

ECONOMIC AND FINANCIAL ANALYSIS

A. Introduction

1. **Project summary.** The governments of Kiribati and Nauru have requested the Asian Development Bank (ADB) to support a submarine internet cable project connecting the Micronesian subregion with the world. The project will link Tarawa, Kiribati; Nauru; and Kosrae State in the Federated States of Micronesia (FSM) via the regional East Micronesia Cable system to Pohnpei, FSM. The project will also connect Kiribati's Kiritimati island to a proposed transpacific cable system connecting Australia and Hawaii. The World Bank has approved grant support to the project to cover the Kosrae and Tarawa portions of the project cost. This financial and economic analysis concerns itself solely with the ADB-funded parts of the project and, in the case of Kiribati, considers only the Kiritimati aspect. The submarine cable system will result in cost-effective broadband connectivity and boost opportunities for inclusive growth.

2. **Demand projection.** A top-down methodology is used to predict adoption rates by benchmarking other broadband connectivity projects in the Pacific region that correspond to the islands' current demand distribution across its telecommunication services. Nauru and Kiribati's recent adoption of the Other Three Billion (O3b) technology, an alternative high-speed satellite solution, is considered as demand driver, and competition with that service is offset. Demand for capacity per megabits per second (Mbps) is forecast conservatively below the region's average adoption rates, at about 50% average growth in the first 5 years after the cable comes into service, and then declining steadily to 2% over 15 years, with minimal growth sustained thereafter as the market saturates. The average annual growth rate over this period is about 25%. The resulting capacity is positioned at the lower end of all available Pacific-based benchmark data, as shown in the figure below. On the same basis, internet penetration was estimated to reach 70% after 5 years as better-quality services at lower costs are introduced, followed by an average 2-percentage-point growth thereafter. Tourist subscribers, particularly in the case of Kiritimati, were also considered in the analysis.

B. Financial Analysis

3. **Pricing.** Table 1 outlines pricing per Mbps that ensures cost recovery and competitiveness of high-speed satellite services, passing on potential financial benefits to customers through wholesale price reductions. The financial model shows that this price scheme can produce a justified return while also forming a fair basis for capacity charges.

4. **Methodology and assumptions.** The financial viability was assessed based on the financial sustainability of the cable wholesale providers over the cable's estimated life (2 years of system implementation, 15 years of right of use for Kiritimati, and 25 years of full operation for Nauru). The weighted average cost of capital (WACC) for each of the project components was compared with the estimated financial internal rate of return (FIRR) to determine the project's financial viability. Sensitivity of the FIRR to adverse movements in the underlying assumptions was also assessed. The total estimated financial cost of the submarine cable system is \$40.0 million, including project management and contingency—\$17.3 million for Nauru and \$22.7 million for Kiritimati. Wholesale operating costs for the cable system are estimated at \$0.20 million for Nauru. Costs for Kiritimati are estimated at a lower \$0.05 million since operating costs are capitalized in an "indefeasible right of use" (IRU) agreement for the 15 years of right of use. For both, an annual increase of 3% in real terms for operating costs, excluding internet transit fees, is assumed. Financial benefits are estimated based on the wholesale operators' revenues

calculated through demand for international bandwidth multiplied by estimated reduced wholesale tariffs.

