ECONOMIC ANALYSIS

1. Samoa is a small and highly import-dependent country that relies largely on official transfers and remittances for foreign currency revenues. Despite vulnerability to external shocks, Samoa has experienced stable economic growth since 2008. Real gross domestic product (GDP) grew at about 4% per annum—well above the average growth rate of the Pacific region economies. The annual long-term growth rate is expected to be about 3.5%. Economic growth is mainly driven by agriculture, construction, finance, and business services. Samoa is also benefiting from an increase in tourism. Broadening of economic activity and private sector development are key strategies for sustaining economic growth rates and reducing poverty.

2. The energy sector in Samoa has undergone rapid transformation over the last decade and energy supply is now based on petroleum and hydropower-generated electricity. This transformation has been driven by economic growth, which has resulted in increasing demand for electricity and transportation. Energy demand in Samoa is met by three main sources: biomass (47%), fossil fuel (45%), and hydropower (8%). Biomass is mainly used for cooking, whereas imported petroleum is used for transportation and power generation.

A. Power Demand and Supply Balances

3. Samoa is a Pacific island country divided into two main islands, Upolu and Savai'i, and two minor outer islands, inhabited by 188,000 people. About 70% live on Upolu, the main island and location of the capital, Apia. In 2012 about 95% of all households had access to grid electricity, while the remaining 5% was connected to small diesel generators or solar systems in urban and rural areas.

4. Samoa had a total installed grid connected power capacity in 2012 of about 42 megawatts (MW), composed of 30 MW diesel generators, 11 MW hydropower plants, 1 MW biofuel power plants, and small solar generators in the few kilowatt range, totaling an electricity consumption of about 90 gigawatt-hours (GWh) per year. The commercial sector accounts for about 43% of the total consumption, followed by the residential sector with about 30%, and the remaining 7% by the public sectorand other private consumers.

5. Samoa's total fossil fuel consumption accounts for about 15% of the total import expenditure every year. In 2012, total fuel imports accounted for about 95 million liters, of which 67% were consumed by the transport sector; 21% were used for electricity generation; and the remaining 12% were consumed by the commercial, agriculture, forestry, and residential sectors. In the same year, fuel imports represented about 10% of the total GDP. This fossil fuel reliance is reflected within Samoa's electricity generation matrix, which comprises 60.0% of electricity generated by diesel generators, 38.9% by hydropower plants, 1.0% by biofuel (coconut oil) plants, and 0.1% by solar generators. For the power utility, Electric Power Corporation (EPC), fossil fuel is by far the single largest expense item—representing 74% of total generation costs and 51% of overall costs. The average electricity tariff as of June 2013 was $0.41 per kilowatt-hour (kWh).

B. Power Demand Analysis

6. In 2010, diesel prices dropped and overall demand rose compared with 2009. However, from 2011 to 2012, even when diesel prices were increasing, demand also gradually rose. The compound annual growth rate for the demand, based on data from 2009 to 2013, indicates that demand may gradually increase at a rate of about 1%. For economic analysis, it is assumed the

generation from hydropower will be constant for the life of the project, and any increase in demand will be met by diesel generation only. This incremental generation nullifies for with- and without-project scenarios. Hence, generation at the 2013 level is kept constant for the analysis. The new and rehabilitated hydropower plants will only replace existing generation capacity in Samoa.

C. Economic Costs

7. Supplying hydro electricity generation results in (i) displacing diesel electricity generation (non-incremental benefit), and (ii) a lower fuel cost per unit of electricity generated because of the incorporation of increased hydro generation in the overall generation mix in Samoa (incremental benefit).

8. The costs in financial terms are adjusted to reflect the economic resource cost of the project inputs in terms of the world price numeraire. The price contingencies and taxes are excluded from the financial costs while deriving the economic costs. The costs have been divided into (i) the capital cost, comprising civil works, electromechanical, and hydro-mechanical costs; and (ii) the operating cost and replacement costs equivalent to depreciation amount. The financial capital cost of the project was converted into economic terms by applying the standard conversion factor (SCF) to the actual cost. The SCF is the ratio between the economic price value and the financial value for a project output or input. This ratio is applied to the constant price financial values in the project analysis to derive the economic values. The SCF removes taxes, subsidies, and other distortions that might affect the financial value from the financial cost of each of the cost components. The SCF is assumed to be 0.9 for economic costs as well as economic benefits.

