

APPENDIX



Chapter 1

Table A1.1. GDP Growth, 2004–2010 (percentage per year)

Subregion/Economy	2004	2005	2006	2007	2008	2009 ^a	2010 ^b
Central Asia	9.4	11.5	13.3	12.0	5.7	3.9	4.8
Armenia	10.5	13.9	13.2	13.8	6.8	0.5	3.0
Azerbaijan	9.3	28.0	34.5	25.4	10.8	8.0	6.7
Georgia	5.9	9.4	9.2	12.4	2.0	2.5	6.0
Kazakhstan	9.6	9.7	10.7	8.9	3.2	2.0	3.3
Kyrgyz Republic	7.0	-0.2	3.1	8.5	7.6	4.0	6.0
Tajikistan	10.6	6.7	7.0	7.8	7.9	3.0	4.0
Turkmenistan	14.7	13.0	11.4	11.6	10.5	10.0	10.0
Uzbekistan	7.7	7.0	7.2	9.5	8.5	7.0	6.5
East Asia (including Japan)	4.1	4.9	5.1	6.2	4.5	2.4	3.9
East Asia (excluding Japan)	8.4	8.3	9.4	10.4	6.6	3.6	6.5
China, People's Rep. of	10.1	10.4	11.6	13.0	9.0	7.0	8.0
Hong Kong, China	8.5	7.1	7.0	6.4	2.5	-2.0	3.0
Japan	1.4	2.7	1.9	2.4	2.1	0.7	0.5
Korea, Rep. of	4.7	4.2	5.1	5.0	2.5	-3.0	4.0
Mongolia	10.6	7.3	8.6	10.2	8.9	3.0	4.5
Taipei, China	6.2	4.2	4.8	5.7	0.1	-4.0	2.4
South Asia	7.3	9.1	9.0	8.6	6.8	4.8	6.1
Afghanistan	8.0	16.1	8.2	12.1	3.4	9.0	7.5
Bangladesh	6.3	6.0	6.6	6.4	6.2	5.6	5.2
Bhutan	7.0	6.6	6.4	14.1	11.5	5.5	6.5
India	7.5	9.5	9.7	9.0	7.1	5.0	6.5
Maldives	9.5	-4.6	18.0	7.2	5.7	1.0	1.5
Nepal	4.4	3.2	3.7	2.7	5.3	3.0	3.5
Pakistan	7.5	9.0	5.8	6.8	5.8	2.8	4.0
Sri Lanka	5.4	6.2	7.7	6.8	6.0	4.5	6.0

Subregion/Economy	2004	2005	2006	2007	2008	2009 ^a	2010 ^b
Southeast Asia	6.5	5.7	6.0	6.4	4.3	0.7	4.2
Brunei Darussalam	0.5	0.4	4.4	0.6	-2.7	-0.4	2.3
Cambodia	10.3	13.3	10.8	10.2	6.5	2.5	4.0
Indonesia	5.0	5.7	5.5	6.3	6.1	3.6	5.0
Lao PDR	7.0	6.8	8.3	7.8	7.2	5.5	5.7
Malaysia	6.8	5.3	5.8	6.3	4.6	-0.2	4.4
Myanmar	13.6	13.6	13.1	11.9	-	-	-
Philippines	6.4	5.0	5.4	7.2	4.6	2.5	3.5
Singapore	9.3	7.3	8.4	7.8	1.1	-5.0	3.5
Thailand	6.3	4.6	5.2	4.9	2.6	-2.0	3.0
Viet Nam	7.8	8.4	8.2	8.5	6.2	4.5	6.5
The Pacific	3.8	2.9	2.0	2.8	5.1	3.0	2.7
Cook Islands	4.3	0.0	0.7	1.3	1.1	1.0	0.8
Fiji Islands	5.5	0.6	3.4	-6.6	1.2	-0.5	0.2
Kiribati	-1.7	1.6	-5.2	0.5	0.6	1.0	0.9
Marshall Islands, Rep. of	6.7	2.0	0.9	1.3	1.5	0.5	0.8
Micronesia, Fed. States of	-3.3	-0.6	-2.3	-3.1	-1.0	-0.1	0.8
Nauru	-	-14.5	6.3	-27.3	1.0	1.5	1.5
Palau, Rep. of	6.0	5.9	4.8	2.1	-1.0	-2.0	-0.2
Papua New Guinea	2.7	3.6	2.6	6.5	7.2	4.0	3.5
Samoa	3.3	4.0	1.9	5.5	0.3	-1.0	-0.1
Solomon Islands	8.0	5.0	6.1	10.3	6.4	2.2	1.7
Timor-Leste, Dem. Rep.	4.1	6.2	-5.8	8.0	10.0	10.0	8.0
Tonga	1.4	2.3	0.8	-3.5	1.2	-2.0	-0.6
Tuvalu	4.0	2.0	1.0	2.0	1.5	1.0	0.9
Vanuatu	5.5	6.5	7.2	6.8	6.3	3.5	0.8
Average (including Japan)	4.6	5.4	5.7	6.6	4.8	2.5	4.2
Average (excluding Japan)	7.9	8.1	8.9	9.5	6.3	3.4	6.0

GDP = gross domestic product; Lao PDR = Lao People's Democratic Republic.
 - data not available.

Notes:

^a estimate.

^b projected.

Sources: ADB (2009) and International Monetary Fund (2008).

Table A1.2. Population and Population Density, 2007–2020

Subregion/Economy	Area (km ²) (in 1,000)	2007		2008		2015		2020	
		Population (in million)	Density	Population (in million)	Density	Population (in million)	Density	Population (in million)	Density
Central Asia	4,189.5	75.6	18.0	76.2	18.0	81.0	19.0	84.4	20.0
Armenia	29.8	3.0	100.0	3.0	100.0	3.0	100.0	3.0	101.0
Azerbaijan	86.6	8.1	94.0	8.2	94.0	8.7	100.0	9.1	105.0
Georgia	69.7	4.7	67.0	4.6	66.0	4.5	65.0	4.4	64.0
Kazakhstan	2,724.9	15.3	6.0	15.3	6.0	15.8	6.0	16.0	6.0
Kyrgyz Republic	199.9	5.3	26.0	5.4	27.0	5.9	30.0	6.3	32.0
Tajikistan	143.1	7.1	49.0	7.2	50.0	8.2	57.0	8.9	62.0
Turkmenistan	488.1	5.1	10.0	5.2	11.0	5.8	12.0	6.2	13.0
Uzbekistan	447.4	27.1	61.0	27.4	61.0	29.2	65.0	30.6	68.0
East Asia	11,662.2	1,530.3	131.2	1,538.7	131.9	1,602.1	137.4	1,637.7	140.4
China, People's Rep. of	9,597.0	1,321.9	138.0	1,330.0	139.0	1,393.4	145.0	1,430.5	149.0
Hong Kong, China	1.1	7.0	6,352.0	7.0	6,386.0	7.2	6,584.0	7.3	6,668.0
Korea, Rep. of	99.5	48.3	485.0	48.4	486.0	49.1	493.0	49.4	496.0
Mongolia	1,564.1	3.0	2.0	3.0	2.0	3.3	2.0	3.5	2.0
Taipei, China	36.0	22.9	635.0	22.9	637.0	23.2	645.0	23.3	647.0
Japan	364.5	127.4	349.5	127.3	349.2	125.8	345.1	123.7	339.3
South Asia	5,139.5	1,532.4	298.0	1,558.8	303.0	1,741.9	339.0	1,870.7	364.0
Afghanistan	652.1	31.9	49.0	32.7	50.0	39.3	60.0	44.6	68.0
Bangladesh	144.0	150.5	1,045.0	153.6	1,066.0	175.1	1,216.0	189.9	1,319.0
Bhutan	47.0	0.7	14.0	0.7	15.0	0.7	16.0	0.8	17.0
India	3,287.3	1,129.9	344.0	1,148.0	349.0	1,273.6	387.0	1,362.1	414.0
Maldives	0.3	0.4	1,225.0	0.4	1,295.0	0.4	1,320.0	0.4	1,315.0
Nepal	147.2	28.9	196.0	29.5	201.0	33.9	230.0	36.9	251.0
Pakistan	796.1	169.3	213.0	172.8	217.0	196.6	247.0	213.0	268.0
Sri Lanka	65.6	20.9	319.0	21.1	322.0	22.4	341.0	23.1	352.0
Southeast Asia	4,456.3	576.5	129.0	583.7	131.0	633.1	142.0	672.0	151.0
Cambodia	181.0	14.0	77.0	14.2	79.0	16.2	89.0	23.1	128.0
Indonesia	1,904.6	234.7	123.0	237.5	125.0	255.8	134.0	267.5	140.0
Lao PDR	236.8	6.5	28.0	6.7	28.0	7.8	33.0	8.6	36.0
Malaysia	329.9	24.8	75.0	25.3	77.0	28.4	86.0	30.8	93.0
Myanmar	676.6	47.4	70.0	47.8	71.0	50.3	74.0	51.8	77.0
Philippines	282.0	94.2	334.0	96.1	341.0	109.6	389.0	119.3	423.0

Subregion/Economy	Area (km ²) (in 1,000)	2007		2008		2015		2020	
		Population (in million)	Density	Population (in million)	Density	Population (in million)	Density	Population (in million)	Density
Singapore	0.7	4.6	6,439.0	4.6	6,517.0	4.9	6,903.0	5.0	7,093.0
Thailand	513.1	65.1	127.0	65.5	128.0	68.1	133.0	69.5	135.0
Viet Nam	331.7	85.3	257.0	86.1	260.0	92.1	278.0	96.3	290.0
The Pacific	543.0	9.3	17.0	9.5	17.0	10.8	20.0	11.7	22.0
Cook Islands	0.2	0.0	54.0	0.0	52.0	0.0	42.0	0.0	36.0
Fiji Islands	18.3	0.9	50.0	0.9	51.0	1.0	56.0	1.1	60.0
Kiribati	0.7	0.1	149.0	0.1	152.0	0.1	177.0	0.1	197.0
Marshall Islands, Rep. of	0.2	0.1	342.0	0.1	349.0	0.1	399.0	0.1	430.0
Micronesia, Fed. States of	0.7	0.1	154.0	0.1	153.0	0.1	150.0	0.1	146.0
Nauru	0.0	0.0	644.0	0.0	656.0	0.0	738.0	0.0	796.0
Palau, Rep. of	0.5	0.0	45.0	0.0	46.0	0.0	49.0	0.0	51.0
Papua New Guinea	462.8	5.8	13.0	5.9	13.0	6.8	15.0	7.4	16.0
Samoa	2.8	0.2	76.0	0.2	77.0	0.2	85.0	0.3	91.0
Solomon Islands	28.9	0.6	20.0	0.6	20.0	0.7	24.0	0.8	26.0
Timor-leste, Dem. Rep.	14.9	1.1	73.0	1.1	75.0	1.3	86.0	1.4	93.0
Tonga	0.8	0.1	157.0	0.1	159.0	0.1	176.0	0.1	189.0
Tuvalu	0.0	0.0	461.0	0.0	468.0	0.0	525.0	0.0	568.0
Vanuatu	12.2	0.2	17.0	0.2	18.0	0.2	19.0	0.3	21.0
Developing Asia	25,626.1	3,597.0	140.0	3,640.0	142.0	3,943.0	154.0	4,153.0	162.0

km² = square kilometer; Lao PDR = Lao People's Democratic Republic.

Note: Population density = population (in million)/area (in km²).

Source: United Nations (2008).