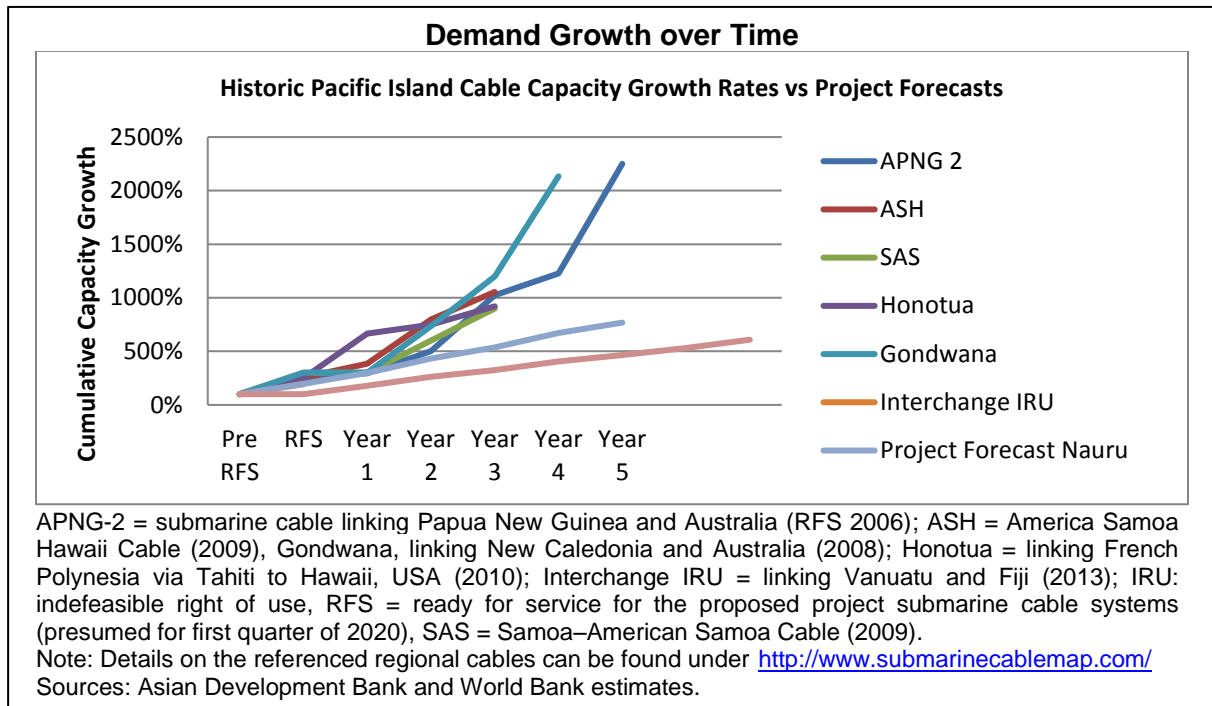


Table 1: Proposed Pricing as Demand Increases

Year	Nauru	2017	2018	2019	2021	2025	2030
Demand	Mbps	369	369	727	1593	3245	6415
Cable	Mbps	0	0	0	1593	3245	6415
Max. pricing	US\$/Mbit/month	544	542	175	131	74	43
	Kiritimati						
Demand	Mbps	5	5	373	974	1983	3921
Cable	Mbps	0	0	0	974	1983	3921
Max. pricing	US\$/Mbit/month	1350	1350	368	255	127	66

Max. = maximum, Mbit = megabit, Mbps = megabits per second, US = United States.

Source: Asian Development Bank estimates.

Table 2: Weighted Average Cost of Capital

Items	Nauru			Kiritimati, Kiribati		
	ADB ADF	Gov	Total	ADB ADF	Gov	Total
A. Amount (\$ millions)	15.83	1.47	17.29	20.78	1.93	22.71
B. Weighting	91.5%	8.5%	100%	91.5%	8.5%	100%
C. Nominal cost (Interest rate)	10.0%	10.0%		13.0%	13.0%	
D. Tax rate	0.0%	0.0%		24.3%	24.3%	
E. Tax-adjusted nominal cost [C x (1-D)]	10.0%	10.0%		9.8%	9.8%	
F. Inflation rate	1.5%	2.0%		1.5%	2.0%	
G. Real Cost $[(1+E)/(1+F)-1]$	8.4%	7.8%		8.2%	7.7%	
H. Weighted component of WACC (Real)	7.7%	0.7%	8.33%	7.5%	0.7%	8.18%

ADB = Asian Development Bank, ADF = Asian Development Fund, Gov = government, WACC = weighted average cost of capital.

Source: Asian Development Bank estimates.

5. Calculation of weighted average cost of capital and financial internal rate of return.

The project's WACC was computed based on the financing plan, which comprises ADB Asian Development Fund (ADF) grant financing, as well as governments' contributions in the form of tax and duties exemptions and wholesale company startup costs. The cost of equity was assumed to be 13% in the case of Kiribati and 10% for Nauru applied to ADB's Asian Development Fund grant.¹ Table 2 outlines the resulting WACC figures. The wholesale price was assumed to be the lowest possible to make WACC just above the FIRR's outlined in Table 4.

6. **Sensitivity analysis.** The main financial risks are (i) an increase in the price of the cable system, (ii) an increase in operating costs, and (iii) a shortfall in anticipated demand and hence revenues. These risks are considered low because the cable system cost estimates and operating costs are based on similar cable project developments; and demand and thus resulting revenue was considered at a growth rate well below similar implementations in the Pacific. The risk of price and hence revenue attrition from a second submarine cable system operator entering the market is considered very low because of the very high capital cost of entry and the countries' small market sizes. As for the funding sources, the requisite ADB grants are already earmarked and contributions from the governments agreed upon.

