimistic scenario have Been provided in Annexure D4. 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 Optimistic scenario (Wind Energy Project)

			Year	**20**		**25**		**30**
Project IRR				15.34%		16.83%		17.35%
Equity IRR				30.02%		30.72%		30.89%
NPV @ Cost of capital								
NPV @ 12%				1,521.61		2,654.23		3,258.41
NPV @ 10%				2,968.89		4,675.98		5,672.42
NPV @ 8%				5,015.26		7,609.34		9,268.97
NPV @ 6%				7,903.37		11,878.97		14,671.58
Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	2.78	2.87	2.95	3.05	3.15	3.25	3.37	3.49
ICR (Interest Coverage)	4.08	4.27	4.47	4.69	4.94	5.22	5.54	5.90
Average DSCR	2.78	2.83	2.87	2.91	2.95	3.00	3.05	3.09
Average ICR	4.08	4.17	4.27	4.36	4.47	4.58	4.69	4.81

Best-case scenario

Following results have been computed under the Best-case scenario: (a) an increase in revenue by 10% and (b) a decrease in CAPEX and OPEX by 10%. Under this scenario, the results suggested that the project offers an extremely comfortable IRR (17%-19%) when computed for 20-30 years. The results from NPV computation also provided similar inferences. We have also estimated the Debt Service Coverage Ratio and Interest Coverage Ratio. As expected, the DSCR and ICR remain between 3 and 6, respectively, which suggests comfortable debt servicing. The projected cash flows corresponding to the Best-case scenario have been provided in Annexure D5. 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 Best-case scenario (Wind Energy Project)

	Year	20	25	30
Project IRR		17.19%	18.55%	19.00%
Equity IRR		33.69%	34.24%	34.36%
NPV @ Cost of capital				
NPV @ 12%		2,311.26	3,506.63	4,148.59
NPV @ 10%		3,909.40	5,711.15	6,769.96
NPV @ 8%		6,146.46	8,884.50	10,648.11
NPV @ 6%		9,278.46	13,474.91	16,442.65

Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	3.13	3.22	3.32	3.43	3.54	3.66	3.79	3.93
ICR (Interest Coverage)	4.59	4.80	5.03	5.28	5.57	5.88	6.24	6.65
Average DSCR	3.13	3.18	3.22	3.27	3.32	3.37	3.43	3.48
Average ICR	4.59	4.69	4.80	4.91	5.03	5.15	5.28	5.42

Pessimistic scenario

Following results have been computed under the Pessimistic scenario: (a) a decrease in revenue by 5% and (b) an increase in CAPEX and OPEX by 5%. Even with the Pessimistic 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 provided similar inferences. Except for one case (12% discount rate, 20-year period), NPV remained positive for all the discount rates employed. We have also estimated the Debt Service Coverage Ratio and Interest Coverage Ratio. The DSCR and ICR ratios remain comfortably above 2 and 4, indicating comfortable debt servicing even during stressed situations. The projected cash flows corresponding to the Pessimistic scenario have been provided in Annexure D6. 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 Pessimistic scenario (Wind Energy Project)

	Year	20	25	30
Project IRR		11.84%	13.62%	14.28%
Equity IRR		22.70%	23.80%	24.14%
NPV @ Cost of capital				
NPV @ 12%		-76.21	931.12	1,459.77
NPV @ 10%		1,067.60	2,585.68	3,457.46
NPV @ 8%		2,730.72	5,037.32	6,489.12
NPV @ 6%		5,129.04	8,663.66	11,106.25

Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	2.20	2.26	2.33	2.40	2.48	2.56	2.65	2.74
ICR (Interest Coverage)	3.22	3.37	3.52	3.70	3.89	4.11	4.35	4.63
Average DSCR	2.20	2.23	2.26	2.30	2.33	2.36	2.40	2.44
Average ICR	3.22	3.29	3.37	3.44	3.52	3.61	3.70	3.79

Worst-case scenario

Following results have been computed under the Worst-case scenario: (a) a decrease in revenue by 10% and (b) 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 (10%-13%). The results from NPV computation also provided similar inferences. Except for one case (12% discount rate, 20-year period), NPV remained positive for all the discount rates employed. We have also estimated 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 3, respectively, indicating comfortable debt servicing conditions. The projected cash flows corresponding to the Worst-case scenario have been provided in Annexure D7. 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-case scenario (Wind Energy Project)

			Year	20	25	30		
Project IRR				10.18%	12.10%	12.84%		
Equity IRR				18.97%	20.35%	20.82%		
NPV @ Cost of capital								
NPV @ 12%				-884.69	60.10	551.01		
NPV @ 10%				106.47	1,530.21	2,339.69		
NPV @ 8%				1,576.98	3,740.09	5,088.06		
NPV @ 6%				3,729.38	7,043.88	9,311.60		
Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	1.95	2.01	2.06	2.13	2.19	2.26	2.34	2.42
ICR (Interest Coverage)	2.86	2.98	3.12	3.27	3.44	3.63	3.85	4.09
Average DSCR	1.95	1.98	2.01	2.03	2.06	2.09	2.13	2.16
Average ICR	2.86	2.92	2.98	3.05	3.12	3.20	3.27	3.36

(B) Solar

Key Results pertaining to Project IRR/NPV

Based on the assumptions noted, we have forecasted the project cash flows and estimated 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.

Optimistic scenario

Following results have been computed under the Optimistic scenario: (a) an increase in revenue by 5% and (b) a decrease in CAPEX and OPEX by 5%. As expected, the results suggest that the project offers a reasonable IRR (25%-27%) when computed for 20-30 years. The results from NPV computation also provided similar inferences. We have also estimated the Debt Service Coverage Ratio and Interest Coverage Ratio. As expected, the DSCR and ICR remain above 5 and 7, respectively, which suggests comfortable debt servicing. The projected cash flows corresponding to the Optimistic scenario have been provided in Annexure D.11.

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. 57: Results under Optimistic scenario (Solar Energy Project)

	Year	20	25	30
Project IRR		25.63%	26.48%	26.71%
Equity IRR		49.04%	49.25%	49.27%
NPV @ Cost of capital				
NPV @ 12%		2,897.88	3,675.63	4,102.27
NPV @ 10%		4,076.39	5,248.84	5,952.63
NPV @ 8%		5,683.31	7,465.30	8,637.77
NPV @ 6%		7,884.94	10,616.51	12,589.81

Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	5.02	5.18	5.34	5.52	5.71	5.91	6.13	6.37
ICR (Interest Coverage)	7.36	7.70	8.08	8.50	8.97	9.50	10.09	10.76
Average DSCR	5.02	5.10	5.18	5.26	5.34	5.43	5.52	5.61
Average ICR	7.36	7.53	7.70	7.89	8.08	8.29	8.50	8.73

Best-case scenario

Following results have been computed under the Best-case scenario: (a) an increase in revenue by 10% and (b) a decrease in CAPEX and OPEX by 10%. Under this scenario, the results suggest that the project offers an extremely comfortable IRR (27%-29%) when computed for 20-30 years. The results from NPV computation also provided similar inferences. We have also estimated the Debt Service Coverage Ratio and Interest Coverage Ratio. As expected, the DSCR and ICR remain above 5 and 8, respectively, which suggests comfortable debt servicing. The projected cash flows corresponding to the Best-case scenario have been provided in Annexure D12. 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. 58: Results under Best-case scenario (Solar Energy Project)

	Year	20	25	30
Project IRR		27.89%	28.63%	28.82%
Equity IRR		52.86%	53.02%	53.04%
NPV @ Cost of capital				
NPV @ 12%		3,309.09	4,127.23	4,577.63
NPV @ 10%		4,574.94	5,808.31	6,551.30
NPV @ 8%		6,293.90	8,168.53	9,406.33
NPV @ 6%		8,640.89	11,514.54	13,597.87

Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	5.63	5.80	5.99	6.19	6.40	6.63	6.88	7.14
ICR (Interest Coverage)	8.24	8.63	9.06	9.53	10.06	10.65	11.31	12.07
Average DSCR	5.63	5.71	5.80	5.89	5.99	6.08	6.19	6.29
Average ICR	8.24	8.43	8.63	8.84	9.06	9.29	9.53	9.79

Pessimistic scenario

Following results have been computed under the Pessimistic scenario: (a) a decrease in revenue by 5% and (b) an increase in CAPEX and OPEX by 5%. Even with the Pessimistic scenario, the results suggest that the project offers a reasonable IRR (21%-23%) when computed for 20-30 years. The results from NPV computation also provided similar inferences. NPV remained positive for all the discount rates employed. We have also estimated the Debt Service Coverage Ratio and Interest Coverage Ratio. The DSCR and ICR ratios remain comfortably above 4 and 5, indicating comfortable debt servicing even during stressed situations. The projected cash flows corresponding to the Pessimistic scenario have been provided in Annexure D13. 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. 59: Results under Pessimistic scenario (Solar Energy Project)

			Year	**20**		**25**		**30**
Project IRR				21.38%		22.46%		22.79%
Equity IRR				41.55%		41.88%		41.94%
NPV @ Cost of capital								
NPV @ 12%				2,068.40		2,765.44		3,144.61
NPV @ 10%				3,071.58		4,122.30		4,747.72
NPV @ 8%				4,453.70		6,050.58		7,092.42
NPV @ 6%				6,363.85		8,811.52		10,564.87
Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	4.00	4.12	4.25	4.39	4.54	4.70	4.87	5.05
ICR (Interest Coverage)	5.86	6.13	6.43	6.77	7.13	7.55	8.01	8.54
Average DSCR	4.00	4.06	4.12	4.19	4.25	4.32	4.39	4.46
Average ICR	5.86	5.99	6.13	6.28	6.43	6.59	6.76	6.94

Worst-case scenario

Following results have been computed under the Worst-case scenario: (a) a decrease in revenue by 10% and (b) 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 (19%-21%). The results from NPV computation also provided similar inferences. NPV remained positive for all the other cases. We have also estimated the Debt Service Coverage Ratio and Interest Coverage Ratio. Except for the initial few years, both the DSCR and ICR ratios remain above 3 and 5, respectively, indicating comfortable debt servicing conditions. The projected cash flows corresponding to the Worst-case scenario have been provided in Annexure D14. 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. 60: Results under Worst-case scenario (Solar Energy Project)

			Year	**20**		**25**		**30**
Project IRR				19.37%		20.58%		20.96%
Equity IRR				37.83%		38.26%		38.34%
NPV @ Cost of capital								
NPV @ 12%				1,650.02		2,306.74		2,662.18
NPV @ 10%				2,565.18		3,555.09		4,141.35
NPV @ 8%				3,834.53		5,338.94		6,315.51
NPV @ 6%				5,598.55		7,904.40		9,547.82
Coverage ratios								
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
DSCR (Debt Coverage)	3.56	3.67	3.79	3.91	4.04	4.18	4.33	4.50
ICR (Interest Coverage)	5.22	5.46	5.73	6.02	6.35	6.72	7.13	7.60
Average DSCR	3.56	3.62	3.67	3.73	3.79	3.85	3.91	3.97
Average ICR	5.22	5.34	5.46	5.59	5.73	5.87	6.02	6.18

32.4.5 Aggregate 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 detail in the previous sections along with their assumptions and cash flow projections.

The base case scenario in Aggregate Analysis considers 20% of VGF and 20% of revenue sharing. Financial analysis here involves the analysis of cash flows from all the sub-projects on a nominal cost basis as per the current prices (Year 2022). For each sub-project (e.g., rail, road, wind, solar, etc.), project and equity IRR and NPV measures are computed. In addition, debt servicing coverage indicators (DSCR, ICR, etc.) are also projected. The analysis has been conducted for 30, 40, and 50 years. For cash flow discounting, discount rates of 6%, 8%, 10%, and 12%, have been employed. 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 monetisation, 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, discount rates of 6%, 8%, 10%, and 12% are employed. The data employed in financial modelling 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 stated.

32.4.5.1 Results of Financial Analysis

Base-case scenario

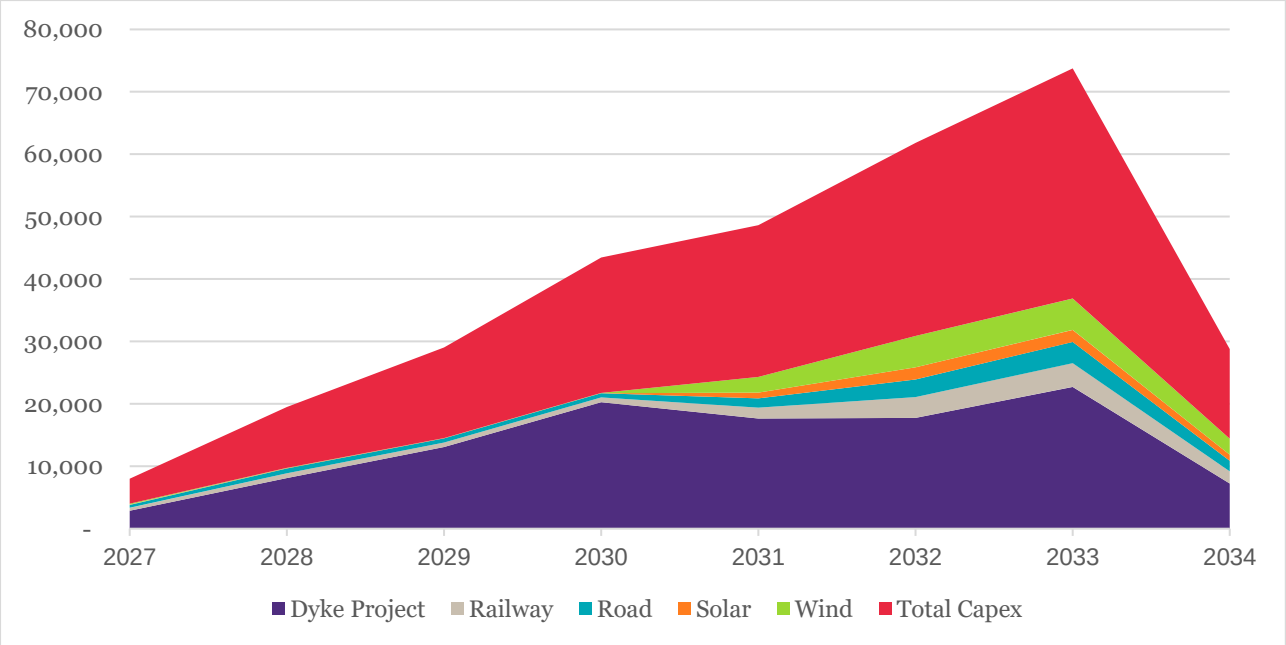


Figure 32. 3: Project Capex – Base case scenario

The total capital cost corresponding to the Base-case scenario presented is provided here. Total cost comprises of dyke, rail, road, solar, and wind. The total capital cost is phased over the period of 8 years starting from 2027 to 2034.

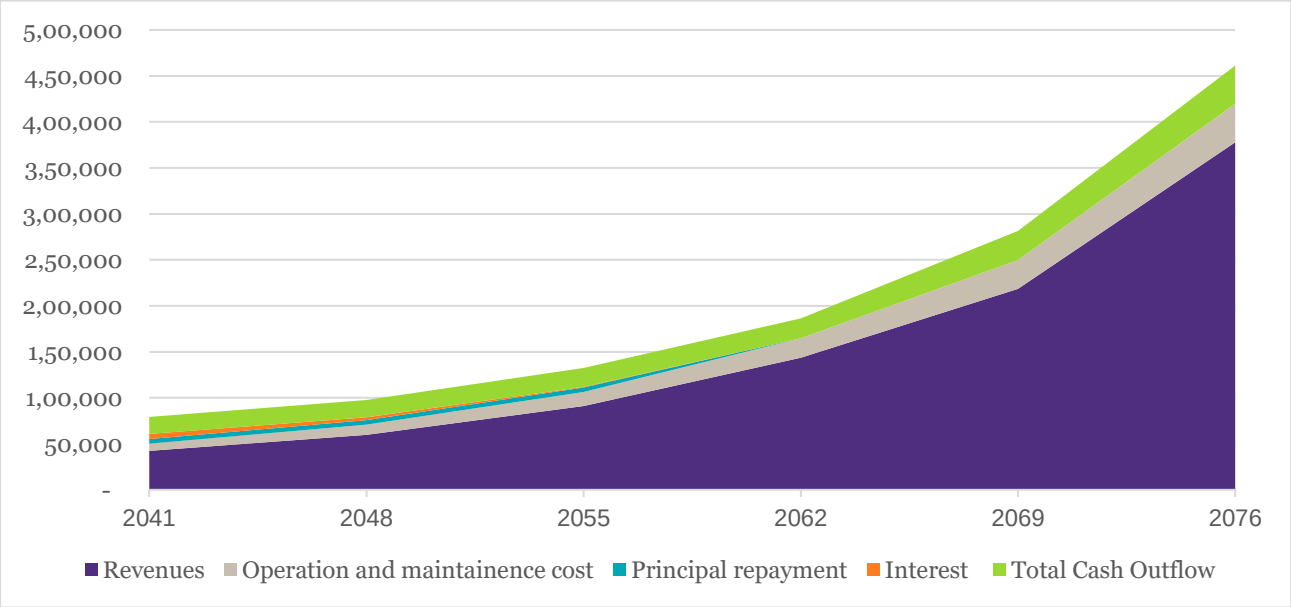


Figure 32. 4: Project cash flow from operating and financing – Base case scenario.

The project cash flow from operating and financing, comprising of dyke, rail, road, solar, and wind, corresponding to the Base-case scenario presented are provided here. The project cash flows include revenues, operations and maintenance, principal repayment, and interest from all the individual projects.

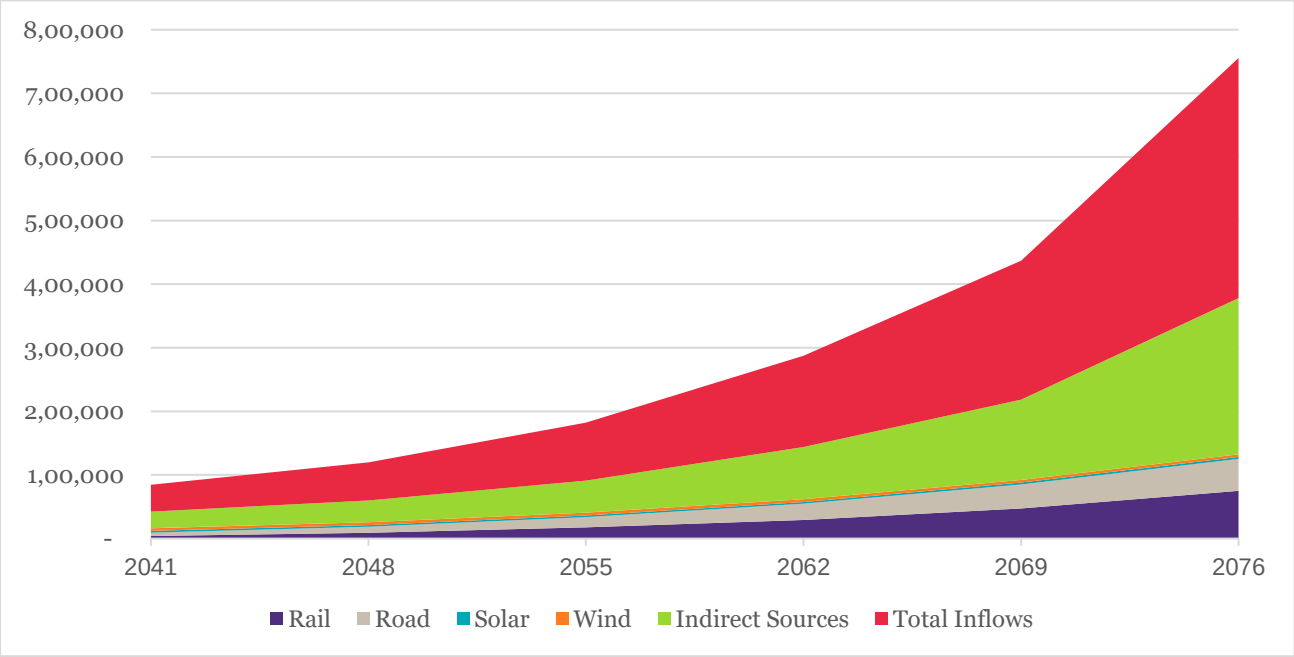


Figure 32. 5: Project cash flow from operating and financing – Base case scenario

The project cash flow from operating and financing, over the life of the project, corresponding to the Base-case scenario presented are provided here. It comprises of project wise revenue from rail, road, solar, wind and indirect sources.

Table 32. 61: Coverage Ratios (Consolidated Project)

Coverage Ratios	Min	2040	2045	2050	2055	2060	2065	2070
DSCR (Debt Coverage)	1.75	3.03	4.60	7.51	13.75	0.00	0.00	0.00
ICR (Interest Coverage)	2.88	5.58	10.15	23.57	141.13	0.00	0.00	0.00
Average DSCR	1.75	2.38	2.91	3.71	4.73	6.97	10.20	14.65
Average ICR	2.88	4.35	5.58	7.68	10.86	16.45	24.18	34.90

Next, project IRR and NPV indicators have been calculated. These measures have been computed for 30-, 40-, and 50-year cash flows. The consolidated project IRR fell within the comfortable range of 13%-15%. Traditionally, for such large-scale government projects, an IRR of 10%-12% is desirable. However, since the project is a combination of several sub-projects, the overall profitability of the project is reduced by the dyke component, which does not have much financial viability. This is attributed to the fact that a major objective of such projects is to create benefits related to externalities (e.g., employment generation, land reclamation, fisheries development, irrigation benefits and other 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. Therefore, to summarise, the project IRR levels are substantially comfortable.

For NPV computation, 6%, 8%, 10%, and 12% discount rates have been considered to indicate the robustness of the results and sensitivities to various scenarios. Traditionally, for such large-scale projects, government bodies often advise a discount rate of 10% (taken from various benchmark projects such as the Chennai Metro, Silverline metro project, and the Bengaluru rail corridor). Except for those scenarios where IRRs are less than opportunity costs, for many scenarios, the consolidated NPV turned out to be positive and considerably large. The project IRR are 13.38%, 14.51%, and 14.94% for 30-, 40-, and 50- years period. The NPV is positive even at higher cost of capital. The project remains substantially viable at opportunity costs 6%, 8%, 10%, and 12%. In fact, for operating periods of 40 years and more, it is also profitable at all levels of opportunity costs.

Table 32. 62: Project IRR and NPV in Rs Crore (Consolidated Project)

Project IRR	%		
30-Years	13.38%		
40-Years	14.51%		
50-Years	14.94%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@12%	13,721.20	32,014.35	43,947.38
NPV@10%	42,615.55	77,066.30	104,082.74
NPV@8%	87,556.54	153,370.50	215,630.83
NPV@6%	157,875.60	285,491.86	431,646.05

In addition to project IRR and project NPV, equity IRR and equity NPVs have been also computed. As expected, the equity IRRs are considerably large. Conventionally, an equity IRR of 14%-18% is desirable from large infrastructure projects of this nature. Equity IRRs of about 38%-39% are observed on a consolidated cash flows basis. This indicates the considerable profitability of the project.

Table 32. 63: Equity IRR and NPV in Rs Crore (Consolidated Project)

Equity IRR	**%**		
30-Years	38.22%		
40-Years	38.30%		
50-Years	38.30%		
Equity NPV	**30-Years**	**40-Years**	**50-Years**
NPV@12%	48,501.48	63,312.16	72,869.35
NPV@10%	69,523.57	97,408.22	119,043.01
NPV@8%	101,073.07	154,328.29	204,180.07
NPV@6%	149,295.55	252,530.32	369,540.81

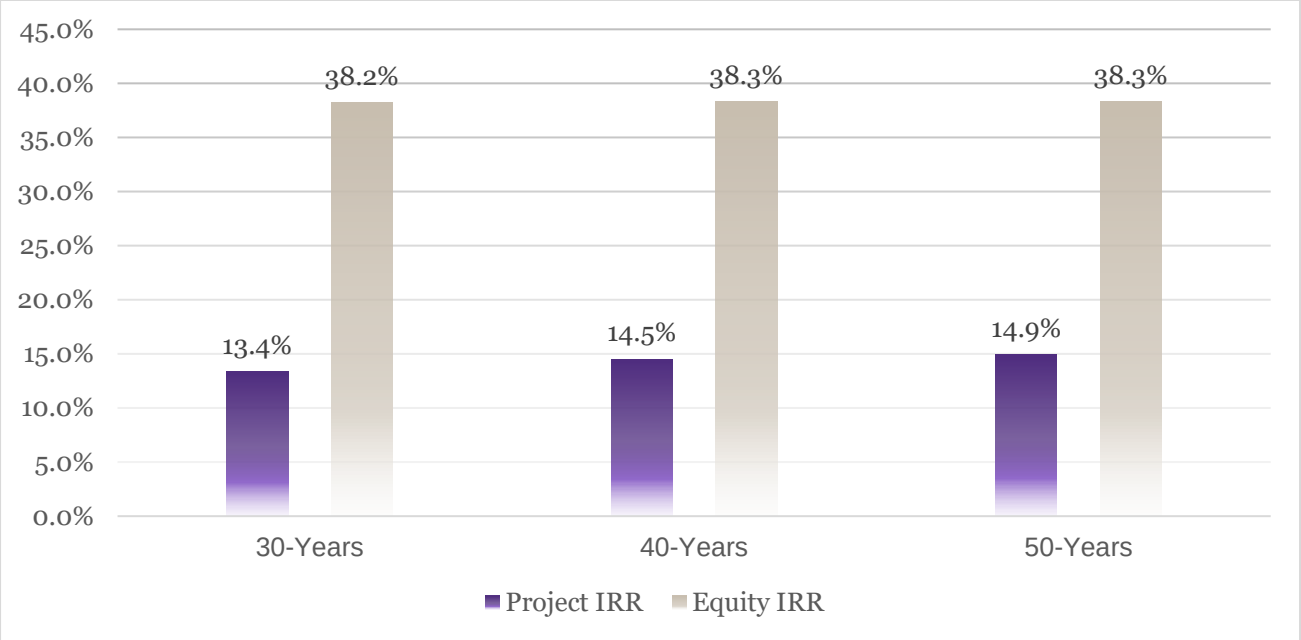


Figure 32. 6: Project Post Tax IRR– Base case scenario

In addition to the above analysis, the fact that such projects result in considerable direct taxes that are part of the exchequer has also been considered. These inflows essentially result in socioeconomic development of the region. Since these cash flows can be directly estimated from the model, another set of optional analyses has been considered where tax is considered while computing the project and equity IRR and NPV analyses. As expected, the figures improved further, indicating the benefits from the project. The project IRR was in the range of 15%-17% and the equity IRR was in the range of 40%-41%.

Table 32. 64: Project IRR and NPV in Rs Crore: Considering taxes as inflows (Consolidated Project)

Project IRR	**%**		
30-Years	15.59%		
40-Years	16.49%		
50-Years	16.78%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@12%	35,937.37	57,391.03	71,004.92
NPV@10%	71,433.93	111,823.92	142,627.73
NPV@8%	125,926.40	203,061.65	274,007.53
NPV@6%	210,395.04	359,915.01	526,356.65

Table 32. 65: Equity IRR and NPV in Rs Crore: Considering taxes as inflows (Consolidated Project)

Project IRR	**%**		
30-Years	40.03%		
40-Years	40.09%		
50-Years	40.09%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@12%	40,084.15	42,222.11	54,372.35
NPV@10%	56,686.86	74,018.96	85,039.02
NPV@8%	81,206.84	113,837.56	138,768.43
NPV@6%	118,060.41	180,378.16	237,788.62

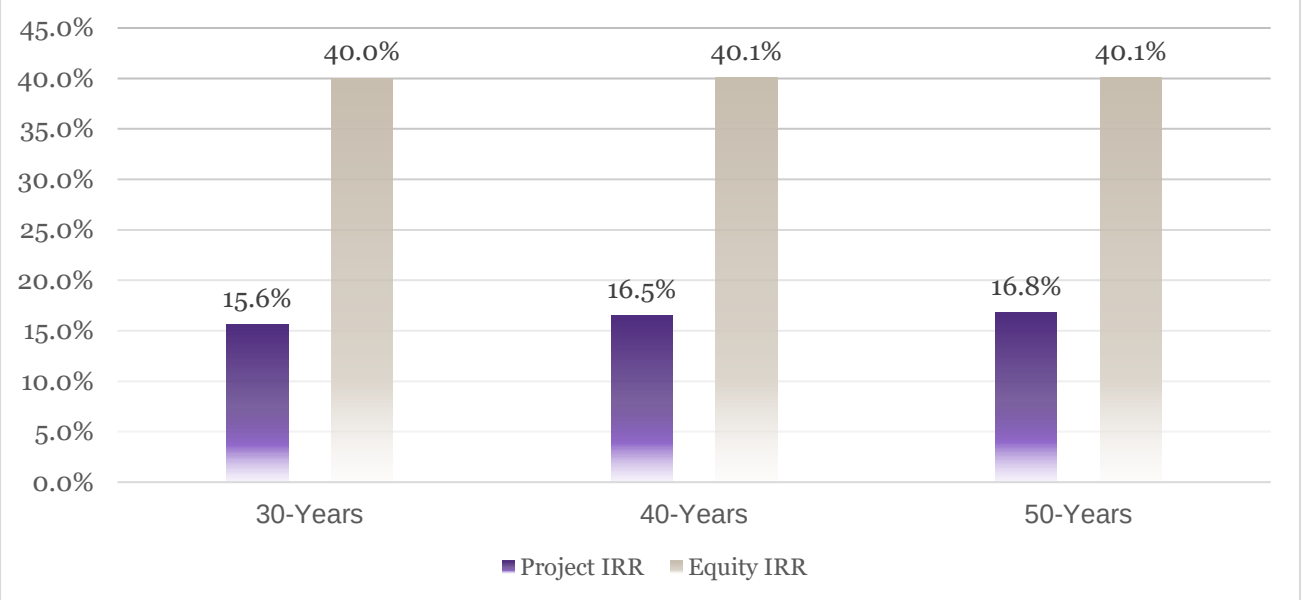


Figure 32. 7: Project IRR (Considering tax as inflow)– Base case scenario (Consolidated Project)

The projected cash flows corresponding to the Base-case 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).