Chapter 2

Table A2.1. Land Transport Indicators in Selected Asian Countries

Subregion/Country	Roads, Total Network (km per 100 km ²)			Road, Paved (% of total roads)			Rail Lines (total route-km per 100 km ²)		
	1991	2000	2005	1991	2000	2005	1991	2000	2005
Northeast Asia									
China, People's Rep. of	12.82	14.61	20.11	78.00	80.00	82.50	0.56	0.61	0.65
Korea, Rep. of	58.52	87.64	101.03	76.40	74.50	86.76	0.36	0.45	0.33
Southeast Asia									
Brunei Darussalam	25.82	19.93	20.10	32.00	34.70	78.06	0.00	0.00	0.00
Cambodia	19.76	20.02	21.13	7.50	16.20	6.29	0.33	0.33	0.36
Indonesia	16.48	18.69	19.34	45.30	57.10	58.00	1.90	1.91	1.93
Lao PDR	5.95	9.17	13.18	16.00	44.50	14.41	0.19	0.20	0.21
Malaysia	27.31	19.98	29.94	73.00	75.30	81.32	0.67	0.60	0.60
Myanmar	3.77	4.13	4.13	11.20	11.44	11.44	0.33	0.38	0.38
Philippines	53.57	67.24	66.68	14.00	21.00	21.64	0.16	0.16	0.16
Singapore	423.97	451.62	456.08	97.10	100.00	100.00	0.00	0.00	0.00
Thailand	10.20	11.19	11.19	88.40	98.50	98.50	0.75	0.79	0.79
Viet Nam	29.60	65.49	67.47	23.90	25.10	25.10	0.86	0.95	0.81
South Asia									
Bangladesh	135.70	144.09	166.13	7.20	9.53	9.50	1.91	1.91	1.98
India	71.50	100.88	102.92	47.30	47.46	47.40	8.26	8.60	8.55
Nepal	4.74	8.98	11.81	38.20	30.80	30.30	0.29	0.29	0.29
Pakistan	22.28	30.07	32.45	53.00	56.00	64.70	1.10	0.98	0.98
Sri Lanka	147.60	146.52	148.28	32.00	40.00	81.00	2.23	2.23	2.23
Central and West Asia									
Georgia	30.84	29.21	29.05	93.80	93.40	39.38	6.06	5.32	5.31
Kazakhstan	5.80	3.43	3.30	68.70	86.50	93.43	0.33	0.33	0.33
Kyrgyz Republic	9.41	9.25	9.42	90.00	91.10	92.00	0.00	0.00	0.00
Mongolia	2.71	3.14	3.14	10.30	3.50	3.50	1.04	1.36	1.36
Tajikistan	19.98	19.48	19.48	74.10	79.00	88.00	0.33	0.42	0.43
Turkmenistan	4.43	4.92	4.92	75.00	81.20	81.20	0.44	0.49	0.52
Uzbekistan	16.44	18.24	18.24	80.50	87.30	87.30	0.76	0.81	0.90
Industrialized									
Australia	10.70	10.48	10.47	35.70	37.00	38.70	0.09	0.12	0.12
Japan	295.29	308.72	311.54	70.10	76.60	77.70	5.33	5.46	5.56

km = kilometer; km² = square kilometer; Lao PDR = Lao People's Democratic Republic.
Source: World Bank (2008b).

Table A2.2. Air Transport Indicators in Selected Asian Countries

Subregion/Country	Air Transport, Freight (million tons per km)				Air Transport, Passengers Carried (per 1000 population)			
	1991	2000	2005	2006	1991	2000	2005	2006
Northeast Asia								
China, People's Rep. of	1,009.5	3,900.1	7,579.4	7,692.2	17.0	49.0	104.8	120.5
Korea, Rep. of	2,597.0	7,651.3	7,432.6	7,751.7	390.8	730.3	701.7	719.6
Southeast Asia								
Brunei Darussalam	22.0	140.2	134.1	130.2	1,161.3	2,589.6	2,614.9	2,726.8
Cambodia	0.0	4.1	1.2	1.1	0.5	6.2	12.0	18.0
Indonesia	475.5	408.5	439.8	469.2	57.4	48.1	121.7	133.9
Lao PDR	0.8	1.7	2.5	2.5	27.2	39.9	49.5	56.7
Malaysia	713.6	1,863.8	2,577.6	2,597.4	646.0	720.1	803.6	682.9
Myanmar	1.1	0.8	2.7	2.8	7.7	9.2	29.8	33.5
Philippines	307.6	290.0	322.7	318.9	87.0	76.0	97.0	96.3
Singapore	1,740.8	6,004.9	7,571.3	7,981.3	2,469.9	4,157.7	4,086.8	4,363.6
Thailand	866.2	1,712.9	2,002.4	2,106.9	139.1	283.1	294.3	316.9
Viet Nam	82.9	117.3	230.2	216.0	2.9	36.7	65.6	62.8
South Asia								
Bangladesh	99.4	193.9	183.5	190.8	9.6	10.3	11.5	11.1
India	493.1	547.7	773.2	842.6	12.4	17.0	25.2	36.3
Nepal	23.9	17.0	6.9	7.2	32.4	26.3	17.7	18.4
Pakistan	373.3	340.3	407.9	427.0	46.9	38.3	34.4	35.9
Sri Lanka	100.7	255.7	310.4	325.4	51.7	90.7	143.6	155.9
Central and West Asia								
Georgia	1.8	2.0	2.8	2.9	12.2	24.9	55.7	61.3
Kazakhstan	32.2	11.8	15.8	16.4	320.8	31.0	76.6	83.8
Kyrgyz Republic	0.7	3.7	2.0	1.2	102.1	49.0	43.9	42.3
Mongolia	1.2	8.4	6.1	6.3	287.5	105.9	115.6	134.6
Tajikistan	2.5	2.7	6.1	12.8	139.6	27.3	73.6	59.4
Turkmenistan	2.3	11.9	10.1	10.5	187.1	285.2	342.1	376.2
Uzbekistan	36.7	79.6	71.6	67.6	188.0	70.8	62.7	62.7
Industrialized								
Australia	1,222.6	1,730.7	2,444.6	2,569.5	1,264.8	1,700.9	2,196.7	2,268.1
Japan	5,225.3	8,672.1	8,549.2	8,480.0	635.2	860.1	800.5	805.0

km = kilometer; km² = square kilometer; Lao PDR = Lao People's Democratic Republic.
Source: World Bank (2008b).

Table A2.3. Global Competitiveness and Infrastructure Quality Index of Asian Economies

Economy	2001–2002 ^a			2008–2009 ^a			
	GCI ^b		Infrastructure Score ^c	GCI ^b		Infrastructure	
	Rank	Rank		Rank	Score ^c	Rank	Score ^c
Developed and Newly Industrialized Asia (Average)			5.87				5.82
Australia	9	14	6.10	18	5.20	21	5.33
Hong Kong, China	18	8	6.60	11	5.33	5	6.32
Japan	15	15	6.00	9	5.38	11	5.80
Korea, Rep. of	28	27	4.80	13	5.28	15	5.63
Singapore	10	2	6.80	5	5.53	4	6.39
Taipei, China	21	25	4.90	17	5.22	19	5.46
Developing and Emerging Asia (Average)			3.11				3.35
Bangladesh	73	74	2.00	111	3.51	122	2.21
China, People's Rep. of	47	61	2.90	30	4.70	47	4.22
India	36	66	2.60	50	4.33	72	3.38
Indonesia	55	59	3.00	55	4.25	86	2.95
Malaysia	37	20	5.40	21	5.04	23	5.25
Nepal	–	–	–	126	3.37	132	1.90
Pakistan	–	–	–	101	3.65	85	2.96
Philippines	54	68	2.40	71	4.09	92	2.86
Sri Lanka	57	62	2.90	–	–	65	3.60
Thailand	38	30	4.60	34	4.60	29	4.67
Viet Nam	62	71	2.20	70	4.10	93	2.86

GCI = Global Competitiveness Index.

– data not available.

Notes:

^a Total number of surveyed countries in the world: 75 (2001–2002) and 134 (2008–2009).^b GCI score of 2001–2002 was not available;^c Score: 1 = poorly developed and inefficient; 7 = among the best in the world.

Sources: World Economic Forum (2001, 2008).

Table A2.4. Primary Energy Consumption in Asia and Other Regions^a (million TOE^b)

Economy/Region	Actual		Forecast		Annual Avg. Growth Rate (%)		
	1990	2000	2010	2020	1990–2000	2000–2010	2010–2020
China, People's Rep. of	673 (40.5)	932 (38.5)	1406 (42.2)	2063 (45.1)	3.3	4.2	3.9
Japan	439 (26.4)	525 (21.7)	543 (16.3)	561 (12.3)	1.8	0.3	0.3
Korea, Rep. of	93 (5.6)	191 (7.9)	262 (7.9)	303 (6.6)	7.5	3.2	1.5
India	187 (11.3)	322 (13.3)	452 (13.6)	684 (15.0)	5.6	3.4	4.2
Indonesia	52 (3.1)	98 (4.1)	144 (4.3)	209 (4.6)	6.5	3.9	3.8
Taipei,China	48 (2.9)	83 (3.4)	110 (3.3)	132 (2.9)	5.6	2.9	1.9
Singapore	13 (0.8)	25 (1.0)	36 (1.1)	48 (1.1)	6.3	4.0	2.9
Malaysia	20 (1.2)	47 (1.9)	74 (2.2)	110 (2.4)	8.7	4.6	4.0
Philippines	18 (1.1)	33 (1.4)	57 (1.7)	96 (2.1)	5.9	5.6	5.5
Thailand	29 (1.7)	58 (2.4)	89 (2.7)	145 (3.2)	7.3	4.4	5.0
Viet Nam	5.8 (0.3)	14 (0.6)	33 (1.0)	54 (1.2)	9.5	8.7	5.2
Hong Kong, China	11 (0.6)	15 (0.6)	18 (0.5)	20 (0.4)	3.8	1.7	1.1
Other Asian countries	71 (4.3)	80 (3.3)	111 (3.3)	144 (3.2)	1.2	3.4	2.6
Asian total	60 (21.2)	2,423 (26.8)	3,335 (30.2)	4,570 (33.6)	3.9	3.2	3.2
North America	2,137 (27.4)	2,555 (28.2)	2,863 (25.9)	3,196 (23.5)	1.8	1.1	1.1
Central and South America	382 (4.9)	526 (5.8)	710 (6.4)	980 (7.2)	3.2	3.0	3.3
OECD Europe	1,624 (20.8)	1,764 (19.5)	1,953 (17.7)	2,116 (15.6)	0.8	1.0	0.8
Non-OECD Europe	1,468 (18.8)	100 (11.1)	1,197 (10.8)	1,385 (10.2)	-3.8	1.8	1.5
World total	7,811 (100.0)	9,057 (100.0)	11,053 (100.0)	13,593 (100.0)	1.5	2.0	2.1

GJ = giga joule; LPG = liquefied petroleum gas; OECD = Organisation for Economic Co-operation and Development; PRC = People's Republic of China; TOE = ton of oil equivalent.

Notes:

^a Number in parentheses indicates the percentage in relation of the world total.

^b For measurement, 1 TOE = 0.93 tons gasoline; 0.99 tons diesel oil; 0.96 tons kerosene; 1.04 tons fuel oil; 0.93 tons LPG; 1.61 tons coal; 6.25 tons bagasse; 2.63 tons fuel wood; 1.35 tons charcoal; 41.84 GJ.

Sources: Based on data from "Energy Balances of OECD Countries" and "Energy Balances of Non-OECD Countries" International Energy Agency; forecast figures prepared by the Institute of Electrical Engineering.

Chapter 3

Box A3.1. Measuring the Benefits of Infrastructure Projects

All infrastructure projects implemented by ADB are subject to rigorous analysis of their economic benefits, along with a thorough study of their environmental and social impacts. These cost-benefit analyses are carried out using economic internal rates of return (EIRRs) for each country and infrastructure component. EIRRs provide a basis for judging whether a project has a rate of return high enough to justify the investment. For example, the Phnom Penh to Ho Chi Minh City highway project was found to have an EIRR of 24% for the entire project, with the Cambodia component appraised at just over 24% and the Viet Nam component at over 25% (ADB 2007e). This far exceeds the estimated opportunity cost of capital of 12%.