Table 3: Sensitivity Analysis

Scenario	Nauru		Kiritimati, Kiribati	
	FNPV (\$ million)	FIRR (%)	FNPV (\$ million)	FIRR (%)
Base-case scenario	0.0	8.3	0.0	8.2
10% decrease in revenue	(2.7)	6.0	(1.7)	6.7
10% increase in capital expenditures	(1.1)	7.5	(0.7)	7.6
10% increase in operating expenditures	0.0	8.3	0.0	8.2

() = negative, FNPV = financial net present value, FIRR = financial internal rate of return.

Source: Asian Development Bank estimates

¹ ADB. 2014. Nauru Electricity Supply Security and Sustainability Project—Financial and Economic Analysis; and International Monetary Fund (IMF). 2016. Kiribati: Staff report for the 2016 Article IV Consultation—Debt Sustainability Analysis.

7. The FIRR and the financial net present value (NPV) were tested against a decrease in revenue (caused by a decline in demand), and increased capital and operational costs. The analysis indicates that the project is sensitive to a revenue decrease, and less sensitive to a capital or operational cost overrun (Table 3). To ensure its financial viability, the wholesale service providers must encourage demand growth through fair and open access and attractive transparent pricing for all retail service providers. It is expected that the governments' efforts to apply regulatory frameworks will ensure that the benefits of lower-cost and better-quality wholesale capacity are passed to the retail operators and then to all end-users.

Table 4: Wholesale Cable Service Providers' Financial Projection

Year	Capital Expenditure	Operating Inflows	Operating Outflows	Operating Cash Adjustments	Net (free cashflow)	Capital Expenditure	Operating Inflows	Operating Outflows	Taxes paid	Operating Cash Adjustments	Net (free cashflow)
Nauru						Kiritimati, Kiribati					
1	(4.33)	-	-	-	(4.33)	(5.66)	-	-	-	-	(5.66)
2	(11.65)	-	-	-	(11.65)	(15.26)	-	-	-	-	(15.26)
3	(0.04)	2.31	(0.73)	-	1.53	(0.06)	2.96	(0.11)	(0.49)	0.20	2.49
4	-	2.50	(0.92)	-	1.58	-	2.98	(0.14)	(0.50)	0.20	2.55
5	-	2.62	(1.04)	-	1.58	-	3.00	(0.15)	(0.50)	0.20	2.54
6	-	2.76	(1.18)	-	1.58	-	3.01	(0.17)	(0.51)	0.20	2.54
7	-	2.83	(1.25)	-	1.58	-	3.02	(0.18)	(0.51)	0.20	2.54
8	-	2.90	(1.32)	-	1.58	-	3.03	(0.19)	(0.51)	0.20	2.53
9	-	2.98	(1.40)	-	1.58	-	3.04	(0.20)	(0.52)	0.20	2.53
10	-	3.06	(1.48)	-	1.58	-	3.05	(0.21)	(0.52)	0.20	2.53
11	-	3.15	(1.57)	-	1.58	-	3.07	(0.22)	(0.52)	0.20	2.52
12	-	3.24	(1.67)	-	1.58	-	3.08	(0.24)	(0.53)	0.20	2.52
13	-	3.35	(1.77)	-	1.58	-	3.09	(0.25)	(0.53)	0.20	2.52
14	-	3.45	(1.88)	-	1.58	-	3.11	(0.26)	(0.53)	0.20	2.51
15	-	3.57	(1.99)	-	1.58	-	3.12	(0.28)	(0.54)	0.20	2.51
16	-	3.56	(1.98)	-	1.58	-	3.12	(0.28)	(0.54)	0.20	2.51
17	-	3.56	(1.98)	-	1.58	-	3.12	(0.28)	(0.54)	0.20	2.50
18	-	3.55	(1.97)	-	1.58	-	-	-	-	-	-
19	-	3.54	(1.97)	-	1.58	-	-	-	-	-	-
20	-	3.54	(1.96)	-	1.58	-	-	-	-	-	-
21	-	3.54	(1.96)	-	1.58	-	-	-	-	-	-
22	-	3.53	(1.96)	-	1.58	-	-	-	-	-	-
23	-	3.53	(1.95)	-	1.58	-	-	-	-	-	-
24	-	3.53	(1.95)	-	1.58	-	-	-	-	-	-
25	-	3.53	(1.95)	-	1.58	-	-	-	-	-	-
26	-	3.53	(1.95)	-	1.58	-	-	-	-	-	-
27	-	3.53	(1.96)	-	1.58	-	-	-	-	-	-
Net Present Value (NPV) @ WACC 8.33%					0.00	Net Present Value (NPV) @ WACC 8.18%					0.00
Financial Internal Rate of Return (FIRR)					8.3%	Financial Internal Rate of Return (FIRR)					8.2%

WACC = weighted average cost of capital. Source: Asian Development Bank estimates.

