This is a new section of the Public-Private Partnership Resource Center website and is currently in draft form. Your feedback is welcome: If you would like to comment on the content of this section of the website or if you have suggestions for links or materials that could be included please contact us at ppp@worldbank.org.

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MRT Energy Efficiencies Model for ERP

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On this page: *MRT Energy Efficiency Deployment leveraging an Existing-Refurbish- User-Tariffs model - Model 1 in the ERP Project Guidelines. Read more below, or visit Strategic Guidance for Country System Assessments, Guidance for Countries in Assessing ERC Projects, or Mobilizing ERC Finance.*

Project Type: Energy efficiency (Transportation)

Sector: Energy - Transport

Applicable Project Methodology: ACM0016 Mass Rapid Transit Projects

The project's main objective is to replace the traditional electro-dynamic rheostatic braking technology used in mass rail transit systems with regenerative braking technology. This new system can generate electrical energy by harnessing the kinetic energy of decelerating rolling stock. This helps to reduce reliance on grid electricity therefore reduce greenhouse gas emissions from mass rail transit systems.

Proposed Structure of this Public Private Partnership (PPP) Model

The project will be leveraging an **Existing-Refurbish- User-Tariffs** model. This will involve the state-owned entity with the existing mandate to operate the mass transit system to improve the energy efficiency of its current assets through refurbishment. The private company engaged to install the technology will be provided financing by the state-owned entity to undertake the refurbishment activities.

Table 1: Model Attributes

Dimension	Attribute	Description
Business	*New* *Existing*	This model involves making energy efficiency improvements to existing mass transport infrastructure
Construction	*Build* *Refurbish*	The model involves the project company installing the regenerative braking technology to existing trains
Private Funding	*Finance*	The state-owned entity is expected to finance the installation of the regenerative braking technology
Service	*Bulk* *User*	The state-owned entity currently delivers services to commuters using the mass transport services
Revenues	*Fees* *Tariffs*	Revenues in this model will continue to be the tariffs collected from commuting users for transport services

Proposed risk allocation of the Public Private Partnership Model

Risk allocation	Public	Private
Design		●
Build	●	●
Financing		●
Operations and maintenance	●	
Demand/Revenue Upside	●	