Cost-benefit analyses do a good job of examining the immediate and direct impacts of a project, but they do not consider its wider implications and indirect effects. Over the longer term, these indirect effects on markets and households can be the primary drivers of gains from infrastructure development. But measuring these benefits can be difficult, especially with cross-border projects. It can be hard to find sufficient comparable and appropriate data, and even more difficult to determine the impact of infrastructure from many other factors in a robust and rigorous fashion.

Another shortcoming of project analysis is that it does not explicitly analyze an investment's detailed distributional impact. Assessing distributional consequences is crucial in cross-border projects. To convince the local population that a project is the best use of limited public funds, each national government has to demonstrate how it benefits, or in some cases disadvantages, each affected population and measure these costs and benefits as thoroughly and accurately as possible.

Global CGE models have many advantages that complement cost-benefit analysis. They can account for a project's indirect effects, as well as the direct ones usually considered as part of a project cost-benefit

analysis. They can also track changes in factor income, allowing for an analysis of changes in household welfare. And they show how benefits from better infrastructure are transmitted through markets: the final equilibrium allocation shows how costs and benefits are distributed across economic agents. This information can help policymakers develop strategies and policies for those who may be disadvantaged by the project.

The CGE studies presented in Section 3.3 have another big benefit: they provide a framework for analyzing the network effects of infrastructure projects and how improvements to infrastructure networks affect the economy as a whole. On a methodological level, the framework can be used to analyze the impact of spatial aggregation on modeling results, an issue that is known to impact outcomes (OECD/International Transport Forum 2008).

These CGE studies also have their shortcomings. Their results are only as good as the model and parameters used. For a variety of reasons, they are likely to underestimate the impact of infrastructure projects. The “comparative static” simulation technique does not capture potential dynamic accumulation effects, whereby some proportion of the income increase may be invested, leading to a multiplier effect. Nor does the competitive model account for scale effects. There could also be internal transport margin effects that a CGE model of this type is unable to capture. More broadly, they do not capture the scope for infrastructure networks to produce a virtuous cycle of increased competition, innovation, and investment that provides a dynamic boost to development.

There are a number of ways to measure the impact of cross-border projects on household welfare. In the first case study, a macro approach is applied, providing cumulative impacts on households in Central Asia. The second examines South Asia, providing evidence of changes in welfare measured in dollar values for the various household groups. The final one measures changes in the poverty headcount in the GMS.

Table A3.1. Household Categories in the Model

Category	Pakistan	Bangladesh	India	Sri Lanka	Nepal
H1	Large farm - Sindh	Agricultural landless	Rural self-employed agricultural	Urban low income	Small rural
H2	Large farm - Punjab	Agricultural marginal land	Rural agricultural labor	Rural low income	Large rural
H3	Large farm - other	Agricultural small land	Rural non-agricultural labor	Estate low income	Landless rural
H4	Medium farm - Sindh	Agricultural large land	Other rural	Urban high income	Urban
H5	Medium farm - Punjab	Non-agricultural poor	Urban agricultural	Rural high income	
H6	Medium farm - other	Non-agricultural rich	Urban self-employed non-agricultural		
H7	Small farm - Sindh	Urban illiterate	Urban salaried		
H8	Small farm - Punjab	Urban low educated	Urban casual labor		
H9	Small farm - other	Urban medium educated	Other urban		
H10	Landless farm - Sindh	Urban highly educated			
H11	Landless farm - Punjab				
H12	Landless farm - other				
H13	Rural landless - Sindh				
H14	Rural landless - Punjab				
H15	Rural landless - other				
H16	Rural nonpoor				
H17	Rural nonfarm poor				
H18	Urban nonpoor				
H19	Urban poor				

Sources: Acharya (2007), Fontana and Wobst (2001), Naranpanawa (2005), Roland-Holst (2008), and Pradhan and Amarendra (2006).

Chapter 4

Box A4.1. Trans-European Energy Network Development

Establishing a trans-European energy grid has been complex and slow, and is still incomplete. But the creation of the single market in 1992, the strengthening of competition policy, and the more recent imperatives of reducing carbon dioxide emissions and increasing energy security have strengthened the hand of the EC. In the new draft EU treaty that is due to be ratified in 2009, energy has been established as an EU priority.

Regional axes are composed of a number of priority projects; projects of European interest are considered crucial for the network and of top priority. In 2006, nine major axes with 164 projects of common interest and 32 of European interest were established in electricity, and six major axes with 122 projects of common interest and 10 of European interest were established in gas. Their total cost was estimated at 23 billion euros. Electricity projects consist mainly of short cross-border connections, as well as the development and linking of renewable energy projects. Gas projects are mostly long-distance connections to third countries and liquefied natural gas ports and storage.

A recent comprehensive review found that many projects are delayed unless the infrastructure is primarily of national interest (MVV Consulting 2007). Because there is no legal requirement to prioritize EU infrastructure development projects, implementation is patchy. Interconnectivity is generally developed only as a backup for national energy security, not as a proper market exchange. Only the Nordic countries have created sufficient capacity to create a genuine cross-border electricity market.

Funding for the electricity grid has come from EIB and European Bank for Reconstruction and Development loans, EU Structural and Cohesion Funds, TEN-E funds, other bank loans, and transmission system operators' equity (Centro Elettrotecnico Sperimentale Italiano et al. 2005). Funding from the TEN budget has been limited and mainly for feasibility studies. The average investment per year in the EU as well as in countries that are candidates for admission (30 countries in total) has been 3 billion euros. Only 4% of the investment has been directed to cross-border projects, generally high-voltage lines.

Investment in the gas transmission network averaged 2.6 billion euros a year in 1990–2004. Financing has benefited from EU loans and grants. This includes investments in national gas transmission systems, liquefied natural gas terminals, import pipelines, and new interconnections such as the one between Bacton in the UK and Zeebrugge in Belgium.

Source: van der Geest and Nunez-Ferrer (2008b).

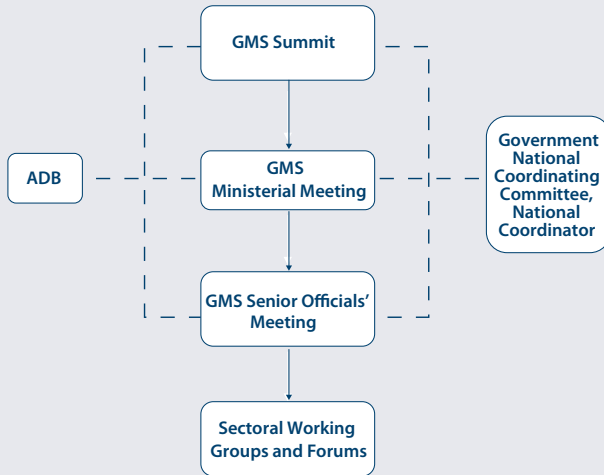
Box A4.2. Mekong River Commission (MRC)

In 2000, PRC, Lao PDR, Myanmar, and Thailand signed an agreement on commercial navigation for the stretch of water between Simao (PRC) and Luang Prabang (Lao PDR). In 2001, MRC produced a hydropower development strategy that calls for the preservation of water resources and the environment.

MRC members seek to ensure reasonable and equitable use of the Mekong River system by involving national Mekong committees in developing procedures for water use. MRC supports a joint basinwide planning process and is also involved in fisheries management, promotion of safe navigation, irrigated agriculture, watershed management, environment monitoring, flood management, and exploring hydropower options.

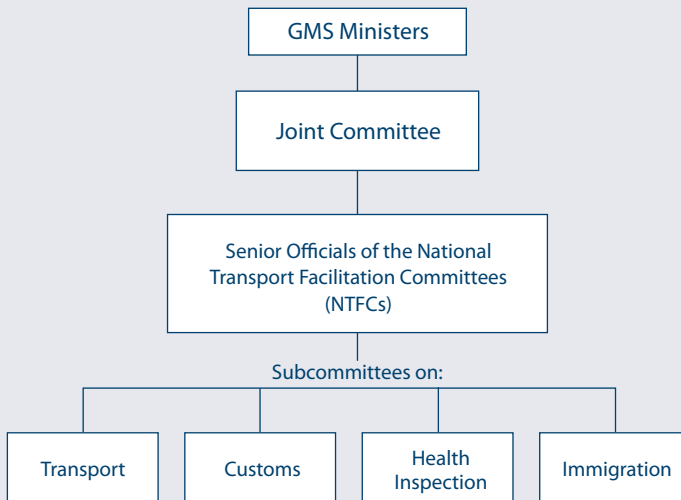
MRC is funded by national governments and aid agencies. Formal consultation with the aid community is carried out through an annual Consultative Group meeting. MRC is composed of three permanent bodies: the Council (composed of one minister from each country), the Joint Committee (made up of one department head from each country), and the Secretariat (which provides technical and administrative services).

Figure A4.1. GMS Institutional Arrangements



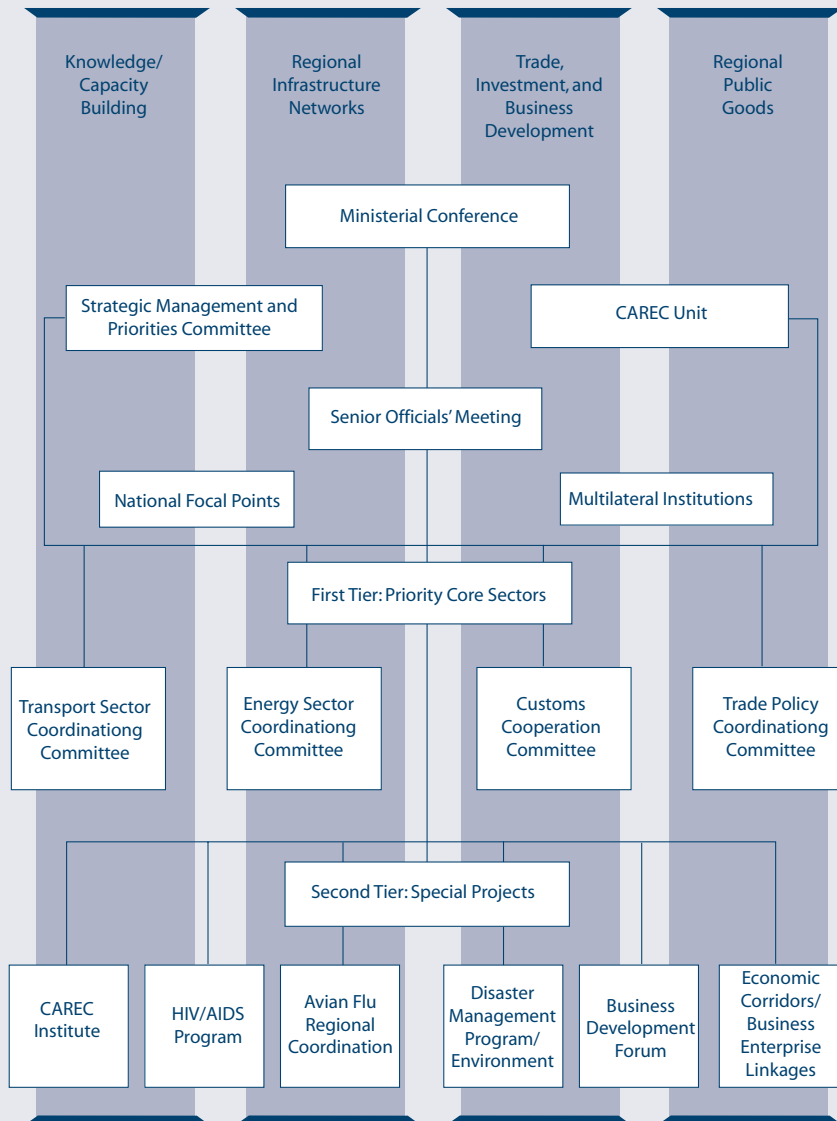
ADB = Asian Development Bank; GMS = Greater Mekong Subregion.
 Source: ADB (2008d).