C. Economic Analysis

8. **Nauru.** The Republic of Nauru is among the smallest states in the South Pacific with a population of about 11,000. While relatively resourceful in the past, the country's economy has taken a downward trend after depletion of large-scale phosphate mining resources. Mining activities have taken a toll on the environment, and tourism has not established itself as a major income source the way it has done elsewhere in the Pacific. The island country was on track to achieve the Millennium Development Goals (MDGs) on education (MDG 2) and major diseases (MDG 6), showed mixed results for gender, child health, and maternal health (MDGS 3, 4, and 5), and struggled to achieve progress in eradicating extreme poverty and hunger (MDG 1) and on the environment (MDG 7).

9. **Kiritimati.** As part of the northern Line Islands in Kiribati, Kiritimati sits 2,000 kilometers east of Tarawa, the most populated island in Kiribati and location of the national capital. Kiritimati has experienced substantial in-migration from other islands of Kiribati, giving it a population of about 6,000. Economic activity is limited to small-scale tourism operations and agricultural exports such as copra. As of 2015, Kiribati, including all its islands, could not achieve any of the MDGs, with merely mixed results on MDGs 3–7.

10. **Macroeconomic context.** The Micronesian countries participating in the project are highly dependent on official development assistance, external funds flows, and rents from a limited set of natural resources such as oceanic fisheries and phosphate (for Nauru, and previously, Kiribati). Nauru and Kiribati are targeting to achieve the Sustainable Development Goals (SDGs) by 2030. Their national development strategies and development plans emphasize the importance of telecommunication systems in various sectors and target the achievement of better-quality, affordable internet access.

11. **Sector-specific context.** Digicel Nauru and Fiji-based Amalgamated Telecom Holdings Kiribati Ltd (ATHK) provide telecommunication retail services with 13,000 connections in Nauru and 2,500 connections in Kiritimati. While capacity in Nauru is estimated at 360 Mbps thanks to O3b adoption, in Kiritimati it is limited to 5 Mbps because of the high costs of conventional satellite connections.

12. In Kiribati, the sector regulator, the Communications Commission of Kiribati (CCK), has already been established and is responsible for ensuring affordable and quality telecom. In May 2017, the Government of Nauru took similar steps and passed the Telecommunication and Regulatory Affairs Act 2017 and established the Department of Telecommunications and Regulatory Affairs under the minister of telecommunications. Regulation of the telecom sector, in parallel with submarine cable development, is an integral and necessary part to assure equitable and affordable access to broadband services.

13. **Methodology.** An economic analysis was conducted to quantify the project's expected benefits. Economic welfare was defined as the sum of consumer surplus (i.e., the difference between a consumer's willingness to pay and the actual price of a good or service) and producer surplus (the difference between actual sales value and the price at which a producer is willing to offer a good or service). Incremental economic growth was excluded from the quantitative analysis. Although an often-cited World Bank study found a correlation between broadband internet penetration and gross domestic product (GDP) growth rates in 120 countries during 1980–2006,² there are doubts regarding the degree of causality, the duration of the incremental

² The World Bank (2009). *Information and Communications for Development 2009: Extending Reach and Increasing Impact*. Washington, DC.

growth effect, and the level of risk of double-counting otherwise quantifiable benefits. Unlike in the financial analysis, the pricing per Mbps was conservatively assumed at higher levels, ensuring minimum competitiveness of the wholesale providers at the minimum price level of comparative high-speed satellite services. Further, it is estimated that prices can be lowered between 10% and 42%—applied throughout the analysis—while passing on potential benefits to customers.

14. **Least-cost analysis.** The project foresees grant funding for a submarine cable system linking Nauru via the FSM to Guam, and Kiritimati through Southern Cross NEXT (NEXT) cable to Hawaii and Australia. Connection of Nauru via the FSM (and of Tarawa, Kiribati with World Bank financing) can take advantage of shared operational costs between the three countries through a regional approach. In the case of Kiritimati, the NEXT cable results in a cost-effective opportunity to connect the island through a branching unit and spur to the third-party cable. Alternative independent cable routes would require at least a 2,000-kilometer connection to the nearest internet hub in Hawaii, whereas NEXT is passing within 400 kilometers of Kiritimati, greatly reducing costs. Further, the operational costs are capitalized for a 15-year period, during which a right-of-use agreement includes capacity of 30 gigabits per second.