32.4.5.2 Results of Sensitivity Analysis

Optimistic scenario

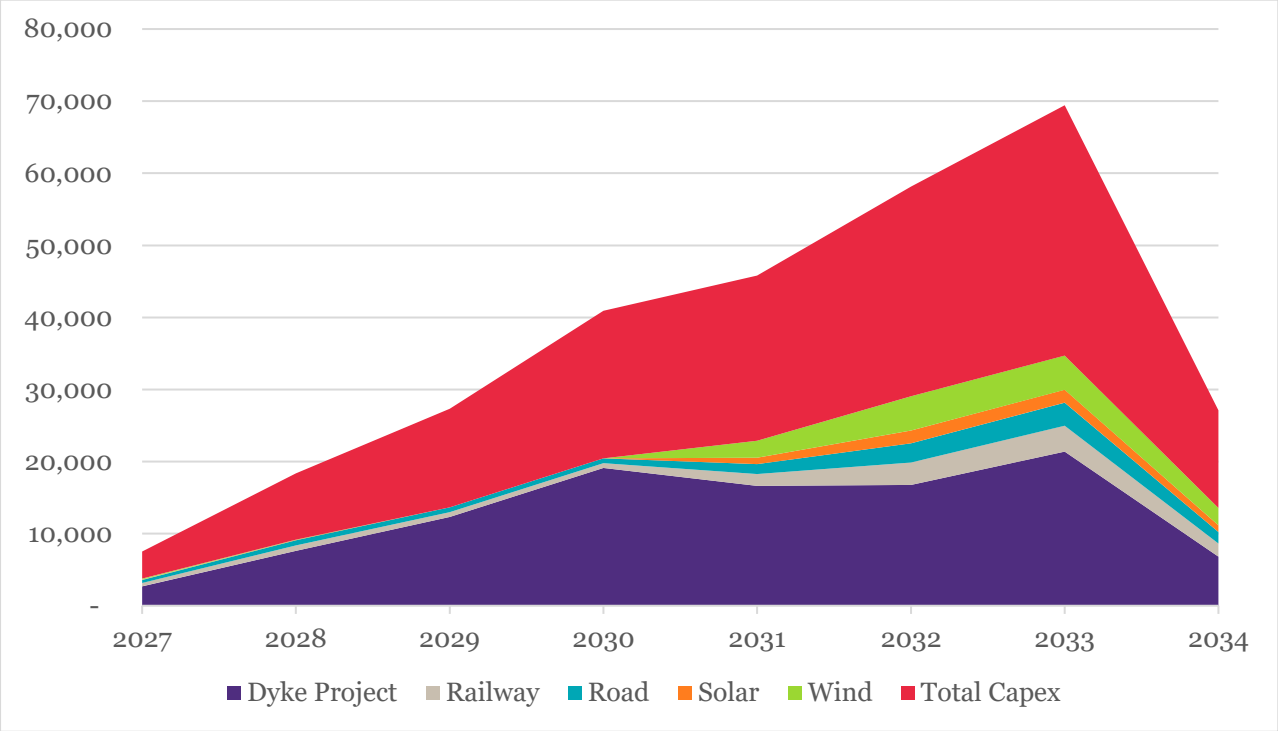


Figure 32. 8: Project Capex – Optimistic case scenario (Consolidated Project)

The total capital cost corresponding to the Optimistic-case scenario presented is provided here. Total cost comprises of dyke, rail, road, solar, and wind. The total capital cost is phased out over the period of 8 years starting from 2027 to 2034.

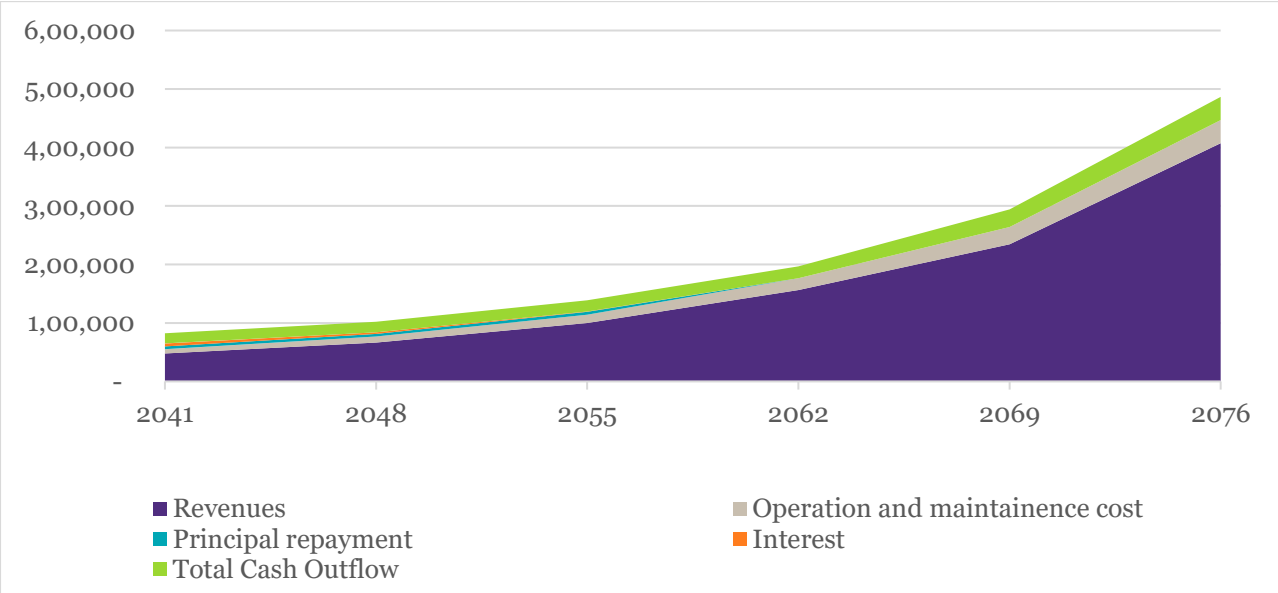


Figure 32. 9: Project cash flow from operating and financing – Optimistic case scenario (Consolidated Project)

The project cash flows from operating and financing, comprising of dyke, rail, road, solar, and wind, corresponding to the Optimistic-case scenario presented are provided here. The project cash flows include revenues, operations and maintenance, principal repayment, and interest from all the individual projects.

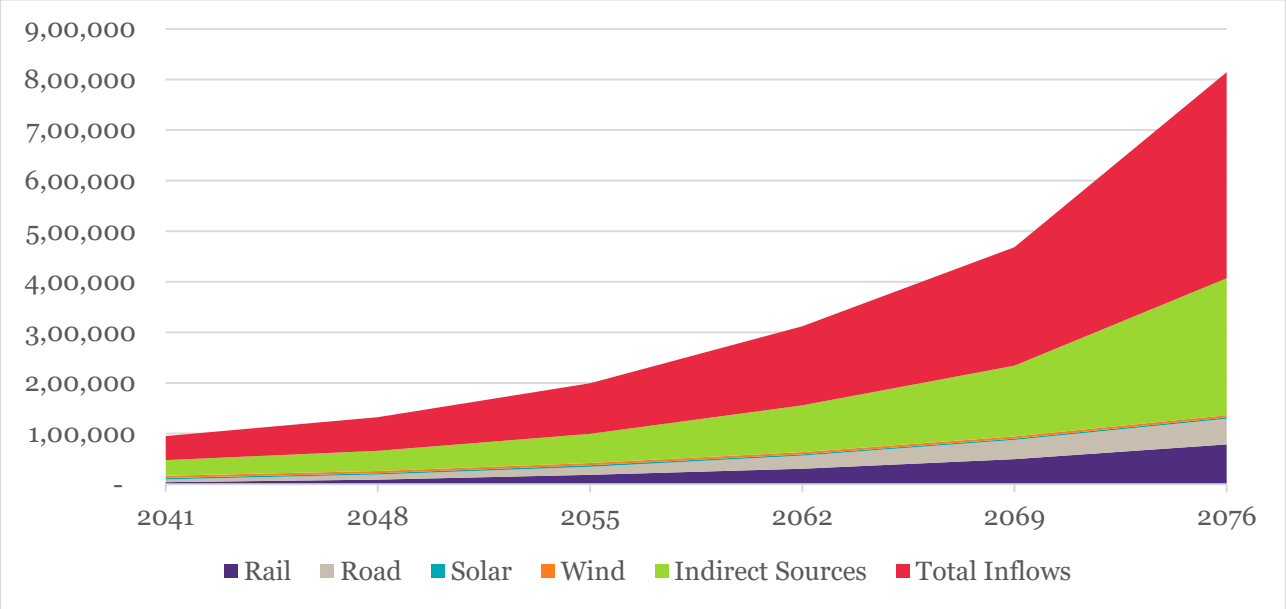


Figure 32. 10: Project cash flow from operating and financing – Optimistic case scenario (Consolidated Project)

The project cash flow from operating and financing, over the life of the project, corresponding to the Optimistic-case scenario presented are provided here. It comprises of project wise revenue from rail, road, solar, wind and indirect sources.

Following the same method as used in the Base-case scenario, the project IRR and NPV indicators have been calculated for 30-, 40-, and 50-year cash flows. The project IRR is found to be within the comfortable range of 15%-17%. This improvement is due to the favourable conditions considered in the model, namely, an increase in revenues by 5% and a decrease in capital expenditure and O&M-related costs by 5%. To summarise, the project IRR levels for this scenario are substantially comfortable.

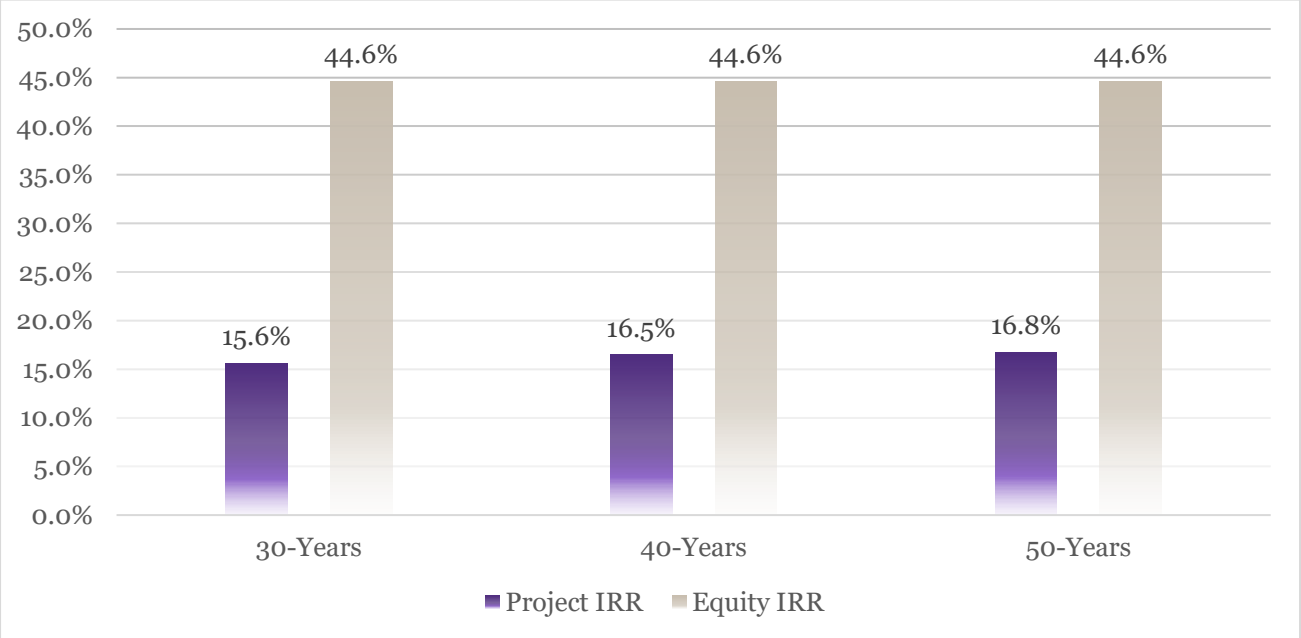


Figure 32. 11: Project Post Tax IRR– Optimistic case scenario (Consolidated Project)

In addition to project IRR and project NPV, equity IRR and equity NPVs have also been computed. As expected, the equity IRRs are found to be considerably large. Equity IRRs of about 44%-45% were observed on a consolidated cash flows basis.

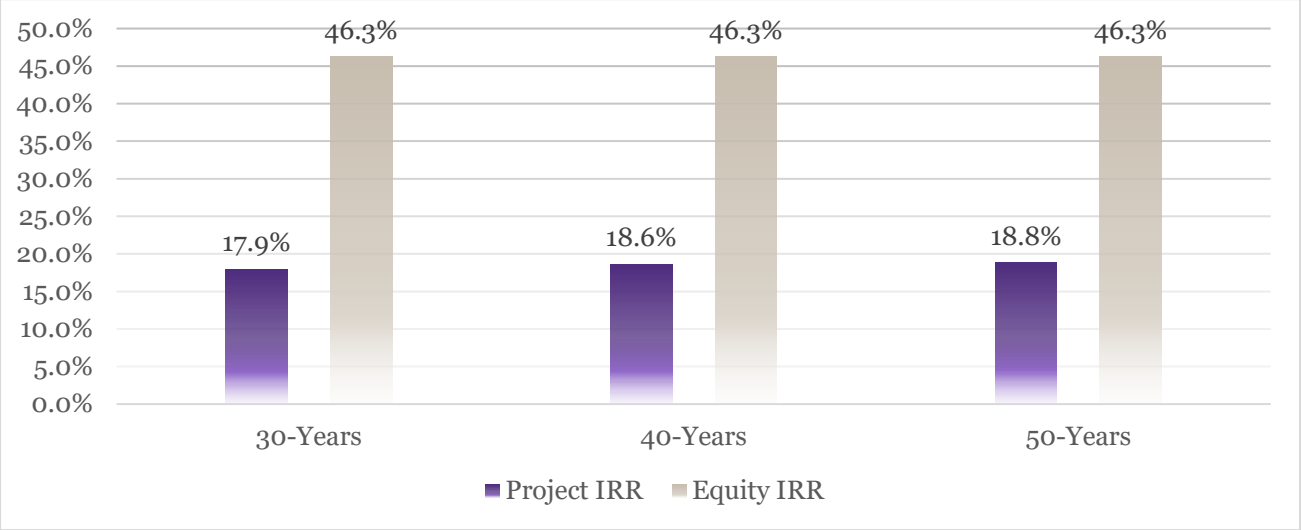


Figure 32. 12: Project IRR (Considering tax as inflow)– Optimistic case scenario (Consolidated Project)

In addition to the above analysis, the fact that such projects have resulted in considerable direct taxes that are part of the exchequer has also been considered. These inflows have resulted in socioeconomic development of the region. Since these cash flows can be directly estimated from the model, another set of optional analyses has been considered where tax has been considered while computing the project and equity IRR and NPV analyses. As expected, the figures have improved further, indicating the benefits from the project. The project IRR has been in the range of 17%-19% and the equity IRR has been in the range of 46%-47%. The NPV values computed for this scenario have also reflected the improvement in project profitability indicators as taxes have been considered part of revenues to the exchequer.

The projected cash flows corresponding to the Optimistic 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).

Best-case scenario

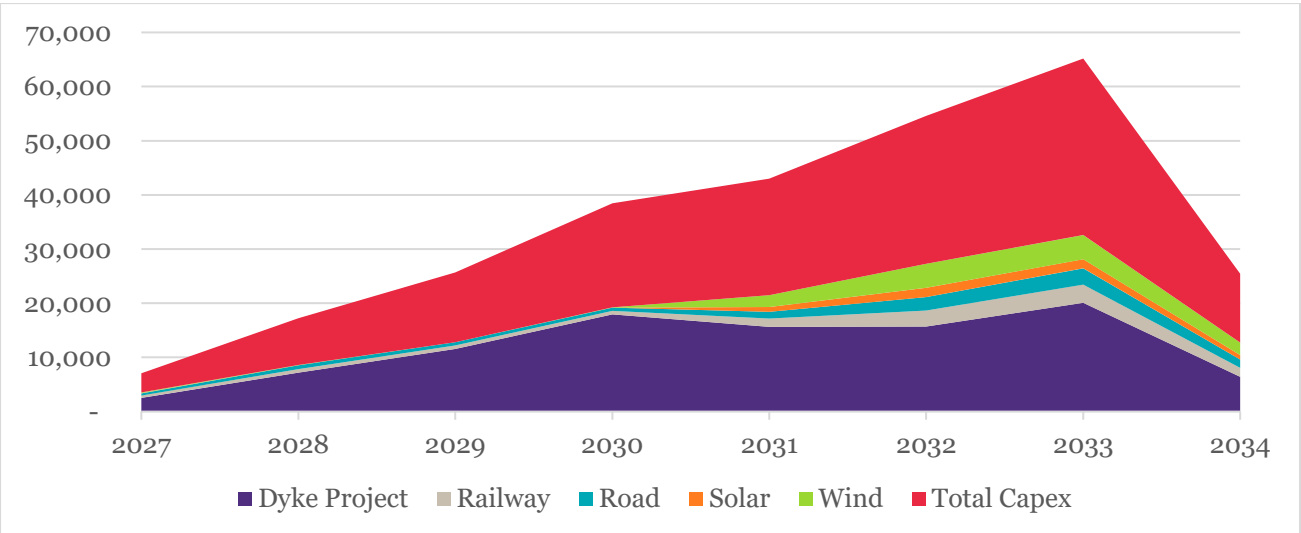


Figure 32. 13: Project Capex – Best case scenario (Consolidated Project)

The total capital cost corresponding to the Best-case scenario presented is provided here. Total cost comprises of dyke, rail, road, solar, and wind. The total capital cost is phased out over the period of 8 years starting from 2027 to 2034.

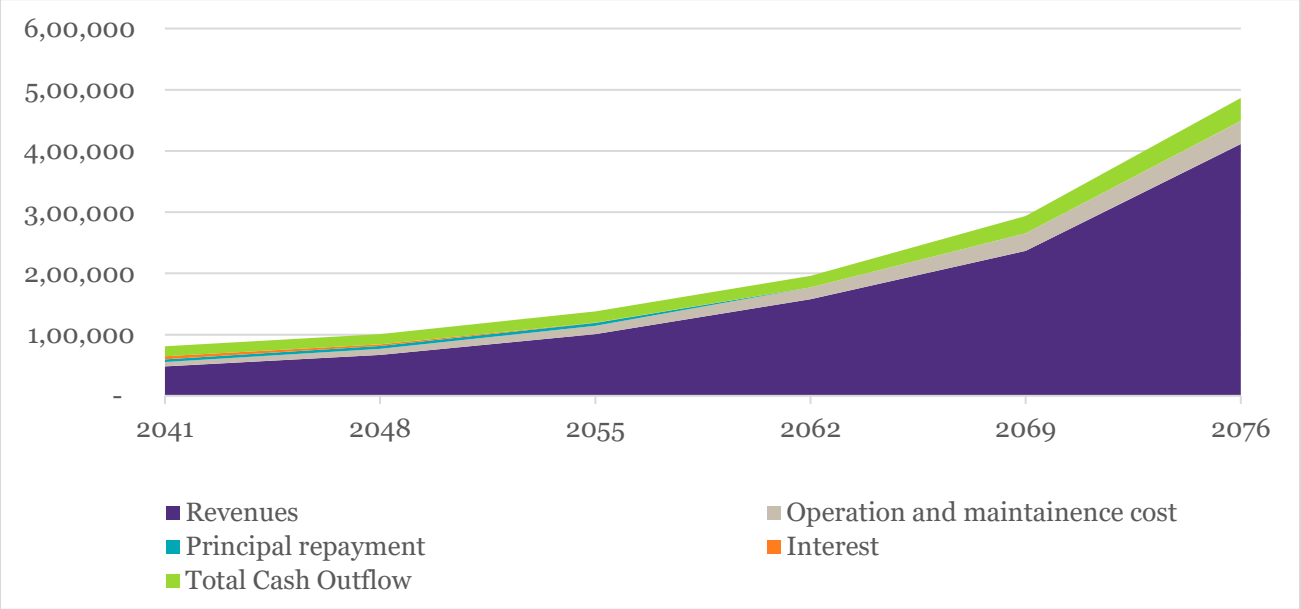


Figure 32. 14: Project cash flow from operating and financing – Best case scenario (Consolidated Project)

The project cash flow from operating and financing, comprising of dyke, rail, road, solar, and wind, corresponding to the Best-case scenario presented are provided here. The project cash flows include revenues, operations and maintenance, principal repayment, and interest from all the individual projects.

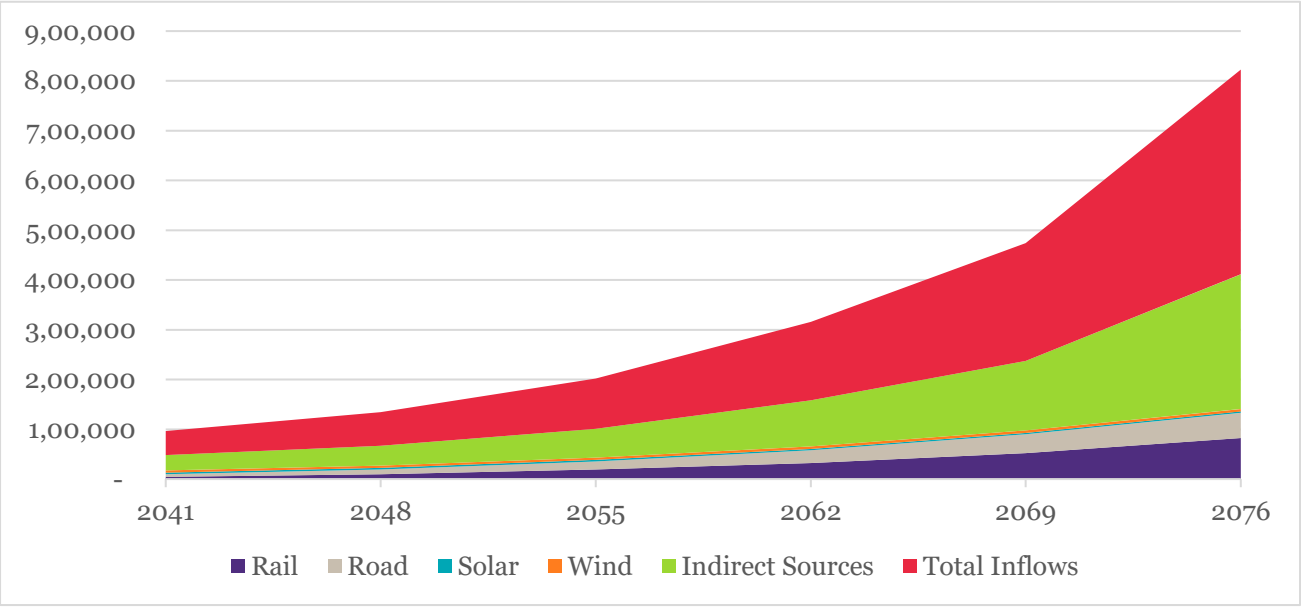


Figure 32. 15: Project cash flow from operating and financing – Best case scenario (Consolidated Project)

The project cash flow from operating and financing, over the life of the project, corresponding to the Best-case scenario presented are provided here. It comprises of project wise revenue from rail, road, solar, wind and indirect sources.

Following the same method as used in the Base-case scenario, the project IRR and NPV indicators have been calculated for 30-, 40-, and 50-year cash flows. The project IRR has fallen in the comfortable range of 16%-18%. The indicators suggest very high profitability of the project. This has been ascribed to the favourable conditions assumed in this scenario. That is, a 10% increase in revenues, and a 10% decrease in capital expenditure and O&M-related costs.

As expected, the equity IRRs have been considerably large. Conventionally, an equity IRR of 14%-18% is desirable from large infrastructure projects of this nature. Equity IRRs of about 46%-47% have been observed on a consolidated cash flows basis.

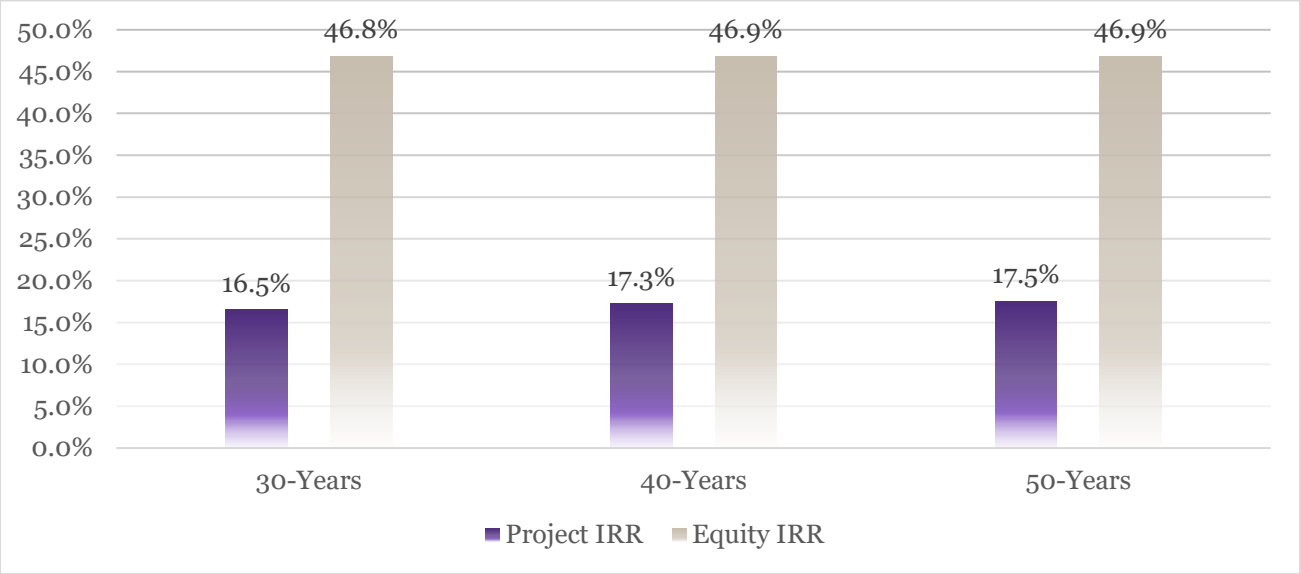


Figure 32. 16: Project Post Tax IRR– Best case scenario (Consolidated Project)

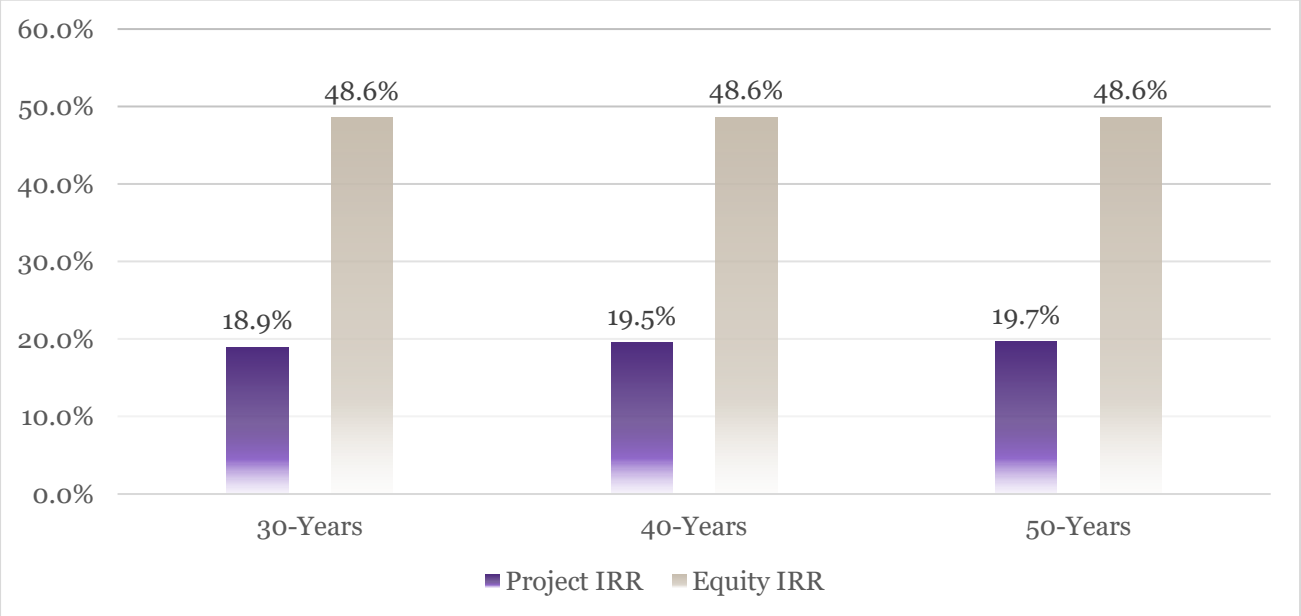


Figure 32. 17: Project IRR (Considering tax as inflow)– Best case scenario (Consolidated Project)

In addition to the above analysis, the fact that such projects have resulted in considerable direct taxes that are part of the exchequer has also been considered. These inflows have resulted in socioeconomic development of the region. Since these cash flows can be directly estimated from the model, another set of optional analyses has been considered where tax has been considered while computing the project and equity IRR and NPV

analyses. As expected, the figures have improved further, indicating the benefits from the project. The project IRR has been in the range of 18%-20% and the equity IRR has been at 48-49% NPV values have also followed suit and indicated the higher profitability of the project, when taxes are also considered as inflows to the government and provide another source of revenue.

The projected cash flows corresponding to the Base-case 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).