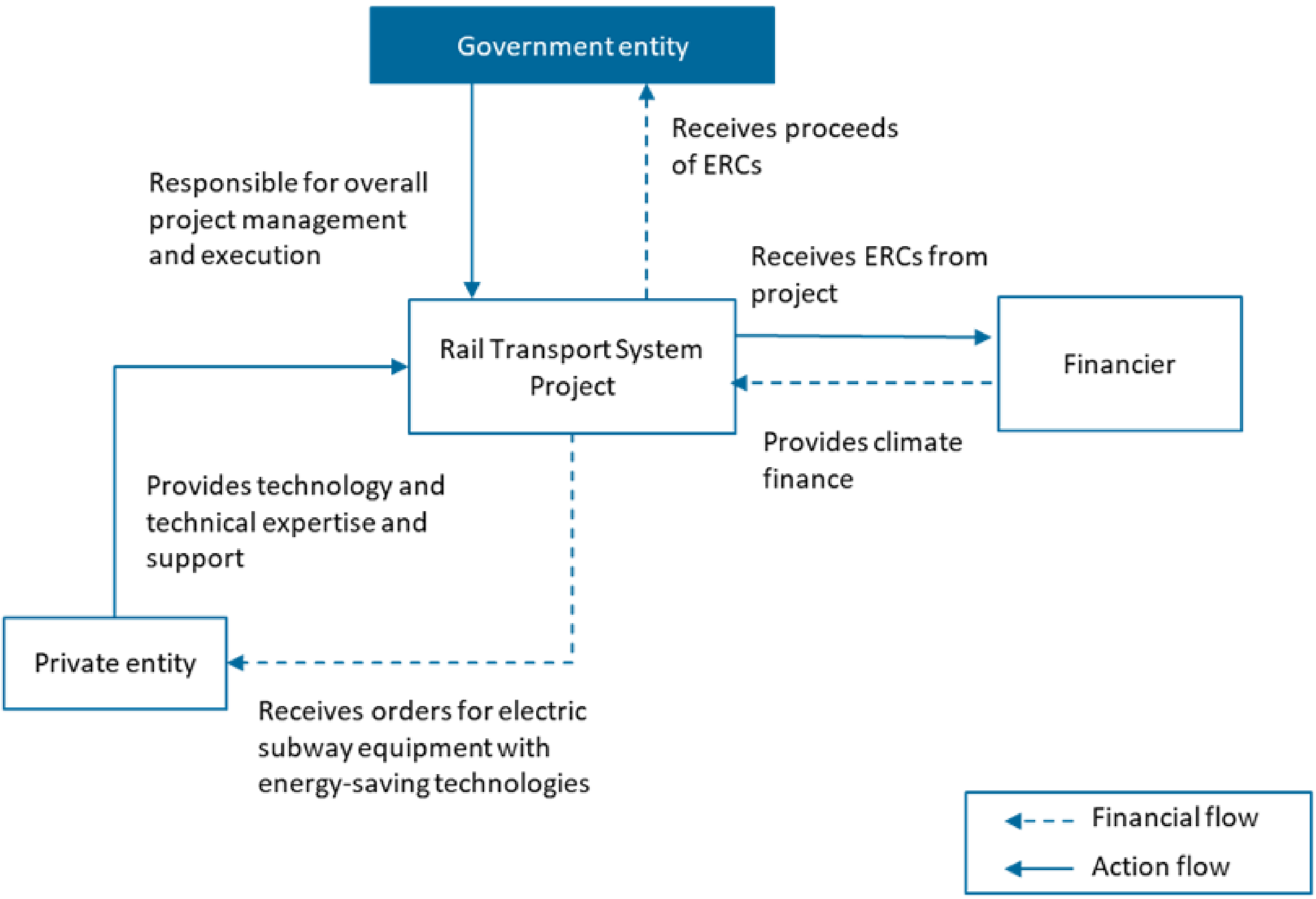
Key features of PPP structure

- Private sector entity supports with the design and build of retrofitting public transport system with lower emissions technology via a contractual agreement with the ministry/ government entity
- The government or state-owned entity acts as the implementation partner, and is responsible for all activities related to the implementation, management, monitoring and reporting of the project over the project's lifetime
- The government or state-owned entity earns fees from public transport use by end users as well as any additional revenue upside from the emission reduction credit (ERC) generation
- Potential to include financiers in this PPP structure in exchange for a portion of the ERC revenues earned in this project

Key considerations/risks for proposed project

- Extensive stakeholder engagement required to ensure buy-in from operators of public transport as well as any other relevant stakeholders
- Close coordination needed between the government or state-owned entity operating the mass transit line and the private sector entity installing the new technology to ensure benefit sharing is aligned and that the project is financially viable for both
- Partnering with a service provider for the project's marketing, sales and pricing is needed to identify potential offset buyers, negotiate contracts, and secure good target price per tonne to enable the financial viability of ERC generation
- Contracting a monitoring, verification and reporting (MRV) service provider with experience in conducting MRV and preparing the necessary documents for generating ERCs in a voluntary carbon market standard will reduce risk of registration and issuance delays or bottlenecks, and strengthen credibility of project's carbon integrity quality

Figure 1: Financing and Activity Flows for the Model



Case Study: Installation of Low Greenhouse Gases (GHG) Emitting Rolling Stock Cars in Metro System, India

Project description

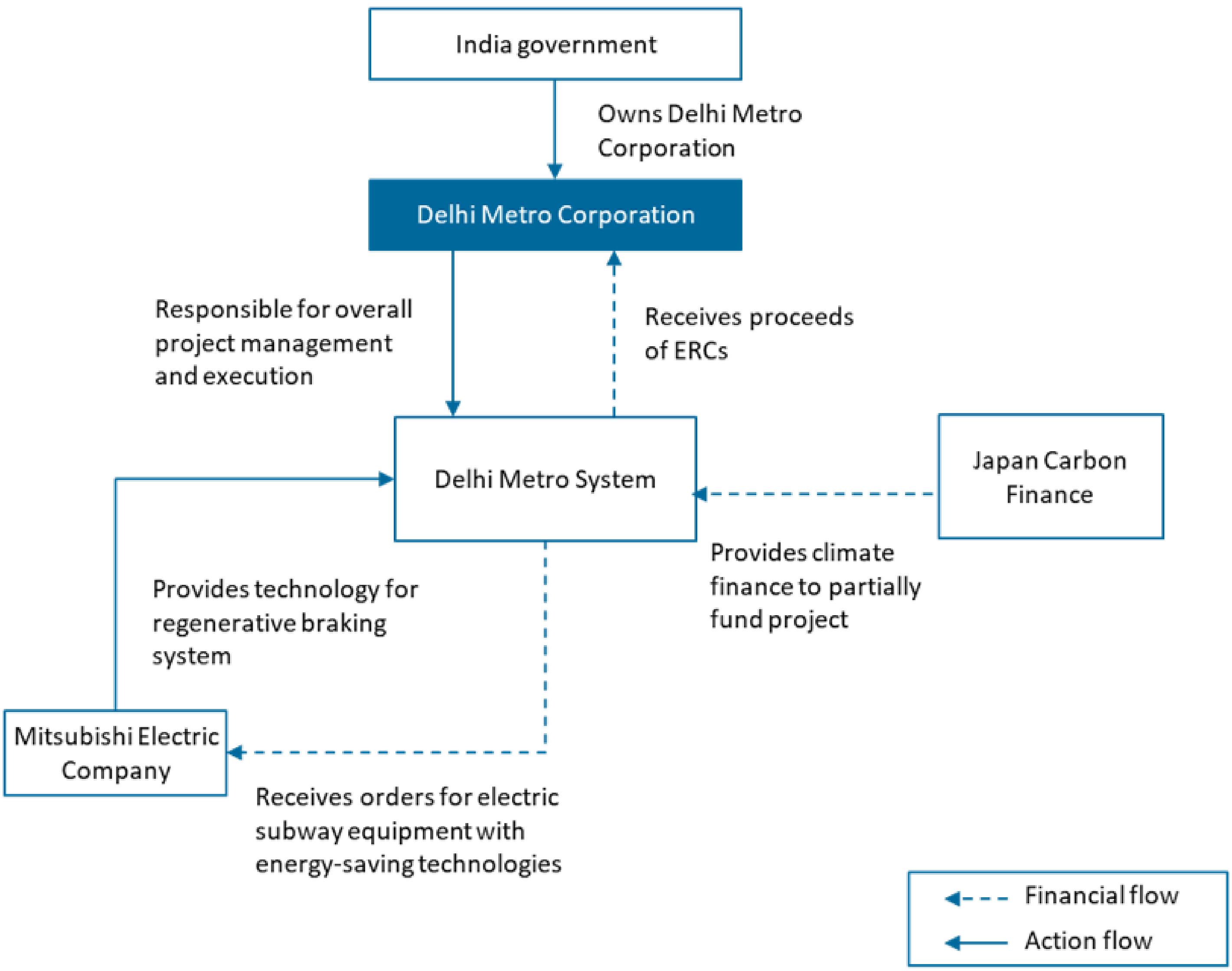
The Delhi Metro Rail project uses low GHG emitting rolling stocks with regenerative braking technology to conserve electrical energy and reduce GHG emissions. Conventional electro- dynamic rheostatic braking technology is replaced with regenerative braking technology in the rolling stocks. This system uses 3 phase AC traction motors and consists of two units each with a Driving Trailer car and a Motor Car. The regenerative braking system generates electrical energy by converting the kinetic energy of decelerating rolling stock, reducing the consumption of grid electrical energy and subsequent GHG emissions.