15. **Economic valuation of costs and benefits.** A detailed cost allocation model and economic analysis was prepared for the configurations discussed. It considers current O3b high-speed satellite contracts and disregards telephony voice usage as insignificant in terms of capacity and scale. For the purposes of the analysis it is assumed that the project will result in a new, faster and more reliable broadband internet service in Nauru and Kiritimati. While in the case of Nauru current O3b based internet services already offer broadband connectivity, the introduction of the fiberoptic cable system replaces the O3b system with a better quality and higher capacity system, allowing for new services to be introduced that were previously not feasible. Having taken this into account, incremental benefits for existing and new user demand are separately considered, where existing user benefits are limited to the expected additional consumer surplus resulting of technology innovation triggered price reductions and a premium for service reliability improvements. While the O3b system is displaced, its satellite infrastructure and operation are assumed to be maintained for backup purposes. A GDP cap of total project benefits is considered to ensure that ICT-related benefits are not overvalued as a share of total GDP.

16. **Estimation of costs.** Nauru's share of the capital cost of the submarine cable system, in economic terms, is estimated at \$16.5 million; Kiritimati's share amounts to \$21.3 million, including physical contingencies.

17. The analysis used constant prices as of 2017 and a world price numeraire. Benefits, onshore operating costs, and 60% of costs incurred by domestic retail service providers were adjusted to economic values using a standard conversion factor of 0.83 for Kiribati and 0.89 for Nauru, and a shadow wage rate factor of 0.9 for Kiribati and 0.85 for Nauru in line with infrastructure development projects in these countries by ADB's Pacific Department. No conversion factors were applied to tradable capital costs. Taxes and subsidies were excluded. The economic price of land is not considered beyond its financial costs because the cable runs either deep underneath land with no impact on land use or occupies only a small footprint for the landing station.

18. Retail service providers would also incur some incremental capital costs to expand and upgrade their capacity to meet increased demand throughout the appraisal period. These costs were assumed at a 30% share of total revenue and split at 50% for capital and operational expenditure respectively. The retail service providers' existing domestic capacity and investment programs (independent of the cable project) are deemed as sufficient to cope with the initial surge in demand given existing 3G deployments. In the case of Nauru, reallocation of O3b network

infrastructure for backup purposes results in savings by replacing costly conventional satellite backup links currently in place.

19. Incremental operating costs are expected at \$0.2–\$0.3 million for the first year, with an annual increase of 3% thereafter. In the case of Nauru, \$0.5 million in internet provider transit fees per year, increasing in line with demand growth, are considered; for Kiribati, under its IRU arrangement, a lower transit fee of \$10 per Mbps applies starting at \$0.07 million for the first year.

20. **Estimation of benefits.** While broadband internet access is already available in Nauru and some areas of Kiribati, thanks to O3b system deployments, the capacity, speed, and reliability fall short of these countries' requirements, and prices are higher than what is achievable with a submarine cable connection. For the purposes of the analysis, price reductions at 30% and a service quality premium at 10% are considered for existing internet users to achieve comparability with existing services. For new customers, willingness to pay corresponds to the entire area under their demand curve. This was evaluated against all capital, operating, maintenance, and incremental costs associated with providing such internet services.

21. The analysis assumed that benefits are proportional to internet users' willingness to pay. Willingness to pay is calculated as a sum of two components: (i) the annual consumer surplus, estimated at about 0.8% of GDP, a constant ratio determined through existing World Bank estimates of comparable demand curves for mobile telephony in the People's Republic of China, India, and the Philippines, and estimated consumer surplus ratios in those countries;³ and (ii) the annual revenue per user (ARPU) for retail internet services, which is the product of the mature-market ARPU and projected number of subscribers. The mature-market ARPU was estimated at 7% of GDP per capita (\$10 per subscriber per month in Kiribati and \$50 in Nauru) based on a composite normalized demand curve for the study's three countries, which flattens out at 7% beyond a 15% penetration rate. While the demand curves based on the World Bank findings relate to mobile telephony, they can be abstracted for broadband purposes, when penetration rates of the islands already approach 50%. Benefits are considered to grow in line with real GDP growth (assumed at 2.0% per annum) and capped between 2.5% and 3.5% of GDP.