Pessimistic scenario

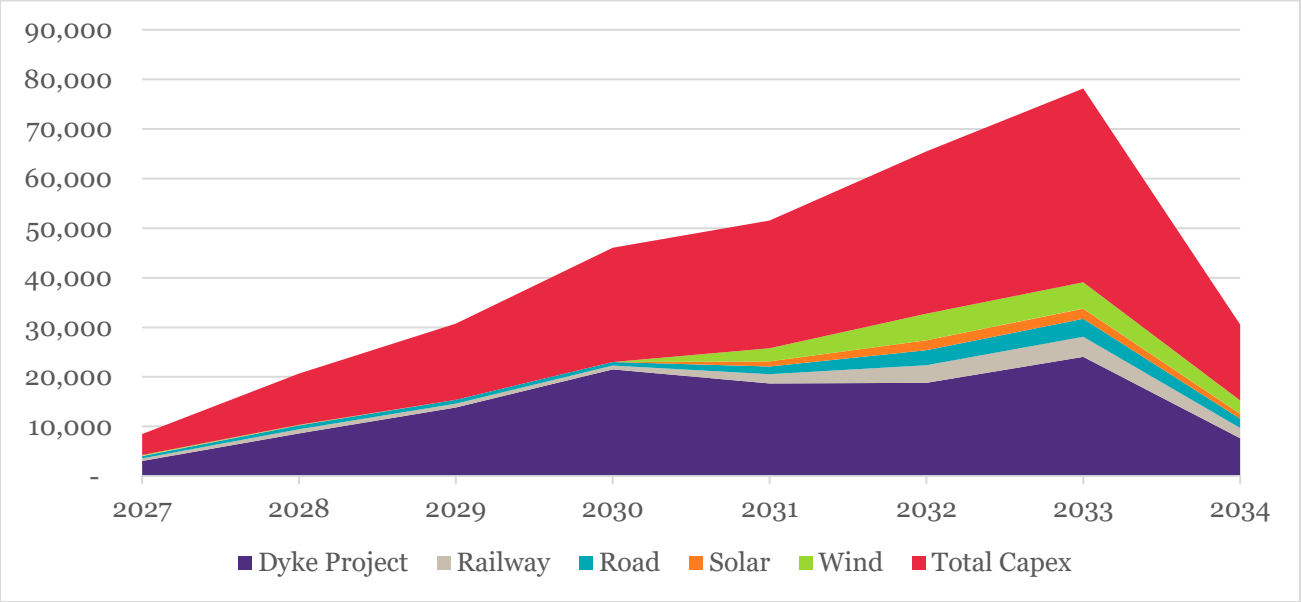


Figure 32. 18: Project Capex – Pessimistic case scenario (Consolidated Project)

The total capital cost corresponding to the Pessimistic-case scenario presented is provided here. Total cost comprises of dyke, rail, road, solar, and wind. The total capital cost is phased out over the period of 8 years starting from 2027 to 2034.

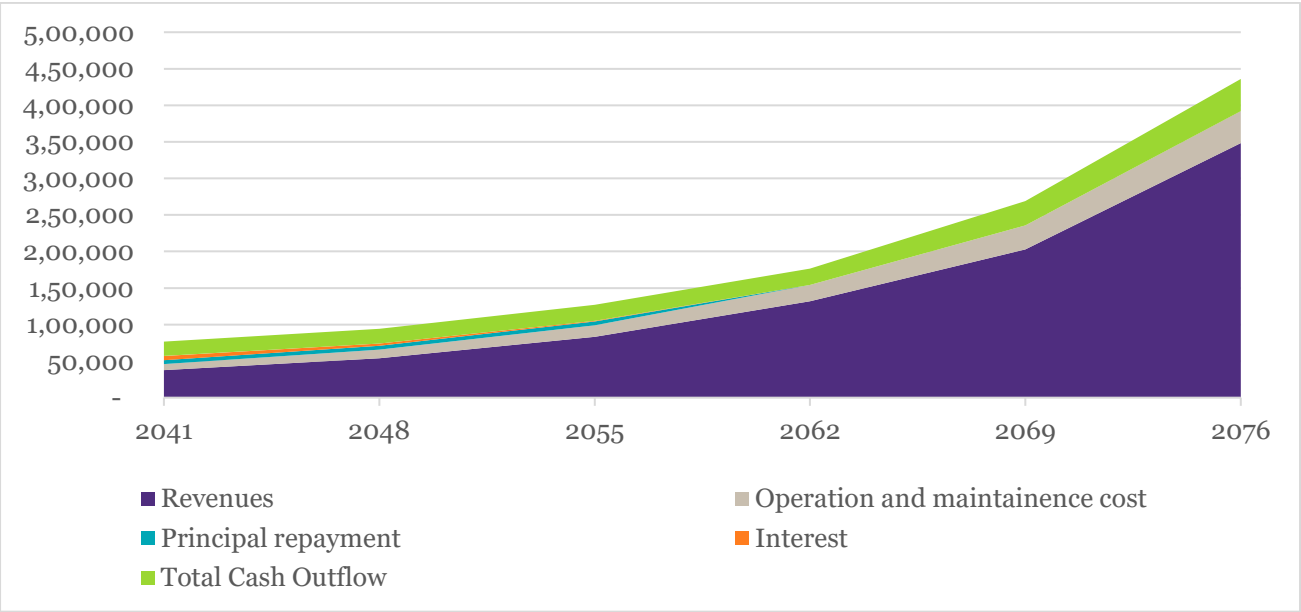


Figure 32. 19: Project cash flow from operating and financing – Pessimistic case scenario (Consolidated Project)

The project cash flow from operating and financing, comprising of dyke, rail, road, solar, and wind, corresponding to the Pessimistic-case scenario presented are provided here. The project cash flows include revenues, operations and maintenance, principal repayment, and interest from all the individual projects.

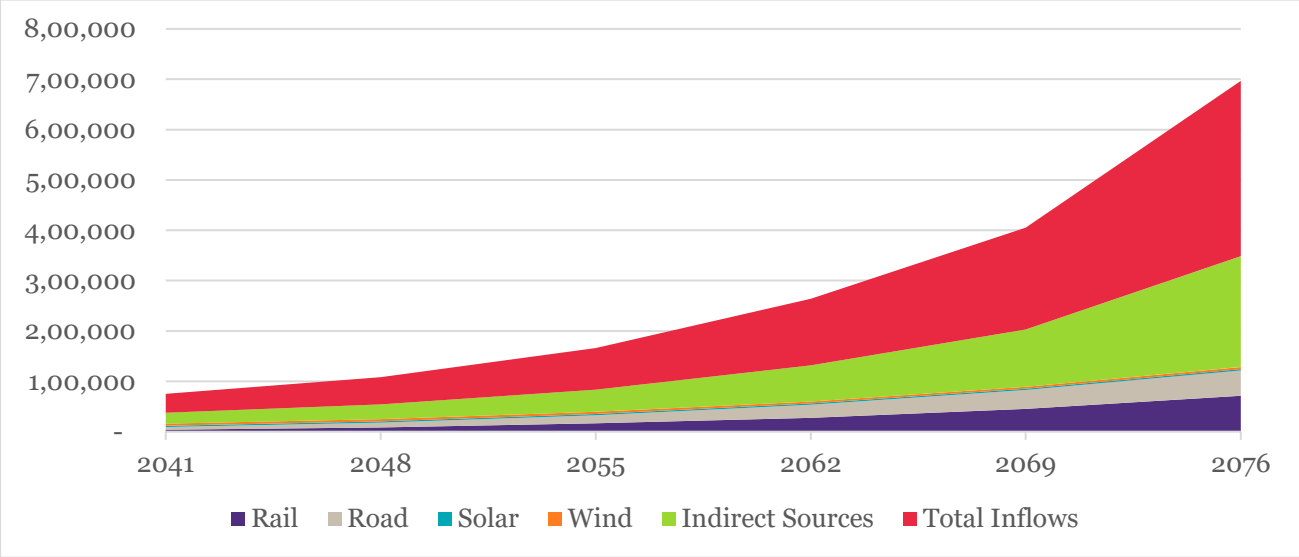


Figure 32. 20: Project cash flow from operating and financing – Pessimistic case scenario (Consolidated Project)

The project cash flow from operating and financing, over the life of the project, corresponding to the Pessimistic-case scenario presented are provided here. It comprises of project wise revenue from rail, road, solar, wind and indirect sources.

Following the same method as used in the Base-case scenario, the project IRR and NPV indicators have been calculated for 30-, 40-, and 50-year cash flows. The project IRR has fallen in the range of 11%-14%. Relatively lower levels of project IRR have been due to the bad conditions considered in this scenario. That is, a decrease in project revenues of 5% and an increase in capital expenditure and O&M expenses of 5%. Notwithstanding the poor conditions assumed in the model, the coverage indicators have appeared to be relatively comfortable. Also, the project IRR and NPV values have been adequate to the project of this nature.

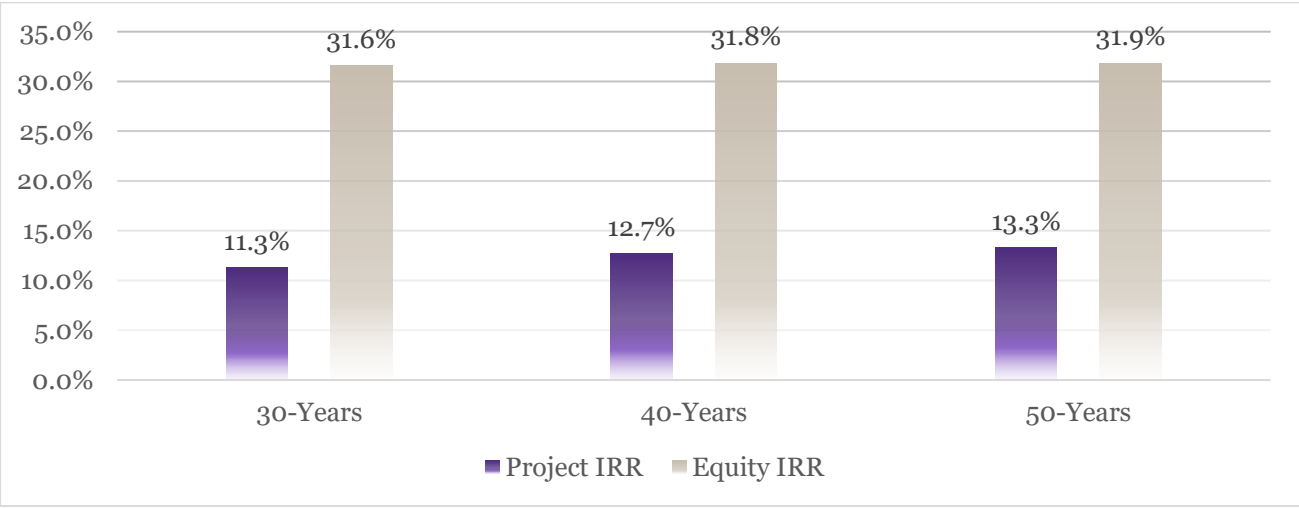


Figure 32. 21: Project Post Tax IRR– Pessimistic case scenario (Consolidated Project)

In addition to project IRR and project NPV, equity IRR and equity NPVs have also been computed. As expected, the equity IRRs have been considerably large. Conventionally,

an equity IRR of 18%-25% is desirable from large infrastructure projects of this nature. Equity IRRs of about 31%-32% have been observed on a consolidated cash flows basis. Equity NPVs have also followed suit and indicated comfortable levels.

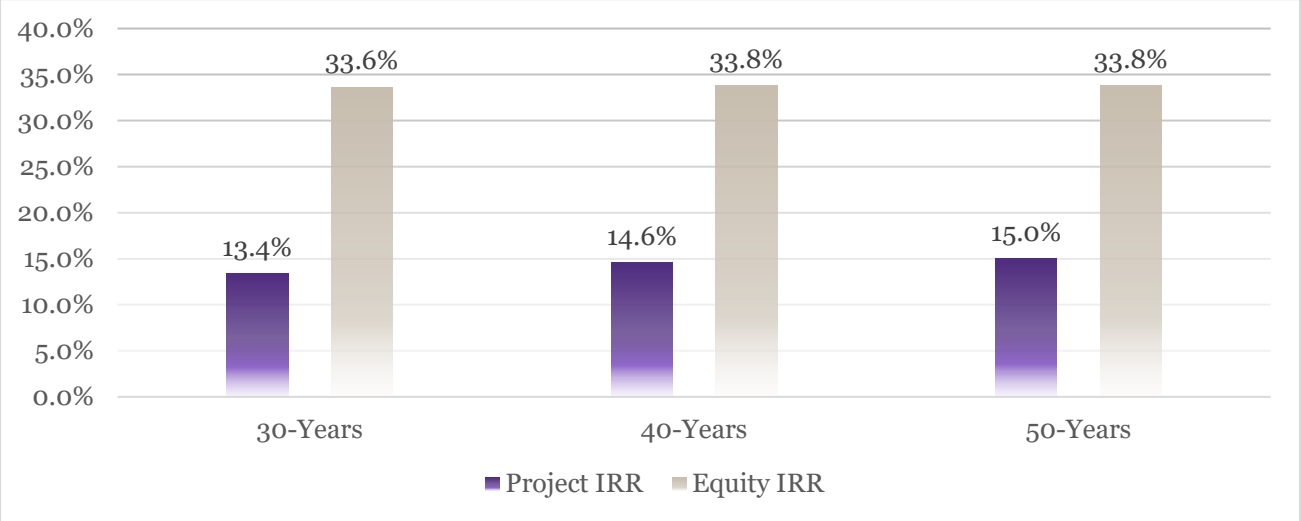


Figure 32. 22: Project IRR (Considering tax as inflow)– Pessimistic case scenario (Consolidated Project)

In addition to the above analysis, the fact that such projects have resulted in considerable direct taxes that are part of the exchequer has also been considered. These inflows have essentially resulted in socioeconomic development of the region. Since these cash flows can be directly estimated from the model, another set of optional analyses has also been considered where tax has been considered while computing the project and equity IRR and NPV analyses. As expected, the figures have improved further, indicating the benefits from the project. The project IRR has been in the range of 13%-15% and the equity IRR has been in the range of 33%-34%. The project and equity NPVs have also agreed with the IRR figures. That is, wherever the IRR levels have been more than discount rates, the project has offered positive NPV.

The projected cash flows corresponding to the Pessimistic 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-case scenario

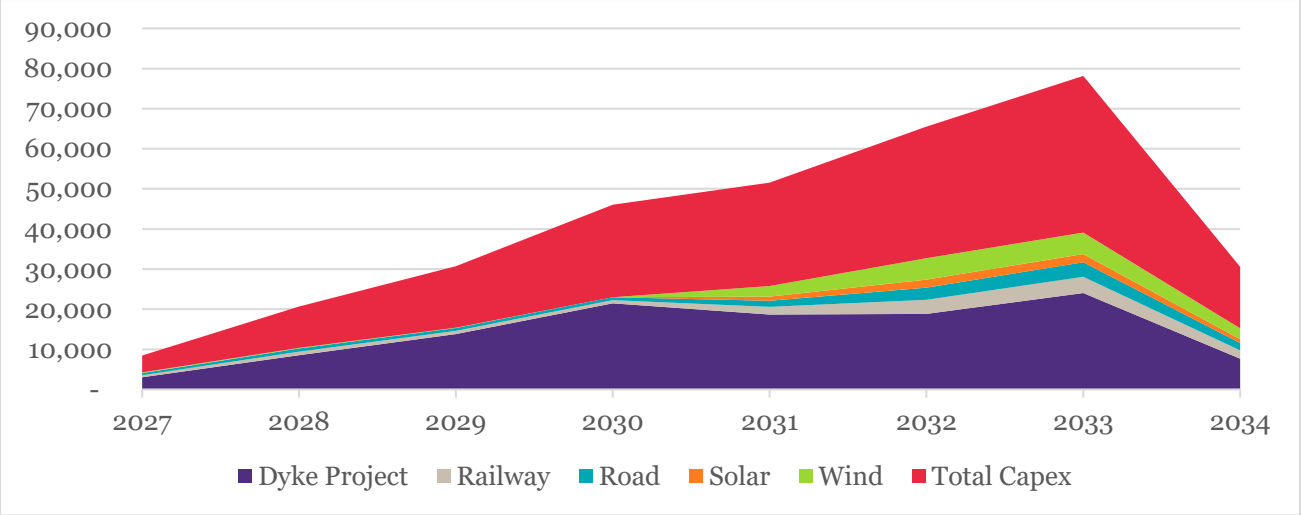


Figure 32. 23: Project Capex – Worst case scenario (Consolidated Project)

The total capital cost corresponding to the Worst-case scenario presented is provided here. Total cost comprises of dyke, rail, road, solar, and wind. The total capital cost is phased out over the period of 8 years starting from 2027 to 2034.

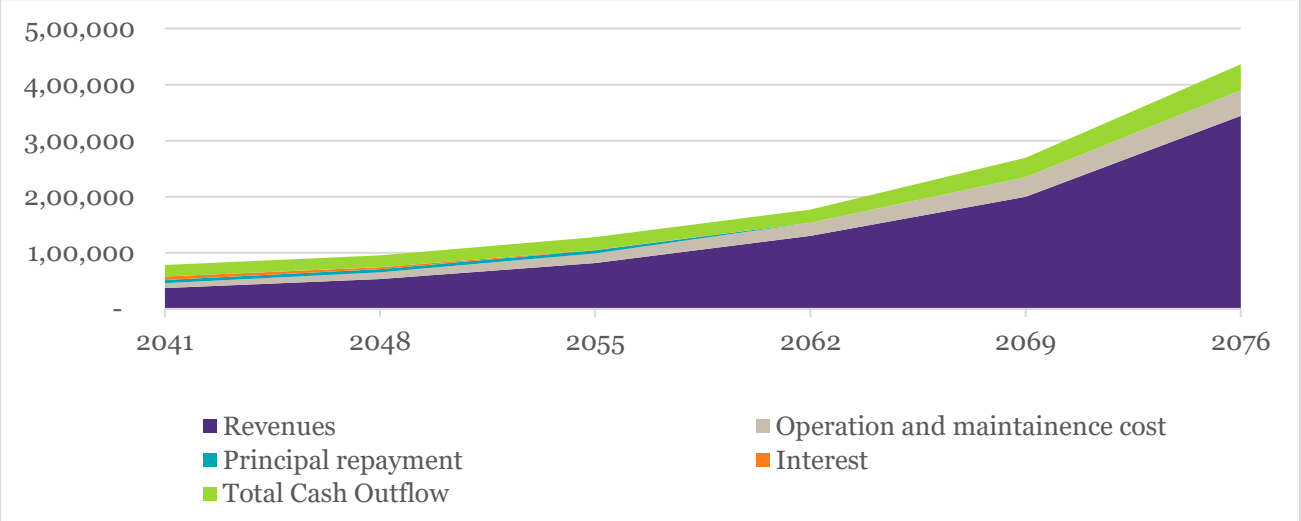


Figure 32. 24: Project cash flow from operating and financing – Worst case scenario (Consolidated Project)

The project cash flow from operating and financing, comprising of dyke, rail, road, solar, and wind, corresponding to the Worst-case scenario presented is provided here. The project cash flows include revenues, operations and maintenance, principal repayment, and interest from all the individual projects.

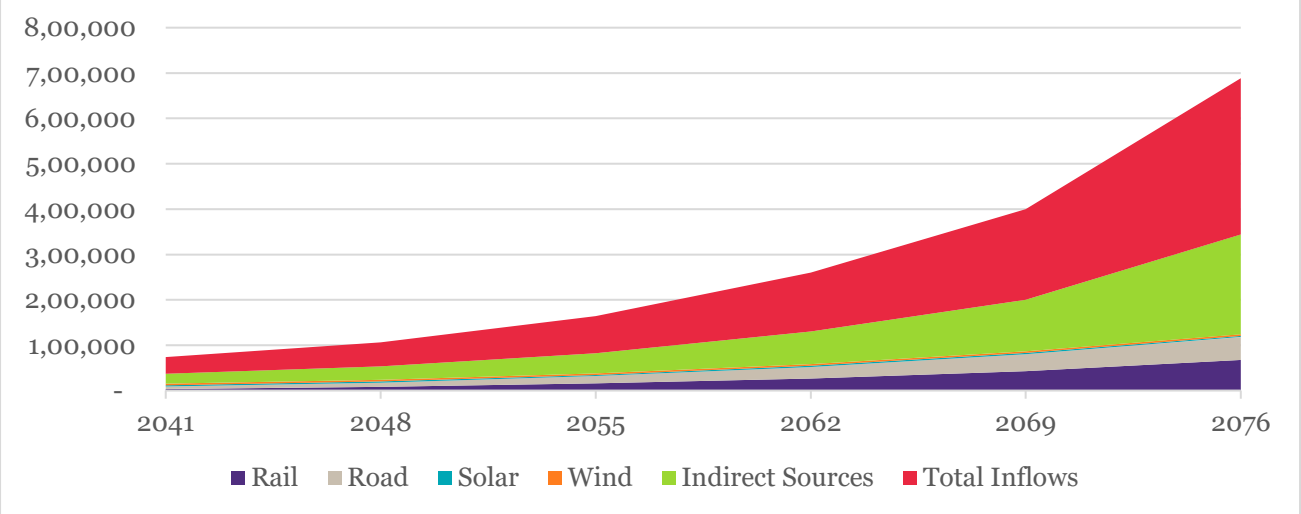


Figure 32. 25: Project cash flow from operating and financing – Worst case scenario

The project cash flow from operating and financing, over the life of the project, corresponding to the Worst-case scenario presented are provided here. It comprises of project wise revenue from rail, road, solar, wind and indirect sources.

Following the same method as used in the Base-case scenario, the project IRR and NPV indicators have been calculated for 30-, 40-, and 50-year cash flows. The project IRR has fallen in the range of 10%-13%. The lower IRR levels have been ascribed to the worst conditions considered in this scenario, which is an increase in project capital expenditure and O&M expenses by 10% and a decrease in project revenues by 10%. Notwithstanding the adverse conditions, the project IRR and NPV values have been adequate to the project of this nature.

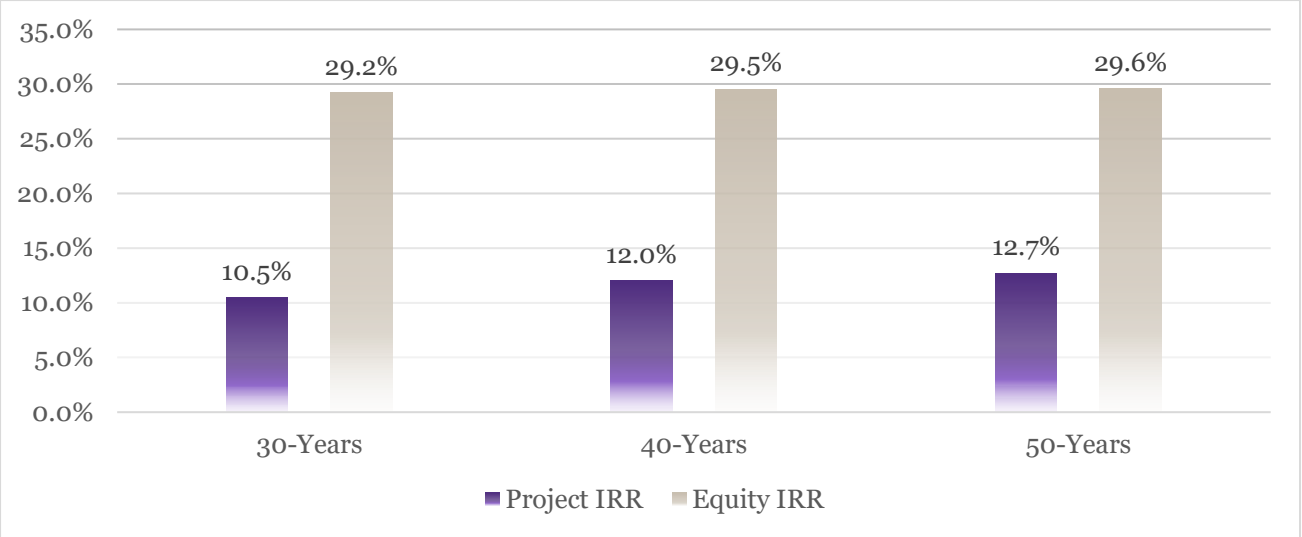


Figure 32. 26: Project Post Tax IRR– Worst case scenario (Consolidated Project)

In addition to project IRR and project NPV, equity IRR and equity NPVs have also been computed. As expected, the equity IRRs have been considerably large. Conventionally, an equity IRR of 15%-20% is desirable from large infrastructure projects of this nature. Equity IRRs of about 29%-30% have been observed on a consolidated cash flows basis. Equity NPVs have also been substantial, indicating the project viability levels. Overall, the IRR and NPV results have been found to be 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.

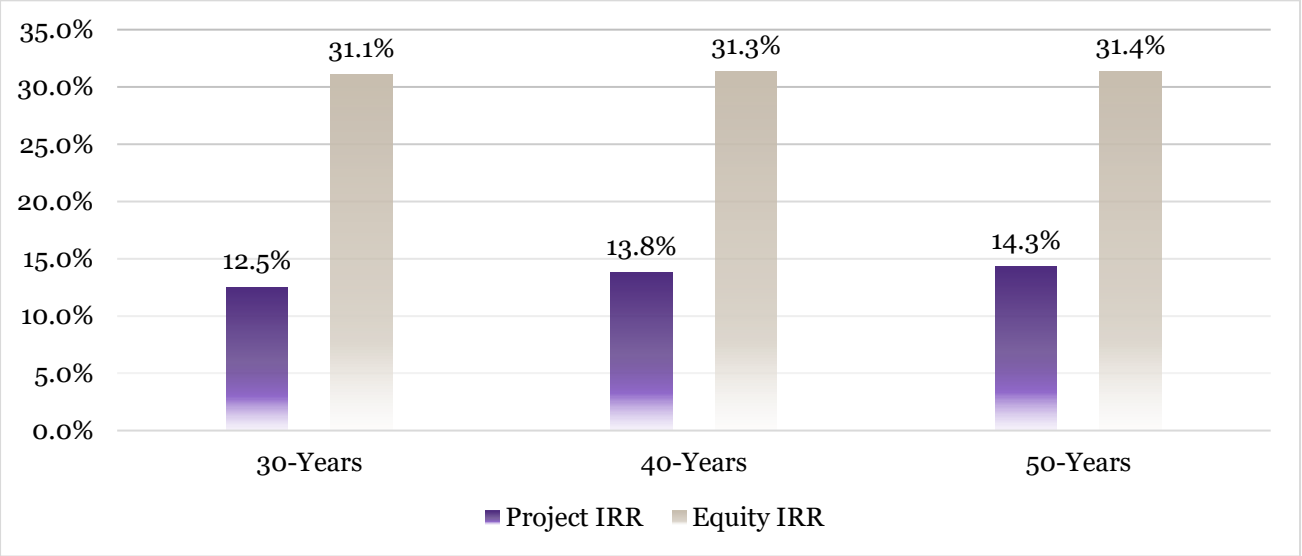


Figure 32. 27: Project IRR (Considering tax as inflow)– Worst case scenario (Consolidated Project)

In addition to the above analysis, the fact that such projects result in considerable direct taxes that are part of the exchequer has also been considered. These inflows have essentially resulted in socioeconomic development of the region. Since these cash flows can be directly estimated from the model, another set of optional analyses has also been considered where tax has been considered while computing the project and equity IRR and NPV analyses. As expected, the figures have improved further, indicating the benefits from the project. The project IRR has been in the range of 12%-15% and the equity IRR has been in the range of 31%-32%. Project and equity NPVs have also followed suit and shown improving financial

viability. This is on expected lines as taxes contribute to the pocket of the exchequer, providing additional sources of revenues that can be employed in the economic development of the region.

The projected cash flows corresponding to the Pessimistic 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).

32.4.6 Cost Benefit Analysis

The cost benefit analysis here follows the well-established approach, also followed by GoI, World Bank, and ADB. [2] The approach employs the ratio of project benefits (financial and economic) and project costs (financial and economic) to compute the benefit-to-cost ratio. Another variant of the same accounts for the time value of money, using the same approach. The results for both the approaches are provided below.

(1) Benefit-to-cost ratio= $\frac{Total\ annual\ project\ benefits\ over\ the\ life\ of\ the\ project}{Total\ annual\ costs\ over\ the\ life\ of\ the\ project}$

(2) Benefit-Cost (Rs Crore) = (Total annual project benefits over the life of the project) - (Total annual costs over the life of the project)

Table 32. 66: Benefit-to-Cost Analysis

Year	Benefit-Cost Ratio (Nominal)	Benefit-Cost (in Rs. Crore) (Nominal)	Benefit-Cost Ratio (In PV Terms)	Benefit-Cost (in Rs. Crore) (In PV Terms)
Dyke	2.34	18,21,471	1.40	64,822
Rail	2.98	6,85,732	1.96	26,870
Road	3.58	6,26,140	2.59	34,340
Solar	2.71	73,444	2.08	8,241
Wind	2.21	95,831	1.54	8,376
Consolidated	3.65	38,98,690	1.85	1,73,920
Economic	5.76	62,91,270	3.55	4,23,666

The discounted figures are arrived at by discounting the respective Cash Flows with the Weighted Average Cost of Capital for the respective projects.

Of the above projects, the Dyke Project involves the maximum Capex against which the revenue streams are limited, resulting in a low BC Ratio (Benefit-to-cost ratio).

The other projects have a reasonable BC Ratio, with the Road project being the most financially beneficial.

The overall project, combining the costs and benefits of the different sub-projects, has a reasonable BC Ratio financially and excellent BC Ratio economically.

[2] https://www.adb.org/sites/default/files/institutional-document/33788/files/cost-benefit-analysis-development.pdf

32.5 Economic Analysis of the Project

The following section reports the results of the economic analysis of the project. First, methodology specific to economic analysis is discussed, and then the approach to quantify the externalities using the shadow cost factor estimation approach and other assumptions are discussed. Further, the results of economic analysis, such as economic IRR (EIRR) and economic NPV (ENPV), are shown.

32.5.1 Specific Methodology

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, some 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 economic analyses, such as economic IRR (EIRR) and economic NPV (ENPV). The Indian government has prescribed an EIRR of 14% from a policy perspective. [3] One widely employed approach to estimate such economic benefits and carry out the analysis is called the Shadow Cost Factor Estimation approach (SCFE). A summary of the approach is provided below. For a detailed discussion of economic analysis and shadow cost factor method, please refer to Annexure F.

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 (or direct) economic benefits accruing due to the project; (4) Quantification of the tangible (or direct) 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.

Economic valuation of project benefits and costs involves converting their financial values into economic values, also known as “shadow pricing.” This conversion requires the 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 non-traded 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 are converted into shadow prices. Further analysis and calculation of EIRR / ENPV follows the same method as is used for the calculation of FIRR.

The Economic Internal Rate of Return (EIRR) is computed based on sound economic principles and globally accepted norms of conducting an 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 (i.e., ENPV) is zero. 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.

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

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.

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

32.5.2 Assumptions

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. [4] These guidelines suggest a shadow cost factor of 0.83 and 0.87 for capital and O&M costs, respectively.

Table 32. 67: Conversion factors

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

All the respective sub-project cash flows (Capex and Opex) are converted into economic costs. In the interest of brevity, the same is not provided here.

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 environmental savings in the form of carbon credits. Overall, the quantification and phasing of these benefits is provided below.

