



# CLIMATE CHANGE INITIATIVE FOR URBAN INFRASTRUCTURE INVESTMENTS



Asian  
Development  
Bank



Cities Development  
Initiative for Asia

1. INTRODUCTION - CDM OPPORTUNITIES FOR IDENTIFIED CDIA PROJECTS
2. POTENTIAL CDIA CDM ACTIVITIES
3. ADB CDM PROJECT EXAMPLES
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## CDM Opportunities for CDIA Projects:

1. 12 CDM PROJECTS IN TEN CITIES THAT WILL HAVE PRE-FS COMPLETION IN A YEAR
2. POTENTIAL CDIA CDM PROJECTS ARE IN WASTE MANAGEMENT, ENERGY EFFICIENCY, URBAN TRANSPORT AND DISTRICT HEATING & COOLING
3. EXISTING CDM REFERENCE PROJECTS AND METHODOLOGIES
4. EXISTENCE OF IN-HOUSE (ADB) CDM CARBON FUNDS AND OF EXPERTS FOR CDM DOCUMENTATION AND REGISTRATION



# POTENTIAL CDIA CDM ACTIVITIES

## CDIA Shortlist of Cities/Sectors

	Country	City	Potential CDM Projects
1	Bangladesh	Khulna	Solid waste management
2	China	Yangzhou	Water resource rehabilitation including wastewater collection and treatment
3	China	Guiyang	Urban public transport (Light Rail Transit) and urban water resource rehabilitation (drinking water)
4	India	Chennai	Waterways improvement and solid waste management systems
5	Laos	Pakse	Solid waste management
6	Mongolia	Ulaan Baatar	Energy efficiency - thermal retrofitting of apartment
7	Nepal	Kathmandu	Solid waste management system
8	Pakistan	Faisalabad	Industrial waste management
9	Philippines	Cebu	Urban public transport and district cooling
10	Vietnam	Thanh Hoa City & Province	Water supply and treatment

## Technology Options for the Waste Sector

### **1. Solid Waste Management**

- Composting of biodegradable portion of municipal solid waste
- Methane capture for flaring/heating/power
- Waste to energy through RDF/incineration
- Household digesters

### **2. Wastewater Treatment**

- Methane capture in wastewater treatment projects
- Methane capture through treatment of sludge
- Energy production from methane capture

## Technology Options in other Urban Sectors

### **3. Energy Efficiency in Municipal Operations**

- Efficient lighting (streets, office)
- Water pumping/piping improvement

### **4. District Heating and Cooling**

- Gas distribution

### **5. Urban Transport**

- Bus rapid transit system
- Low carbon intensive vehicle (CNG/LPG/Electric)/Metro Rail

### **6. Land Use**

- Restoration of degraded land
- Reforestation of water sheds

## 1. Solid Waste Management

Technology Option	Minimum Requirement/s	Cost	CERs (tCO <sub>2</sub> e)	Reference/CDM Methodology
a) LFG to Flare	six million tons existing in a 25 hectare dumpsite; 1700 tons fresh MSW per day; started operations in 1975 and closed in 2006	US\$ 14 million total (\$7.7M for landfill closure and \$ 6.3M for flaring at a rate of 1840 cbm/hr to 710 cmb/hr from year 2008 to 2027	715,559 over a 10 year period	Gorai Landfill Closure and Gas Capture Project (AMS III.G)
b) LFG to Power	3000 tons MSW/day since Jan 2002; will be operational for next 12 yrs; 15 MW electricity capacity	US\$ 300 million	5,899,931 over 10 yrs	Montalban, Phils. Methane Recovery & Power Generation (ACM 0001 v6; AMS 1.D v12)
c) Composting of MSW and Food Waste	ave 116 tons/day pure organics over 10 yrs (80% MSW, 15% fish waste; 5% rice husks)	INR 29 million (20 m capex + 9 m 1st yr oprtg exp)	234,314 over ten yrs	Puri, India Composting Facility (AMS III.F v5)
d) Composting of Wet Waste	85 tons per day (80% food waste and 5.7% pulp and paper)	US\$ 1.37 million	129,677 over ten years at	Kerala India Waste Composting Project
e) LFG to District Heating (boiler to supply hot water to public bathrooms, hotels and other heat recipients)	6 million tons of MSW accumulated in three closed landfills	US\$ 350 million with IBRD providing \$ 110 million	634,667 over ten yrs	Liaoning, PROC Landfill Gas Recovery and Utilization Project (ACM 00001 v9)
f) Household Digesters to produce biogas, thermal energy for cooking w/ cattle dung & human waste as feedstock	The power equivalent HH biogas plants ranges from 1.16 KW to 2.32 KW; total installed generation capacity of the proposed project activity totals 14.73 MW	US 19.68 million (\$9.15 frm KfW; \$4.92 Netherland Govt & \$ 5.61 Nepal Govt)	328,900 over seven yrs	Biogas Support Program - Nepal (AMS I.C)