The project involves installing these low GHG emitting rolling stocks in 3 service lines which are Shahdara-Rithala; Vishva Vidyalaya-Central Sectt.; and Indraprastha-Dwarka-Sub City. These lines are expected to serve an estimated 2,182,000 passengers on a daily basis.

Targeted results

Expected annual ERCs generated from the program will be 41,160 tonnes.

Figure 2: Structure of Case Study PPP



The project is partly financed by the Government of Japan through Japan Carbon Finance Ltd. Mitsubishi Electric fulfilled orders for energy-efficient electric subway equipment from the Delhi Metro Corporation, which included locomotive products equipped with electric power generating brake systems. Overall project management and execution was by the Delhi Metro Corporation.

Summary of the Model Financials

Assuming a similar project scale, context and arrangements as in the case study of installing rolling stocks in a metro system that serves an estimated 2 million (M) passengers, the project's Net Present Value (NPV) without ERC in- and outflows – only considering non-ERC inflows through other revenue streams or cost savings enabled by the project – is positive at $15.5M[1]. With ERC cashflows, the total project will have a greater positive NPV of $16M, which makes these types of mass rail transit systems projects more financially attractive. The revenues generated from ERCs helped to provide additional justification to pursue the project despite its high upfront capital expenditure.

Table 2: Summary of sources of inflows and outflows and key assumptions

Value component	Assumptions	Sources
ERC revenues or inflows	• Three issuances across the project's 10-year crediting period, at year 3, year 7 and year 10 • $4.20 per tonne today for 118,372 estimated tonnes of ERCs likely generated in the first issuance • 10% price increase to $4.62 for 236,743 estimated tonnes of ERCs likely generated for the second and third issuance	Average price of Transport project in Asia, registered under Verified Carbon Standard (VCS)
Non-ERC revenues or inflows	• Average annual energy regenerated of 44,389,479 kilowatt hours (kWh) • Average energy consumption tariff of $0.16 per kWh	Delhi Metro Corporation (DMC) case study benchmark, World Bank – Cost of Doing Business study
Project investment and implementation cost	• Investment and installation costs for of rolling stocks in transport system of $26,005,607 • Operating and maintenance costs assumed to be 5% of total investment and installation costs	DMC case study benchmark

Value component	Assumptions	Sources
ERC generation	• $10,000 for the project's registration and first issuance • $15,000 for each verification process across three issuance cycles • $0.14 per tonne for subsequent issuances	Verra Fee Schedule

Table 3: Net cashflows summary (in USD)

Components	Sum of initial outlays	Sum of in- or outflows from crediting period	Total cashflow
ERC Component			
Revenues/Inflows	0	1,590,915	1,590,915
Costs/Outflows	0	-104,716	-104,716
Net value	0	1,486,199	1,486,199
Primary/Non-ERC Component			
Revenues/Inflows	0	79,590,336	79,590,336
Costs/Outflows	-26,005,607	-1,300,280	-27,305,887
Net value	-26,005,607	78,290,055	52,284,448
Net Present Values			
NPV	$16,030,635		
NPV (ERC Component)	$565,106		
NPV (Non-ERC Component)	$15,465,529		

Footnote 1: All prices are expressed in United States Dollars (USD)

Related Content

- **Guidance for Countries in Assessing ERC Projects (Download PDF version)**

Additional Resources

- Climate-Smart PPPs
- Finance Structures for PPP

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