Table 32. 68: Quantification of economic benefits from the project (Rs Crore)

Year	2036	2046	2056	2066	2076
Economic benefits from road					
VOT Savings	5056.00	8595.80	12932.20	17621.50	20156.70
VOC Savings	1796.5	2656.6	3729.3	4817.3	5374.8
Economic benefits from Rail					
VOT Savings	7406.69	10127.97	11752.67	12954.92	13460.22
VOC Savings	1402.2	2149.1	2676.1	3017.2	3147
Carbon Credits	45.7	67.3	93.4	120.3	134.2
Total Benefits	**15707.09**	**23596.77**	**31183.67**	**38531.22**	**42272.92**

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

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

Assumptions related to agricultural employment

The monetary potential of employment opportunities from the development in the region has been estimated using inputs provided in the concept structure plan report (CEPT university) submitted to Kalpasar authorities. This includes two scenarios with Rs 250 per day and Rs 300 per day wage rates. Other assumptions related to workforce in agricultural areas and the related job opportunities are provided in the table below.

Table 32. 69: 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, the cash inflows from agricultural employment have been projected. The assumptions related to phasing are provided below.

Table 32. 70: Phasing of potential inflows from agricultural employment phasing

Year	2035	2045	2055	2065	2076
Phasing of Jobs	5%	10%	0%	0%	0%
Cumulative phasing	5%	90%	100%	100%	100%
Base Case (Rs Crore): Rs 250 Daily wage	103	2054	2520	2784	3106

Assumptions related to industrial employment

The monetary potential of employment opportunities from the development in the region has been estimated using inputs provided in the concept structure plan report (CEPT university), submitted to Kalpasar authorities. This includes two scenarios with Rs 10,000 per month 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. 71: 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, cash inflows from the industrial employment have been projected. The assumptions related to phasing are provided below.

Table 32. 72: Phasing of potential inflows from industrial employment

Year	2035	2045	2055	2065	2076
Phasing of Jobs	5%	10%	0%	0%	0%
Cumulative phasing	5%	90%	100%	100%	100%
Base Case (Rs Crore): (@ Rs 10000 per month)	224	4446	5457	6028	6725

Assumptions related to tourism employment

The monetary potential of employment opportunities from the development in the region has been estimated using inputs provided in the concept structure plan report (CEPT university), submitted to Kalpasar authorities. This includes two scenarios with Rs 5,000 per month 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. 73: 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, cash inflows from the tourism employment have been projected. The assumptions related to phasing are provided below.

Table 32. 74: Phasing of potential inflows from tourism employment phasing

Year	2035	2045	2055	2065	2076
Phasing of Jobs	5%	10%	0%	0%	0%
Cumulative phasing	5%	90%	100%	100%	100%
Base Case (Rs Crore): (@ Rs 5000 per month)	24	481	591	653	728

Assumptions related to urbanisation/urban agglomeration employment

The monetary potential of employment opportunities from the development in the region has been estimated using inputs provided in the concept structure plan report (CEPT university), submitted to Kalpasar authorities. This includes two scenarios with Rs 5,000 per month and Rs 10,000 per month salaried jobs. Other assumptions related to workforce in the urbanisation and the related job opportunities are provided in the table below.

Table 32. 75: Urbanisation/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, cash inflows from the urbanisation/urban-agglomeration related employment have been projected. The assumptions related to phasing are provided below.

Table 32. 76: Phasing of potential inflows from Urbanisation/Urban-agglomeration employment phasing

Year	2035	2045	2055	2065	2076
Phasing of Jobs	5%	10%	0%	0%	0%
Cumulative phasing	5%	90%	100%	100%	100%
Base Case (Rs Crore): (@ Rs 5000 per month)	281	5587	6857	7575	8451

Assumptions related to Dholera SIR related employment

The monetary potential of Dholera SIR related employment opportunities from the development in the region has been estimated using inputs provided in the concept structure plan report (CEPT university), submitted to Kalpasar authorities. This includes two scenarios with Rs 5,000 per month 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. 77: 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, cash inflows from the Dholera SIR related employment have been projected. The assumptions related to phasing are provided below.

Table 32. 78: Phasing of potential inflows from Dholera SIR employment phasing

Year	2035	2045	2055	2065	2076
Phasing of Jobs	5%	10%	0%	0%	0%
Cumulative phasing	5%	90%	100%	100%	100%
Base Case (Rs Crore): (@ Rs 5000 per month)	435	8648	10614	11724	13080

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 the Base case scenario.

Table 32. 79: Total value add from employment generation in the region

Year	2035	2045	2055	2065	2076
Base Case (Rs Crore)	1,067	21216	26039	28763	32090

F) Assumptions related to taxation

While considering the economic benefits, we considered corporate taxes (25.17%) and GST (18%). GST is considered on capital expenditure items and revenues. For revenues, GST is taken as applicable. For example, on road toll and water supply (drinking and agriculture) no GST is considered. For railways, 5% GST is considered. This has resulted in additional cash flows, as provided below.

Table 32. 80: Cash flow from corporate taxes (Rs Crore)

Corporate Tax	2041	2046	2051	2056	2061	2066	2071	2076
Dyke	2,646	4,420	6,642	9,876	14,700	18,402	31,419	52,823
Railway	-	1,416	2,676	4,392	6,407	9,182	12,928	17,981
Road	1,010	1,849	2,879	4,254	6,029	7,967	10,431	12,574
Solar	503	550	582	603	606	588	565	537
Wind	542	664	748	805	787	748	695	626
Total	**4,701**	**8,899**	**13,526**	**19,930**	**28,530**	**36,887**	**56,037**	**84,542**

Table 32. 81: Cash flow from GST-Capex (Rs Crore)

GST- Capex	2027	2028	2029	2030	2031	2032	2033	2034
Dyke	219	617	996	1,547	1,347	1,356	1,731	551
Railways	37	61	56	56	133	254	293	148
Road	35	57	53	53	110	215	258	131
Solar	4	2	0	0	73	147	146	74
Wind	11	6	1	1	191	385	384	194
Total	**305**	**744**	**1,107**	**1,658**	**1,854**	**2,356**	**2,813**	**1,098**

Table 32. 82: Cash flow from GST-Revenues (Rs Crore)

GST-Revenues	2041	2046	2051	2056	2061	2066	2071	2076
Land Monetisation	1,500	1,500	1,500	1,500	1,500	-	-	-
Railways	143	264	435	684	986	1,408	1,983	2,759
Road	66	114	187	304	481	710	1,035	1,385
Solar	249	249	249	249	249	249	249	249
Wind	376	376	376	376	376	376	376	376
Total	**2,334**	**2,503**	**2,747**	**3,112**	**3,591**	**2,743**	**3,643**	**4,768**

32.5.3 Results of economic analysis

Base-case scenario

The project Economic IRR and NPV indicators for the Base-case scenario have been calculated based on the economic value of project cost and benefits. These measures have been computed for considering 30-, 40-, and 50-year cash flows. The Economic IRR falls in the comfortable range of 23%-25%. Moreover, the economic NPV value ranges from Rs 134862.52 Crore to Rs 877116.59 Crore. This strongly indicates the viability of the project.

For economic NPV computation, 6%, 8%, 10%, and 12% discount rates have been considered 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 benchmark projects such as Chennai Metro, Silverline metro project, Bengaluru rail corridor). For different discount rates, the consolidated NPV turns out to be

positive and large. In addition, the results corresponding to the analysis where tax revenues are also considered as inflows have been shown. The project economic IRR remains in the range of 26%-27%. Moreover, the economic NPV value ranges from Rs 157078.68 Crore to Rs 971827.18 Crore.

Overall, both the results strongly establish the financial and economic viability of the Kalpasar project. 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. 83: Economic IRR and NPV (Rs Crore) – Base Case Scenario

Economic IRR	**%**		
30-Years	23.8%		
40-Years	24.1%		
50-Years	24.2%		
Economic NPV	**30-Years**	**40-Years**	**50-Years**
NPV@12%	134862.52	165407.32	181946.89
NPV@10%	204066.10	261451.46	298784.34
NPV@8%	307603.16	416962.50	502733.04
NPV@6%	464875.90	676402.14	877116.59

Table 32. 84: Economic IRR and NPV (Rs Crore): taxes as inflows – Base Case Scenario

Economic IRR	**%**		
30-Years	26.1%		
40-Years	26.4%		
50-Years	26.4%		
Economic NPV	**30-Years**	**40-Years**	**50-Years**
NPV@12%	157078.68	190784.00	209004.44
NPV@10%	232884.48	296209.08	337329.33
NPV@8%	345973.01	466653.64	561109.74
NPV@6%	517395.33	750825.28	971827.18

The projected economic benefits corresponding to the Base-case scenario presented are provided here. Total benefit comprises of economic benefits from rail, road, solar, wind, Fresh water, Land, Fisheries, and Employment. The quantification of benefits is phased out as follows.

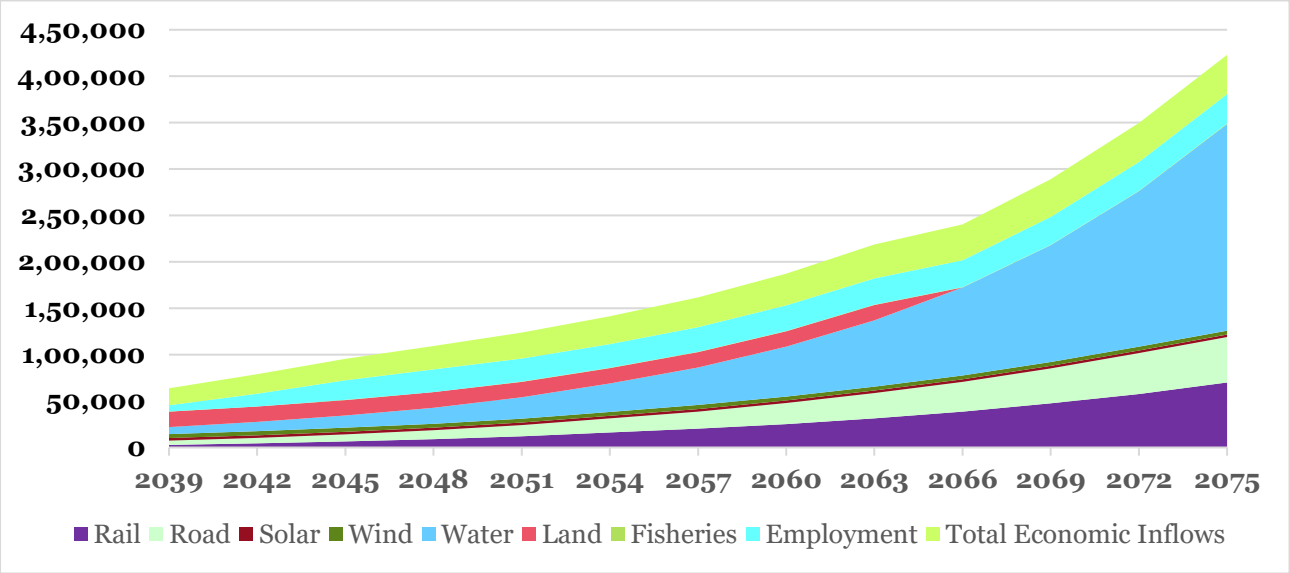


Figure 32. 28: Project economic benefits – Base case scenario

Table 32. 85: Project economic benefits – Base case scenario

Year	2036	2046	2056	2066	2076
Economic benefits from road					
VOT Savings	5056.00	8595.80	12932.20	17621.50	20156.70
VOC Savings	1796.5	2656.6	3729.3	4817.3	5374.8
Economic benefits from Rail					
VOT Savings	7406.69	10127.97	11752.67	12954.92	13460.22
VOC Savings	1402.2	2149.1	2676.1	3017.2	3147
Carbon Credits	45.7	67.3	93.4	120.3	134.2
Total Benefits	**15707.09**	**23596.77**	**31183.67**	**38531.22**	**42272.92**

The projected economic benefits corresponding to the base case scenario presented are provided here. Total benefit comprises of economic benefits from road, economic benefits from rail, and carbon credits. The quantification of benefits is phased out as shown here. Detailed cash flows are provided in Appendix E. **The economic benefits corresponding to road, rail, and carbon credits remain the same for all other scenarios.**

32.5.4. Sensitivity analysis

This section deals with the economic analysis results for the other scenarios, except Base-case scenario (the results of which are discussed above in the economic Analysis results section).

Optimistic scenario

The project Economic IRR and NPV indicators for the Optimistic scenario have been calculated based on the economic value of project cost and benefits. These measures have been computed considering 30-, 40-, and 50-year cash flows. The Economic IRR falls in the comfortable range of 27%-28%. Moreover, the economic NPV value ranges from Rs 184955.66 Crore to Rs 1092316.57 Crore. This strongly indicates the viability of the project. Customarily, for such large-scale government projects, an IRR of 14% is desirable.

For NPV computation, 6%, 8%, 10%, and 12% discount rates have been considered 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 benchmark projects such as Chennai Metro, Silverline metro project, Bengaluru rail corridor). For different discount rates, the consolidated NPV turns out to be positive and large. In addition, the results corresponding to the analysis where tax revenues are also considered as inflows have been shown. The project economic IRR remains in the range of 29%-30%. Moreover, the economic NPV value ranges from Rs 208696.81 Crore to Rs 1193090.66 Crore.

Overall, both the results strongly establish the financial and economic viability of the Kalpasar project. 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. 86: Economic IRR and NPV (Rs Crore) – Optimistic Scenario

Economic IRR	**%**		
30-Years	27.0%		
40-Years	27.2%		
50-Years	27.2%		
Economic NPV	**30-Years**	**40-Years**	**50-Years**
NPV@12%	184955.66	221955.27	241186.47
NPV@10%	272989.24	342459.36	385848.44
NPV@8%	404348.59	536655.37	636294.55
NPV@6%	603507.02	859255.22	1092316.57

Table 32. 87: Economic IRR and NPV (Rs Crore): taxes as inflows – Optimistic Scenario

Economic IRR	**%**		
30-Years	29.4%		
40-Years	29.5%		
50-Years	29.6%		
Economic NPV	**30-Years**	**40-Years**	**50-Years**
NPV@12%	208696.81	249014.17	269981.16
NPV@10%	303945.21	379648.43	426948.66
NPV@8%	445742.41	589927.40	698536.08
NPV@6%	660355.63	939078.43	1193090.66

Detailed cash flows are provided in Appendix E. The economic benefits corresponding to road, rail, and carbon credits remain the same for all other scenarios.

Best-case scenario

The project Economic IRR and NPV indicators for the Best-case scenario have been calculated based on the economic value of project cost and benefits. These measures have been computed for considering 30-, 40-, and 50-year cash flows. The Economic IRR falls in the comfortable range of 28%-29%. Moreover, the economic NPV value ranges from Rs 191207.46 Crore to Rs 1109550.83 Crore. This strongly indicates the viability of the project. Customarily for such large-scale government projects an economic IRR of 14% is desirable.

For economic NPV computation, 6%, 8%, 10%, and 12% discount rates have been considered 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 benchmark projects such as Chennai Metro, Silverline metro project, Bengaluru rail corridor). For different discount rates, the consolidated NPV turns out to be positive and large. In addition, the results corresponding to the analysis where tax revenues are also considered as inflows have been shown. The project economic IRR remains in the range of 30%-31%. Moreover, the economic NPV value ranges from Rs 215428.92 Crore to Rs 1213446.87 crore.

Overall, both the results strongly convey the financial and economic viability of the Kalpasar project. 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. 88: Economic IRR and NPV (Rs Crore) – Best-case Scenario

Economic IRR	**%**		
30-Years	28.0%		
40-Years	28.2%		
50-Years	28.2%		
Economic NPV	**30-Years**	**40-Years**	**50-Years**
NPV@12%	191207.46	228614.22	248067.26
NPV@10%	280505.10	350741.67	394630.60
NPV@8%	413603.55	547373.96	648159.45
NPV@6%	615226.66	873811.87	1109550.83

Table 32. 89: Economic IRR and NPV (Rs Crore): taxes as inflows – Best-case Scenario

Economic IRR	**%**		
30-Years	30.5%		
40-Years	30.6%		
50-Years	30.6%		
Economic NPV	**30-Years**	**40-Years**	**50-Years**
NPV@12%	215428.92	256254.03	277497.76
NPV@10%	312211.16	388870.23	436794.06
NPV@8%	456148.82	602159.23	712198.08
NPV@6%	673832.52	956093.81	1213446.87

Detailed cash flows are provided in Appendix E. The economic benefits corresponding to road, rail, and carbon credits remain the same for all other scenarios.

Pessimistic scenario

The project Economic IRR and NPV indicators for the Pessimistic scenario have been calculated based on the economic value of project cost and benefits. These measures have been computed for considering 30-, 40-, and 50-year cash flows. The Economic IRR falls in the comfortable range of 22%-23%. Moreover, the economic NPV value ranges from Rs 115421.75 Crore to Rs 802142.69 Crore. The 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% is desirable.

For economic NPV computation, 6%, 8%, 10%, and 12% discount rates have been considered 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 benchmark projects such 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, the results corresponding to the analysis where tax revenues are also considered as inflows have been shown. The project economic IRR remains in the range of 24%-25%. Moreover, the NPV value ranges from Rs 136303.70 Crore to Rs 891298.62 Crore.

Overall, both the results strongly convey the financial and economic viability of the Kalpasar project. 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. 90: Economic IRR and NPV (Rs Crore) – Pessimistic Scenario

Economic IRR	**%**		
30-Years	22.1%		
40-Years	22.4%		
50-Years	22.5%		
Economic NPV	**30-Years**	**40-Years**	**50-Years**
NPV@12%	115421.75	143867.90	159227.48
NPV@10%	178750.76	232193.81	266855.01
NPV@8%	273889.04	375736.96	455350.09
NPV@6%	418882.32	615883.65	802142.69

Table 32. 91: Economic IRR and NPV (Rs Crore): taxes as inflows – Pessimistic Scenario

Economic IRR	**%**		
30-Years	24.2%		
40-Years	24.5%		
50-Years	24.5%		
Economic NPV	**30-Years**	**40-Years**	**50-Years**
NPV@12%	136303.70	167762.60	184748.10
NPV@10%	205680.90	264786.79	303111.53
NPV@8%	309565.97	422210.90	510225.53
NPV@6%	467519.86	685415.79	891298.62

Detailed cash flows are provided in Appendix E. The economic benefits corresponding to road, rail, and carbon credits remain the same for all other scenarios.

Worst-case scenario

The project Economic IRR and NPV indicators for the Worst-case scenario have been calculated based on the economic value of project cost and benefits. These measures have been computed for considering 30-, 40-, and 50-year cash flows. The Economic IRR falls in the comfortable range of 21%-22%. Moreover, the economic NPV value ranges from Rs 108878.22 Crore to Rs 784343.13 Crore. The 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% is desirable.

For economic NPV computation, 6%, 8%, 10%, and 12% discount rates have been considered to indicate the robustness of the results and sensitivities to various scenarios. Notwithstanding the extremely adverse 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 12% (taken from various benchmark projects such 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, the results corresponding to the analysis where tax revenues are also considered as inflows have been shown. The project economic IRR remains in the range of 23%-24%. Moreover, the NPV value ranges from Rs 129318.20 Crore to Rs 870411.97 Crore.

Overall, both the results strongly convey the financial and economic viability of the Kalpasar project. 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. 92: Economic IRR and NPV (Rs Crore) – Worst Case Scenario

Economic IRR	**%**		
30-Years	21.2%		
40-Years	21.6%		
50-Years	21.7%		
Economic NPV	**30-Years**	**40-Years**	**50-Years**
NPV@12%	108878.22	136908.64	152041.91
NPV@10%	170901.24	223561.73	257713.00
NPV@8%	264248.32	364601.88	443045.59
NPV@6%	406710.79	600815.61	784343.13

Table 32. 93: Economic IRR and NPV (Rs Crore): taxes as inflows – Worst Case Scenario

Economic IRR	**%**		
30-Years	23.3%		
40-Years	23.6%		
50-Years	23.7%		
Economic NPV	**30-Years**	**40-Years**	**50-Years**
NPV@12%	129318.20	160260.62	176964.85
NPV@10%	197121.81	255255.44	292946.38
NPV@8%	298814.42	409602.64	496163.70
NPV@6%	453627.71	667924.58	870411.97

Detailed cash flows are provided in Appendix E. The economic benefits corresponding to road, rail, and carbon credits remain the same for all other scenarios.

32.6 Non-Quantifiable Externalities of the Project

Large infrastructure projects have numerous benefits, both direct and indirect. Of these direct/indirect benefits, some can be quantified, and others cannot be.

Quantifiable benefits are those where:

- Investments are required to be made to reap the eventual benefits
- The benefits can be quantified in terms of market estimates or close economic approximations. 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 have both positive benefits and 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 should be offered.

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

Increase in Agri Gross Regional Product

The reservoir developed in Kalpasar Project is expected to irrigate approximately 10.50 lakh hectares of 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 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 the availability of water for irrigation, 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 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.

As far 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 km^2 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 dilute 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. Many 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 because of the construction of the dyke.

Improvement in Groundwater

Due to the availability of fresh water from the 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 the 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 seacoast of the 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.

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 reduce, thus, reviving the ferry route and reducing the cost of dredging along the route.

Projects under the Conceptual Structure Planning of Kalpasar Project

A Conceptual Structure Plan for the 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.

- To delineate the area under the influence of Kalpasar Project for the purpose of comprehensive development.
- 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.
- To induce optimum development for the improvement of the regional economy as well as environmental protection.
- Region as a Global Hub of Eco-Centric development.
- To create balanced physical and social infrastructure for sustainable development.
- Capitalise on the proposed investments in the study area, through the development of suitable forward and backward linkages.
- To enhance the infrastructure facilities for better connectivity of the region to achieve faster growth of the study area.
- Propose an institutional structure and legal backing for the Structure Plan.

The concept of 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 was used to understand and design the future growth trends in the region.

- Lakefront zone detailing
- Health city
- Waterfront real estate
- Logistic hub
- Education city
- Green energy research and development centre
- Riverfront and tourism development
- Ghogha port redevelopment

We understand that while these are part of the overall development plans, these projects would entail CAPEX for each of the subcomponents 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.

Impact on Social & Cultural Practices

It is possible that social and cultural behaviours in some of the villages in the Bhavnagar district will not 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. Most 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.

Impact on Water Bodies

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

- River Boundaries will change; presently, rivers in catchment areas are not perennial rivers.
- 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.
- Red and Blue Line demarcation of rivers in catchment areas required to be redefined.
- Total Water disposal through rivers in the catchment area (including the monthly pattern thereof) is required to be estimated.
- 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.
- 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.

– 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)

Impact on Institutions & Sociology

- **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 investigated. Details on similar institutions working on marine and other research and the impact of the proposed project is required to be assessed.
- **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).

Further elucidation can be made basis the availability of information regarding the following:

- List of industries currently operating in the region and for whom Consent to Operate was conditional upon the Kalpasar Project. (Partial list is available; since it might not be possible to collate their contingency plans, the effect of possible relocation might be difficult to quantify).
- List of Ecological (Bird Parks, National Parks etc.), Archaeological and other sensitive areas within 10 KM of project boundary are required to be delineated for appropriate actions there upon.
- The Project will need huge quantities of Construction Materials (Such as Sand, Stone & Aggregates etc.) which will be procured from parts of Gujarat, leading to management of Natural Resources.

32.7 Transaction Structure and Financing Options

32.7.1 Overview

In this section the potential project structures have been discussed with necessary caveats presented below is a schematic representation (Fig. 32.29) of one genetic structure which represents a family of transaction structures that will be subsequently discussed. Further, a list of comparable project structuring has been presented in Table 32.93 for the analyst team to draw necessary references.

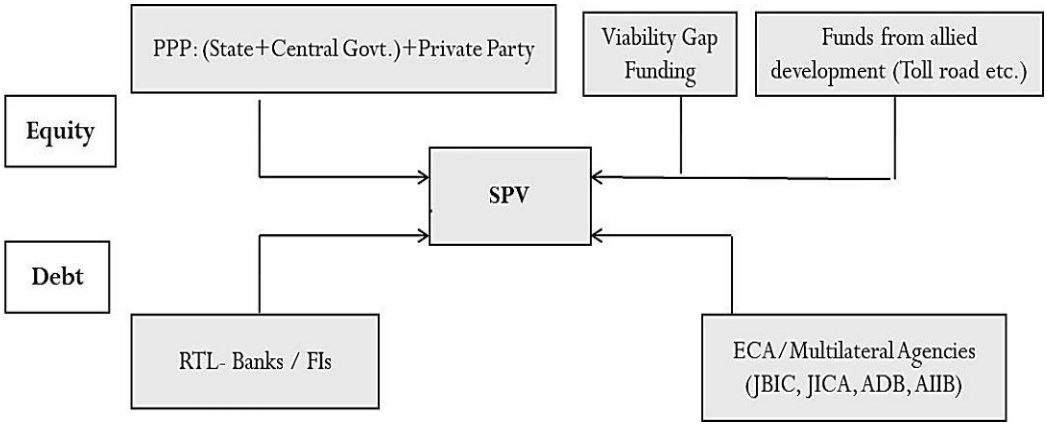


Figure 32. 29: Indicative Financing Structure

Key Financing Attributes

The equity portion (~30% of total project cost) is expected to be partly contributed by the State/Central Government (if performed in EPC mode) or PPP partner (if performed in PPP/DBFOT mode). Also, the project SPV is expected to be provided a sovereign guarantee by Central Government (GoI), interest free loans, or any such support for Government of Gujarat (GoG) 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 and various support mechanisms from GoG (interest free loan, assured payment such annuities, etc.), the rupee term loans are expected to cost 7%-9%. Thus, the borrowing costs are expected to range from 8% to 10%, depending upon the Rupee-Dollar funding mix.

Estimation of Weighted Average Cost of Capital (WACC)

For the estimation of WACC, the cost of equity and cost of debt have been taken from the publicly available DPRs of similar large infrastructure projects. Some of the comparable projects are provided here at Table 32.94.

Loan Tenor

The project is expected to have a very long-gestation period (30-50 years) with ballooning revenues during the last 15 years of the project. The debt component may carry an 8-10-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. 94: Comparable Projects for Project Financial Structuring

Sl. No.	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 Corridors	15767	SPV Model	Equity (40%): Govt of India, Govt of Karnataka, Private Partner	Loan (60%): Soft loans from 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

(a) Financing Options

An indicative list of the possible financing options is given in Table 32. 95 below.

Table 32. 95: 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 • International developers • Equipment suppliers • Dedicated infrastructure funds • Other international equity investors • Multilateral agencies	**Foreign** • International commercial banks • Export Credit Agencies • International Bond markets • Multilateral agencies • Bilateral aid agencies

Key Considerations for Government

- Such projects are highly capital-intensive with long gestation periods.
- Construction period is generally 5-8 years and much longer periods of the order of 30-50 years are necessary for debt servicing.
- Such projects are undertaken by governments in view of its social responsibility to provide sustainable infrastructure; returns are not the prime drivers.
- 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
- 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.
- Government of Gujarat (GoG)/ Government of India (GoI) as Co-sponsors may jointly; contribute to the equity of the project.
- Both GoG and GoI may allow certain policy incentives (rebates in taxes payable apart from GST ITC) during the construction and concession period.
- GoG may facilitate the acquisition of land at subsidised rates for development of the reclaimed land.
- GoG/ GoI may provide equity support through Viability Gap Funding if necessary for initial cash losses.

- GoG may consider ensuring electricity supply to the project on a no-profit- no-loss basis.
- GoG may have to provide a guarantee for refinancing domestic loans for the bullet portion to be paid at the end of the 15th year.
- Sale of property development rights will also form a source of funding for the project.
- GoI may also provide guarantee for raising funds through bonds.

Key Considerations for Debt Financing

- Project would require debt funding spread over at least 30 - 50 years.
- Quantum of debt and repayment profile will depend upon the projected revenues over 30–50-year period.
- Debt would be funded through various instruments, i.e., External Credit Agency (ECA)/Multilateral funds, Govt. guaranteed bonds and domestic Rupee loan.
- 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.
- 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.
- 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.
- 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*

- ECAs like JICA, Korean Exim, KFW etc. can provide cheap long-term funding i.e., 30 – 50 years plus for such projects.
- Repayment would be spread over 30 - 50 years after construction and a moratorium period of 5 to 8 years.
- Low interest rate during construction which will increase after the 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

- ADB and World Bank can provide long-term funding at attractive rates.
- Repayment would be spread over 15 - 20 years after construction and a moratorium period of 10 years.
- MFAs / Development agencies generally provide fixed-rate loans.

c. Government Guaranteed Bonds

- The SPV can raise 10-15 years of funds by issue of government-guaranteed bonds.
- Tax-free features can make them more attractive.
- SPV can repay these bonds by raising fresh debt once operations are stabilised.

d. Rupee Term Loans

- 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.
- Repayment will be step-up to match the cash flows.
- Step up repayment with full amortisation of Rupee loan at the end of 15 years; or
- 30%-40% of loan repayment over 15 years and balance bullet repayment at the end of tenor to be refinanced by fresh debt.

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 minimise the dependence on subsidies; (e) To recover returns from both the direct and indirect beneficiaries, among others.

Such massive infrastructure projects are characterised by capital intensity, long gestation periods, poor financial returns, and significant social benefits. They also frequently produce externalities that are difficult to quantify financially. Thus, experience worldwide reveals that such projects are highly subsidised by the government for their construction and operation. As a result, government involvement and a substantial share in the ownership of such projects is inevitable, 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 privatisation in large infrastructure projects with considerable socioeconomic benefits is not desirable.

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, project management is improved, and proper maintenance is ensured in PPPs, avoiding cycles of construction followed by persistent neglect and high-cost reconstruction. Well-designed PPPs bring the private investment capital, private sector expertise, 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 is used for two crucial purposes in a PPP. Firstly, it supplements public sector financing and enables projects that would have been abandoned due to fiscal limitations to proceed. Secondly, an incentive mechanism is established that aligns private and public interests.

32.7.2 Results of Analysis

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

32.7.2.1 Transaction Structure 1- Single-Bundle PPP

In this scenario, the project is considered 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 a PPP basis (Design, Build, Finance, Operate and Transfer: DBFOT; VGF+Revenue Share). The approach stipulates all the projects as a consolidated offering for implementation on the Design, Build, Finance, Operate, and Transfer (DBFOT) model of PPP with –

(a) an additional Viability Gap Funding (VGF) support (approx. 20%) to make it viable for the private developer and

(b) a revenue sharing mechanism to ensure distribution of profits in case of any upside. A brief discussion on the rationale for VGF and revenue sharing is provided in the subsequent paragraphs.