## 2. Waste Water Treatment

Technology Option	Minimum Requirement/s	Cost	CERs (tCO <sub>2</sub> e)	Reference (CDM Methodology)
a) Biogas to Power from an existing WWT Plant's sludge	average flow of 7.6 cbm/second of the wastewater; 2MW power generation	US\$ 2 million or US\$ 1 million per MW	566,325 over ten yrs	Ca-averalejo Wastewater Treatment Plant of EMCALI in Cali, Colombia (AMS III.H v9)
b) Biogas to Cogen (electricity and hot water) from on site wastewater biodigesters of a food processor	60,000 operating hours; 1000kW electric power generating capacity	US\$ 2.77 million for three 7.5 tons per hour steam boilers and one MW genset	77,206 tCO <sub>2</sub> e over 21 year	La Costena - Jugomex Co-Generation Project (AMS I.C v8)
c) Upgrade of an Existing Septic Waste Treatment Plant for Power Generation	35,000 cbm of sewage per day; 900 cbm of sludge/day; 3 MW power plant	US\$ 6 million capital costs total	201,102 over seven yrs	Makati South Sewage Treatment Plant Upgrade with On-Site Power (AMS I.D v10 III & II.H v4)
d) Biogas to Flare from an Existing WWT Plant's sludge	37,000 cbm of wastewater per day; 165 cbm of sludge per day	A flare capable of burning 25 to 50 cbm/hour gas can cost about US\$60,000 to 80,000	25,000 over seven years	Kinoya Wastewater Treatment Project

## 3. Urban Transport

Technology Option	Minimum Requirement/s	Cost	CERs (tCO <sub>2</sub> e)	Reference (CDM Methodlogy)
a) Bus Rapid Transit (BRT) system	9,000 conventional buses retired; 130 kms of new dedicated lanes (trunk routes); around 1200 new articulated buses with a capacity of 160 passengers	US\$ 205 million or \$5 million per kilometer for a 41 kilometer long system	1,725,940 over seven years	BRT Bogotá, Colombia: TransMilenio Phase II to IV (AM03)
b) Emission reduction by Low Greenhouse Gas Emitting Vehicles	installation of low GHG emitting rolling stocks in metro rail system; regenerative braking technology; thus, regenerative electricity reduces consumption of grid electricity required in powering the trains	Phase I covering 65 kilometers with 23 rolling stocks costs Rs 10,571 crores	411,600 over 10 years at US\$ 10 per ton or US\$ 4.1 million CER revenues	Delhi Metro CDM Project (AMS III.C)
c) Fuel switch from Petro Diesel to Biofuel	switching of 280 buses from petro diesel to biofuel (vegetable oil as a fuel blend comprising 20% with diesel)	prices of the biofuel blend will be the same as diesel; however, carbon credits will provide Rs 51 (approximately US\$1) per bus per day or a total of US\$ 102,200 annually for its fleet of 280 buses	27,840 over ten years	Bangalore Fuel Switch Project in the Transport Sector (AMS III.C ver 10)
d) Engine Retro-fitting	address the high emissions of 2 stroke engines by retrofitting up to 6000 tricycles with direct in-cylinder fuel injection in the Cities of Vigan and Puerto Princesa, Philippines	Retrofit kit costs approx \$350. Envirofit's product allows a fuel/oil savings of about \$1.50 USD per day or about \$470 annually.	77,082 over ten years	Envirofit Tricycle-taxi Retrofit Program (AMS III.C ver 11)