D. Economic Benefits

9. The project is not expected to generate external and/or indirect employment benefits. Its total economic benefits will be divided into the following categories:

(i) **Non-incremental benefit.** The value of displacing the electricity generated by diesel was calculated using the average cost avoided from the diesel electricity source, which is valued at the current electricity tariff. The economic revenue in the cash flow statements from the energy sales can be quantified by the following formula: economic revenue of the project = energy produced by the hydro system in kWh x rate of supply x SCF.[1]

(ii) **Energy and environmental benefits**. The economic benefit of the reduction in air pollutants is quantified by accounting each kWh of energy produced through renewable energy-based projects instead of conventional diesel power plants, and converting the saved pollutants into emission certificates using Clean Development Mechanism methodologies. However, for a conservative scenario, the Clean Development Mechanism credits are not considered in the current economic evaluation.

(iii) **Incremental benefit.** The incremental benefit between the with- and without-project scenarios is the fuel benefit. The fuel benefit will be the lower fuel cost per unit of electricity. Savings in fuel cost are quantified by calculating the hydro generation in GWh x current diesel cost / kWh of electricity x SCF.

[1] The weighted average tariff is ST0.9877 per kWh as of July 2013 prices, and is kept constant for the life of the project.

E. Economic Internal Rate of Return

10. The economic internal rate of return (EIRR) is the rate of return at which the present value of the net benefit stream becomes zero, or at which the present value of the benefit stream is equal to the present value of the cost stream. The economic net present value (ENPV) is the difference between the discounted total social benefits and costs. In the base case scenario of this project, the EIRR is estimated at 34.08%. The EIRR sensitivity analysis is in Table 2.

11. The basic difference between the financial and economic benefit–cost analyses of a project is that the financial analysis compares the benefits and costs to the enterprise in constant financial prices, while the economic analysis compares the benefits and costs to the whole economy in constant economic prices. Indirect taxes and subsidies are important to understanding the difference between economic and financial prices. For the project output, the economic price exceeds the financial price by at least the amount of the indirect tax, whereas for the project input, the financial price exceeds the economic price by at least the amount of the indirect tax. This result applies whether the project output or input is tradable or not tradable. The EIRR is estimated by (i) quantifying all project-related financial costs (capital costs and operating costs) in terms of economic costs; (ii) quantifying the economic benefits of a project; and (iii) calculating a project's EIRR, based on a projected cash flow statement.

F. Sensitivity Analysis for Economic Internal Rate of Return and Net Present Value

12. The sensitivity analysis for the EIRR showed the project to be robust under various scenarios. The estimated base case EIRR of 31.80% was most sensitive to a 15% drop in hydro generation and a 10% increase in replacement costs. This reduced the estimated EIRR to 25.69%. However, since the EIRR exceeds the normal hurdle rate of 12% in all scenarios, the project is expected to be economically viable.

Table 1: Sensitivity Analysis for Economic Internal Rate of Return and Net Present Value

Particulars	**Change**	**ENPV** (ST$ million)	**EIRR** (%)
Base case		55.53	31.80
Construction delay	1 year	47.72	28.43
Reduce hydro generation by 10%	(10%)	44.20	28.03
Reduce hydro generation by 15%	(15%)	38.54	26.10
Increase in replacement costs by 10%	10%	54.33	31.41
Drop in diesel prices by 10%	(10%)	50.19	30.04
Increase in diesel prices by 10%	10%	60.87	33.55
Reduce generation by 15% and increase replacement costs by 10%		37.34	25.69
Environmental benefits considered at $3 per certified emission reduction		56.00	31.96

( ) = negative, EIRR = economic internal rate return, ENPV = economic internal rate of return.
Source: Project preparatory technical assistance estimates.