Projects of this nature contribute heavily to the socio-economic development of various lower strata of society (e.g., employment generation through tourism, fishing, and infrastructure development). However, such projects are not financially feasible, strictly on parameters such as Financial IRR, on a standalone basis. However, given their significant positive social externalities, such projects are supported in early phases through VGF support.[5] For example, in the Kalpasar project, a considerable investment is made in dyke construction and construction of flood regulators. Thus, with no VGF, the equity and project IRRs to private developers are extremely low. Thus, to implement such projects of significant economic value, it is customary to provide VGF support (approx. 10%-20%).[6] The VGF further mitigates the funding risk of these projects during the construction stage to a significant extent.

Revenue sharing mechanism has also been proposed basis the following rationale. A large area of land is expected to be reclaimed upon commissioning of the dyke in its entirety. In concessioning out the project, the authorities shall be permitting the developer to further employ the reclaimed land during the currency of the project (30-50 years) leading to additional future benefits. This is similar to quasi (or de-facto) leasing of the land to the private developer. The developer is expected to benefit from the same by creating commercial establishments, revenues from advertising, rentals etc., during the currency of the project. The revenue-sharing mechanism effectively compensates the authorities on account of the de-facto lease as well as a share of the future upside from the projects expected to be commenced. Thus, revenue sharing can also be considered as a combination of the lease compensation for the previously mentioned quasi-land lease and a share of profit from commercial upside from future monetisation of the reclaimed land.

Detailed description of the financing structure for individual projects is provided in the main report.

[5] https://pppinindia.gov.in/vgfguidelines
[6] https://pppinindia.gov.in/vgfguidelines

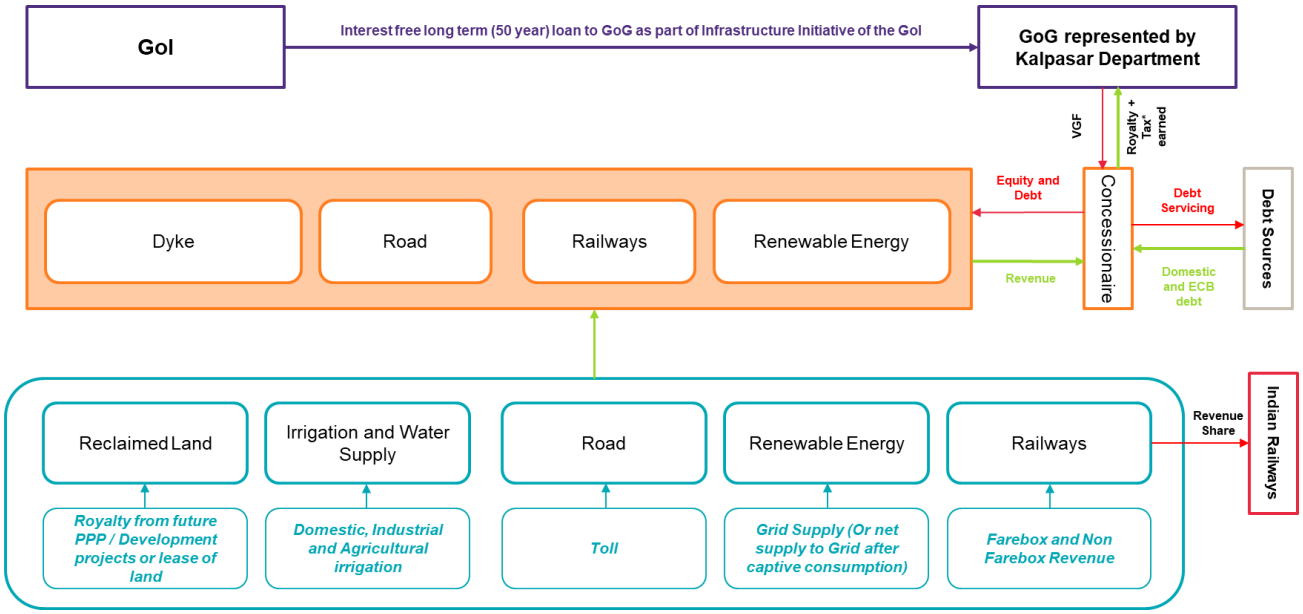


Figure 32. 30: Transaction Structure 1 - Complete Project Bundle DBFOT-PPP

The salient features of the proposed structure one (TS1) are as follows

- All the projects [Dyke (and water supply network), Transport (rail and road), and Renewable energy (wind and solar)] to be executed in a single project bundle with DBFOT mode of procurement.
- The private consortium (SPV) is expected to raise funds through a combination of loans from ECB/Domestic debt (RTL)/multilateral funding institutions (ADB, World Bank, JBIC/JICA, etc.), and equity from the sponsors.
- In addition, GoG is expected to provide viability gap funding (VGF) to support the dyke project and make it financially viable.
- The proposed land reclaimed as part of dyke project will be developed by the concessionaire, and the same may be considered as a de facto lease during the concession period.
- On account of this de facto land lease and any other upside to transport and renewable energy projects, the concessionaire will provide royalty/revenue share (10%-20%) to the concessioning authority.
- The private SPV will have the rights to sub-contract different project bundles and will be responsible for the overall quality of project execution.
- The cash inflows to the government on account of project execution include state GST (to GoG), corporate taxes (to GoI), royalty/revenue share from the DBFOT-PPP; also, part of revenues will be shared with Indian Railways for its support in railway operations (ticketing, signalling, etc.,).
- Cash outflows of GoG (through Kalpasar department) primarily include the VGF spending to make the Dyke project viable.

Risk Allocation

The approach stipulates all the projects as a consolidated offering for implementation on Design, Build, Finance, Operate, and Transfer (DBFOT) model of PPP with (a) an additional Viability Gap Funding (VGF) support (approx. 20%) to make it viable for the private developer and also (b) a revenue sharing mechanism to ensure distribution of profits, in case of upside. The concessioning authority [Government of Gujarat (GoG) through Kalpasar department] 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 project bundle 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 (corporate and GST) from the area in the project vicinity. In case of any upside to the project, a revenue-sharing mechanism is stipulated to add to the kitty of the government.

This kind of structure mitigates various project execution risks. First, to a considerable extent, funding risk is mitigated with the VGF support. Additional risk can be mitigated through securitisation of receivables against the proposed debt funding to be availed from banks. Also, in case of any upside in the project the revenue sharing mechanism ensures a certain share of the upside to the government. The risk of corporate balance sheet contamination and fiscal burden on the exchequer is mitigated through SPV based project finance mechanism. The bank's interest is further ensured with the TRA-Escrow mechanism to allow for a waterfall structure that gives priority to repayment of principal and interest before any distribution of cash to sponsors of the SPV. The SPV may further suballocate the contracts pertaining to design, construction, and O&M to further mitigate project implementation risks.

The SPV, with adequate support from the concessioning authority, can sign long-term sale, purchase, and other operations contracts (e.g., sale and purchase of power from renewable energy plants, industrial consumption, and domestic use, toll road operations, etc.). This kind of contractual structure may help mitigate various project risks and ensure smooth operations in long-term and create value for all the stakeholders in the PPP project.

Summary of Financial Analysis

The key results from the analysis are provided below. Comprehensive results pertaining to cash flow analysis, balance sheet, and profit and loss are provided in **Annexures A-F** in a project-wise manner as well as on a consolidated basis.

Table 32. 96: Project and Equity IRR (Transaction Structure 1)

Year	Project IRR	Equity IRR
30-Years	13.38%	38.22%
40-Years	14.51%	38.30%
50-Years	14.94%	38.30%

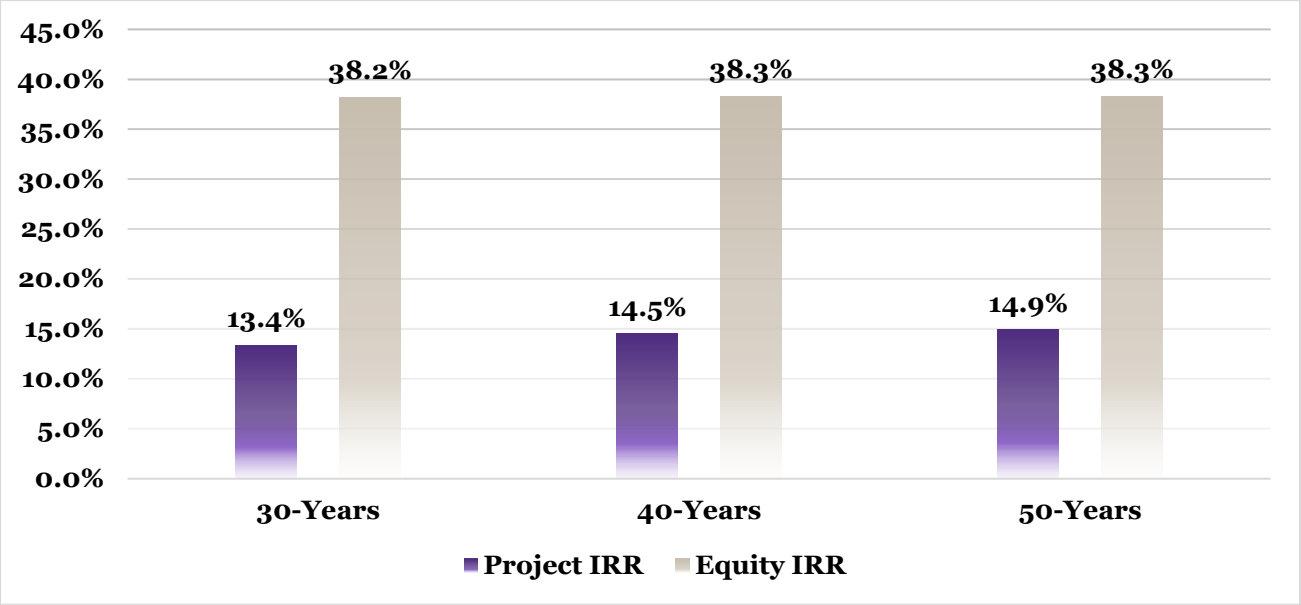


Figure 32. 31: Project and Equity IRR (Transaction Structure 1)

Table 32. 97: Value to Govt. (VGF=20% and RS=20%) (Transaction Structure 1)

Discount rate	VGF (V)	Revenue Share (RS)	Taxes (T)	Total Value=T+RS-V
6%	23,075	147,348	69,197	193,471
8%	20,977	86,599	41,608	107,230
10%	19,127	54,032	27,019	61,925
12%	17,489	35,542	18,839	36,892

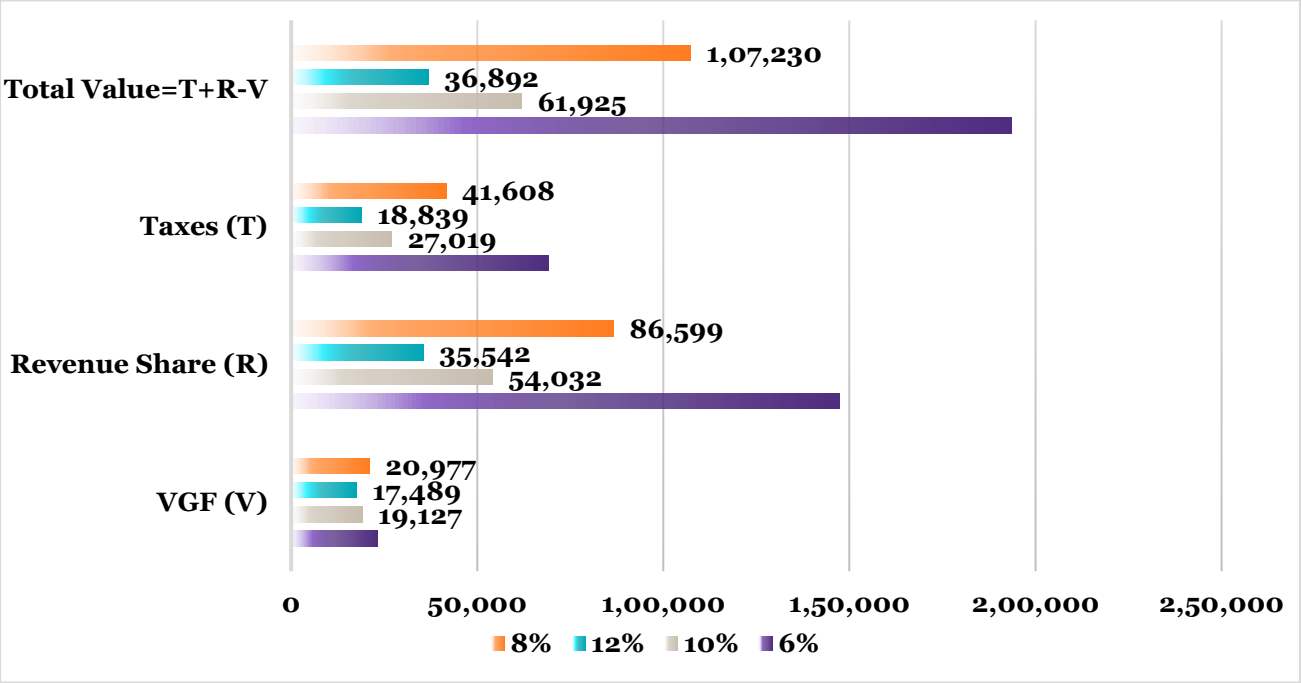


Figure 32. 32: Value to Govt. (VGF=20% and RS=20%) (Transaction Structure 1)

Table 32. 98: Benefits and Challenges involving the Transaction Structure 1

Benefits	Challenges
Finance Related	
- Considerable financing risk is mitigated for all the stakeholders - VGF provides sufficient cushion to the developer in the preliminary stages of project implementation - Equitable distribution of financing risk between the stakeholders - The revenue-sharing mechanism distributes the gains in upsides with the concessioning authority - Securitisation of project receivables may provide the requisite comfort to lenders	- For a single consortium, it may be difficult to tie-up/avail such large financing - Availability of adequate security against the large quantum of high-cost debt - Possible challenges in availing ECBs in the required quantum - Unavailability of low-cost and extended-period debt from Multilateral Funding Agencies for private parties
Technical	
- DBFOT PPP model has evolved from the public sector's inability to not only finance the required investment in a project but also its limited capacity related to designing and O&M - DBFOT may result in improved operational standards with reduced O&M costs, including reduction of energy costs, as the existing public installations have exhibited moderate operational standards, high O&M costs, and high energy consumption and have seen minimal year-on-year operational improvement - Most of the construction, and implementation risks (project level procurement risk, regulatory risk, financing risk, construction risk, O&M risk, Revenue risk) are transferred from the concessioning authority to the developer, and in turn to the SPV entity, which is better placed to mitigate these risks with the help of project finance contractual structure - Private developer is better placed to adopt modern technology and efficiently execute similar projects that require considerable use of technology - Better scheduling and implementation of the projects since different projects (e.g., Dyke, Fisheries) are interconnected and a single developer consortium can monitor and execute the same more effectively - Consolidated DBFOT project remains a design challenge. For example, the design of dyke, flood regulator, road, rail, renewables, etc., poses a mammoth task. Moreover, all these projects are interlinked, that is, the success of one is dependent on another. For example, the success of rail, road, and renewables depend to a significant extent on the success of dyke, reclamation of land and creation of freshwater reservoir. However, a considerable amount of design work has been done by authorities through various reputed institutes (IITs) and a	- Most of the design risks is transferred from the concessioning authority to the developer, and in turn to the SPV entity for the project where institutes of national importance like the IITs have put forward the optimum design in consultation with other global players as and where necessary. - Expected increase in project period due to complexity of design followed by a vetting process for the selected designs since the Concessionaire shall have to, as per the Terms of the Contract prepare the designs prior to implementation. - A single consortium may not have the complete core competence and wherewithal to execute all the projects. It may eventually have to subcontract different project components. Thus, monitoring the implementation of all the projects to meet their specification requirements and performance would be a challenge. The contractual obligations may need to envisage performance standards in the long-term, much ahead even after the handover of the facility has taken place - Land provided to the concessionaire is effectively a quasi (or de facto) lease; government rules and regulations need to be enforced upon the concessionaire thereby leaving little room for possible maximisation of returns from the reclaimed land.

consortium of consultants. The private developer can leverage this work and save time and resources. Thus, the initial feasibility studies are already conducted, and the project is not a black box anymore. Lot of preliminary to advanced information is already made available by the early studies for the perusal of the developer.	
Procurement	
- Procurement of entire project under a single procurement contract - PPP and its sponsors are single point of contact; Govt. does not have to manage multiple stakeholders' interests. - Facilitates government/concessioning authority to shift its focus away from day to day running of the operations and complete control, and focus more on policy making and regulation	- A project of such a large scale is difficult to implement; thus, finding a financially suitable consortium that can meet the required eligibility norms and subsequently execute the entire project bundle and execute it, may be challenging. - Unless clearly and tangibly supported by the authority, due to the lack of tangible authority, the private developer consortium may find it difficult to obtain various Environmental/Pollution Control Board and regulatory approvals and acquire land (for the approach portion of the Roads and Railway project). While it is easier for the Govt. to take various regulatory and environmental approvals, the same may be difficult for a private developer; hence, regulatory and environmental approvals may need concessioning authority / Government intervention from time to time to avoid potential time and consequent cost overruns. - Leasing of reclaimed public land to private developer and temporary transfer of ownership for private development does not have much prior precedence in the Indian context. - Various procurement-related risks such as cost overruns, quality issues, delivery delays, contract disputes are easier to manage by private developers. However, now that a private party is in control, there is a higher information asymmetry, and the concessioning authority needs to carefully design the contracts and formulate relevant clauses pertaining to damages to ensure that the interest of the private developer is aligned with that of the authority. Thus, contract management and monitoring of project execution requires careful due diligence while formulating the roles and responsibilities of the private developer in establishing the contractual obligations. These include performance indicators, penalties for failing to meet performance standards, etc.

32.7.2.2 Transaction Structure 2- Two project Bundle EPC+DBFOT-PPP

In this scenario, the project is considered as a combination of two sub-bundle projects (a) Dyke (and auxiliary water reservoir), (b) Transport and Renewable energy bundle. **Part (a)**, that is, Dyke (and auxiliary water reservoir) is to be given on EPC basis with complete government ownership. A brief discussion on the rationale for keeping the dyke (and auxiliary, offering on EPC basis) is provided as follows.

Given the significant costs involved with the dyke (and auxiliary) project (Approx Rs 1,06,640 crore), it is difficult to be executed by a single consortium. Even more so due to the fact that there are not many revenue streams that are directly linked to this project resulting in low tangible financial IRR to the private developer.

For example, in the Kalpasar project, a considerable investment is made in dyke construction and construction of flood regulators. Thus, with no support from authorities, the equity and project IRRs to the private developers are extremely low (refer to the Table below). Most of the revenue potential and economic benefits of the dyke project are of indirect nature (e.g., employment opportunities, tourism potential, fisheries, availability of fresh water, reclamation of land, etc.). Most of these are indirect socio-economic benefits, expected to accrue to society over the long-term. Such benefits are not visible in the financial parameters such as financial IRR, and hence do not invite much private investment and may even contaminate the balance sheet of other financially feasible projects (transportation and renewable energy).

Nonetheless, such projects are of critical importance to the socio-economic development of lower strata in society. In the long-term, these projects also support the allied infrastructure (such as schools, hospitals, etc.) as the lower strata of society witness growth on other economic parameters (per capita income, consumption, etc.).

Part (b) comprising of transport and renewable energy bundle to be offered on DBFOT-PPP basis (Design, Build, Finance, Operate Transfer: DBFOT; Revenue Share) to the private developer. The approach stipulates all the projects in Part (b) as a consolidated offering for implementation on the Design, Build, Finance, Operate, and Transfer (DBFOT) model of PPP with a revenue-sharing mechanism to ensure distribution of profits in case of any upside. Since, unlike the dyke projects, these projects are profitable on a standalone basis, provision for VGF is not required.

Large infrastructure projects of this nature contribute heavily to the socio-economic development through the creation of social and commercial infrastructure and energy security in a sustainable manner (e.g., construction of road, railways, renewable energy). Moreover, the in-house captive consumption of electricity from the proposed renewable energy plants is expected to make the energy costs cheaper. Revenue-sharing is stipulated to compensate the authorities for any potential future upside from the project bundle (such as large growth in traffic volumes on toll road and rail).

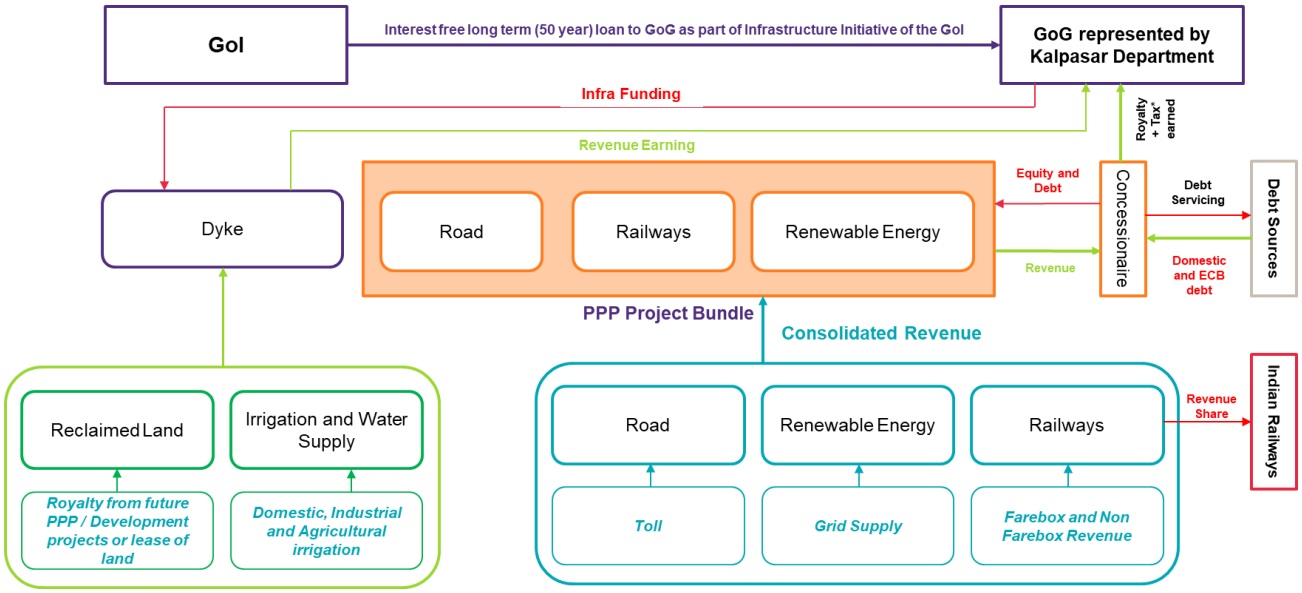


Figure 32. 33: Transaction Structure 2 - Complete Project A Dyke and Auxiliary (EPC)+ Transport and Renewable (DBFOT+PPP)

The salient features of the proposed structure two (TS2) are as follows

- All the projects to be executed in two project bundles with (a) Dyke (and water supply network) project under EPC by GoG (through Kalpasar) and (b) the transport and renewable energy bundle under DBFOT-PPP mode of procurement.
- The EPC project will be funded by GoG (through Kalpasar department) with requisite support from GoI under infrastructure funding schemes.
- The revenues from Kalpasar project (land monetisation, water supply, etc.) will accrue to Kalpasar department
- The DBFOT-PPP project bundle will be partly funded through a mix of debt-equity by the private developer (or concessionaire).
- The concessionaire will pay a royalty/revenue share (10%-20%) to the concessioning authority; and a payment from farebox revenues to Indian Railways on account of services provided (ticketing, signalling, etc.).
- The cash inflows to the government on account of DBFOT-PPP project execution include state GST (to GoG), corporate taxes (to GoI), royalty/revenue share from the DBFOT-PPP; the revenues to GoG (through Kalpasar dept) from Dyke project include revenues from land monetisation and water supply (domestic, industrial, and agriculture).
- Cash outflows of GoG (through Kalpasar department) primarily include the Capex and opex pertaining to the Dyke project under EPC.

Risk Allocation

The approach stipulates all the projects as a sub-bundle of two projects. Part (a), that is, Dyke (and auxiliary infra) two be executed on engineering, procurement, and construction contract to be executed through a turn-key contract by a private developer consortium; and Part (b) that is a consolidated offering of transportation and renewable energy project bundle for implementation on Design, Build, Finance, Operate, and Transfer (DBFOT) model of PPP a revenue sharing mechanism to ensure distribution of profits, in case of upside. In case of Part (b) DBFOT-PPP the concessioning authority [Government of Gujarat (GoG) through Kalpasar department] 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 project bundle over the life of the concession agreement. The project development will lead to the collection of additional taxes (corporate and GST) from the transportation and renewable project bundles. In case of any upside to the project, a revenue-sharing mechanism is stipulated to add to the kitty of the government.

This kind of structure mitigates various project execution risks.

First, to a considerable extent, funding risk of the private developer consortium is mitigated by the securitisation of receivables (from road, rail, wind, and solar projects) against the proposed debt funding to be availed from banks. Also, in case of any upside in the DBFOT-PPP project the revenue sharing mechanism ensures a certain share of the upside to the government. The risk of corporate balance sheet contamination and fiscal burden on the exchequer is mitigated through the SPV-based project finance mechanism. The bank's interests are further ensured with the TRA-Escrow mechanism to allow for a waterfall structure that gives priority to repayment of principal and interest before any distribution of cash to the sponsors of the SPV.

The SPV may further suballocate the contracts pertaining to design, construct, and O&M to further mitigate project implementation risks. The SPV, with adequate support from the concessioning authority, can sign long-term sale, purchase, and other operations contracts (e.g., sale and purchase of power from renewable energy plants, toll road operations, etc.). This kind of contractual structure may help mitigate various project risks and ensure smooth operations in long-term and create value for all the stakeholders in the PPP project.

Further, in this structure the complete award of Dyke project on EPC basis by the authority mitigates its execution and funding risk to an extent for the following reasons. First, we stipulate considerable support from GoI to GoG, as interest-free subordinate debt for a long tenor (approx. 50 years).

Given the sufficient fiscal strength of GoI and GoG, the funding risk is mitigated to an extent. The presence of GoI and GoG as direct owners of the project and given the nature of project (creation of freshwater reservoir), it will be eligible for support from various multilateral financing institutions (World Bank, ADB, JBIC, JICA, etc.). This will help facilitate availing large door-to-door tenor (30-40 years) low-cost soft-loans (at LIBOR+1-2%). Moreover, given the sovereign support, the project may enjoy favourable procurement terms and conditions as well.

Financial Analysis Summary

In the financial analysis section, we discuss the key measures of project performance evaluation. Comprehensive results pertaining to cash flow analysis, balance sheet, and profit and loss are provided in **Annexures A-F** in a project-wise manner as well as on a consolidated basis.

A. Value to Private Developer: Transportation and Renewable Energy Bundle: DBFOT PPP

Table 32. 99: Project and Equity IRR/NPV Analysis (Concessionaire)

Project Level Analysis (NPV in Rs crore)					Equity Analysis (NPV in Rs crore)			
Project IRR	**%**				**Equity IRR**	**%**		
30-Years	17.61%				**30-Years**	20.89%		
40-Years	18.39%				**40-Years**	21.70%		
50-Years	18.60%				**50-Years**	21.87%		
Project NPV	**30-Years**	**40-Years**	**50-Years**		**Equity NPV**	**30-Years**	**40-Years**	**50-Years**
NPV@12%	16,083	23,612	27,964		**NPV@12%**	10,215	15,577	18,701
NPV@10%	28,161	42,332	52,138		**NPV@10%**	16,484	26,574	33,612
NPV@8%	46,670	73,725	96,212		**NPV@8%**	26,162	45,422	61,562
NPV@6%	75,338	1,27,771	1,80,293		**NPV@6%**	41,295	78,612	1,16,312

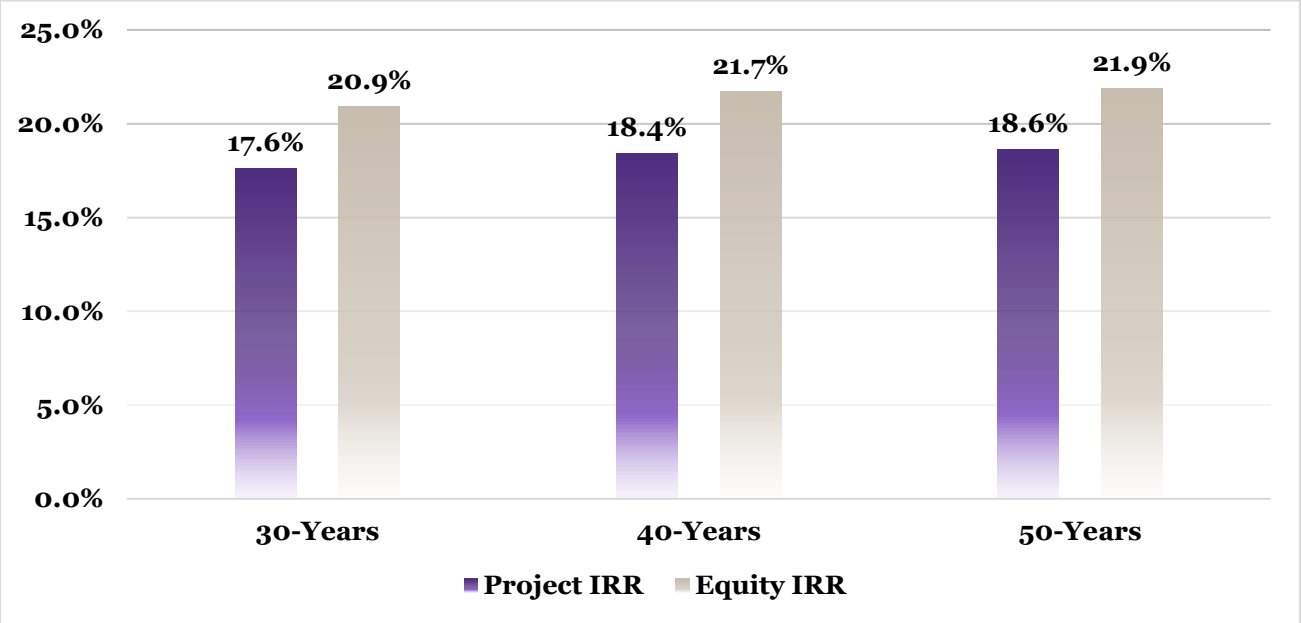


Figure 32. 34: Project and Equity IRR (%) – Transaction Structure 2

B. Value to Govt.: Dyke Project (EPC), Revenue Share, and Taxes

The Dyke project is completely owned by the authorities (GoG and GoI) and implemented on EPC turnkey contract basis. In addition, we consider the cash flows from corporate tax and GST to government as they will be utilised in socio-economic development of the region. In measuring the IRR and NPV for the authority, following metrics are obtained.