22. Other benefits may be substantial but are more difficult to include in a formal quantitative analysis. They include (i) improved efficiency and quality of service delivery in an e-government regime; (ii) remote delivery of agricultural extension, education, health, policing, judicial, employment, disaster management, and other public services; (iii) mobile banking; and (iv) incremental economic growth. Given that such benefits are not easily quantifiable, they are excluded.

23. **Economic internal rate of return.** Applying the above estimates and assumptions, and allowing benefits to grow in line with real GDP, the economic performance of the project is as shown in Table 5 under the base-case scenario. The estimated economic internal rate of return for each component exceeds the minimum required economic internal rate of return for ADB investment projects, which is 9% per year.

24. Sensitivity tests were applied as follows: (i) 20% decrease in benefits, (ii) 10% increase in capital costs, and (iii) 10% increase in operating costs. The risks of the latter two are considered low because the cable system cost estimates are based on similar cable project developments in the region and operating costs are conservatively estimated during the cost allocation determination. Further, a 30% price reduction allows for headroom in case of increased operating costs. The economic risk of a decrease in benefits is considered low, as benefits are directly

³ A. Bhavnani et al. 2008. *The Role of Mobile Phones in Sustainable Rural Poverty Reduction*. Washington DC: World Bank, ICT Policy Division, Global Information and Communications Department.

proportional to demand and subscriber growth rates, which are for the purposes of the analysis conservatively assumed to grow at a rate well below similar projects across the Pacific. Governments' commitment to implementing regulatory frameworks will further ensure that benefits are duly passed on to end-consumers. Sensitivity tests confirm that economic viability is maintained under each adverse shock considered (Table 6).

Table 5: Summary of Economic Internal Rate of Return Calculation (\$ million)

Nauru Year	Economic Costs			Economic Benefits [c]	Net Economic Benefits
	Operating Costs [a]	Capital Costs [b]	Total		
2017	0.00	0.00	0.00	0.00	0.00
2018	0.00	4.41	4.41	0.00	-4.41
2019	0.34	12.06	12.39	0.00	-12.39
2020	1.16	0.50	1.67	2.09	0.43
2025	1.80	0.51	2.31	4.46	2.15
2030	2.29	0.56	2.85	4.92	2.07
2035	2.55	0.62	3.17	5.44	2.27
2040	2.59	0.68	3.27	6.00	2.73
2045	1.90	0.00	1.90	6.50	4.59
EIRR	10.3%	pa	Switching values:		
NPV	1.91	\$M	Costs	33%	
			Benefits	-25%	

Year	Economic Costs			Economic Benefits [c]	Net Economic Benefits
	Operating Costs [a]	Capital Costs [b]	Total		
2017	0.00	0.00	0.00	0.00	0.00
2018	0.00	5.76	5.76	0.00	-5.76
2019	0.21	15.57	15.78	0.00	-15.78
2020	0.40	0.35	0.75	2.93	2.18
2025	0.71	0.52	1.23	5.08	3.85
2030	1.04	0.80	1.84	5.61	3.76
2035	0.00	0.00	0.00	0.00	0.00
2040	0.00	0.00	0.00	0.00	0.00
2045	0.00	0.00	0.00	0.00	0.00
EIRR	14.0%	pa	Switching values:		
NPV	6.60	\$M	Costs	152%	
			Benefits	-60%	

EIRR = economic internal rate of return, p.a. = per annum, NPV = net present value.

^a Operating costs include wholesale service provider operating costs and internet access fees paid offshore, and incremental operating costs by retailers to maintain network improvements.

^b Corresponds to the project's financial drawdown schedule during implementation and includes capital expenditures by retailers to invest in network improvements as subscriber base grows.

^c New and existing broadband internet subscribers.

Source: Asian Development Bank estimates.

Table 6: Sensitivity Test Results (\$ million)

Scenario	ENPV (\$ millions)	EIRR (%)	Switching Value (%)	ENPV (\$ millions)	EIRR (%)	Switching Value (%)
	Nauru			Kiritimati, Kiribati		
Base case scenario	1.9	10.3		6.6	14.0	
20% decrease in benefits	0.2	9.1	21.0	5.5	13.1	59.9
10% increase in capital expenditures	0.5	9.3	14.0	4.8	12.4	37.0
10% increase in operating expenditures	0.7	9.5	16.0	6.5	13.9	520.0

ENPV = economic net present value, EIRR = economic internal rate of return.

Source: Asian Development Bank estimates.