Figure A4.2. Institutional Framework of the GMS CBTA



CBTA = Cross-Border Transport Agreement; GMS = Greater Mekong Subregion.
 Source: ADB (2008d).

Figure A4.3. CAREC's Institutional Framework



CAREC = Central Asia Regional Economic Cooperation; HIV/AIDS = human immunodeficiency virus/acquired immunodeficiency syndrome.
 Source: CAREC (2006).

Chapter 5

Indicative Investment Needs for Regional (Identified and in the Pipeline) Infrastructure Projects, 2010–2020

Table A5.1. Current Investment Needs for the Asian Highway Network

Country	Road Length (km)	Investment Need (\$ million)
Afghanistan	3,134	829
Armenia	35	31
Azerbaijan	447	126
Bangladesh	1,373	2,392
Bhutan	161	26
Cambodia	308	190
China, People's Rep. of	2,885	6,650
Georgia	0	108
India	3,180	3,640
Indonesia	3,576	245
Iran	5,594	1,151
Kazakhstan	3,649	2,068
Kyrgyz Republic	656	328
Lao PDR	369	245
Malaysia	106	281
Mongolia	430	78
Myanmar	268	66
Nepal	179	49
Pakistan	1,317	807
Philippines	505	413
Russian Federation	3,049	2,655
Sri Lanka	164	271
Tajikistan	140	20
Thailand	1,273	373
Turkey	215	722
Turkmenistan	220	67
Uzbekistan	2,761	59
Viet Nam	572	1,961
Total	36,566	25,851

\$ = United States dollar; Lao PDR = Lao People's Democratic Republic; UNESCAP = United Nations Economic and Social Commission for Asian and the Pacific.

Note: These figures represent investments as of 2004 and 2005 that are backed by a financial commitment from either government or another source, including where construction will be carried out in the future. This does not represent the current level of investment in the highway sector, as the Asian Highway in a country is only part of the country's highway system and is based on UNESCAP 2006: 25–34.

Source: UNESCAP (2006c).

Table A5.2. Unmet Investment Needs for Asian Highway Identified Projects

Projects	Road Length (km)	Investment Need (\$ million)
Afghanistan	1,317	331
Kabul-Surubi	68	30
Kabul-Bamiyan	140	40
Kandahar-Gereshk	114	76
Heart-Andkhoy	550	80
Polekhumri-Hayratan	265	29
Balkh-Andkhoy	180	36
Bridge over the Ammour River	–	40
Armenia	276	116
Vaik-Gorhayq	75	30
Goris-Agarak (Islamic Republic of Iran border)	140	56
Bavra-Gumri	10	5
Border of Azerbaijan-Agarak-Meghri-Azerbaijan border	51	25
Azerbaijan	355	160
Kazakh-border of Georgia	38	20
Nakchivan-Sadarak-border of Turkey	92	46
Goradiz-Gazi Mammed	185	74
Ring Road connected AH5 and AH8 around Baku	40	20
Bangladesh	771	413
Daukandi-Chittagong (upgrading four lanes)	246	191
Chittagong-Cox's Bazar-Ramu-Gundam	186	144
Beldanga-Panchagarh	77	9
Dasuria-Paksey-Kushtia	38	4
Jhenaidah-Jessore	45	5
Bhutan		
Puentsholing-Thimpu (upgrading to doublelanes)	179	60

Projects	Road Length (km)	Investment Need (\$ million)
Cambodia	980	714
National Road Junction to Banlung (Rattanak Kiri)	125	44
Banlung (Rattanak Kiri)-Oyadav-border with Viet Nam	78	27
Battambang-Palin-border with Thailand	113	40
Preak Kdam-Thnal Keng	16	6
Snoul to Sen Monorom (Mondulkiri)-Lumphat (Rattanakiri)	335	117
National Road (NR) 7 Junction at Pratheath to Chhlong	57	20
Neak Leoung Mekong River Bridge	3	200
Siem Reap-Stung Treng	253	260
China, People's Rep. of	1,443	1,430
Jinghong-Mohan	343	1,160
Jinghong-Daluo	60	60
Kashi-Honqiraf	360	70
Lhaza-Zhangmu	680	140
Georgia	623	2,462
Poti-Tbilisi-Red Bridge	397	2,300
Poti-Batumi-Sarpi	87	123
Mtskheta-Kazbergi-Larsi	139	39
India	52	11
Shillong-Dwaki	7	6
India-India/Nepal border	10	1
Siliguri-Fulbari Mod-border with Bangladesh	16	2
Madurai-Dhanushkodi	19	2
Indonesia	572	29
Improvement and upgrading of various sections	160	14
Improvement and upgrading of various sections	412	15

Projects	Road Length (km)	Investment Need (\$ million)
Iran	927	1,224
Bazargan-Tabriz Freeway	280	250
Qazvin-Saveh Freeway	153	135
Khorramad-Andimeshk	159	200
Sirjan-Bandar Abbas	332	290
Quesm Bridge in the Persian Gulf	3	349
Lao PDR	316	63
Oudomaxay-Muangkhua-Tai Chang	202	40
Phiafai-Attapeu	114	23
Mongolia	3,120	454
Ulaanbaishint-Ulgii-Khovd-Bulgan-Yarant	785	114
Western link: Ulaanbaatar-Hovd	1,291	188
Eastern link: Baganuur-Ondorhaan-Choibalsan-Sumber-border with PRC	1,044	152
Myanmar	674	82
Myawadi (border with Thailand)-Kawkareik	40	19
Monyawa-Kalay/Kalewa	184	40
Kyaing Tong-Takaw-Loilem-Taunggyi	450	23
Nepal	328	135
New Koshi bridge at Chatara and widening of bridges	170	31
Naubise-Thankot (tunnel)-Kathmandu-Kodari upgrading	48	24
Kathmandu-Birgunj	110	80

Projects	Road Length (km)	Investment Need (\$ million)
Pakistan	2,076	776
Improvement of Sibi-Sariab	160	68
Lakpass Tunnel	–	9
Improvement of the Dalbandin-Naishki section	167	34
Dualization of Hassanbdal-Abbodtabad-Mansehra	90	51
Hub-Uthal	80	27
Improvement of Kuchlac-Zhob	306	60
Gwadar-Turban-Hoshab-Awaran-Khozdar	650	271
Hyderabad-Mirpurkhas-Umarkot-Khokhropar	222	50
Sehwan-Dadu-Ratodero	199	103
National Highway N70	202	103
Philippines	213	135
Tuguegarao City Bypass	8	5
Santiago City Bypass	3	2
San Jose City Bypass	7	8
Tiaong Bypass	3	2
Candelaria Bypass	9	5
Sariaya Bypass	8	5
Daraga Diversion Road	15	9
Sipocot-Putiao Diversion Road	58	36
Palo Bypass	4	2
Cebu North Coastal Road	9	6
Tagum City Bypass	13	8
Panabo City Bypass	10	6
Davao City Coastal Road	10	6
Cotabato City Bypass	12	7
Digos City Bypass	6	4
Koronodal City Bypass	10	6
General Santos City Bypass	14	9

Projects	Road Length (km)	Investment Need (\$ million)
Russian Federation	1,983	1,250
Moscow-Khabarovsk-Vladivostok	1,400	950
Moscow-Tambov-Volgograd-Astrakhan-Mahachkala	390	300
Border of Ukraine-Kursk-Voronezh-Saratov-border with Kazakhstan	–	–
Bridge over the Kigach River in Astrakhan-Atrau road section (bridge length is 393m)	3	11
Yekaterinburg-Tumen-Ishim-Omsk	140	60
Sri Lanka	144	916
Talaimannar-Medawachchiya	112	36
Land bridge connecting Sri Lanka and India	32	880
Viet Nam	565	3,024
Hanoi-Hai Phong Expressway (four to six lanes)	100	410
Bien Hoa-Vung Tau Expressway (four to six lanes)	90	600
Da Nang-Quang Ngai (four lanes)	140	700
Sai Gon-Long Thanh-Dau Day (four to six lanes)	55	350
Ha Noi-Lao Cai Wxpressway	290	600
Vinh-Cau Treo rehabilitation	85	44
Ha Noi Ring Road	65	600
Vang Phong Transshipment Hubport (two terminals, 700m, 500,000 TEU/year)	–	200
Rehabilitation of the Soai Rap Assess Channel in Ho Chi Minh City (for ships of 30,000 DWT assessable)	30	120
Total	25,587	17,425

\$ = United States dollar; AH = Asian Highway; DWT = deadweight tonnage; km = kilometer; Lao PDR = Lao People's Democratic Republic; m = meter; PRC = People's Republic of China; TEU = twenty-foot equivalent unit; UNESCAP = United Nations Economic and Social Commission for Asia and the Pacific.

– data not available.

Note: These figures represent investments needs in priority projects as of 2004 and 2005 that are not backed by any financial commitment from either government or another source, including where construction will be carried out in the future. This does not represent the current level of investment in the highway sector, as the Asian Highway in a country is only part of the country's highway system and is based on UNESCAP 2006: 25–34.

Source: UNESCAP (2006c).

Table A5.3. Indicative Investment Needs for Trans-Asian Railway Network Projects

Projects	Investment Need (\$ million)
Turkey	
Kars-Tbilisi-Baku Railway Line	420.0
Signaling Projects	866.5
Electrification Projects	346.9
Procurement of Ferrries, Piers Extension, Establishment of Maintenance and Repair Facility	67.0
Bangladesh	
Strengthening of Jamuna Bridge for higher axle load	25.0
Line capacity improvement between Dhaka and Tongi by introducing intermediate block signaling	5.0
Double tracking between Akhaura-Laksham and Dhaka-Laksham chord line	200.0
Upgrading of signaling at 19 stations along Chittangong-Akhaura section (West Zone)	25.0
Upgrading of signaling at 18 stations along Abdulpur-Parbatipur section (West Zone)	22.0
Double tracking of Chinkiastana-Laksham section, including signaling	70.0
Georgia	
Connecting rail networks of Georgia and Turkey (2008–2012)	215.0
Tbilisi-Poti Line (2008–2017)	450.0
Coastal Line Batumi-Kobuleti (2008–2011)	25.0
Senaki-Poti Line (2008–2011)	25.0
Kulevi Oil terminala	
India	
Dedicated freight corridors	7,800.0
Construction of missing links-Moreh (India)/Tamu (Myanmar)	649.0
Kazakhstan	
Mangishlak-Baytino	190.0
Epaliyev-Kypik	62.0
Yzen-border of Turkmenistan	250.0
Electrification of Kandiagash-Makat	298.0
Jezkazgan-Beiney	2,300.0
Korgas-Jetigen	775.0
Electrification of Almaty-Akogai	250.0

Projects	Investment Need (\$ million)
Electrification of Doystek-Aktogai	141.0
Electrification of Aktogai-Mointi	258.0
Kyrgyz Republic	
PRC-Kyrgyzstan-Uzbekistan (2009–2014)	1,400.0
Balkchy-Kochor-Kara-Keche (2009–2011)	136.4
Kara-Keche-Arpa (2011–2013)	570.0
Use of electric traction on Lugovaya-Bishkek railway (2015–2018)	100.0
Lugovaya-Balykchy railway (2011–2014)	65.0
Procurement of equipment for van repair shops (2011–2012)	4.0
Mongolia	
Sukhbaatar-Zamin Uud second railway line	2,900.0
Capacity Strengthening of Mongolian Railway	189.0
Tajikistan	
New line Kolkhozabad-Nizhniy Pianj (3 years)	55.0
Access line to Kunduss (Afghanistan) (3 years)	64.0
Electrification of Nau-Kanibadam Line section (2 years)	110.0
Modernization of telecoms and introduction of fibre optic cable (3 years)	20.2
Renovation of 142 km Khoshadi-Kurgan Tube line	28.4
Construction of new line Vachdat to Yavan	–
Republic of Korea	
Kyoubu Line	7,200.0
Honam Line	10,500.0
National Railway Development Plan (2006–2015)	43,000.0
Azerbaijan	723.9
Total	82,801.2

\$ = United States dollar; km = kilometer; PRC = People's Republic of China.