Table 32. 100: Value addition to the Govt.

Value addition to Govt.			
Govt. IRR	**%**		
30-Years	16.5%		
40-Years	17.3%		
50-Years	17.5%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@12%	33,173	49,353	59,889
NPV@10%	61,172	91,637	115,507
NPV@8%	103,865	162,056	217,099
NPV@6%	169,709	282,522	411,818

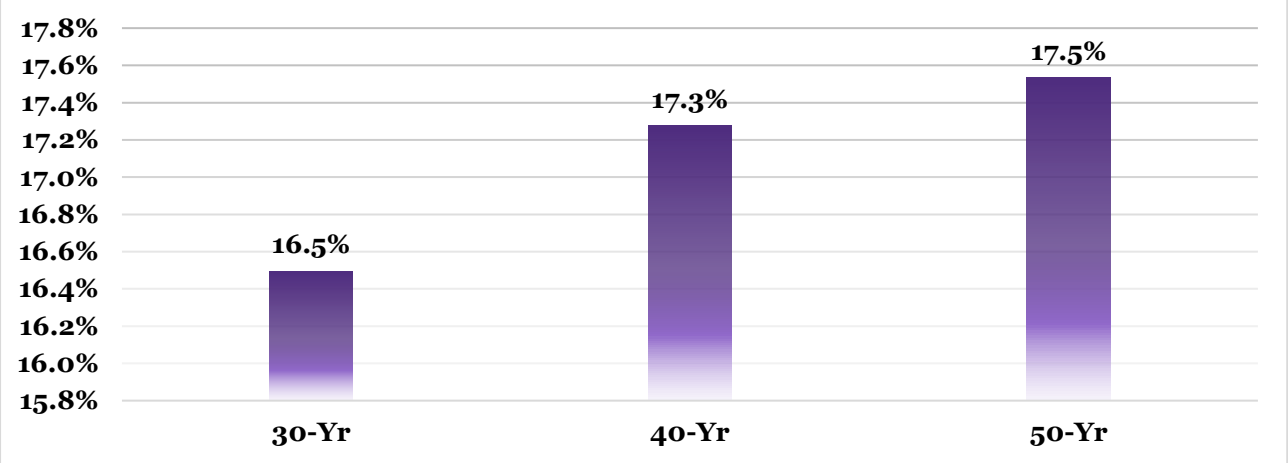


Figure 32. 35: Value addition to the Govt. – Transaction Structure 2

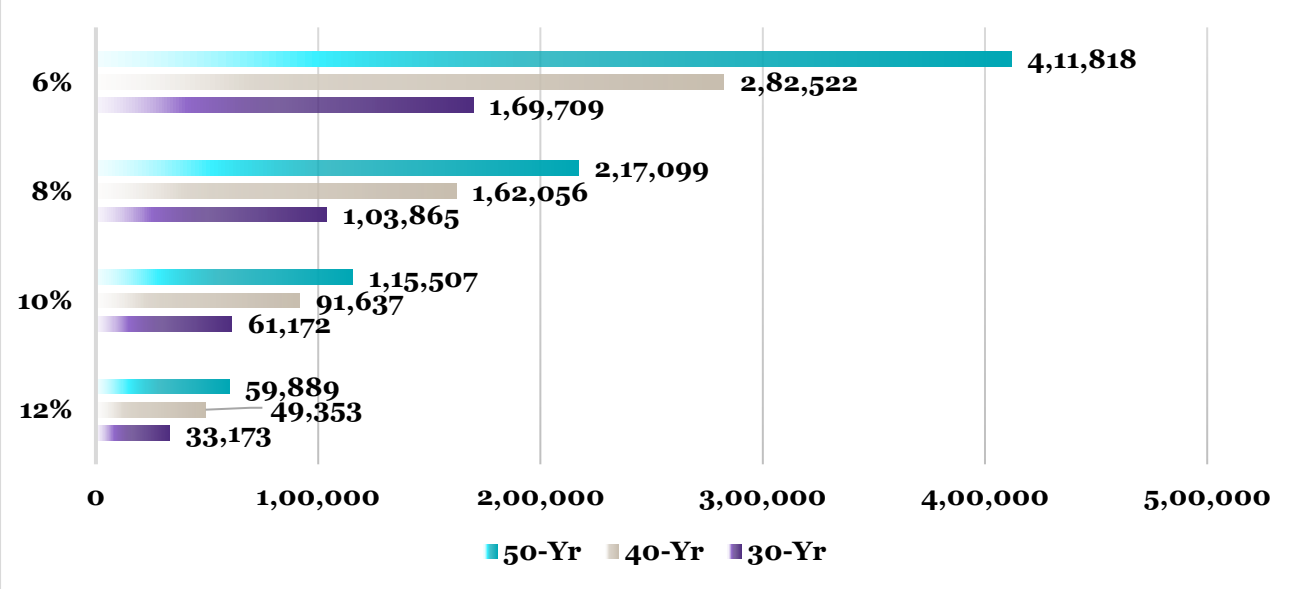


Figure 32. 36: Value addition to the Govt. (Rs. Cr) – Transaction Structure 2

Table 32. 101: Benefits and Challenges Involving the Transaction Structure 2

Benefits	Challenges
Finance Related	
- With the EPC turn-key execution of the Dyke project under the aegis of the GoG, the project financing and implementation risk is mitigated to an extent; this also facilitates the involvement of multilaterals and helps in availing long-duration soft-loans. - The Dyke project has fewer visible direct revenue streams, and hence fares low on financial parameters (e.g., FIRR). The separation of Dyke project from the transportation and renewable energy project bundle will safeguard the balance sheets of road, rail, solar, and wind projects from contamination due to the inclusion of the less financially feasible Dyke project. - The DBFOT-PPP implementation of the transportation and renewable energy project bundle mitigates the burden of financing from the exchequer. - VGF provides sufficient cushion to the developer [Part (b)] in the preliminary stages of project implementation. - Securitisation of project receivables from the transportation and renewable energy project bundle may provide the requisite comfort to lenders. - Equitable distribution of financing risk between the stakeholders; compared to structure 1, the exclusion of Dyke creates additional comfort and a more financially feasible transaction structure for the private developer. - The revenue-sharing mechanism distributes the gains in upsides with the renewable and transportation project bundle with the concessioning authority.	- For a single consortium, it may be difficult to tie-up/avail such large financing for Part (b), i.e., transportation and renewable energy project bundle; nonetheless, this risk has come down substantially from transaction structure 1 (TS1) with the separation of the Dyke project. - For Part (b) availability of adequate security against the large quantum of high-cost debt, direct/indirect support from GoG/GoI would be required to tie-up the financing (e.g., sovereign letter of comfort) - Possible challenges in availing External Commercial Borrowings (ECBs) in the required quantum and tenor. - For Part (b), the unavailability of low-cost and extended-period debt from Multilateral Funding Agencies for private parties may put pressure on the consortium's liquidity. - Given the huge cost of Dyke project (approx. Rs 1,06,640 crore), it may put some burden on the exchequer.
Technical	
- For Part (b), the DBFOT PPP model is expected to add to the gains in efficiency of the execution on design, finance, build, and implementation-related aspects. - DBFOT PPP (transportation and renewable energy bundle) may result in improved operational standards with reduced O&M costs, including reduction of energy costs, as the existing public installations have exhibited moderate operational standards, high O&M costs, and high energy consumption, and have seen less year-on-year operational improvement. - For Part (b), most of the construction and implementation risks (project-level procurement risk, regulatory risk, financing risk, construction risk, O&M risk, Revenue risk) are transferred from the concessioning authority to the developer, and in turn, to the SPV entity, which is better placed to mitigate these risks with the help of project finance contractual structure	- For the Dyke project, pure public ownership and implementation may remain a challenge as the previous experience of the same for large infrastructure projects has shown mixed results. - For Part (b), most of the design risks are transferred from the concessioning authority to the developer, and in turn to the SPV entity for the project where institutes of national importance like the IITs have put forward the optimum design in consultation with other global players as and where necessary. - For Part (b), expected increase in project period due to complexity of design followed by a vetting process for the selected designs since the Concessionaire shall have to prepare the designs prior to

- For Part (b), the private developer is better placed to adopt modern technology and efficiently execute similar projects that require considerable use of technology (transportation and renewable energy project bundle). - All the projects' [Part (a) and Part (b)] timelines are linked to the successful implementation of the Dyke project. The complete ownership of Dyke project with one single public authority may reduce various uncertainties customary to such projects (political, legal, and regulatory challenges, financing risks, etc.), and may increase the visibility of its completion in the near term. This facilitates better scheduling and implementation of the other dependent projects, since different projects (e.g., reclamation of land, transportation, renewable energy) are interconnected and dependent on the successful completion of the Dyke project. - For both, Part (a) & (b), a considerable amount of design work has been done by authorities through various reputed institutes (IITs) and a consortium of consultants. Thus, the initial feasibility studies are already conducted, and the project is not a black box anymore. Lot of preliminary to advanced information is already made available by the early studies. This will help the private developer (for Part (b)) in the subsequent stages of project execution.	implementation as per the Terms of the Contract. - A single consortium may not have the complete core competence and wherewithal to execute all the projects [in Project sub-bundle Part (b)]. It may eventually have to subcontract different project components. Thus, monitoring the implementation of all the projects to meet their specification requirements and performance would be a challenge. The contractual obligations may need to envisage performance standards in the long-term, much ahead even after the handover of the facility has taken place.
Procurement	
- Compared to TS1, now part (b) is relatively small and more financially feasible; hence finding a financially suitable consortium that can meet the required eligibility norms and subsequently execute the entire project bundle is relatively less challenging - For part (a), relative to TS1, the public authority may find it easier to obtain various Environmental/Pollution Control Board and regulatory approvals and acquire land (for the approach portion of the Roads and Railway project). It is easier for the Govt. to take various regulatory and environmental approvals, the same may be difficult for a private developer. -	- Procurement is more complex compared to the transaction structure 1 (TS1); since now there are two bundles of projects, and the government has to manage multiple stakeholders' interests; and coordinated execution and implementation of the same will be an arduous task. - For Part (b), since a private party is in complete control, there is a higher information asymmetry, and the concessioning authority needs to carefully design the contracts and formulate relevant clauses pertaining to damages to ensure that the interest of the private developer is aligned with that of the authority. Thus, contract management and monitoring of project execution requires careful due diligence while formulating the roles and responsibilities of the private developer in establishing the contractual obligations. These include performance indicators, penalties for failing to meet performance standards, etc. - For the Dyke project [Part (a)], government remains solely responsible for short-medium-long term aspects of the project and may require considerable resources in coordination, execution, and project implementation.

32.7.2.3 Transaction Structure 3 - Three project Bundles EPC+HAM+DBFOT-PPP

In this scenario, the project is considered as a combination of three sub-bundle projects (a) Dyke (and auxiliary water reservoir) to be given on EPC basis with complete government ownership (b) Road project as Hybrid Annuity Model (HAM) to a private developer, and (c) Rail and Renewable energy bundle to be offered on DBFOT-PPP basis.

Part (a) A brief discussion on the rationale for keeping the dyke (and auxiliary, offering on EPC basis) is provided as follows.

Given the significant costs involved with the dyke (and auxiliary) project (Approx Rs 1,06,640 Crore), it is difficult to be executed by a single consortium. Even more so due to the fact that there are not many revenue streams that are directly linked to this project, resulting in low tangible financial IRR to the private developer.

For example, in the Kalpasar project, a considerable investment is made in dyke construction and construction of flood regulators. Thus, with no support from authorities, the equity and project IRRs are extremely low. Most of the revenue potential and economic benefits to the dyke project are of indirect nature (e.g., employment opportunities, tourism potential, fisheries, availability of fresh water, reclamation of land, etc.).

Most of these are indirect socio-economic benefits, expected to accrue to society over the long-term. Such benefits are not visible in the financial parameters such as financial IRR, and hence as such do not invite much private investment and may even contaminate the balance sheet of other financially feasible projects (transportation and renewable energy).

Nonetheless, such projects are of critical importance to the socio-economic development of lower strata in society. In the long-term, these projects also support the allied infrastructure (such as schools, hospitals, etc.) as the lower strata of society witness growth on other economic parameters (per capita income, consumption, etc.).

Part (b) includes the road project under the Hybrid Annuity Model (HAM) approach. Following are some of the salient features of HAM model.

The HAM model of PPP execution is novel and offers considerable flexibility and benefits over the conventional DBFOT/BOT structures. In this structure, 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 on capital investment that is MCLR+1.25% 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 (15 years). Collection of taxes, toll, fairbox, and other charges will be done by the authority. These revenues can be securitised to back the financing from multilaterals. Moreover, the revenues can also support the payments of annuities (project cost and O&M) which are the obligations of Kalpasar authorities (on behalf of the statement government). To part fund its part, GoG can explore the issuance of special purpose tax-free bonds/multilateral funding in the form of soft loans.

Part (c) comprising railways and renewable energy bundle to be offered on DBFOT-PPP basis (Design, Build, Finance, Operate , and Transfer: DBFOT; VGF+Revenue Share) to the private developer.

The approach stipulates all the projects in Part (c) as a consolidated offering for implementation on the Design, Build, Finance, Operate, and Transfer (DBFOT) model of PPP with a revenue sharing mechanism to ensure distribution of profits in case of any upside. Additional revenue-sharing is stipulated to compensate the authorities for any potential future upside from the project bundle (such as large growth in traffic volumes on toll road and rail). Moreover, these projects have a proven viability and future upside. Thus, inviting private participation, which brings gains in efficiency and technology from the private sector. Moreover, the provision of revenue sharing mechanism further helps the government to take share of any upside potential.

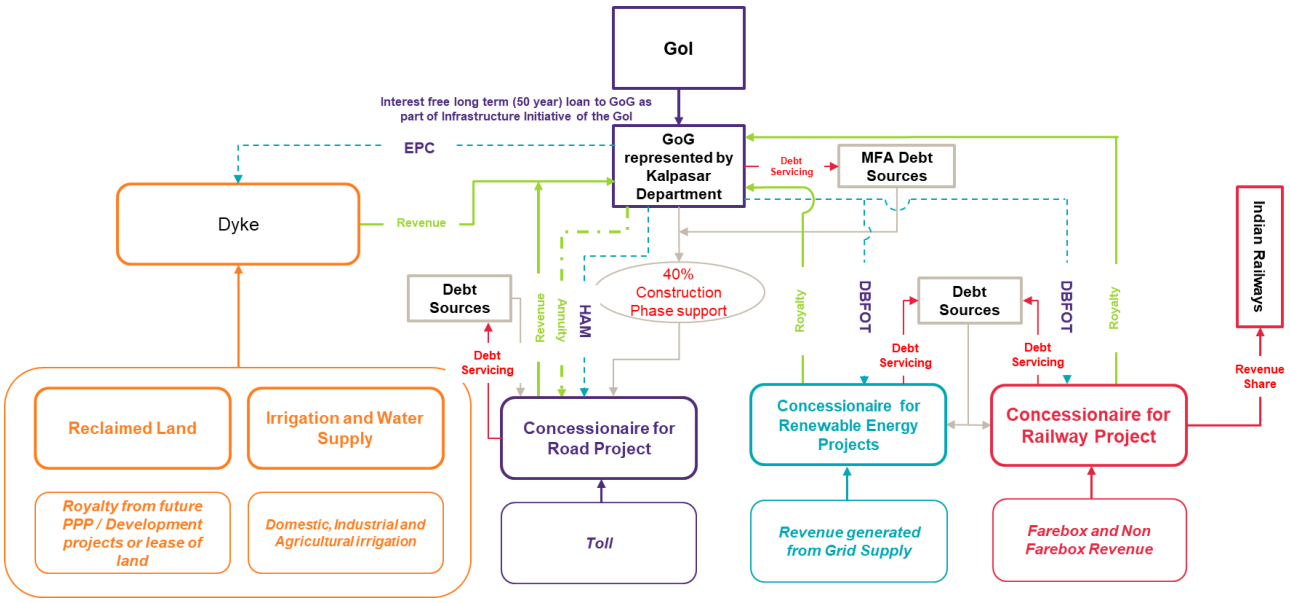


Figure 32. 37: Transaction Structure 3 - Complete Project A Dyke and Auxiliary (EPC)+ Road (HAM)+ Rail and Renewable (DBFOT+PPP)

The salient features of the proposed structure three (TS3) are as follows

- All the projects to be executed in three project bundles with (a) Dyke (and water supply network) project under EPC by GoG (through Kalpasar department), (b) Road under HAM mode, and (c) the transport and renewable energy bundle under DBFOT-PPP mode of procurement.
- The EPC project will be funded by GoG (through Kalpasar department) with requisite support from GoI under infrastructure funding schemes.
- The revenues from Kalpasar project (land monetisation, water supply, etc.) will accrue to the Kalpasar department
- The DBFOT-PPP project bundle will be partly funded through a mix of debt-equity by the private developer (or concessionaire).
- The concessionaire will pay a royalty/revenue share (10%-20%) to the concessioning authority; and a payment from farebox revenues to Indian Railways on account of services provided (ticketing, signalling, etc.).

- The road project will be executed under HAM-PPP model wherein 40% construction support will be provided by GoG (through Kalpasar department) linked to physical progress of the project; the same is proposed to be funded through Area Improvement Bonds and Multilateral Funding.

- The balance 60% of the HAM construction cost will be funded through a mix of debt-equity raised by private concessionaire (~ 70:30 D: E), which will be recovered during the operational phase in the form of annuities.

- Under the HAM model, GoG will make payments to the private concessionaire for O&M, interest on capital, and recovery of construction cost to mitigate the revenue risk and funding risk.

- The cash inflows to the government on account of DBFOT-PPP project execution include state GST (to GoG), corporate taxes (to GoI), royalty/revenue share from the DBFOT-PPP; the revenues to GoG (through Kalpasar dept) from Dyke project include revenues from land monetisation and water supply (domestic, industrial, and agriculture); and toll revenues and non-fare revenues from the HAM project.

- Cash outflows of GoG (through Kalpasar department) primarily include the Capex and opex pertaining to the Dyke project under EPC; outflows on account of HAM project include funding support in the form of annuity, interest on capital, and O&M recovery

Risk Allocation

The approach stipulates all the projects as a sub-bundle of three projects. Part (a), that is, Dyke (and auxiliary infra) two be executed on engineering, procurement, and construction basis through a turn-key contract by a private developer consortium; part (b) road project on the basis of HAM approach; and Part (c) that is a consolidated offering of railways and renewable energy project bundle for implementation on Design, Build, Finance, Operate, and Transfer (DBFOT) model of PPP with a revenue sharing mechanism to ensure distribution of profits, in case of upside.

In part (a), the complete award of Dyke project on EPC basis by the authority mitigates its execution and funding risk to an extent for the following reasons.

First, we stipulate considerable support from GoI to GoG, as interest-free subordinate debt for a long tenor (approx. 50 years). Given the sufficient fiscal strength of GoI and GoG, the funding risk is mitigated to an extent. The presence of GoI and GoG as direct owners of the project and given the nature of the project (creation of freshwater reservoir), it will be eligible for support from various multilateral financing institutions (World Bank, ADB, JBIC, JICA, etc.). This will help facilitate availing large door-to-door tenor (30-40 years) low-cost soft-loans (at LIBOR+1-2%).

Moreover, given the sovereign support, the project may enjoy favourable procurement terms and conditions as well.

For example, the ministry of Jal Shakti (formed in 2019) has been allocated a budget of close to Rs 97,278 crore for the year 2023-24 itself.[7] The Department has implemented two major schemes: (i) the Jal Jeevan Mission (JJM), and (ii) the Swachh Bharat Mission - Gramin (SBM-G). JJM aims to provide drinking water through tap connections to every

[7] https://prsindia.org/budgets/parliament/demand-for-grants-2023-24-analysis-jal-shakti

household by 2024. It also promotes greywater (used water) management, water conservation, and rainwater harvesting. The Swachh Bharat Mission was launched as a nationwide campaign to achieve universal sanitation coverage by 2019. 91% of the budgetary allocation for the department in 2023-24 is for the JJM, and 9% for SBM-G. This demonstrates the focus of the government towards the projects related to drinking water, sanitation, and availability of water for various end-uses (e.g., industrial, consumption, etc.).

In part (b), the road project is stipulated to be awarded on the basis of the popular HAM model. The HAM model provides clear visibility of project execution through rigid timelines of construction and a concession period (15 years).

The reimbursement of 40% of project cost (linked to physical progress of the project) considerably mitigates the funding risk for the developer. Also, the 60% project cost reimbursement, along with pass-through O&M, and MCLR+1.25% return on capital investment, eliminates the revenue risk of the developer in the form of assured receivables. Since these receivables are from government authorities, these can be securitised to avail long-duration soft loans from multilaterals.

Moreover, road being a critical area of state subject, the overall control of the project remains with the public authority. Thus, while the HAM approach provides the efficiency gains of DBFOT, and at the same it also carries the public interest with a crucial element being the public ownership, considering the socio-economic welfare nature of the project.

For example, the present location of the proposed project is yet to be developed and may take some time; on a standalone basis, a private developer may not find the potential revenues from the project attractive, leading to poor participation in project award tenders. Also, since the authority directly collects toll, any upside remains with the authority. While the developer is given assured returns and hence revenue risk and funding risks are mitigated to a significant extent.

In case of Part (c) that is DBFOT-PPP, the concessioning authority [Government of Gujarat (GoG) through Kalpasar department] 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 project bundle over the life of the concession agreement.

The project development will lead to the collection of additional taxes (corporate and GST) from the transportation and renewable project bundles. In case of any upside to the project, a revenue-sharing mechanism is stipulated to add to the kitty of the government. This kind of structure mitigates various project execution risks.

First, these projects are financially viable and provide considerable returns to private developer (as observed in project/equity IRRs). Separation of Dyke project and road project avoids contamination of rail and renewable projects, thus keeping their profitability intact. Additional risk can be mitigated through the securitisation of receivables (from rail, wind, and solar projects) against the proposed debt funding to be availed from banks. Also, in case of any upside in the DBFOT-PPP project the revenue sharing mechanism ensures a certain share of the upside to the government.

The risk of corporate balance sheet contamination and fiscal burden on the exchequer is mitigated through the SPV-based project finance mechanism. The bank's interests are further ensured with the TRA-Escrow mechanism to allow for a waterfall structure that gives priority to the repayment of principal and interest before any distribution of cash to the sponsors of the SPV. The project SPV may further suballocate the contracts pertaining to

design, construction, and O&M to further mitigate project implementation risks. The project SPV, with adequate support from the concessioning authority, can sign long-term sale, purchase, and other operations contracts (e.g., sale and purchase of power from renewable energy plants, construction of railway network, etc.).

This kind of contractual structure may help mitigate various project risks and ensure smooth operations in long-term and create value for all the stakeholders in the PPP project.

Financial Analysis Summary

In the financial analysis section, we discuss the key measures of project performance evaluation. Comprehensive results pertaining to cash flow analysis, balance sheet, and profit and loss are provided in **Annexures A-F** in a project-wise manner as well as on a consolidated basis.

A. Value to Private Developer and Govt.: Road (HAM)

Table 32. 102: Project, Equity and Govt. IRR/NPV Analysis

	Project	Equity	Govt.
IRR (8+15 Years)	13.0%	24.6%	31.4%
NPV	**(Rs crore)**	**(Rs crore)**	**(Rs crore)**
NPV@12%	263	1,284	8,135
NPV@10%	945	1,803	11,464
NPV@8%	1,914	2,505	16,203
NPV@6%	3,290	3,464	23,009

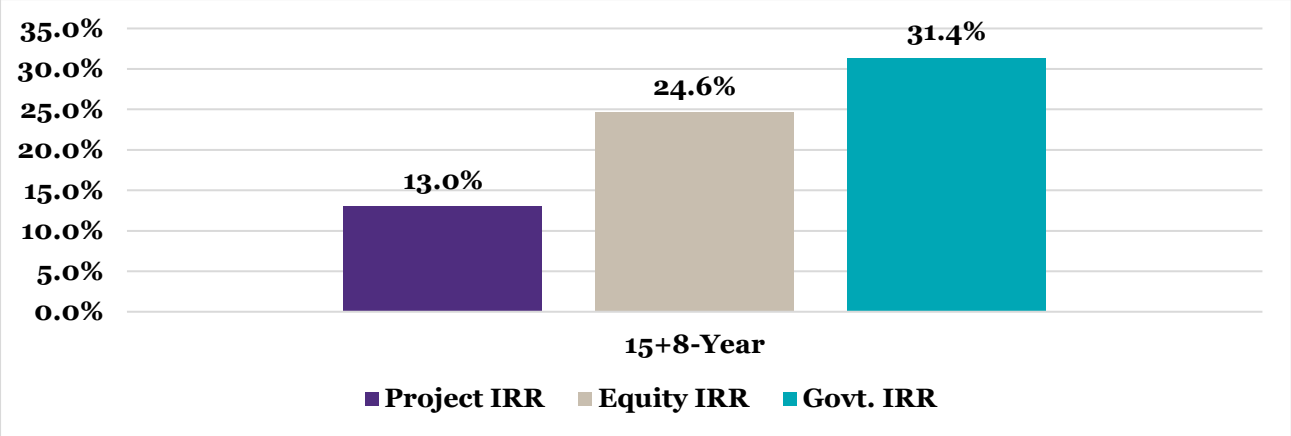


Figure 32. 38: Project, Equity and Govt. IRR/NPV Analysis – Transaction Structure 3

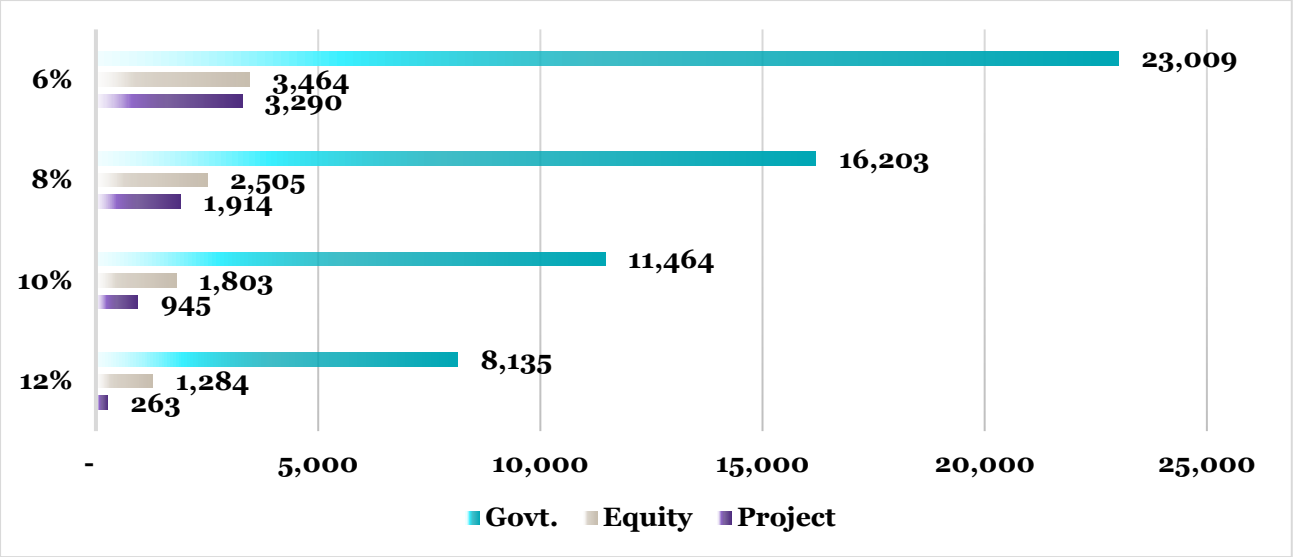


Figure 32. 39: Project, Equity and Govt. NPV Analysis – Transaction Structure 3

B. Value to Private Developer: Rail and Renewable Energy Bundle: DBFOT PPP

Table 32. 103: Project and Equity IRR/NPV Analysis

Project Level Analysis (NPV in Rs Crore)					Equity Analysis (NPV in Rs Crore)			
Project IRR	**%**				**Equity IRR**	**%**		
30-Years	16.2%				**30-Years**	18.0%		
40-Years	17.1%				**40-Years**	19.1%		
50-Years	17.3%				**50-Years**	19.4%		
Project NPV	**30-Years**	**40-Years**	**50-Years**		**Equity NPV**	**30-Years**	**40-Years**	**50-Years**
NPV@12%	7,852	12,119	14,654		**NPV@12%**	4,258	7,252	9,054
NPV@10%	14,889	22,914	28,631		**NPV@10%**	7,422	13,050	17,114
NPV@8%	25,686	40,997	54,118		**NPV@8%**	12,330	23,064	32,391
NPV@6%	42,394	72,046	1,02,718		**NPV@6%**	20,024	40,802	62,608

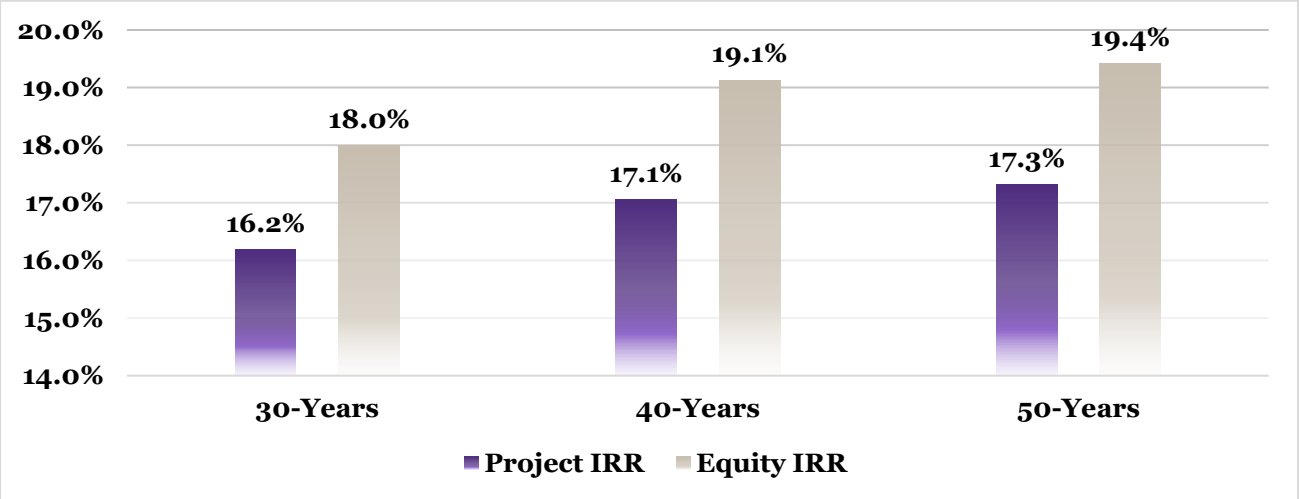


Figure 32. 40: Project and Equity IRR (%) – DBFOT Packages (Transaction Structure 3)

C. Overall Value to Govt.: Dyke Project (EPC), Revenue Share, and Taxes

Table 32. 104: Value addition to the Govt.