Table 2: Detailed Economic Internal Rate of Return

Item	1 Jan 14–30 Jun 14	1 Jul 14–30 Jun 15	1 Jul 15–30 Jun 16	1 Jul 16–30 Jun 17	1 Jul 17–30 Jun 18	1 Jul 18–30 Jun 19
No. of implementation months	6.00	12.00	6.00	0.00	0.00	0.00
No. of operational months	0.00	0.00	6.00	12.00	12.00	12.00
Financial year	2014	2015	2016	2017	2018	2019–2041
	Y1	**Y2**	**Y3**	**Y4**	**Y5**	**Y6–Y28**
1. Economic Benefits						
a. Economic revenue from sales [a]	0.00	0.00	5.05	10.12	10.12	10.12
b. Savings in diesel cost [b]	0.00	0.00	4.50	9.02	9.02	9.02
Total Economic Benefits	**0.00**	**0.00**	**9.55**	**19.12**	**19.12**	**19.12**
2. Economic Costs						
a. Capital costs [c]						
i. Civil costs						
Site access and administrative costs	(0.53)	(1.29)	(0.99)	(0.20)	0.00	0.00
Intake structure and/or sand trap	(0.16)	(0.40)	(0.30)	(0.10)	0.00	0.00
Headrace and/or penstock	(2.68)	(6.51)	(4.98)	(1.10)	0.00	0.00
Powerhouse	(0.51)	(1.25)	(0.96)	(0.20)	0.00	0.00
ii. Electromechanical costs						
Generation units	(0.71)	(1.73)	(1.32)	(0.30)	0.00	0.00
Electrical equipment	(0.46)	(1.11)	(0.85)	(0.20)	0.00	0.00
iii. Hydro-mechanical						
Intake gate, screen, auxiliary equipment, actuators	(0.09)	(0.21)	(0.16)	0.00	0.00	0.00
iv. Additional costs						
Engineering and general items	(1.56)	(3.78)	(2.89)	(0.67)	0.00	0.00
PMC and owner's power engineer	(0.87)	(1.74)	(1.06)	(0.19)	0.00	0.00
Physical contingency [d]	(0.35)	(0.84)	(0.63)	(0.10)	0.00	0.00
b. Operating costs						
i. Depreciation [e]			(0.97)	(1.95)	(1.95)	(1.95)
ii. O&M costs			(1.01)	(2.03)	(2.03)	(2.03)
Total economic costs	**(7.90)**	**(18.90)**	**(16.10)**	**(7.20)**	**(4.00)**	**(4.00)**
Net Economic Benefits	**(7.90)**	**(18.90)**	**(6.60)**	**12.00**	**15.20**	**15.20**
SCF	0.90					
Discount Rate (%)	12.00					
EIRR (%)	31.80					
ENPV (ST $ million)	55.53					

( ) = negative, EIRR = economic internal rate of return, ENPV = economic net present value, GWh = gigawatt-hour, kWh = kilowatt-hour, O&M = operation and maintenance, SCF = standard conversion factor, Y = year.

[a] Economic revenue = hydro generation (GWh) x tariff x SCF.

[b] Diesel cost savings = hydro generation (GWh) x diesel cost / kWh of electricity x SCF.

[c] Considered cost, insurance and freight (world price numeraire) x SCF.

[d] Physical contingency is considered as 5% of the base costs.

[e] Depreciation is considered on a straight line basis method for the entire life of the plant with the residual value of the plant as zero.

Source: Project preparatory technical assistance estimates.

Table 3: Relief Distress Impact of the Hydro Plant on the Existing Electric Power Corporation Tariff

Item	Unit	Total
Proposed hydropower installed capacity	kW	5,500.00
Estimated capacity factor for the plant	%	28.6%
Annual generation by proposed hydropower plant	kWh million p.a.	13.78
Net billed generation in Samoa (FY2013)	kWh million p.a.	93.14
Fuel consumption (based on data for FY2012 and FY2013)	liter/kWh	0.26
Diesel cost	$/liter	1.16
Diesel cost	$/kWh	0.31
Diesel cost	ST/kWh	0.73
LCOE for hydropower generation	ST/kWh	0.23
Net savings on account of hydropower generation		
Fuel cost savings on account of hydro generation	ST million	10.03
Less: LCOE for hydropower generation	ST million	(3.12)
Net savings on account of hydropower generation	ST million	6.91
Net savings per kWh on account of hydro generation (only from project perspective)	ST/kWh	0.50
Net savings per kWh on account of hydro generation (from overall perspective)	ST/kWh	0.07
Net savings per kWh on account of hydro generation (from overall perspective)	$/kWh	0.03

( ) = negative, FY = fiscal year, kW = kilowatt, kWh = kilowatt-hour, LCOE = levelized cost of electricity, O&M = operation and maintenance, p.a. = per annum.
Source: Project preparatory technical assistance estimates.