– data not available.

Source: United Nations Economic and Social Commission for Asian and the Pacific staff.

Table A5.4. Energy Projects Linking East and Southeast-Central-South Asia

Projects	Investment Need (\$ million)
Central Asia-China Natural Gas (Turkmenistan-PRC Gas Pipeline)	2,200
Turkmenistan-Afghanistan-Pakistan-India (TAPI) Gas Pipeline Project	7,600
Iran-Pakistan-India (IPI) Natural Gas Pipeline	7,000
Myanmar-Bangladesh-India (MBI) Gas Pipeline	1,000
Myanmar-India Hydro Power Project	5,175
Total	22,975

\$ = United States dollar; PRC = People's Republic of China.

Sources: China Post (2007), Aftab Maken (2008), Subhash Vohra (2008), Vinish Kathuria (2006), and Bhattacharya and Kojima (2008).

Table A5.5. Indicative Investment Needs for GMS Transport and Energy Projects

Projects	Investment Need (\$ million)	Implementation Period
Transport Projects		
Viet Nam		
Kunming-Haiphong Transport Corridor-Noi Bai-Lao Cai Hway	1,216.0	2008–2011
GMS Southern Coastal Road Corridor II	140.0	2012–2016
GMS East-West Corridor	140.0	2012–2015
Ha Noi-Lang Son Expressway	300.0	2011–2014
GMS Ha Long-Mong Cai Highway	1,000.0	2012–2015
Dau Giay-Lien Khuong Expressway	600.0	2011–2015
Van Phong Deep Sea Port	200.0	2010–2013
Second GMS Northern Transport Network Improvement: Luangprabang-Thanh Hoa	95.0	2008–2012
Lao PDR		
Second GMS Northern Transport Network Improvement: Luangprabang-Thanh Hoa	40.0	2009–2013
GMS East-West Corridor	23.0	2012–2015
Route14A: Junction Route 16-Lao PDR/Cambodian border	33.0	–
Route16A: Junction Route 16 Junction Route 11	34.0	–
Cambodia		
Rehabilitation of the Railway	73.0	2008–2012

Projects	Investment Need (\$ million)	Implementation Period
Thailand		
Highway Expansion Project	230.0	2009–2013
PRC		
Western Yunnan Roads Development II	250.0	2009–2013
Mengzhi-Hekou railway line	1,450.0	2010–2014
Lao PDR and Myanmar: bridge over Mekong between Xieng Kok and Kyaing Lap including access road	34.0	–
Subtotal for Transport Projects	5,858.0	
Energy Projects		
GMS Countries		
Subregional Strategy for Cooperation in Renewable Energy	1.2	2009
Developing the Regional Transmission and Regulatory Authority	1.0	2010–2012
Lao PDR, Thailand: GMS Nabong-Udon Thani Power Transmission and Interconnection	110.0	2010–2012
Lao PDR, Viet Nam: GMS 500 kV Lao PDR-Viet Nam Interconnection (Ban Sok-Pleiku)	270.0	2010–2012
Lao PDR: GMS Northern Power Transmission	53.5	2009–2011
Viet Nam-PRC (Yunnan) 500kV Power Interconnection	400.0	2010–2013
Cambodia: Transmission Line-220kV link between Kampot and Shihanoukville	52.4	2009–2010
Lao PDR-Cambodia-Viet Nam Power Interconnection: A Study	1.3	2009–2011
Lao PDR		
Lao PDR, Thailand: Nam Ngum 3,440 MW Hydropower Project	600.0	2009–2011
Lao PDR, Thailand: Nam Ngiep 1,261 MW Hydropower Project	380.0	2010–2012
Lao PDR, Thailand: Xe Pian-Xenamnoy 390 MW Hydropower Project	400.0	2009–2012
PRC, Lao PDR, Thailand		
PRC Thailand Power Transmission through Lao PDR	70.0	2009–2013
Lao PDR, Viet Nam		
Nam Mo-Ban Mai Interconnection Project	14.4	2010–2013
Nam kong 1 (Lao PDR) 100 MW Hydropower Project	250.0	2009–2012
Subtotal for Energy Projects	2,603.8	

\$ = United States dollar; GMS = Greater Mekong Subregion; kV = kilovolt; Lao PDR = Lao People's Democratic Republic; MW = megawatt; PRC = People's Republic of China.

– data not available.

Sources: ADB (2008a, 2008d).

Table A5.6. Other Energy Projects in Southeast Asia

Projects	Investment Need (\$ million)
Thailand-Cambodia Transmission PTL	7.0
Peninsular Malaysia-Sumatra	143.0
Batam (Indonesia) Singapore PTL Project	177.0
Malaysia-Brunei Darussalam PTL Project	18.4
Malaysia-West Kalimantan PTL	18.4
Thailand-Lao PDR PTL	124.8
Thailand-Myanmar PTL	91.2
Lao PDR-Viet Nam PTL Project	117.6
Viet Nam-Cambodia PTL	7.2
Lao PDR-Thailand; Nam Theun 2 HPP	2,477.6
Lao PDR-Thailand; Nam Ngum HPP	1,400.5
Lao PDR-Thailand; Xe Pian HPP	887.9
Lao PDR-Thailand; Xe Khaman 1	1,065.8
Myanmar-Thailand; Tasang HPP	8,200.0
PRC-Thailand; Jinghong HPP	3,416.6
PRC-Thailand; Nuozhadu HPP	12,527.8
Cambodia-Viet Nam; Sambor CPEC HPP	1,059.0
BIMP-EAGA Renewable Energy Investment Fund	100.0
Trans-ASEAN Gas Pipeline	7,000.0
Total	38,839.80

\$ = United States dollar; ASEAN = Association of Southeast Asian Nations; BIMP-EAGA = Brunei Darussalam-Indonesia-Malaysia-Philippines East ASEAN Area; HPP = hydropower plant; Lao PDR = Lao People's Democratic Republic; PRC = People's Republic of China; PTL = power transmission line.

Note: Except for Trans-ASEAN gas pipeline estimates, the rest of the projects were based on Bhattacharya, A. and Kojima, S., "Impact of Cross Border Energy Infrastructure Investment on Regional Environment, Society and Climate Change," background paper for Flagship Study, 31 October 2008 wherein the source of energy projects is ASEAN Centre for Energy (2008) and the investment costs have been estimated using the data provided in the Annex-1 of Von Hippel (2001).

Sources: ASEAN Center for Energy (2005), and Bhattacharya and Kojima (2008).

Table A5.7. CAREC Transport, Trade Facilitation, and Energy Projects

Projects	Investment Need (\$ million)	Implementation Period
Transport and Trade Facilitation Projects		
Afghanistan		
Leman-Armalick Road	30.0	2009–2010
Kazakhstan		
Astana-Karaganda Road Rehabilitation	1,000.0	2009–2012
Almaty-Kapchagay Road Rehabilitation	580.0	2009–2011
Aktau-Beyneu Road Rehabilitation	550.0	2009–2012
Rehabilitation of Western Europe-Western PRC Transit Corridor	6,561.0	2009–2012
Electrification of Almaty-Aktogay Railway Section	243.0	2009–2011
Electrification of Dostyk-Aktogay Railway Section	134.0	2009–2011
Electrification of Aktogay-Mointy Railway Section	250.0	2009–2011
Expansion of Shymkent, Semey, and Kokchetau Airports	163.0	2009–2011
Kyrgyz Republic		
Bishkek-Torugart Road Rehabilitation	300.0	2009–2014
CAREC Regional Road Corridor Improvement (Sary Tash-Karamik)	39.5	2009–2012
Electrification of Bishkek-Balykchy Railway	100.0	2015–2017
Track Rehabilitation Project (Chaldovar-Balykchy)	65.0	2011–2014
Equipment Purchase for Wagon Repair/Maintenance Facility	4.0	2011–2012
Electrification of Bishkek-Balykchy Railway	100.0	2015–2017
Track Rehabilitation Project (Chaldovar-Balykchy)	65.0	2011–2014
Equipment Purchase for Wagon Repair/Maintenance Facility	4.0	2011–2012
Rehabilitation of Osh Airport	40.0	2011–2012
Kyrgyz Air Traffic Control Capacity Enhancement	4.5	2009–2013
Mongolia		
Western Regional Road	200.0	2008–2011
Ulaanbaatar-Russian Border Road Rehabilitation	120.0	2010–2013
Improvement of Olgiy and Hovd Airports	25.0	2009–2010
New International Airport in Ulaanbaatar	280.0	2010–2015
Establishment of Altanbulag Free Trade Zone	90.0	2010–2011
Improvement of Tsaganuur Free Trade Zone	30.0	2010–2011
Establishment of Zamyn-Uud Free Trade Zone	100.0	by 2015

Projects	Investment Need (\$ million)	Implementation Period
Tajikistan		
Dushanbe-Tursunzade-Uzbek Border Road	100.0	2010–2012
Uzbekistan		
CAREC Regional Road Improvement	173.5	2009–2011
Regional Railway	50.0	2011–2015
Acquisition of New Locomotives	25.0	2009–2010
Electrification of Kashi-Tashguzar Baisun-Kumgurgan Section	180.0	2011–2014
Electrification of Samarkand-Navoi and Samarkand-Kashi Sections	185.0	2011–2014
Electrification of Navoi-Bukhara and Bukhara-Kashi Sections	195.0	2011–2014
Electrification of Navoi-Uchkuduk Section	180.0	2011–2014
Azerbaijan		
Acquisition of High Capacity Ferries and Ro/Ros	69.0	2010–2013
CAREC countries		
Enhancements of IT Systems at Customs	5.0	2011
Border Post Improvements and Joint Border Processing	200.0	2009–2017
Trade and Industrial Logistic Centers with Information Exchange System	150.0	2011–2014
CAREC Transport Corridor 1b	6,700.0	from 2009
Caucasus Corridor (Armenia-Georgia Regional Transport Project)	323.0	–
CAREC Transport Corridor 2	1,800.0	2009–2012
Subtotal (Transport and Trade Facilitation)	21,413.5	
Energy Projects		
Afghanistan		
Transmission and distribution rehabilitation in Afghanistan to enable the country to absorb the imported power from Iran, Turkmenistan, Uzbekistan, and Tajikistan and distribute it to load centers.	784.6	*
Azerbaijan		
Rehabilitation of the T&D system in the gas sector as well as gas flaring reduction.	336.5	*
Study for improving the economics of BTC oil pipeline and BTE.	0.1	*
Construction of a set of 330 kV, 220 kV, and 110 kV transmission lines and substations to improve interconnection of the Azeri power system with those of the Russian Federation, Georgia, and Iran to enable larger power flows among these systems.	107.1	*