Value addition to Govt. (NPV in Rs Crore)			
Govt. IRR	**%**		
30-Years	17.2%		
40-Years	18.0%		
50-Years	18.2%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@12%	40,500	59,053	70,913
NPV@10%	71,771	106,708	133,557
NPV@8%	119,459	186,194	248,062
NPV@6%	193,068	322,456	467,673

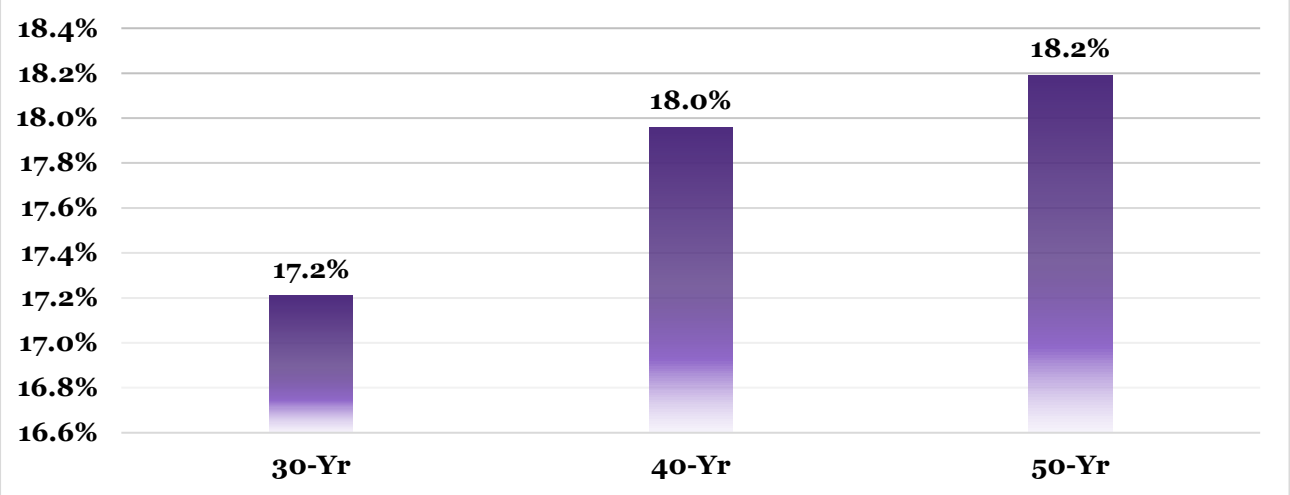


Figure 32. 41: Value addition to the Govt. (%) – Transaction Structure 3

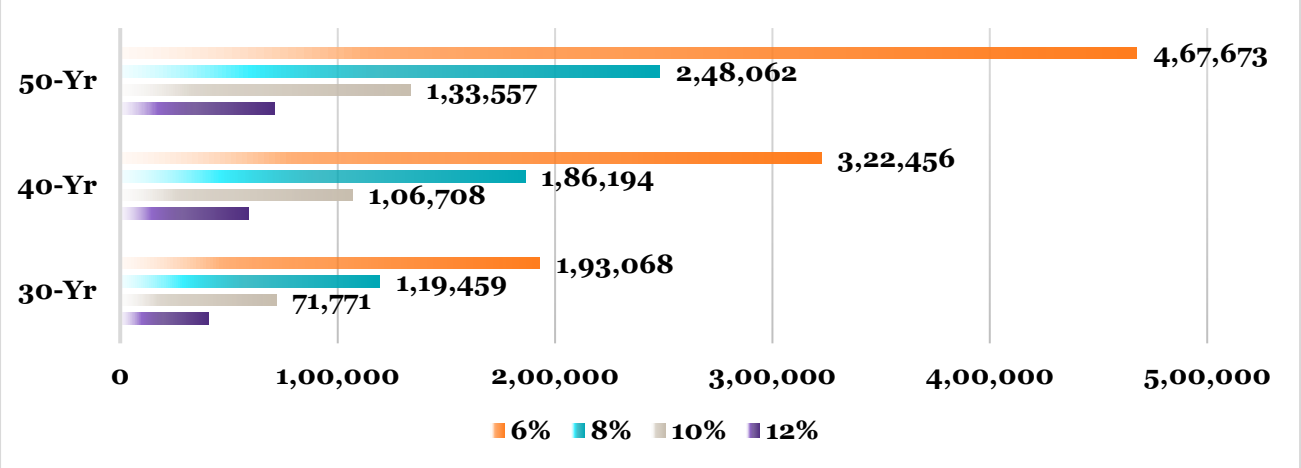


Figure 32. 42: Value addition to the Govt. (Rs. Cr) – Transaction Structure 3

Table 32. 105: Benefits and Challenges Involving Transaction Structure 3

Benefits	Challenges
Finance Related	
- With the EPC turn-key execution of the Dyke project under the aegis of the GoG (though Kalpasar department), the project financing and implementation risk is mitigated to an extent; this also facilitates the involvement of multilaterals and helps in availing long-duration soft-loans. - The Dyke project [Part (a)] has fewer visible direct revenue streams, and hence fares low on financial parameters (e.g., FIRR). The separation of Dyke project from the transportation and renewable energy project bundle will safeguard the balance sheets of road, rail, solar, and wind projects from contamination due to the inclusion of less financially feasible Dyke project. - The DBFOT-PPP implementation of the rail and renewable energy project bundle [Part (c)] mitigates the burden of financing from the exchequer; and may also result in efficiency gains on account of private party execution in PPP mode. - HAM mode of execution of road project mitigates the funding and revenue risk of private developer [Part (b)], especially in the preliminary stages of project implementation, and provide the benefit of upside to authority if any. - Securitisation of project receivables from the transportation and renewable energy project bundle may provide the requisite comfort to lenders. - Relatively more equitable distribution of financing risk between the stakeholders; compared to structure 1 & 2; the exclusion of Dyke (in EPC) and road (in HAM) creates additional comfort and a more financially feasible transaction structure for the private developer. - The revenue-sharing mechanism distributes the gains in upsides with the renewable and transportation project bundle with the concessioning authority and may provide additional funding support to Dyke project and may reduce the burden of the exchequer.	- For a single consortium, it may be difficult to tie-up/avail such large financing for Part (c), i.e., rail and renewable energy project bundle; nonetheless, this risk has come down substantially from transaction structure 1 &2 (TS 1&2) with the separation of the Dyke project and Road project. - Possible challenges in availing External Commercial Borrowings (ECBs) in the required quantum and tenor, especially for the Dyke project. - For the Dyke project, Part (a), possible challenges in availing low-cost and extended period debt from External Commercial Borrowings (ECBs) and Multilateral Funding Agencies in the required quantum and tenor. - Given the huge cost of Dyke project (approx. Rs 1,06,640 crore), it may put some burden on the exchequer.
Technical	
- For Part (b & c), the HAM and DBFOT PPP model is expected to add to the gains in efficiency of the execution on design, finance, build, and implementation-related aspects. - HAM and DBFOT PPP (transportation and renewable energy bundle) may result in improved operational standards with reduced O&M costs, including reduction of energy costs, as the existing public installations have exhibited moderate operational standards, high O&M costs,	- For the Dyke project, pure public ownership and implementation may remain a challenge as the previous experience of the same for large infrastructure projects has shown mixed results. - For Parts (b & c), most of the design risks are transferred from the concessioning authority to the developer, and in turn to the SPV entity for the project where institutes of national importance like the IITs have put forward the optimum design in consultation with other global players as and where necessary.

and high energy consumption, and have seen less year-on-year operational improvement. - For Parts (b & c), most of the construction and implementation risks (project-level procurement risk, regulatory risk, financing risk, construction risk, O&M risk) are transferred from the concessioning authority to the developer, and in turn, to the SPV entity, which is better placed to mitigate these risks with the help of project finance contractual structure. - For Parts (b & c), the private developer is better placed to adopt modern technology and efficiently execute similar projects that require considerable use of technology (transportation and renewable energy project bundle) - All the projects' [Part (a, b & c) timelines are linked to the successful implementation of the Dyke project. The complete ownership of Dyke project with one single public authority may reduce various uncertainties customary to such projects (political, legal, and regulatory challenges, financing risks, etc.), and may increase the visibility of its completion in the near term. This facilitates better scheduling and implementation of the other dependent projects, since different projects (e.g., reclamation of land, transportation, renewable energy) are interconnected and dependent on the successful completion of the Dyke project. - For all the Parts [(a), (b) & (c)], a considerable amount of design work has been done by authorities through various reputed institutes (IITs) and a consortium of consultants. Thus, the initial feasibility studies are already conducted, and the project is not a black box anymore. Lot of preliminary to advanced information is already made available by the early studies. This will help the private developer (for Part (b)) in the subsequent stages of project execution. - The structure TS3, is particularly suitable for risk diversification, as each project can be allocated to the party most capable and suitable in managing the project risks separately.	- For Part (b & c), expected increase in project period due to the complexity of design followed by a vetting process for the selected designs since the Concessionaire shall have to prepare the designs prior to implementation as per the Terms of the Contract. - TS3 has the relative advantage compared to TS2 and TS1, since multiple agencies are involved in the three project bundles according to their core competency; however, due to significant linkages and interdependence across these projects, coordination, monitoring, and implementation of all the projects across different agencies, to meet their specification requirements and performance would be a challenge. The contractual obligations may need to envisage performance standards in the long-term, much ahead even after the handover of the facility has taken place.
Procurement	
- For part (b & c), relative to TS1&2, the public authority may find it easier to obtain various PPP partners, due to the relatively small size and specific nature of projects (finding developers with a specific skill set in road, renewable energy, bundle, etc.) may be easier than finding one partner for all the projects, on both technical and financial capability parameters. - Such structure also provides additional diversification of risk in procurement (for example, HAM mode of execution is more suitable for Road projects, while DBFOT mode is suitable for renewable projects as there is less revenue risk and more assured inflows).	- Procurement is more complex compared to the transaction structure 1&2 (TS 1&2); since now there are three bundles of projects, and the government has to manage multiple stakeholders' interests; and coordinated execution and implementation of the same will be an arduous task. - For the Dyke project [Part (a)], government remains solely responsible for short-medium-long term aspects of the project and may require considerable resources in coordination, execution, and project implementation .

- Compared to TS2, managing the incentives of private parties (information asymmetry and principal agent) is relatively easier as performance agreements and formulation of relevant clauses pertaining to damages to ensure that the interest of the private developer is aligned with that of the authority can be done in a more objective and targeted manner according to the nature of the project (HAM, DBFOT, EPC). However, given that multiple agencies are involved contract management and monitoring of project execution would require careful due diligence.	

32.7.2.4 Transaction Structure 4 – Kalpasar SPV for the three project bundles (EPC+HAM+DBFOT-PPP)

In this scenario, similar to TS3, the project is considered as a combination of three sub-bundle projects (a) Dyke (and auxiliary water reservoir) to be given on EPC basis with complete government ownership (b) Road project as Hybrid Annuity Model (HAM) to a private developer, and (c) Rail and Renewable energy bundle to be offered on DBFOT-PPP basis. However, now the projects are proposed to be executed under an SPV entity separate from Government of Gujarat (GoG).

This SPV will be a separate standalone entity, which is liable for taxes, raising financing, implementing projects on various PPP models. Thus, this SPV will be conferred with the relevant set of rights and obligations from GoG (through Kalpasar department). The discussion here focusses on SPV operations, as separate project bundles (EPC, HAM, and DBFOT-PPP) are already discussed in detail in TS3 (in the previous section).

The SPV entity acts as nodal agency for the complete project execution. Thus, it would require the relevant set of rights to act as concessioning authority to execute the (a) Dyke projects through EPC based execution (award of contract, monetisation of land, development of tourism, fisheries etc.); (b) Road project under HAM (acquisition of land, collection of tolls, payment of annuity etc.) (c) Rail and renewable DBFOT-PPP (acquisition of land and various permits, necessary approval to laydown railway tracks, sale/purchase of power, etc.).

This proposed ownership structure of this SPV is as follows: GoG (50%), and other organisations such as NHAI, Indian Railways etc. owning the balance 50%, the proposed paid-up capital being Rs 200 crore.

This SPV will raise funding in the form of soft loans from multilateral funding agencies to part fund (1) Dyke project under EPC and (2) payment of obligations under the road HAM project (annuity, interest on capital, O&M recovery, etc.). This may require sovereign support from GoG and GoI, in the form of letter of comfort, and assignment of project receivables (toll, water charges, etc.).

In addition, the investment by the SPV is stipulated to be sourced in the form of interest free sub-ordinated loans (for long duration door-to-door tenors of 40 years) from GoG. SPV will pay dividends (after accounting for taxes) and repayment on interest free loans back to its shareholders (GoG).

Further, loans are proposed to be raised in the form of auxiliary special purpose tax free bonds (e.g., Area Improvement Bonds) and loans from multilateral funding institutions. The repayment of these loans will be done with the dividends received from the SPV and state GST inflows (engendered on account of Kalpasar project).

It is proposed that all the applicable rules of GoG (as authority awarding project contracts on PPP basis) will be applicable to the Kalpasar SPV entity, thereby making it a quasi-state body.

Moreover, the borrowings of Kalpasar SPV, will have financing support from GoG in the form of interest-free subordinated loans. Since the implementation of this project will result in significant benefits to GoG in the form of state GST, the same may be employed to fund the investment (interest-free subordinated loans to SPV with back-ended repayments).

Unlike conventional project finance-based SPV funding, this SPV does not hold assets per se, and therefore, borrowing from multi-laterals would require considerable support (tangible and intangible from state bodies). Thus, SPV should appear like a quasi-state body

in its rights and obligations. The illustrative diagram for the transaction structure is provided below.

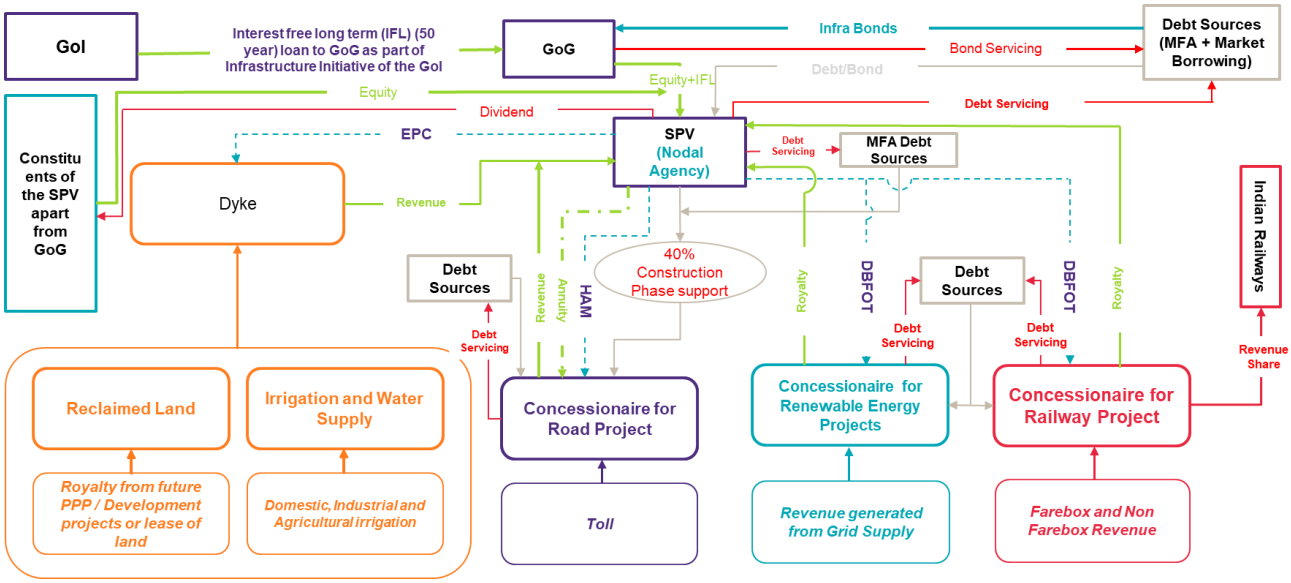


Figure 32. 43: Transaction Structure 4- Kalpasar SPV for the three project bundles (EPC+HAM+DBFOT-PPP)

The salient points of this Kalpasar SPV-based execution are as follows.

- Project to be executed by a SPV formed with equity contribution from beneficiary state government and other nodal organisations (NHAI, Indian Railways etc.).
- The combination of project bundle includes (a) Dyke and Water network under EPC; (b) road under HAM; (c) Railway and Renewable Energy in DBFOT-PPP.
- The EPC project (a) is proposed to be partly funded through funds borrowed from the market, Multilateral Funding Agencies (MFA), market borrowing and equity contribution (funded partially by GoI and partially by GoG through issue of interest bearing Infra Bonds).
- Revenues from land and water supply (domestic, industrial and agriculture), road toll, and revenue sharing from DBFOT-PPP accrues to SPV.
- Projects under DBFOT-PPP model are funded by private concessionaire through debt-equity mix.
- Revenue from DBFOT-PPP accrues to the Concessionaire and Royalty/Revenue share (~20%) is shared with the SPV; railways paid a revenue share out of earnings from Farebox Revenue.
- Projects under EPC and DBFOT can be either through project bundles or single packages executed by specific agencies (for EPC) or Concessionaire (for DBFOT).
- MFA debt, market borrowing, equity inflow from GoG with contribution from GoI and issue of Area Improvement Bonds (Infra Bonds).
- The SPV is responsible for Construction and O&M of the EPC project.

- The SPV will also pay out obligations (annuity, O&M, interest on capital) to HAM concessionaire.

- SPV will also pay dividends from profits (after providing for taxes) and repayment of interest-free loans.

Risk Allocation

In addition to the risk and their mitigants, as already discussed in the previous section for TS3, we highlight the specifics of the Kalpasar SPV operation. This is so because all the risk-diversification benefits and benefits related to procurement and technology pertaining to TS3 will also accrue to TS4. However, there are certain Kalpasar SPV related advantages and caveats specific to this structure that are highlighted here. The SPV entity here acts as a quasi-state entity. Thus, while it provides control and ownership that is desired in projects of national importance (such as road, railways, and water supply), it also gets much-desired freedom from state ownership in short-to-medium-term transactions.

The SPV mode of execution provides an additional advantage as it is responsible for raising funds on its own, thus putting less burden on the exchequer. This avoids cash flow fungibility, as cash from sources engendered on account of Kalpasar can be directly allocated to debt servicing or raising funds through securitisation for the Kalpasar project.

While the structure may appear inefficient from the tax perspective, as it is paying taxes on income and dividends and GST, those are earnings of GoI and GoG. And the same may be stipulated to provide additional support in part funding the Kalpasar project execution (e.g., interest free long-term loans from GoI). Moreover, this structure provides more flexibility operational freedom in running the sources and uses of funds tied up to the Kalpasar project.

However, the following caveats may be associated with the SPV entity. It may need to be conferred rights and permissions that GoG would employ while awarding the project through the Kalpasar department, thus ensuring its de facto status as a quasi-state entity.

Moreover, unlike traditional SPVs that own large infrastructure assets, the Kalpasar SPV may not have such a structure and may award projects (EPC, DBFOT, and HAM) that may ultimately become the property of state. This aspect needs to be taken care of, that state and central governments may need to provide tangible and intangible support, in order for this SPV to raise soft loans from multilateral or interest-free subordinate loans from the state government.

Financial Analysis Summary

In the financial analysis section, we discuss the key measures of project performance evaluation. Comprehensive results pertaining to cash flow analysis, balance sheet, and profit and loss are provided in **Annexures A-F** in a project-wise manner as well as on a consolidated basis.

A. Value to Private Developer and Govt: Road (HAM) (same as TS3)

Table 32. 106: Project, Equity and Govt. IRR/NPV Analysis – Transaction Structure 4

	Project	Equity	Govt.
IRR (8+15 Years)	13.0%	24.6%	31.4%
NPV	**(Rs crore)**	**(Rs crore)**	**(Rs crore)**
NPV@12%	263	1,284	8,135
NPV@10%	945	1,803	11,464
NPV@8%	1,914	2,505	16,203
NPV@6%	3,290	3,464	23,009

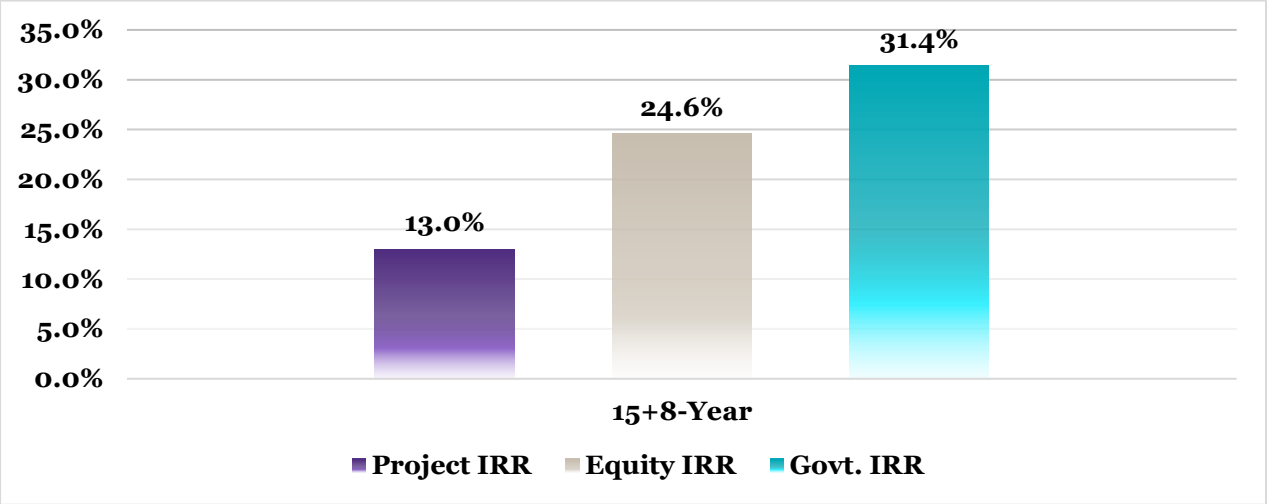


Figure 32. 44: Project, Equity and Govt. IRR Analysis – Transaction Structure 4

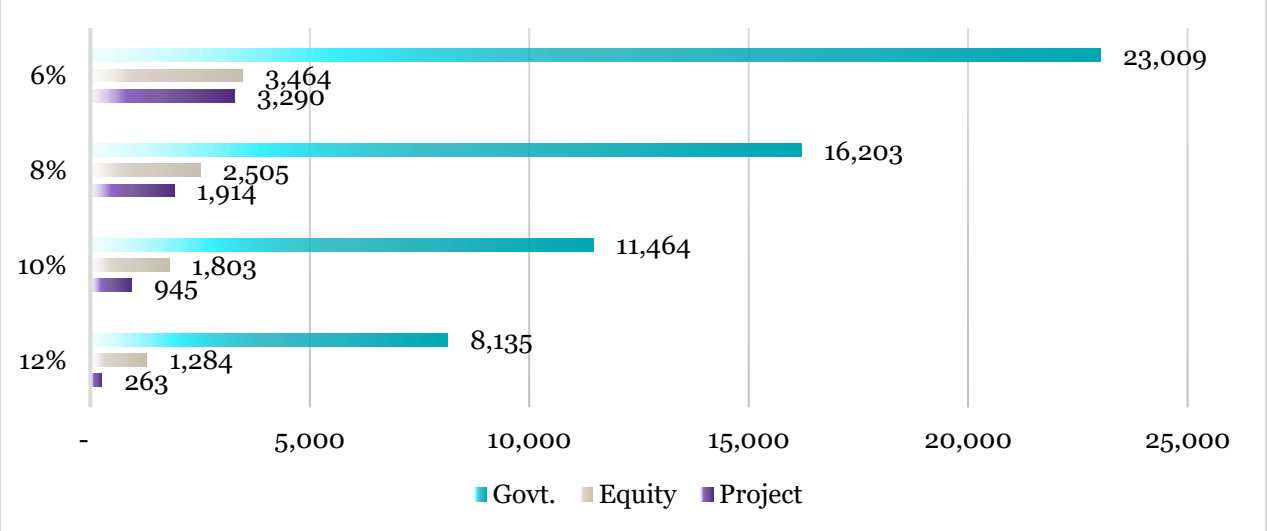


Figure 32. 45: Project, Equity and Govt. NPV Analysis – Transaction Structure 4

B. Value to Private Developer: Rail and Renewable Energy Bundle: DBFOT PPP

Table 32. 107: Project and Equity IRR/NPV Analysis

Project Level Analysis (NPV in Rs. Crore)					Equity Analysis (NPV in Rs. Crore)			
Project IRR	**%**				**Equity IRR**	**%**		
30-Years	16.2%				**30-Years**	15.62%		
40-Years	17.1%				**40-Years**	17.16%		
50-Years	17.3%				**50-Years**	17.58%		
Project NPV	**30-Years**	**40-Years**	**50-Years**		**Equity NPV**	**30-Years**	**40-Years**	**50-Years**
NPV@12%	7,852	12,119	14,654		**NPV@12%**	2,431	5,107	6,725
NPV@10%	14,889	22,914	28,631		**NPV@10%**	4,916	9,945	13,596
NPV@8%	25,686	40,997	54,118		**NPV@8%**	8,830	18,419	26,798
NPV@6%	42,394	72,046	1,02,718		**NPV@6%**	15,033	33,592	53,182

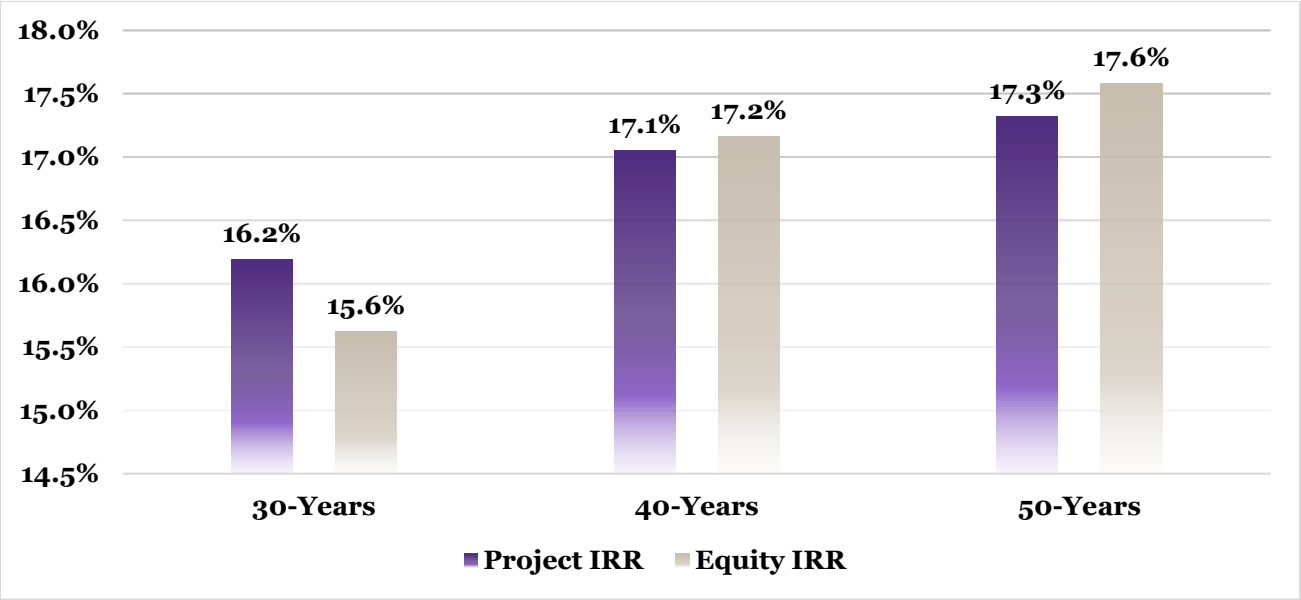


Figure 32. 46: Project and Equity IRR (DBFOT Bundle) – Transaction Structure 4

C. Overall Value to SPV: Dyke Project (EPC), HAM and DBFOT Revenue Share

Table 32. 108: Project and Equity IRR/NPV Analysis

Project Level Analysis (NPV in Rs Crore)					Equity Analysis (NPV in Rs Crore)			
Project IRR	**%**				**Equity IRR**	**%**		
30-Years	14.0%				**30-Years**	22.0%		
40-Years	14.9%				**40-Years**	22.5%		
50-Years	15.3%				**50-Years**	22.6%		
Project NPV	**30-Years**	**40-Years**	**50-Years**		**Equity NPV**	**30-Years**	**40-Years**	**50-Years**
NPV@12%	14,766	27,847	36,063		**NPV@12%**	35,992	48,858	57,074
NPV@10%	37,742	62,366	80,971		**NPV@10%**	56,016	80,238	98,842
NPV@8%	73,145	120,161	163,044		**NPV@8%**	86,314	132,568	175,451
NPV@6%	128,130	219,244	319,932		**NPV@6%**	132,858	222,508	323,196