## 4. Energy Efficiency

Technology Option	Minimum Requirement/s	Cost	CERs (tCO <sub>2</sub> e)	Reference Methodology (CDM)
a) GHG emission reduction as result of efficiency improvements and fuel switching measures for a series of public buildings	identified and appraised 20 public buildings, including the pilot project in municipality of Ungheni. which included installation of 4 heating plants, connection pipes and individual heating substations for 3 kindergartens and a medical school.	US\$ 45 million credit facility from World Bank	114,469 over 10 years	WB Moldova Energy II Project (AMS II.E and III.B)
b) Distribution of Compact Florescent Lamps (CFL)	Distribution of approx. 450,000 to 500,000 CFLs in the district of Visakhapatnam, which numbers about 700,000 households.	Euro 1.486 total costs; average absorbed cost: Euro 3.00 per CFL plus ave. overhead: Euro 0.30 per CFL	274,275 over 10 years	Visakhapatnam (India) OSRAM CFL distribution CDM Project (AMS II.C ver 9)
c) Improvement of the thermal performance of housing units thru better lighting & water heating efficiency.	3 interventions per household unit: insulated ceilings; solar water heater installation; and energy efficient lighting within a 100 hectare area	US\$ 2400 per 30 sqm housing unit	2.85 tons per HH over seven years (programmatic)	Kuyasa low-cost urban housing energy upgrade project, Khayelitsha, Cape Town; South Africa (AMS I.C, II.C & II.E)
d) Solar - Household lighting systems	101,500 households to be equipped with individual PV kits for domestic electricity use (bulbs, plugs), each kit with average capacity of 75,7 Wp (Watt peak) 1, adding up to a total installed capacity of around 7,7 MW.	Moroccan Dirham 9000 per unit or US\$ 972; financing via 10% downpayment & balance payable over 10 years; includes running costs; ie. battery renewal, maintenance & collection fees	386,368 over 10 yrs	PV Solar home systems for rural electrification in Morocco (AMS I.A)

# REFERENCE PROJECTS & METHODOLOGIES

## 5. Land Use

Technology Option	Minimum Requirement/s	Cost	CERs (tCO2e)	Reference (CDM Methodology)
a) Restoring productivity of degraded lands, enhancing forest product supplies to local communities and promoting actual net GHG removals by sinks.	20,289.91 ha of degraded lands with negative anthropogenic or natural processes that could cause at least 5% or more of loss in productivity and corresponding increase in the restoration expenditure, with productivity declines from the loss carbon pools	US \$14.42 million or approximately US\$ 711 per hectare	3,584,846 over 20 yrs	Moldova Soil Conservation Project (AR-AM0002 v1)
b) Carbon sequestration and enhancement of the livelihoods of people and natural environment by facilitating reforestation activities in watershed areas	200,000 ha of timber plantations in Huanjiang County of Guangxi; and, 100,00 ha of multiple-use protection forests on sites with severe soil and water erosion in Cangwu County of Guangxi; and, 4000 hectares for carbon sequestration	US\$ 105.25 (\$100 million loan from World Bank and \$5.25 GEF grant for its bio diversity conservation component)	net 773,842 tons over 30 yrs	Facilitating Reforestation for Guangxi Watershed Management in Pearl River Basin (AR-AM0001 v2)

## ADB Urban Climate Change Project List

### **1. Landfill Gas Capture and Utilization**

- Shandong Province, PRC
- Anhui Province, PRC

### **2. Waste Composting**

- Kerala, India
- Rajasthan, India
- Bangladesh, Khulna

### **3. Wastewater Treatment**

- Kinoya, Fiji
- Colombo, Sri Lanka

### **4. Bus Rapid Transit System**

- Lanzhou, PRC

## Kerala Waste Composting



- **Location:** Kollam, Kerala, India
- **Population:** 361,000
- **Amount of Waste:** 85 tons/day
- **Waste Composition:**
  - food 80%,
  - pulp & paper 5.7%
  - inert 15%



# ADB CDM PROJECT EXAMPLES

## Kerala: Potential Carbon Finance Impact

### Kerala Composting Project

#### Emissions and carbon financing

	Annual CERs 2010-20	Total CERs up to end-2012	Total CERs Post 2012
Emissions reduction (tCO <sub>2</sub> e)	5,102	23,395	129,677
Potential revenue			
\$5/ton	\$ 25,512	\$ 76,535	\$ 178,582
\$10/ton	\$ 51,023	\$ 153,070	\$ 357,163
\$15/ton	\$ 76,535	\$ 229,605	\$ 535,745