Projects	Investment Need (\$ million)	Implementation Period
Kazakhstan		
Completion of the oil pipeline section from Kenkiyak to Kumkol, to enable the full intended level of exports of Kazakh oil to the PRC.	453.7	*
Capacity expansion of CPC oil pipeline to Novorossiysk from 28 to 67 million tons/year including Kazakh oil of 50 million tons/year.	1,286.3	*
Kazakhstan Caspian Transportation System (KCTS) to export oil from Tengiz, Kashagan, and Karachaganank field westwards.	1,015.4	*
Caspian Littoral Gas Pipeline 1000 km long running along the existing Central Asia Center IV pipeline from Turkmenistan to the Russian Federation via Uzbekistan and Kazakhstan.	461.5	*
Construction of the second North-South 500 kV power transmission line (1,115 km long) in Kazakhstan to enable 600 MW of power to move from north to south Kazakhstan.	160.2	*
A project on the border river (Khorgos River) involving the construction of a series of dykes with flood control and irrigation benefits and with a cascade of small HPPs totaling 21 MW. All benefits to be shared equally between Kazakh and Chinese sides.	9.7	*
Construction of a 300 MW Moinak HPP on Charyn River in South Kazakhstan by a Kazakh-Chinese Joint Venture with a credit of \$200 million provided by the PRC. Scheduled for completion in 2009 and output will reduce power deficit in South Kazakhstan.	143.1	*
Kyrgyz Republic		
Transmission and distribution Rehabilitation in the power sector.	115.4	*
Kyrgyz Link to CASAREM line: Rehabilitation of 140 km of 220 kV line between Alai S/S and Aigul Tash S/S, construction of a new 207 km long 220 kV line between Alai and Datka where a new 500/220 kV substation would be constructed.	38.5	*
Construction of 400 km long 500 kV transmission line from Kemin (northern border) to Datka.	175.4	*
Construction of Kamarata II HPP (360 MW) (1,100 GWh), along with associated 500 kV transmission line.	129.3	*
Construction of Kamarata I HPP (1,900 MW storage) (5,100 GWh) with associated 500 kV transmission links to Kemin in Kyrgyzstan.	895.4	*
Transmission and distribution Rehabilitation in the Natural Gas Sector.	23.1	*
Mongolia		
Distribution Rehabilitation and Power System loss reduction in Mongolia.	15.9	*
Tajikistan		
Loss reduction in power and gas sectors in Tajikistan Capital.	167.1	*
Rehabilitation of Nurek HPP and its switch yard, Kairakum HPP, Golovnaya HPP, and Varzob Cascade HPPs to increase capacities by 550 MW (270-300 GWh) in Tajikistan.	184.6	*

Projects	Investment Need (\$ million)	Implementation Period
Construction of Sangtuda I HPP (670 MW) (2,700 GWh).	323.1	*
Sangtuda II HPP (220 MW) (930 GWh).	92.3	*
Tajikistan Rogun Storage hydro (3,600 MW) (13,000 GWh). Incremental capital cost for completing the project.	1,130.8	*
Tajikistan North-South 500 kV transmission line (350 km long) and associated substations. Power transfer capacity from 600 to 800 MW.	129.7	*
Tajikistan: 220 kV double circuit transmission line from the Nurek area to Afghanistan border (about 110 miles) to enable 300 MW of export to Afghanistan.	15.2	*
CASAREM transmission line (750 km long, 450 kV HVDC line) from Sangtuda I HPP area in Tajikistan to Peshawar in Pakistan via Afghanistan.	242.8	*
Yavan HPP on Zarafshan river (150 MW) (540 GWh) including 60 km of associated 220 kV transmission lines.	120.2	*
Development of a captive coal mine at Fon Yagnob and construction of a coal fired power plant (1,000 MW) (6,000 GWh) in Tajikistan.	738.5	*
Uzbekistan		
Construction of 220 km of 500 kV transmission line from Syrdarya TPP to Sogdiana Sub Station.	31.3	*
Construction of 217 km of 500 kV transmission line from Sogdiana S/S to Talimardjan TPP.	43.9	*
Construction of a 190 km long 500 kV line along with associated substation expansions from Surhan 500 kV substation to Guzar 500 kV substation.	50.3	*
Pipeline reinforcements in Uzbekistan to augment the transport capacity of (a) Bukhara-Ural gas pipeline, (b) Central Asia Center gas pipeline to the Russia Federation, and (c) expansion of compressor station No.5 at Ghazli.	98.8	*
Central Asia-South Asia Regional Electricity Market (CASAREM)	962.0	–
Regional Power Transmission Interconnection Project	109.5	–
Northeast Power System (NEP) Afghanistan	270.0	–
Subtotal (Energy)	10,861.3	
Grand Total	32,274.8	

§ = United States dollar; BTC = Baku-Tbilisi-Ceyhan; BTE = Baku-Tbilisi-Erzurum; CAREC = Central Asia Regional Economic Cooperation; CASAREM = Central Asia and South Asia Regional Electricity Market; CPC = Caspian Pipeline Consortium; GWh = gigawatt-hour, HPP = hydropower plant; IT = information technology; km = kilometer; kW = kilowatt; MW = megawatt; PRC = People's Republic of China; S/S = substation; T&D = transmission and distribution; TPP = thermal power project/thermal power plant.

– data not available.

* Figures presented are the result of recalculations to reflect 2009–2020.

Note: For the energy projects, except the last three projects (CASAREM, Regional Power Transmission Interconnection Project, and NEP), the computation of total estimated investment need is classified into short term (2008–2009), medium term (2010–2014), and long-term (2015–2027) or spanning the 2008–2027 duration. CAREC programs include Afghanistan and two provinces of the PRC (Xinjiang Uygur Autonomous Region and Inner Mongolia). These two countries were originally under the subregion of East Asia according to ADB's classification.

Sources: ADB staff, Bhattacharyay (2008), and CAREC (2008c).

Table A5.8. Transport Logistics and Energy Projects in South Asia

Projects	Investment Need(\$ million)
Transport Logistics Projects	292.5
ICT: SASEC Information Highway Project (Bangladesh, Bhutan, India, and Nepal)	24.0
RETA-6435 REG: SASEC Transport Logistics and Trade Facilitation (formerly Subregional Transport Connectivity and SASEC Multimodal Transport and Trade Facilitation):	
Sub-regional Transport Logistics and Trade Facilitation Project (Bangladesh)	23.0
Sub-regional Transport Logistics and Trade Facilitation Project (Nepal)	58.0
Sub-regional Transport Logistics and Trade Facilitation Project (Bhutan)	48.0
Sub-regional Transport Logistics and Trade Facilitation Project (India)	50.0
Improving Connectivity and Destination Infrastructure for Subregional Tourism Development	89.5
Energy Projects	6,845.6
Green Power Development (Bhutan)	234.5
West Seti Hydroelectric Project	1,700.0
Bhutan-India Hydropower Plant Projects	3,744.1
Bangladesh-India Power Project (Tata Group Proposal)	1,025.0
India-Sri Lanka Grid Connection	133.0
Bangladesh-Bhutan-Nepal-India Multilateral Power Line Interconnection	9.0
Total	7,138.1

\$ = United States dollar; ICT = information and communication technology; REG = Regional, RETA = Regional Technical Assistance; SASEC = South Asia Subregional Economic Cooperation.

Sources: ADB staff, Bhattacharya and Kojima (2008), and Bhattacharyay (2008).

Table A5.9. Description of High-Priority GMS Energy and Transport Projects

Projects	Brief Description
Transport Projects	
1. GMS: Kunming-Hai Phong Transport Corridor-Noi Bai-Lao Cai Highway	<ul style="list-style-type: none"> • The project will construct a 244 km long, access-controlled highway starting at Noi Bai in a suburb of Hanoi and ending at Lao Cai on the border with the PRC in northwest Viet Nam, forming an integral section of the GMS Eastern Corridor identified in the GMS Transport Sector Strategy (2006–2015). • It will provide an efficient, safe, and reliable high-standard transport link between the PRC’s Yunnan Province and Hanoi, Hai Phong port, and Cai Lan port in northern Viet Nam, thus helping to enhance cross-border trade and access to seaports by the more interior areas of the GMS. • Estimated cost: \$1,216 million
2. Second GMS Northern Transport Network Improvement	<ul style="list-style-type: none"> • The project involves upgrading around 200 km of Route 217 in Thanh Hoa Province in Viet Nam and around 140 km of sections of Routes 6, 6A, and 6B in Houaphanh Province in the Lao PDR, which are part of the GMS Northeastern Transport Corridor. • It will also include a total of about 200 km of rural access roads linking the corridor to the hinterlands in the Lao PDR and Viet Nam. • Estimated cost: \$135 million
3. Rehabilitation of the Railway in Cambodia	<ul style="list-style-type: none"> • The project involves physical rehabilitation of the railway in Cambodia, which is among the national railway links that have to be rehabilitated and upgraded to complete the Singapore-Kunming Railway Link (SKRL). The rehabilitated Cambodian railway line will connect to the railway in Thailand at the border in Poipet and run through Sisophon, through Phnom Penh, to the port at Sihanoukville. • It also includes the restructuring of the railway organization, inclusive of establishing a PPP to operate it. • Estimated cost: \$73 million
4. Ha Long-Mong Cai Expressway	<ul style="list-style-type: none"> • The project will construct an expressway in northern Viet Nam between Ha Long and Mong Cai on the border with Guangxi Zhuang Autonomous Region in the PRC. • The expressway is part of the GMS Eastern Corridor and will be linked to the planned Fangcheng–Dongxing Expressway in the Guangxi Zhuang Autonomous Region, and will thus promote efficient cross-border movement of goods and people in the area. • Estimated cost: \$1,000 million
5. GMS Hanoi-Lang Son Expressway	<ul style="list-style-type: none"> • The project will construct an expressway from Ha Noi to the Vietnamese province of Lang Son at the border with Guangxi Zhuang Autonomous Region in the PRC. • In addition to being part of the GMS Eastern Corridor, the expressway is also part of the PRC-Viet Nam “two corridors-one economic belt” initiative, which aims to further enhance trade and investment flows between the two countries. • Estimated cost: \$900 million

Projects	Brief Description
Energy Projects	
6. GMS Northern Power Transmission	<ul style="list-style-type: none"> • The project will develop/strengthen 115 kV transmission lines across the northern provinces of Louangnamtha, Phongsali, Oudomxai, Xaignabouri, and Vientiane in the Lao PDR, and includes three new substations and low/medium voltage distribution facilities for rural electrification. • Expected project benefits include (i) providing power to rural areas in the northern region of the Lao PDR with no access to the grid, thus improving livelihoods; (ii) boosting infrastructure supportive of economic growth in these areas; (iii) improving reliability of power supply; and (iv) strengthening power interconnection with Thailand. • Estimated cost: \$53.5 million
7. GMS Nabong-Udon Thani Power Transmission and Interconnection	<ul style="list-style-type: none"> • The project will construct 27 km of 500 kV transmission line from Na Bong substation in the Lao PDR to the border with Thailand to evacuate power to Thailand from four hydropower projects in the Lao PDR, with a total capacity of 1,500 MW. • Expected project benefits include (i) providing revenues to the Lao PDR government; (ii) leveling the playing field for private investors; and (iii) enabling power trade, which will lower tariffs, reduce investment costs, and lead to more secure power supply. • Estimated cost: \$110 million
8. Lao PDR-Viet Nam Power Interconnection (Ban Sok-Pleiku)	<ul style="list-style-type: none"> • The project will construct a 500 kV transmission line from Ban Sok (Lao PDR) to Pleiku (Viet Nam) to export power from six hydropower plants in the Lao PDR (Dak Emeule, Sekong 3A/3B, Sekong 4, Sekong 5, Xe Ka Man 1, and Nam Kong 1) to Viet Nam. • Expected project benefits include (i) increasing power export capacity from the Lao PDR to Viet Nam; (ii) generating revenues for the Lao PDR's development projects; and (iii) ensuring stable, low-cost power in Viet Nam. • Estimated cost: \$270 million
9. GMS Nam Ngiep 1 Hydropower Project	<ul style="list-style-type: none"> • The project will construct the Nam Ngiep 1 Hydropower Plant, with a capacity of 260 MW (for export to Thailand) plus 20 MW for the use by the Lao PDR under a PPP arrangement. • It includes the construction of 230 kV transmission lines to connect the plant to the Na Bong substation and related 115 kV lines to connect the power station. • Expected benefits include (i) generating revenues for the Lao PDR's environmental conservation and poverty reduction initiatives (livelihood, rural infrastructure, water, health, and education), and (ii) realizing economic benefits from power trade. • Estimated cost: \$380 million
10. GMS Nam Ngum 3 Hydropower Project	<ul style="list-style-type: none"> • The project will develop, construct, and operate a 440 MW hydropower plant under a BOT arrangement. • It includes the construction of a 250 kV line to Na Bong substation, and a 200 kV line from Na Bong to the grid at Pakpeng. • Expected benefits include (i) generating foreign exchange and boosting domestic power supply for the Lao PDR while meeting Thailand's power needs, and (ii) providing support for the Lao PDR's development and poverty reduction undertakings. • Estimated cost: \$600 million

\$ = United States dollar; GMS = Greater Mekong Subregion; km = kilometer; kV = kilovolt; Lao PDR = Lao People's Democratic Republic; MW = megawatt; PPP = public-private partnership; PRC = People's Republic of China.