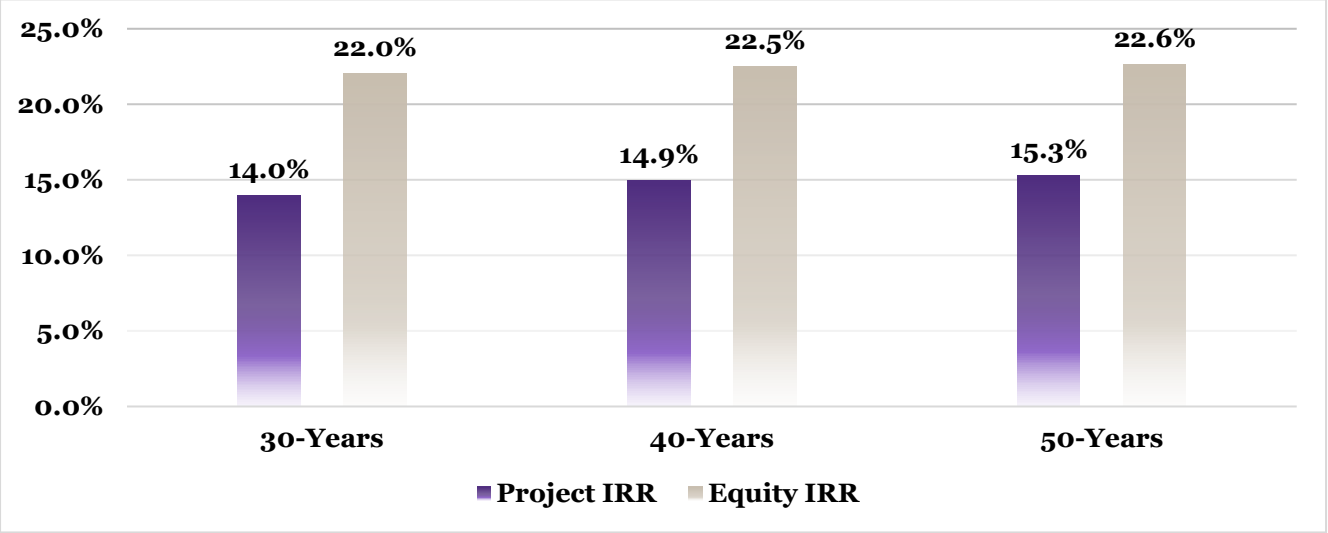


Figure 32. 47: Project and Equity IRR for SPV (%)

D. Overall Value to SPV (Project/Equity), Government and Total

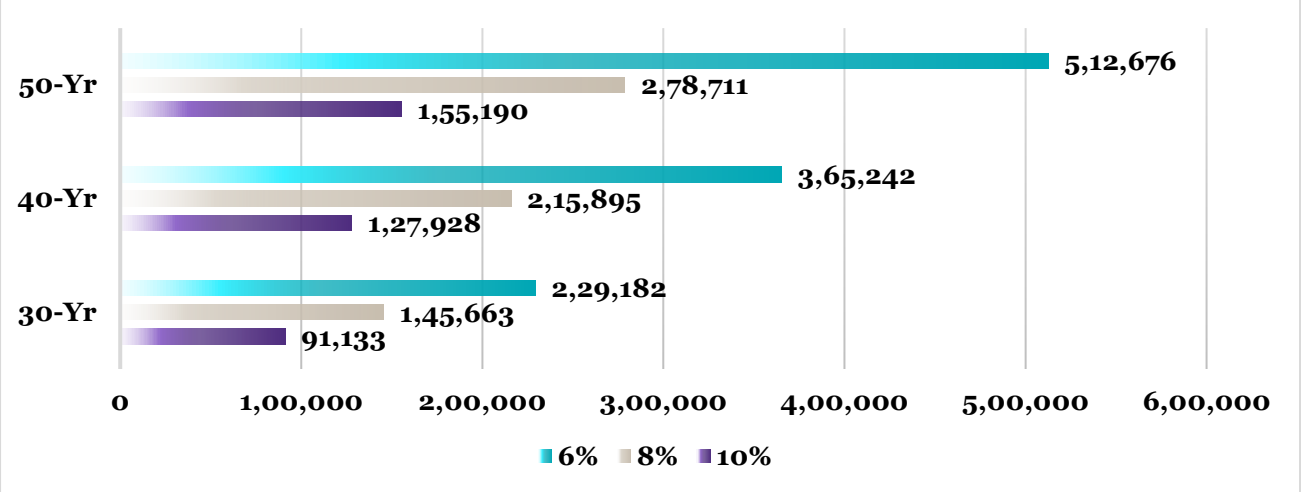


Figure 32. 48: PV to SPV (Project/Equity)/Govt./Total (Rs Crore)

Table 32. 109: Benefits and Challenges Involving the Transaction Structure

Benefits	Challenges
Finance Related	
- Customary financing benefits associated with TS3 will also accrue to TS4. - SPV mode will provide more flexibility and freedom to implement projects. - SPV entity will tie-up funding on its own and may not be dependent on state authorities for short-medium term operations and decision-making. - Since, the sources and uses of funds are directly identified with the Kalpasar project, the utilisation of funds is expected to be less wasteful and more efficient. - Also, the sources of funds generated on account of the Kalpasar project (reclamation of land, water supply, etc.) can be identified more precisely and availed for development of the project itself. - Since, the SPV is a quasi-state entity, it may be able to avail interest-free subordinate debt from GoG and soft loans from MFIs more comfortably. - Thus, Kalpasar mode of operation provides the flexibility and efficiency of PPP/private execution while creditworthiness and control of government/public work. - Moreover, it is not afflicted by the wasteful expenditure/time-cost overruns associated with the public works, and at the same time problems related to information asymmetry and principal-agent problem associated with PPP/private execution are circumvented.	- Customary financing challenges associated with TS3 will also accrue to TS4. - However, the following caveat may be considered for the Kalpasar SPV mode of operations. The SPV may need to be conferred with the rights and permissions that are customary for the award of projects (EPC and DBFOT) from GoG through the Kalpasar department - Also, since the SPV does not carry any asset of its own, it may need tangible and intangible support from GoG to raise funds (letter of comfort, assignment of receivables, interest-free subordinated debt, etc.). -
Technical	
- Customary technical benefits associated with TS3 will also accrue to TS4	- Customary technical challenges associated with TS3 will also accrue to TS4.
Procurement	
- Customary procurement benefits associated with TS3 will also accrue to TS4. - The SPV may avail best of both the worlds in procurement. That is, it enjoys the freedom and flexibility of PPP/private procurement and control and creditworthiness of a government entity.	- Customary procurement challenges associated with TS3 will also accrue to TS4. - The SPV may need to be conferred with the rights and permissions that are customary for the award of projects (EPC and DBFOT) from GoG through the Kalpasar department

32.7.2 Comparison of different structures and recommendation

In this section, a comparative analysis of different transaction structures has been discussed, using the empirical analysis carried out in the previous sections. Not only have quantitative parameters such as IRR, NPV, and Value-for-Money (VFM) been looked at, but qualitative discussion has also been provided. Lastly, the discussion has been closed by providing a recommendation based on this analysis. For the quantitative as well as qualitative analysis, the first transaction structure remains the benchmark to judge all the projects. The discussion has started by discussing the overall value of the project to the government.

A) Quantitative Analysis: Overall value and Value-for-Money

The discounted net present value of these projects is computed at different opportunity costs (6%, 8%, 10%, 12%). Though 10% and 12% are more acceptable industry benchmarks, the values are also shown for 6% and 8%.

For TS4, the present value includes the value to Kalpasar SPV and to GoG as well. For the computation of VFM TS1 has been taken as the benchmark structure and compute the incremental value added by different PPP structures.

Overall, the analysis suggests that TS3 and TS4 fare much better than TS1 and TS2. Though it may seem that quantitatively, TS1 is better than TS2, however, given the execution risks involved in TS1, it would be the least desirable structure. This is so because it has a huge concentration of project risk. Finding one consortium that can execute the complete project bundle is a difficult task, with risks related to funding, execution, among others. Thus, it is desirable to have projects in separate bundles, such as those in TS3 and TS4 that leads to diversification of risk. Each project is executed separately by a private developer in an appropriate mode (HAM and DBFOT) that suits the nature of the project, which further mitigates the risks associated with the project.

Table 32. 110: Comparison of Overall value to the Govt.

Discount rate	TS1	TS2	TS3	TS4
12%	36,892	59,889	70,913	73,574
10%	61,925	115,507	133,557	137,655
8%	107,230	217,099	248,062	253,931
6%	193,471	411,818	467,673	475,305

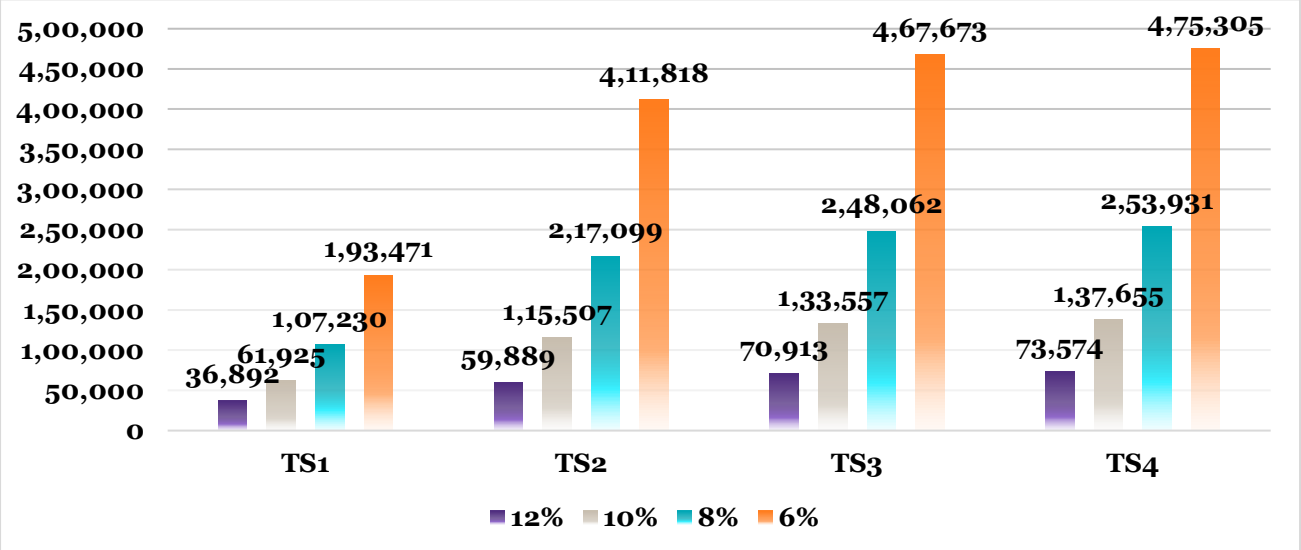


Figure 32. 49: Comparison of Overall value to the Govt.

Table 32. 111: Comparison of Value-for-Money (VFM: Rs Crore)

Discount rate	TS2	TS3	TS4
12%	22,997	34,021	36,682
10%	53,581	71,631	75,730
8%	109,869	140,832	146,701
6%	218,348	274,202	281,834

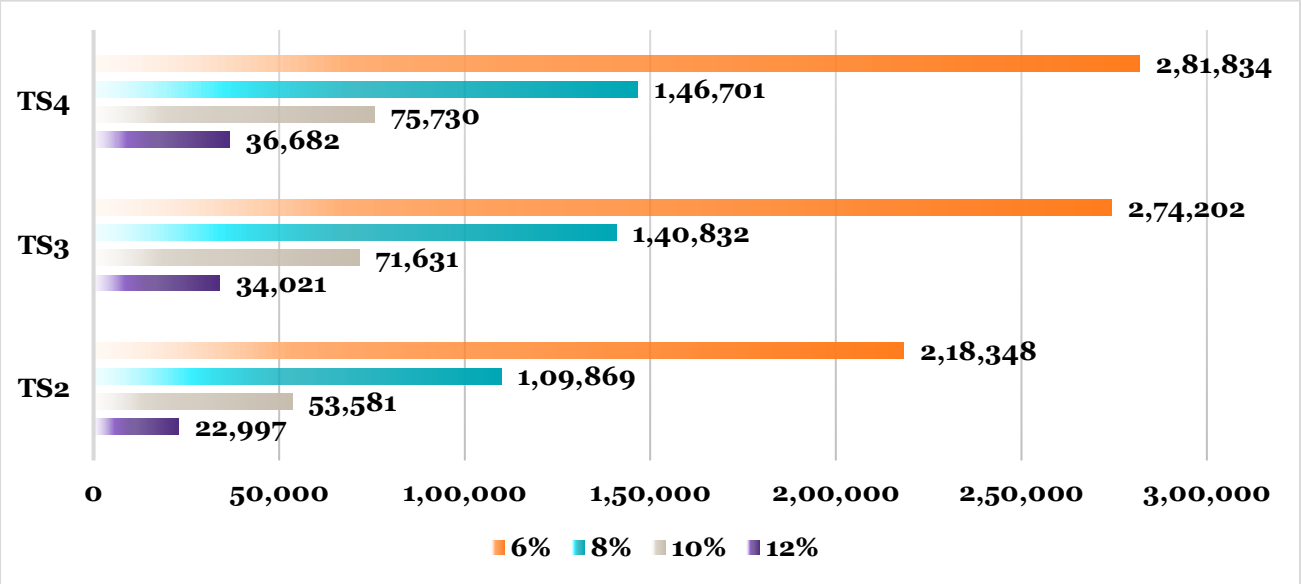


Figure 32. 50: Comparison of Value-for-Money (VFM: Rs Crore)

B) Qualitative Analysis: Risk Comparison between different structures

Apart from the quantitative analysis and comparison of these projects, a brief qualitative argument is discussed in the present section. Seven parameters are used to evaluate these four transaction structures: ease of procurement, design challenge, ease of taking approvals, financial closure, execution risk, time-cost overrun possibility, and overall risk.

Due to large size and scale of projects, TS1 and TS2 fare poorly on the easy of procurement dimension. In contrast, TS3 and TS4 employ the most suitable method of procurement for the respective projects; that is, (a) using EPC for Dyke project, which has limited cash flow visibility, (b) HAM for road, which is arguably most suitable procurement for the road projects, and (c) DBFOT for rail and renewable bundle which are inherently profitable. Thus, avoiding contamination of standalone profitable projects from the risker ones (i.e., Dyke).

While TS3 and TS4 are similar in various aspects, the hybrid nature of TS4 (Kalpasar SPV) makes it more suitable. This is so because, the SPV is more independent in terms of financing and decision-making related to various aspects of procurement vis-à-vis a completely state-owned public entity which is not as dependent on finances and decision-making.

Next, it may be noted that given the significant concentration of size and scale, the design of the project for a single consortium may be a challenge from technical competence perspective as well as execution perspective. Therefore, as the project bundles are diversified from TS1 -> TS2-> TS3, this risk is mitigated, and project design can be assigned in a more targeted manner to a private PPP partner that has the demonstrated track record in given set of industry business. On this dimension, TS3 and TS4 appear to fare in a qualitatively similar manner.

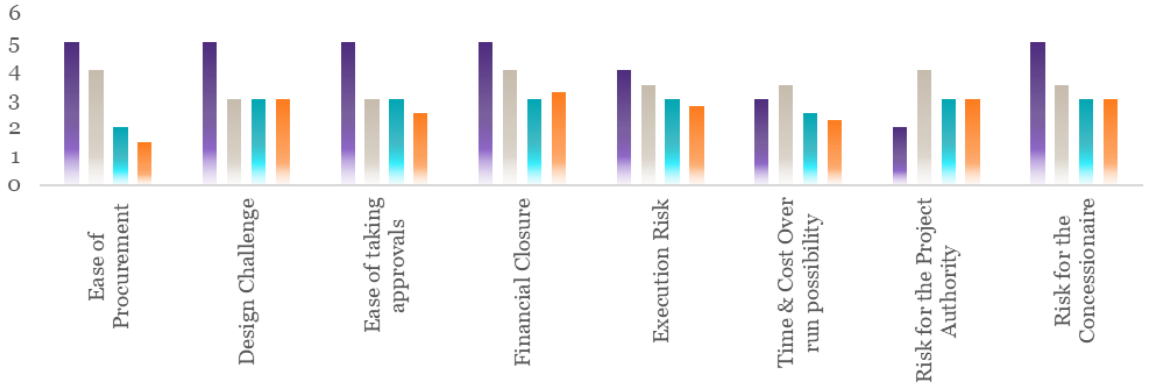


Figure 32. 51: Risk Comparison between different structures

In terms of ease of taking approvals, TS1 may find it difficult due to limited involvement of authorities and also given the large size of the project bundle. For TS3, the project bundle is broken into sub-projects, and each entity is responsible for the respective project bundle. Moreover, in the Kalpasar SPV mode of execution, we achieve the best of both worlds; that is, a quasi-state entity that has the credibility of a public unit and, at the same time, the agility to turnaround things in a swift manner.

Thus, TS4 and to an extent, TS3 appear to provide the structure that is more efficient in taking approvals. Next, on the financial closure dimension, TS1 and TS2 are bulky and may find it difficult to avail such a large quantum of financing at reasonable costs. Moreover, TS4 appears to have an advantageous position in this regard. First, being a quasi-state entity, it may find it easier to raise debt from MFIs and interest-free loans from GoG. Moreover, it is independent from GoG and can identify the new sources of funds engendered on account of

the Kalpasar project. These new sources can be assigned/securitised to mitigate the funding requirements of the project.

Table 32. 112: Risk Comparison between different structures

	Ease of Procurement	**Design Challenge**	**Ease of taking approvals**	**Financial Closure**	**Execution Risk**	**Time & Cost Overrun possibility**	**Overall distribution of Risk**
Transaction Structure 1	High degree of difficulty	High	High degree of difficulty	High degree of difficulty	Moderately high difficulty	Moderate	High risk for Concessionaire; Moderately Low risk for Government
Transaction Structure 2	Moderately high degree of difficulty	Moderately low	Moderately low	Moderately high degree of difficulty	Moderately difficult	Moderately high	Relatively equitable distribution of risks
Transaction Structure 3	Moderately low difficulty	Moderately low	Moderately low	Moderately difficulty	Moderately difficult, lower risk than other structures	Moderately high; lower than other structures	Equitable distribution of risk between different stakeholders
Transaction Structure 4	Relatively improved than TS3	Similar to TS3	Similar to TS3	Relatively improved than TS3	Relatively improved than TS3	Relatively improved than TS3	Relatively improved than TS3

Moreover, in terms of project execution risk, time-cost overrun, and overall distribution of risk, TS4 and to an extent TS3 appear more efficient. This is primarily ascribed to (a) the diversified nature of project bundles which employs different procurement methods according to the risk and visibility of cash flows in the project, (b) the unique hybrid positioning of Kalpasar SPV as a quasi-state entity, that may have the credibility and incentives to execute a large social-infrastructure project such as Kalpasar, and at the same time the agility and efficiency gain of the nature assigned to PPP/Private nature of execution.

32.7.3 Recommendation

Examining all the transaction structures on qualitative and quantitative parameters TS3 and TS4 turn out to be the efficient ways of executing the project. However, TS4 appears to be marginally more efficient as it is a hybrid structure that has several benefits compared to TS3.

The standalone, independent SPV mode provides more flexibility and freedom to implement large projects of this nature, which may be prone to time and cost overrun if implemented purely under public ownership. The proposed Kalpasar SPV is stipulated to independently tie up the financing and identify and allocate sources and uses of funds to avoid cash flow fungibility, which often afflicts the fund management in public work procurements.

Given the quasi-state-owned nature of Kalpasar SPV, it can avail low-cost financing from MFIs as well as interest-free subordinate debts from GoG. Moreover, the execution of a large Dyke project on a separate balance sheet of SPV will not vitiate the GoG fiscal position. For example, funds given to SPV will be in the form of interest-free debt. The repayment of these borrowings will provide the cushion for GoG debt servicing.

Moreover, the funds given to the SPV and revenue sources generated from the Kalpasar can be more efficiently identified and employed for the development of the project. Thus, on an overall basis, TS4 appears to be the best mode of project execution.

In recommending TS4, the following other recommendations are also being proposed:

1. Project to be executed through a SPV in which the State Government shall hold 50% equity stake; balance equity stake to be held by organisations such as NHAI, Indian Railways etc.

2. The SPV to act as a quasi-state (Government) organisation with the executive powers as bestowed upon the respective departments e.g., land, revenue etc.

3. SPV to independently tie-up the financing and identify and allocate sources and uses of funds to avoid cash flow fungibility. Government of Gujarat to provide State Guarantee as comfort for market borrowings of the SPV.

4. Unlike in other places, the land available in the project is reclaimed land for which a substantial amount of infrastructure expenses needs to be incurred by the Project Authorities. Owing to this, the Project Authorities (through the Project Development Agencies as decided appropriately) should look to monsetise the land in a manner which is both economically feasible as well as financially profitable to the overall sustainability of the project.

5. SGST accruing from the project should be earmarked in the State Budget as budgetary support exclusive for the purpose of the project.

6. Government of Gujarat to issue Area Improvement Bonds with coupon rates of 6% as Senior Debt (as compared to Interest-Free long-term loans from the Government of India), to be serviced through dividends received from the SPV and through the budgetary support as mentioned at Sl. No. 3 above.

7. At least 10% of the loan from the Government of Gujarat to the SPV to be sourced from Government of India (GoI) through the Interest Free Long-Term Loan for a 50-year period. A higher quantum of loans is recommended from GoI to reduce

dependency on dividend to be received from the SPV which effectively would be utilised for bond repayment. That would allow the SPV to either retain a part of the profit for future exigencies, or, alternately, allow the SPV to pass on social sector benefits in the form of lower charges on bulk water supply for irrigation purposes.

8. SPV to enter into negotiations with Indian Railways regarding the modalities of passenger and freight train operations. Depending on the modalities finalised, Revenue Sharing mechanism with the Railways to be finalised. At this stage, it has been found that Revenue Share of up to 5% of the farebox revenue does not affect the profitability of the Railways project. Further detailed discussions with the Railway Authorities shall reveal the financial feasibility at their end at this revenue share.

9. Minimum Royalty from the DBFOT projects, Railways and Renewable Energy, to be fixed at 25%

10. The road and railways project are of considerable length, more than 60 Kms. To effectively execute the project, Concessionaires for the respective projects may be allowed to sub-contract these are EPC packages of smaller lengths. Similar arrangement may also be allowed under the Concession Agreement for the Renewable Energy package.

11. Procurement and Contract Management for a project of this extent needs to be suitably executed and monitored. It is recommended that a separate PMU dedicated towards Procurement and Contract Management may be set up.

12. For effective project execution, it is proposed that separate PMUs be set up for the different packages and a Master PMU to oversee the separate packages. This would also ensure that the SPV has minimum manpower requirement, with the stated manpower solely dedicated towards decision making responsibilities.

13. There is massive potential to harness the agricultural output through sustained irrigation and multi-cropping. The Government of Gujarat or the SPV should make concentrated efforts through reputed Agriculture Institutes of Excellence to identify cropping and multi-cropping issues.

Appendix: Comparison of Results between Without Irrigation and With Irrigation Scenarios

A1. Comparison of Aggregate Analysis between With Irrigation and Without Irrigation Scenarios

Table 32. 113: Comparison of Project Returns, Equity Returns and NPV

	Without irrigation		With irrigation	
Year	**Project IRR**	**Equity IRR**	**Project IRR**	**Equity IRR**
30-Years	13.38%	38.22%	9.1%	27.0%
40-Years	14.51%	38.30%	10.8%	27.4%
50-Years	14.94%	38.30%	11.6%	27.4%

Table 32. 114: Comparison of the Benefit-to-Cost analysis

	Without Irrigation				With Irrigation			
Year	**Benefit-Cost Ratio (Nominal)**	**Benefit-Cost (in Rs. '000 Crore) (Nominal)**	**Benefit-Cost Ratio (In PV Terms)**	**Benefit-Cost (in Rs. '000 Crore) (In PV Terms)**	**Benefit-Cost Ratio (Nominal)**	**Benefit-Cost (in Rs. '000 Crore) (Nominal)**	**Benefit-Cost Ratio (In PV Terms)**	**Benefit-Cost (in Rs. '000 Crore) (In PV Terms)**
Dyke Project	2.34	1821	1.40	65	1.9	1480	1.0	1
Consolidated	3.65	3899	1.85	174	2.8	3432	1.4	98
Economic	5.76	6291	3.55	424	4.4	5892	2.6	362

The discounted figures are arrived at by discounting the respective Cash Flows with the Weighted Average Cost of Capital for the respective projects. Aggregate figures, both nominal and in PV terms, are summations of all the projects. Since the other projects are not affected, they have not been shown in the table above. Figures for other projects may be referred to in Table 32. 66

A2. Comparison of the Results of Analysis in the various Transaction Structures

The following results provide a comparison between those with irrigation and those without irrigation. For brevity, only those results are shown that are affected due to the exclusion of irrigation expenditure. First, we show the cost-benefit analysis pertaining to the aggregate financial and economic dimensions of the project. Next, TS1 considers the project as a bundle of four sub-projects (a) Dyke, (b) Road, (c) Railways, (d) Wind and Solar (RE Project). With the changes in the irrigation scheme, except Dyke, the other four project bundles remain unaffected. So, for TS1, the project value to the government (i.e., VGF, revenue share, and taxes) is shown.

In TS2, we have the project as a sub-bundle of two projects, namely, (a) Dyke (and auxiliary water reservoir and irrigation network) and (b) Transport and Renewable energy bundle. Here also, the value addition to government (from Dyke project, revenue share, and taxes, with and without irrigation) with the IRR and NPV measures are shown.

In TS3, the project is considered as a sub-bundle of three projects, namely, (a) Dyke (and auxiliary water reservoir, and irrigation network) to be given on EPC basis with complete government ownership, (b) Road project as Hybrid Annuity Model (HAM) to a private developer, and (c) Rail and Renewable energy bundle to be offered on DBFOT-PPP basis. Here also, the value addition to government (from Dyke project, revenue share, and taxes, with and without irrigation) with the IRR and NPV measures are shown.

In TS4, the project is considered as a combination of three sub-bundle projects (a) Dyke (and auxiliary water reservoir, and irrigation network) to be given on EPC basis with complete government ownership, (b) Road project as Hybrid Annuity Model (HAM) to a private developer, and (c) Rail and Renewable energy bundle to be offered on DBFOT-PPP basis. However, now the projects are proposed to be executed under an SPV entity separate from the Government of Gujarat (GoG). Here, the overall value to the SPV is shown (Dyke Project (EPC), HAM, and DBFOT Revenue Share with and without irrigation), using project and equity IRR and NPV measures.

Comparison of the Results of Financial Analysis for Transaction Structure 1

Table 32. 115: Comparison of Value to Govt. (VGF=20% and RS=20%) TS1

Discount rate	VGF (V)	Revenue Share (RS)	Taxes (T)	Total Value=T+RS-V
Panel A: without Irrigation				
6%	23,075	147,348	69,197	193,471
8%	20,977	86,599	41,608	107,230
10%	19,127	54,032	27,019	61,925
12%	17,489	35,542	18,839	36,892
Panel B: with Irrigation				
6%	33,240	1,48,625	73,074	1,88,458
8%	30,271	87,668	45,153	1,02,549
10%	27,647	54,930	30,269	57,552
12%	25,322	36,298	21,826	32,803

Comparison of the Results of Financial Analysis for Transaction Structure 2

Table 32. 116: Comparison of Value to Govt.: Dyke Project (EPC), Revenue Share, and Taxes TS2

Value addition to Govt.			
Panel A: without Irrigation			
Govt. IRR	**%**		
30-Years	16.5%		
40-Years	17.3%		
50-Years	17.5%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@12%	33,173	49,353	59,889
NPV@10%	61,172	91,637	115,507
NPV@8%	103,865	162,056	217,099
NPV@6%	169,709	282,522	411,818
Panel B: with Irrigation			
Govt. IRR	**%**		
30-Years	10.9%		
40-Years	12.3%		
50-Years	12.9%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@12%	-10,774	3,502	13,040
NPV@10%	10,243	37,130	58,751
NPV@8%	43,600	94,964	1,44,857
NPV@6%	96,551	1,96,147	3,13,422

Comparison of the Results of Financial Analysis for Transaction Structure 3

Table 32. 117: Comparison of Overall Value to Govt.: Dyke Project (EPC), Revenue Share, and Taxes TS3

Value addition to Govt. (NPV in Rs Crore)			
Panel A: without Irrigation			
Govt. IRR	**%**		
30-Years	17.2%		
40-Years	18.0%		
50-Years	18.2%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@12%	40,500	59,053	70,913
NPV@10%	71,771	106,708	133,557
NPV@8%	119,459	186,194	248,062
NPV@6%	193,068	322,456	467,673
Panel B: with Irrigation			
Govt. IRR	**%**		
30-Years	11.5%		
40-Years	12.9%		
50-Years	13.4%		
Project NPV	**30-Years**	**40-Years**	**50-Years**
NPV@12%	(5,224)	10,894	21,495
NPV@10%	18,264	48,621	72,638
NPV@8%	55,384	1,13,384	1,68,767
NPV@6%	1,14,178	2,26,653	3,56,744

Comparison of the Results of Financial Analysis Transaction Structure 4

Table 32. 118: Comparison of Overall Value to SPV: Dyke Project (EPC), HAM, and DBFOT Revenue Share TS4

Project Level Analysis (NPV in Rs Crore)					**Equity Analysis (NPV in Rs Crore)**			
Panel A: without Irrigation								
Project IRR	**%**				**Equity IRR**	**%**		
30-Years	14.0%				**30-Years**	22.0%		
40-Years	14.9%				**40-Years**	22.5%		
50-Years	15.3%				**50-Years**	22.6%		
Project NPV	**30-Years**	**40-Years**	**50-Years**		**Equity NPV**	**30-Years**	**40-Years**	**50-Years**
NPV@12%	14,766	27,847	36,063		**NPV@12%**	35,992	48,858	57,074
NPV@10%	37,742	62,366	80,971		**NPV@10%**	56,016	80,238	98,842
NPV@8%	73,145	120,161	163,044		**NPV@8%**	86,314	132,568	175,451
NPV@6%	128,130	219,244	319,932		**NPV@6%**	132,858	222,508	323,196
Panel B: with Irrigation								
Project IRR	**%**				**Equity IRR**	**%**		
30-Years	9.3%				**30-Years**	14.0%		
40-Years	10.8%				**40-Years**	15.4%		
50-Years	11.5%				**50-Years**	15.9%		
Project NPV	**30-Years**	**40-Years**	**50-Years**		**Equity NPV**	**30-Years**	**40-Years**	**50-Years**
NPV@12%	(26,445)	(14,975)	(7,611)		**NPV@12%**	8,161	19,299	26,663
NPV@10%	(8,909)	12,682	29,370		**NPV@10%**	21,009	41,981	58,669
NPV@8%	19,375	60,605	99,097		**NPV@8%**	41,161	81,218	1,19,710
NPV@6%	64,700	1,44,608	2,35,050		**NPV@6%**	73,014	1,50,667	2,41,109

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