#### Indicative project financing plan (with pricing examples)

	\$5-10/ton	\$10-15/ton
<b>Total Investment Cost</b>	\$ 1,368,751	\$ 1,368,751
<b>Financing Sources</b>		
Government & Other	\$ 200,154	\$ 27,950
ADB loan	\$ 958,126	\$ 958,126
<u>APCF (50% of CERs)</u>	\$ 76,535	114,803
<u>FCF (75% of CERs)</u>	\$ 133,936	267,873
<b>Ratio (APCF&amp;FCF/Total)</b>	<b>15.4%</b>	<b>28.0%</b>

## Kinoya Wastewater Treatment



*Anaerobic Sludge Digester*



*Sludge Drying Beds*

- Location: Kinoya, Fiji
- Population: 800,000
- Amount of Wastewater: 37,000 cubic meters/day
- Sludge Generation: 165 cbm/day
- Expected CERs: 24,000 tCO<sub>2</sub>e (flaring only)

## Kinoya: Potential Carbon Finance Impact

### Emissions and carbon financing (estimates only)

	Annual CERS 2010-20	Total CERS up to end 2012	Total CERS Post 2012
Emissions reduction (tCO <sub>2</sub> e)	20,000	40,000	160,000
Potential Revenue			
\$5/ton	\$ 100,000	\$ 200,000	\$ 800,000
\$10/ton	\$ 200,000	\$ 400,000	\$ 1,600,000
\$15/ton	\$ 300,000	\$ 600,000	\$ 2,400,000

### Indicative project financing plan (with pricing examples)

	\$5-10/ton	\$10-15/ton
Total Investment Cost	72,400,000	72,400,000
Financing Sources		
Government & Other	\$ 25,400,000	25,400,000
ADB Loan	\$ 47,000,000	\$ 47,000,000
APCF (50% of CERS)	\$ 100,000	\$ 200,000
FCF (75% of CERS)	\$ 600,000	\$ 1,200,000
Ratio (APCF & FCF/Total)	1.38%	2.76%

## Gorai Landfill Rehabilitation



- Landfill closure and installation of gas collection, venting and flaring system
- Leachate collection system
- Storm water drainage system
- Sheet piling to prevent leachate from entering adjacent creek

# ADB CDM PROJECT EXAMPLES

## Gorai: Potential Carbon Finance Impact

### Gorai Landfill Project India

#### Emissions and carbon financing

	Annual CERs 2010-20	Total CERs up to end-2012	Total CERs Post 2012
Emissions reduction (tCO <sub>2</sub> e)	41,070	715,559	516,532
Potential revenue			
\$5/ton	\$ 205,349	\$ 616,046	\$ 1,437,440
\$10/ton	\$ 410,697	\$ 1,232,091	\$ 2,874,879
\$15/ton	\$ 616,046	\$ 1,848,137	\$ 4,312,319

#### Indicative project financing plan (with pricing examples)

	\$5-10/ton	\$10-15/ton
Total Investment Cost	\$ 6,344,000	\$ 6,344,000
Financing Sources		
Government & Other	\$ 4,649,875	\$ 3,263,773
ADB loan	\$ -	\$ -
<u>APCF (50% of CERs)</u>	\$ 616,046	924,068
<u>FCF (75% of CERs)</u>	\$ 1,078,080	2,156,159
Ratio (APCF&FCF/Total)	26.7%	48.6%

## Philippine CFL Distribution Project



- Installation of 13 million CFLs in residential areas
- Distribution through service providers, private distribution utilities and electric cooperatives
- Free of Charge, no fees collected
- Households can substitute up to 6 incandescent light bulbs (GLS) bulbs
- CFLs 10,000 hour quality with power outputs of between 13 to 15W



# ADB CDM PROJECT EXAMPLES

## Philippine CFL Project Potential Carbon Finance Impact

### Emissions and carbon financing

	Annual CERS 2010-2012	Total CERS up to end 2012	Total CERS Post 2012
Emissions reduction (tCO <sub>2</sub> e)	70,000	140,000	420,000
<b>Potential Revenue</b>			
\$5/ton	\$ 350,000	\$ 700,000	\$ 2,100,000
\$10/ton	\$ 700,000	\$ 1,400,000	\$ 4,200,000
\$15/ton	\$ 1,050,000	\$ 2,100,000	\$ 6,300,000