Source: ADB staff, Bhattacharyay (2008).

Table A5.10. Description of High-Priority CAREC Transport and Energy Projects

Projects	Brief Description
Transport Projects	
1. CAREC Transport Corridor 1b	<ul style="list-style-type: none"> • The corridor in Kazakhstan runs from Korgas at the border with the PRC to Zhaisan at the Russian Federation border via Almaty and Shymkent. Rehabilitation of this segment, together with the planned improvement of the border crossing at Korgas and the ongoing development of the high-tech logistics centers in Almaty and Aktobe, as well as the Khorgas Global Logistics Center in Xinjiang, PRC, will facilitate trade between Europe and East Asia. • This corridor is underpinned by road investments made in the PRC, Kyrgyz Republic, and Tajikistan. In this sense, the corridor is an integral part and flagship transaction under CAREC. Further, the corridor paves the way and justifies the development of the North-South Corridor, which runs into Uzbekistan, Turkmenistan, Afghanistan, and Pakistan. Each of these corridors will be backed by work at the national level on rural access roads. • The output of the investment program will be (i) around 480 km of constructed highway sections in Zhambyl Oblast, and (ii) an improved road operation and maintenance system. The highway is the main route between the western PRC, Central Asian countries, and the Russian Federation. The investment program will help the government accelerate the completion of the entire corridor. The investment program is split into several projects, and comprises reconstruction of the existing roads and construction of new roads. Project 1 will have two major components: (i) a road development component, targeting construction of 125 km of highway sections between Taraz and Korday in Zhambyl Oblast; and (ii) a road operation and maintenance component. • Estimated investment need: \$6,700 million
2. Caucasus Corridor: Armenia-Georgia Regional Transport Project	<ul style="list-style-type: none"> • Armenia and Georgia, because of their geographical location and relative isolation, rely on smooth and efficient transport links to neighboring countries, particularly through the major road corridors. The proposed regional transport project will address the weakest segments of the important North-South Corridor, which runs from the ports in Georgia in the north, through Armenia, to Iran in the south. Because of the significant increases in traffic in recent years, the current North-South Road Corridor requires upgrading and rehabilitation in order to cope with future traffic effectively. It is estimated that Armenia will receive 80% of the project benefits and Georgia 20%. • Project scope will include (i) road connectivity and safety improvement, (ii) cross border infrastructure and facilities improvement, (iii) capacity development, and (iv) project supervision and management. • Estimated investment need: \$323 million
3. CAREC Transport Corridor 2	<ul style="list-style-type: none"> • The improvement of the railway line from Baku, Azerbaijan, to Beyuk Kesik at the Georgia border along CAREC Corridor 2 is a Program priority project scheduled for implementation in 2009–2012. The corridor carries a significant volume of transit cargo of oil and oil products from Kazakhstan and Turkmenistan to European markets. These, together with the ongoing improvement of the CAREC Corridor 2 road segment and border crossing at Beyuk Kesik, will increase the transport capacity of the corridor. • Estimated investment need: \$1,800 million

Projects	Brief Description
<p>4. Western Regional Road Corridor Development Project-Mongolia</p>	<ul style="list-style-type: none"> • Under the proposed Western Regional Road Corridor Development Project, a 748.4 km road corridor will be developed through the western region of Mongolia connecting Yarant at the PRC border to Ulaanbaishint at the Russian Federation border via Hovd and Olgij, the aimag (province) centers. Making up a portion of Asian Highway 4 and a component of the larger UNESCAP-designated Asian Highway Network, the road corridor will link Mongolia with both the PRC and the Russian Federation, facilitating the flow of goods and passengers among the three countries. The proposed road corridor will be developed in two phases. Under phase I, a 431.2 km road from the PRC border to Hovd aimag center will be developed. Phase II will develop a road from Hovd aimag center to the Russian Federation border. • The project supports Mongolia's priority development plan of building roads for the Asian Highway under the national development strategy, which is based on the MDGs. As part of the Asian Highway Network, the project road will serve as an important route for domestic and international traffic. The proposed road corridor will also facilitate sustainable economic growth in the two most western aimags of Mongolia (Hovd and Bayan-Olgij), which had a poverty rate of 38.7% in 2006 compared with the national average of 32.2% and Ulaanbaatar's 20.4%. • The proposed road corridor will strengthen Mongolia's transport links to the PRC and the Russian Federation as well as other countries in the region. • Estimated investment need: \$220 million
<p>Energy Projects</p>	
<p>5. Central Asia-South Asia Regional Electricity Market (CASAREM)</p>	<ul style="list-style-type: none"> • This project is the most important regional cooperation investment for the Central Asian region today. The objective of the proposed project is to develop the regional electricity trade between Central Asian and South Asian countries, given that significant potential for exports of hydropower, and to a lesser extent thermal power, exists in the Kyrgyz Republic and Tajikistan. Meanwhile, Afghanistan and Pakistan are in electric power deficit and are thus large potential importers. • There are potentially huge economic gains from the export of surplus power from Central Asia to two energy-deficient countries of South Asia—Afghanistan and Pakistan. Establishing this crucial link between the energy networks of Central and South Asia would also facilitate the development of the large hydropower potential in two Central Asian countries—the Kyrgyz Republic and Tajikistan. The impact of this flagship project on growth and poverty reduction in all four participating economies will be significant. • The project will put in place initial interconnection infrastructure. The facilities will involve (i) a high voltage direct current (HVDC) transmission system between Tajikistan and Pakistan via Afghanistan to include 750 km of 500 kV DC overhead line, an alternating current (AC) to a direct current (DC) converter station in Tajikistan, and DC/AC converter stations in Afghanistan and Pakistan; and (ii) an AC transmission link between the Kyrgyz Republic and Tajikistan to supply Kyrgyz electricity to South Asia via Tajikistan. The scope of the proposed project includes developing the associated institutional and legal framework to enable such electricity trade. • Estimated investment need: \$962 million

Projects	Brief Description
6. Regional Power Transmission Interconnection Project	<ul style="list-style-type: none"> • The project will interconnect the power grids in Afghanistan and Tajikistan. Its scope will cover the construction of a 220 kV double-circuit transmission line that will link the hydropower stations located on the Vakhsh River in Tajikistan to the border town of Sherkan Bandar; then to Kunduz, Baglan, and Pul-e-Khumri in Afghanistan. This line will be linked ultimately to Afghanistan's major electricity demand center, Kabul, through the Afghan 220 kV corridor currently under construction, linking Pul-e-Khumri to Kabul. • The project will also include upgrading and new investments in Tajikistan that will help reduce the winter power deficit by (i) increasing the available level of power generation, and (ii) decreasing the level of technical losses in south Tajikistan. Both measures will aim to export 300 MW to Afghanistan and to generate an additional 320 GWh annually in Tajikistan. • The project is in line with the governments' strategies and policies. In Afghanistan, the policy is to provide reliable power supply to all Afghans. In Tajikistan, the policy is to maximize the use of its hydropower assets. • Estimated investment need: \$109.5 million

\$ = United States dollar; CAREC = Central Asia Regional Economic Cooperation; GWh = gigawatt-hour; km = kilometer; kVDC = kilovolt direct current; MDG = United Nations' Millennium Development Goals; MW = megawatt; PRC = People's Republic of China; UNESCAP = United Nations Economic and Social Commission for Asia and the Pacific.

Sources: Bhattacharyay (2008) and ADB staff.

Table A5.11. Description of High-Priority Transport and Energy Projects in South Asia

Projects	Brief Description
Transport Projects	
1. Information Highway Project in South Asia (Bangladesh, Bhutan, India, and Nepal)	<ul style="list-style-type: none"> • To support the South Asia information highway initiative, the project has three components: (i) a South Asia regional network with fiber-optic and data interchange capacity, directly connecting the four South Asian countries; (ii) a South Asia village network expanding broadband ICT access to 110 rural communities in the South Asian countries and directly connecting the communities for local networking and information sourcing; and (iii) a South Asia research and training network building technical and business skills in ICT, particularly in developing local content and e-applications (such as eGovernment, eLearning, tele-medicine, eRemittance, and eCommerce) for the needs of the poor. • Estimated investment need: \$24 million
2. Subregional Transport Logistics and Trade Facilitation Projects (Bangladesh, Bhutan, India, and Nepal)	<ul style="list-style-type: none"> • For Bangladesh, the project outputs will include a rehabilitated rail link in the Agartala-Akhaura section of around 10 km and recommended operational arrangements of rail services including the changes in the location of transshipment of cargoes from meter gauge to broad gauge and the location of locomotive exchange. Institutional arrangements for transit cargo in respect of customs clearance and border facilities will be improved at both Chittagong and Agartala. • For Bhutan, the project outputs will include improved road corridors of about 314 km and local connections, transit arrangements and facilities, and strengthened institutional governance capacity in land port administration. It will make trade and transport management more efficient and effective. • For India, the project will cover a rehabilitated Kakarvitta-Panitanki-Fulbari-Banglabandha road, and the Agartala-Akhaura-Chittagong rail link that will facilitate smoother transport to neighboring countries. • For Nepal, outputs will include improved trade corridors, transit arrangements and facilities, and strengthened institutional capacity in land port administration and customs administration for goods clearance. It will make trade and transport management more efficient and effective. • Estimated investment need: \$179 million

Projects	Brief Description
<p>3. Improving Connectivity and Destination Infrastructure for Subregional Tourism Development (Bangladesh, Bhutan, India, Nepal, and Sri Lanka)</p>	<ul style="list-style-type: none"> • For Bangladesh, the project will promote a new tourism circuit connecting Bagdogra, the subregional hub in India, with a heritage-focused corridor in the western regions of Bangladesh, which is connected to Kolkata via the border point at Benapole. The scope includes (i) improvement of four key cultural heritage sites along the heritage highway through conservation of heritage structures and environmental services, and (ii) support for capacity building of sector agencies and fostering community engagement in tourism and heritage site management. • For Bhutan, the project intends to reinstate a circuit that links with India's West Bengal and Assam in the southwest and southeast border points. The circuit forms part of the Great Himalayan Trail that extends the full length of the Himalaya range through Nepal, India, and Bhutan, linking established trekking areas with remote valleys in between. The scope involves (i) nature- and culture-based tourism destination development in central and eastern Bhutan, including small-scale facilities such as parking, toilets, trail improvements, interpretative signs, and waste management systems in selected sites and trails; (ii) development of a domestic airport in Trashigang in east Bhutan; and (iii) capacity building of relevant public agencies and communities in management of tourism infrastructure and natural and cultural heritage sites. • For India, the project will focus on Sikkim state, which has a good road connection to Bagdogra, a regional hub, and an airport site with potential links to North Bangladesh, East Nepal, Bhutan, and other northeastern Indian states. Sikkim is part of the subregional Buddhist circuit and the Great Himalayan Trail. The project for the Sikkim state of India involves (i) access and on-site infrastructure and visitor facility improvements to the well-known Buddhist monastery of Rumtek; (ii) nature-based tourism destination infrastructure and facilities including trail development, signage, sanitation improvements, other tourist facilities, and a subregional training institute to be specialized in ecotourism and mountaineering; and (iii) related capacity building activities for public sector institutions and communities in tourism and heritage management. • For Nepal, the project will develop the Nepal portion of the "Footsteps of the Lord Buddha Circuit." It will include (i) upgrading of the nearest airport to Lumbini (Bhairawaha airport) to enable direct access by visitors from the region and western markets to Lumbini; (ii) Lumbini site improvements (e.g., water, sanitation, and road improvements; construction of a visitor center; and landscaping work around the visitor center); and (iii) a capacity building program to strengthen sector agencies and to foster involvement of communities in tourism and heritage site management. • Estimated investment need: \$89.5 million

Projects	Brief Description
Energy Projects	
4. Green Power Development (Bhutan)	<ul style="list-style-type: none"> • The Dagachhu hydropower development project will be a 114 MW run-of-river operation with minimal adverse environmental and social impacts. Generated power will be sold to India through the existing grid connected to India. • The rural electrification system will be extended to provide a clean and reliable power supply to rural areas, mainly in seven districts of Bhutan. It will electrify 8,767 domestic households and facilities in the remote central and eastern regions. In addition to the grid extension, 119 solar photovoltaic systems, using an emerging energy-efficient technology, will be installed to support electrification in isolated off-grid rural areas, especially in schools, health clinics, monasteries, and other community facilities. • Estimated investment need: \$234.45 million
5. West Seti Hydroelectric Project (Nepal)	<ul style="list-style-type: none"> • The project will (i) facilitate generation of 750 MW of electricity, (ii) ensure that social and environmental impacts have been properly identified and impacts mitigated (iii) support sufficient allocation and proper channeling of project revenues to poverty reduction initiatives, (iv) improve quality of life, and (v) promote capacity building for implementation of hydropower projects. • The project will build a 195 meter high storage type dam for generation of 750 MW of hydroelectricity. • The project will also build 132.5 km of 400 kV double circuit transmission line from the project switchyard to the Nepal-India border at Mahendranagar in Kailali District. Another 98 km of transmission line will be built by the Power Grid Corporation of India in Uttar Pradesh within India to link it to the Indian grid. • The project will utilize Nepal's natural resources and will provide construction opportunities for the PRC and power exports to India. It will be developed through a PPP to leverage private capital and maximize the impacts of the government investment. • Estimated investment need: \$45 million

\$ = United States dollar; ICT = information and communication technology; km = kilometer; kV = kilovolt; MW = megawatt; PPP = public-private partnership; PRC = People's Republic of China.
 Sources: ADB staff and Bhattacharyay (2008).

Table A5.12. Additional Transport and Energy Projects (Identified and in the Pipeline) Without Available Investment Estimates

Region/Subregion	Number of Projects		
	Transport	Energy	Total
Asia-Wide			
Trans-Asian Railway	40	–	40
East/Southeast-Central-South Links	4	1	5
Southeast Asia			
GMS	24	6	30
ASEAN	2	1	3
East Asia	–	6	6
Central Asia	–	8	8
South Asia	2	1	3
Total	72	23	95

ASEAN = Association of Southeast Asian Nations; GMS = Greater Mekong Subregion.

– data not available.

Source: Bhattacharyay (2008).

Table A5.13. Trans-Asia Railway Projects Without Available Investment Estimates

Countries and Railway Projects
Bangladesh
Construction of missing link from Dohazari to Gundum (border with Myanmar)
Georgia
Establishment of container block trains Poti-Tbilisi Baku (2008–2011)
Tbilisi airport line
Poti Station
Mongolia
Zamin Uud Intermodal Terminal
Gobi Region Railway Network
Eastern Region Railway Network
Sri Lanka
Northern line
Coast line
Connecting line

Countries and Railway Projects

Iran

Construction of Sangan-Herat rail line (link to Afghanistan)
Construction of Qazvin-Rasht-Astara (link to Azerbaijan and on to the Russian Federation)
Construction of Arak-Kermanshah-Khosravi (construction)
Construction of high-speed line Tehran-Qom-Esfahan
Construction of Gorgan-Bereket-Gyzylgaya (Turkmenistan)-Uzen (Kazakhstan) (link to Turkmenistan and Kazakhstan)
Construction of Khoramshahr-Bazra line (connection to port)
Construction of Esfahan-Shiraz
Construction of Fahraj-Port of Chabahar line section (connection to port)
Double-tracking of Miyaneh-Bostanabad-Tabriz line (capacity enhancement of east-west corridor)
Electrification of Tehran-Mashhad route
Electrification of Tabriz-Azershahr route
Electrification of Tehran-Qom-Esfahan
Renewal Projects: South railways
Renewal Projects: Tehran-Mashhad
Renewal Projects: North Railways
Upgrading: Switch welding on Tehran-Mashhad line
Upgrading: axle-load increase
Upgrading: Strengthening of bridges against earthquake
Capacity Enhancement: Bafq-Bandar Abbas (double-tracking of Bafq-Bandar Abbas)
Capacity Enhancement: Bandar Imam-Ahwaz
Capacity Enhancement: Sarkahs-Kashmar (3rd Motohari-Fariman-Kashmar)
Capacity Enhancement: Kashmar-Razi (3rdline Garmsar-Bahram)
Capacity Enhancement: Kashmar-Bandar Abbas
Signaling and telecom: Bafq-Bandar Abbas
Signaling and telecom: Tehran-Mashhad
Signaling and telecom: Badrood-Meybod
Signaling and telecom: Ardakan-Chadormalu
Signaling and telecom: Bafq-Zarand
Development of freight yards: Signaling of link to Sarakhs
Development of freight yards: Enhancement of bogie-changing facilities at Sarakhs

Source: United Nations Economic and Social Commission for Asia and the Pacific staff.

Table A5.14. East and Southeast-Central-South Asia Transport Projects Without Available Investment Estimates

Countries Involved	Projects
PRC, Nepal	PRC-Nepal 2nd Friendship Bridge
GMS countries	Mekong Industrial Corridor
India, Afghanistan	Afghanistan Road (implemented by India)
India, Myanmar, Thailand, Viet Nam	India-Myanmar-Thailand-Viet Nam Railway Cooperation: Delhi-Hanoi Railway Link
Cambodia, Viet Nam	Lower Se San 1 (Cambodia) 90 MW Hydropower Project 2009–2012

GMS = Greater Mekong Subregion; PRC = People's Republic of China.
Sources: ADB staff and Bhattarchay (2008).

Table A5.15. ASEAN Projects Without Available Investment Estimates

ASEAN Power Grid
ASEAN Highway Network
Singapore-Kunming Rail Link

ASEAN = Association of Southeast Asian Nations.
Source: ASEAN (2009).

Table A5.16. List of GMS Projects Without Available Investment Estimates and Target Schedules

Projects	Target Schedule
Transport	
PRC	
Nanning-Kunming Railway Capacity Expansion	2009–2016
Dali-Lijiang Road Upgrading	2008–2010
Baise-Debao-Lonbang (Viet Nam border) Expressway	2009–2012
Yuxi-Mohan Railway Line	2010–2014
Guangdong-Chuxiong-Dali Railway Capacity Enhancement Project	2010–2014
Chengdu-Kunming Railway Double Tracking	2009–2011
Guilin International Airport Expansion	2010–2014
Nanning International Airport Improvement	2009–2012
Viet Nam	
Da Nang-Quang Ngai Expressway	2010–2013
Noi Bai-Halong-Mong Cai Expressway	2010–2014
Ha Noi-Ho Chi Minh City Express Railway	2010–2020
Ha Noi-Langson Railway (standard gauge)	2011–2015
Noi Bai International Airport Expansion	2010–2014
Da Nang Port Upgrading Phase 2	2009–2011
Floating Port on Hamluong River	2009–2012
Lao PDR, Thailand	
Thanaleng-Nong Khai Railway Extension	2009–2010
Than Hoa-Vinh Expressway	2010–2012
Thanaleng-Vientiane Railway	2008–2010
PRC border (Lao Cai)-Ha Noi-Haiphong Railway (standard gauge)	2011–2015
Thailand	
Chiang Saen Kok/Mekong Rivers	2008–2010
Cambodia	
Kratie Domestic Airport Improvement	2008–2011
Preha Vihear Domestic Airport Improvement	2008–2011
Mondulhiri Domestic Airport Improvement	2008–2011
Channel Navigation and Port Improvements on the Mekong, Access to port at Siem Reap, and Development of Intermodal Terminal at Khone Falls	2008–2012
Energy	
Cambodia	
Cambodia, Viet Nam Lower Se San 1 (Cambodia) 90 MW Hydropower Project	2009–2012
Lao PDR	
Lao PDR, Thailand Nam Theun 1,523 MW Hydropower Project	2010–2013
Lao PDR, Viet Nam Xe Kong 4,400 MW Hydropower Project	2009–2012
Lao PDR, Viet Nam Xe Kong 5,250 MW Hydropower Project	2010–2013
Lao PDR, Viet Nam Nam Mo 105 MW Hydropower Project	2010–2013
Lao PDR, Thailand Thenu-Hinbuon Expansion 210 MW Hydropower Project	2011–2014

GMS = Greater Mekong Subregion; Lao PDR = Lao People's Democratic Republic; MW = megawatt; PRC = People's Republic of China.
Sources: ADB (2008a, 2008d).

Table A5.17. East Asia's Regional Energy (Power Grid Interconnection) Project Without Available Investment Estimates

Countries Involved	Projects
PRC, Mongolia	East Siberia-North PRC-Ulan Bator-Mongolia
Russian Federation, PRC, ROK	RFE-North PRC-Kovtyka-Chachum-Bohai Bay, Korea
Russian Federation, Japan, ROK	RFE-Japan-Yakutsk-Chanchum-Korea
Russian Federation, PRC, ROK	RFE-NE PRC-South Korea
Russian Federation, DPRK, ROK	RFE-DPRK-ROK
Russian Federation, ROK, PRC	RFE-PRC-ROK

DPRK = Democratic People's Republic of Korea; PRC = People's Republic of China; RFE = Russian Far East; ROK = Republic of Korea.
Source: Bhattacharyay (2008).

Table A5.18. CAREC Energy Projects Without Available Investment Estimates

Projects
Gas: Feasibility study for gas pipeline from Kazakhstan to PRC
Kazakhstan/PRC gas pipeline
Rehabilitation and upgrade of the gas transmission system
Modernizing Central Asia Center III gas pipeline
Electricity: Distribution Rehabilitation and Power System loss reduction
Interconnection of the three major grids in Mongolia
Feasibility Study for the construction of three 3,600 MW coal fired thermal power plants
Gas pipeline from Uzbekistan to PRC

CAREC = Central Asia Regional Economic Cooperation; MW = megawatt; PRC = People's Republic of China.
Source: CAREC (2008d).

Table A5.19. Regional Transport Projects in South Asia Without Available Investment Estimates

Projects
India-Nepal Railway
India-Sri-Lanka Bridge
India-Sri Lanka Thermal Power Project

Source: Bhattacharyay (2008).