### Indicative project financing plan (with pricing examples)

	\$5-10/ton	\$10-15/ton
Total Investment Cost	16,160,000	16,160,000
<b>Financing Sources</b>		
Government & Other	\$ 11,000,000	11,000,000
ADB Loan	\$ 5,160,000	\$ 5,160,000
APCF (50% of CERS)	\$ 350,000	\$ 700,000
FCF (75% of CERS)	\$ 1,575,000	\$ 3,150,000
Ratio (APCF & FCF/Total)	17.33%	34.65%

## Lanzhou Rapid Bus Transit System



- Located in the Peoples Republic of China
- Dedicated BRT lane for 13 kilometers.
- Improved fuel use efficiency through new and larger buses
- Mode switching from private car and taxi users with higher emission rates to public transport
- Potential fuel switch to low carbon fuels



# ADB CDM PROJECT EXAMPLES

## Lanzhou BRT: Potential Carbon Finance Impact

### Emissions and carbon financing

	Annual CERS 2010-20	Total CERS up to end 2012	Total CERS Post 2012
Emissions reduction (tCO2e)	5,000	-	40,000
<b>Potential Revenue</b>			
\$5/ton	\$ 25,000		\$ 200,000
\$10/ton	\$ 50,000		\$ 400,000
\$15/ton	\$ 75,000		\$ 600,000

### Indicative project financing plan (with pricing examples)

	\$5-10/ton	\$10-15/ton
Total Investment Cost	\$ 11,100,000	\$ 11,000,000
Annual Operating Costs	\$ 680,000	\$ 680,000
<b>Financing Sources</b>		
Government & Other	\$ -	-
ADB Loan	\$ 11,100,000	\$ 11,000,000
APCF (50% of CERS)	\$ -	\$ -
FCF (75% of CERS)	\$ 150,000	\$ 300,000
Ratio (APCF & FCF/Total Investment)	1.80%	3.64%
Ratio (APCF & FCF/Operating Cost)	29.41%	58.82%

## Carbon Market Initiative

### ADVANTAGES FOR PROJECT

1. Certainty of value
2. Lower budget to close financing plan
3. Comprehensive technical & implementation support
4. Marketing of extra credits with ADB for further financial upside

### PRIORITY TARGET PROJECTS

- **Energy Efficiency**
  - Industrial Technology
  - Buildings & Equipment
  - Supply Side Efficiency
- **Transport**
  - Public Transport
  - Vehicle Efficiency
- **Renewable Energy**
  - Waste to energy, wind, hydro, solar, biomass, geothermal



# ADB CARBON FINANCE SERVICES

## Future Carbon Fund

### HIGHLIGHTS

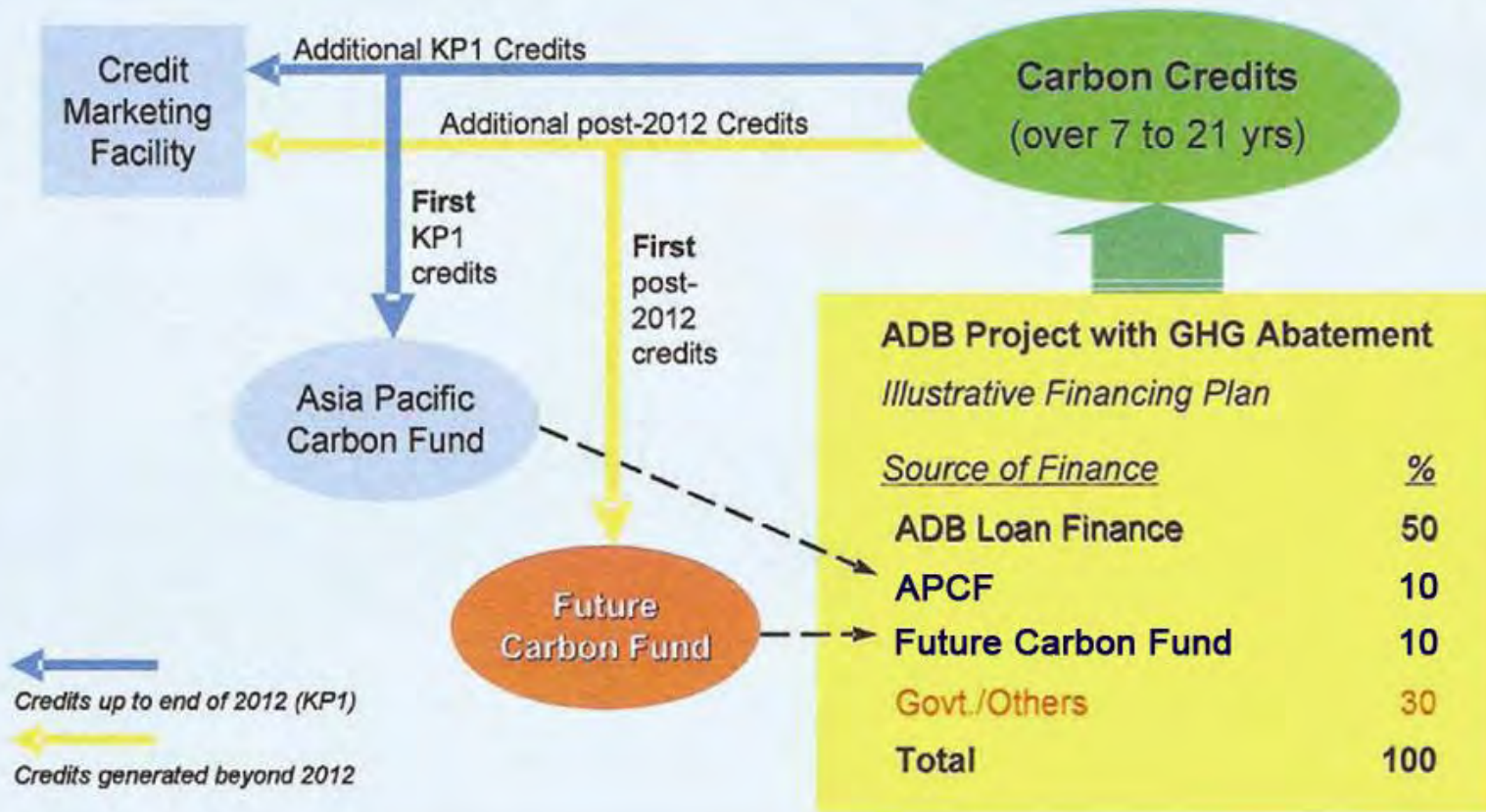
- Pre-purchase carbon credits from projects supported by ADB
- Started 30 Jan 2009
- Integrated with:
  - Carbon Market Initiative
  - Asia Pacific Carbon Fund
  - Technical Support Fund
  - Credit Marketing Facility

### KEY FEATURES

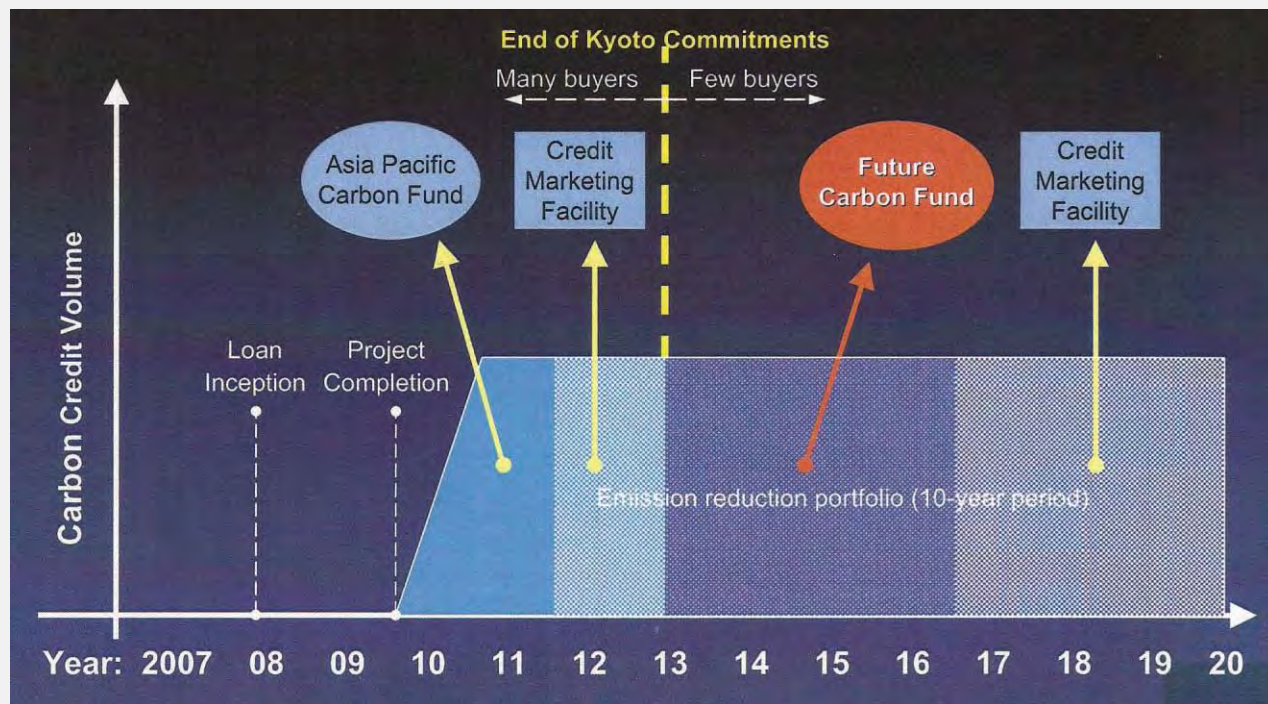
- Purchase post 2012 carbon credits
- Upfront payment
- For project developers in conjunction with CMI and ADB support
- ADB grant based technical support
- Reduction of costs and risks with “piggy back” design and strategy

# ADB CARBON FINANCE SERVICES

## Sample Project Financing

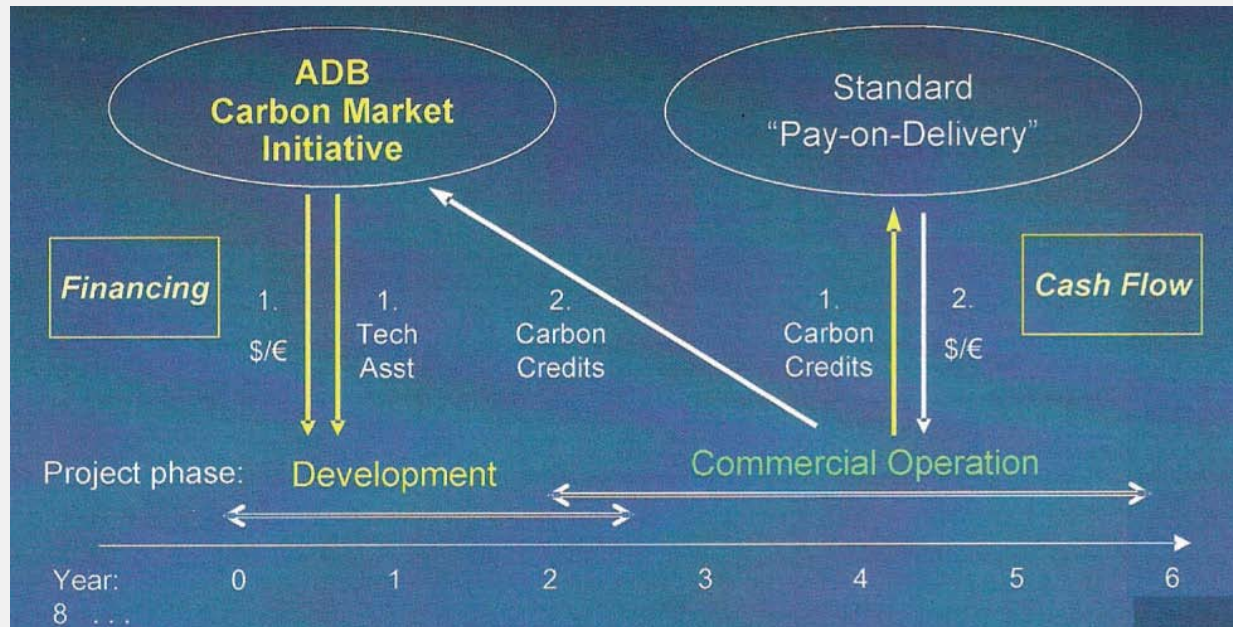


## Sample Project Credit Flow



# ADB CARBON FINANCE SERVICES

## Turning Carbon Cash Flow into Financing



## CDIA and CMI Coordination

- 1.** Training of CDIA Team Leaders for CDM data gathering and preliminary documentation
- 2.** Information campaign to CDIA potential project developers
- 3.** Preparation of preliminary documentation
  - Sectoral data questionnaire
  - Carbon emission estimates
  - Project information note
  - Application to Future Carbon Fund



**THANK YOU!**