ECONOMIC AND FINANCIAL ANALYSIS

A. Project Economic and Financial Analysis

1. Financial analysis of the project has been carried out in accordance with the Asian Development Bank's (ADB's) *Handbook for Borrowers on the Financial Management of Analysis of Projects*[1] for the Ho Chi Minh City Water Supply Project.[2] An incremental cost calculation for the grant investment component for energy efficiency is included as a supplementary document, as requested by the external financier, the Government of Japan, funding the Asian Clean Energy Fund under the Clean Energy Partnership Facility, managed by ADB.[3]

2. Economic analysis of the project was carried out in accordance with ADB guidelines.[4] Economic benefits arise from increased and improved water supply to both existing and new domestic and commercial customers, while a reduction in nonrevenue water from 40% to 32% by 2015 and 25% by 2020 makes more water available and reduces operation and maintenance costs, especially regarding energy and water and carbon footprints.

3. Cost streams used to determine the financial internal rate of return (FIRR)—i.e., capital investment and operation and maintenance—reflect the costs of delivering benefits. The tariffs for water sales used to estimate the net financial benefits for the project are those approved by the Ho Chi Minh City (HCMC) People's Committee[5] and have been in effect since 1 March 2010. This tariff results in an estimated weighted average tariff for all consumers of D6,046 per cubic meter (m^3), up from the previous average tariff of D4,630/m^3 (2004). In 2013, the weighted average tariff of D7,496/m^3 is effective under the water tariff road map, 2010–2013. The ADB project team and SAWACO are negotiating the next water tariff road map (2014–2018).

4. The weighted average cost of capital (WACC) was calculated based on project financing and compared with the project FIRR to ascertain the financial viability of the project. The sensitivity of the FIRR to adverse movements in the underlying assumptions was also assessed. This analysis and the incremental cost calculation found the project financially viable.

B. Project Assumptions

5. The following general assumptions are adopted for the analysis:
   (i) All costs are expressed in January 2013 prices.
   (ii) The exchange rate adopted is D21,000 = $1.
   (iii) The real opportunity cost of capital employed in the economic analysis is 12% per annum, which is the social opportunity cost of capital in Viet Nam.
   (iv) Capital expenditures include all costs (less price contingencies); capital expenditures are recorded at the time they are incurred, while interest and

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1 ADB. 2006. *Handbook for Borrowers on the Financial Management of Analysis of Projects*. Manila.

2 ADB. 2011. *Ho Chi Minh City Water Supply Project*. Manila (Loan2754-VIE).

3 Incremental Cost Calculation (accessible from the list of linked documents in Appendix 2 of report and recommendation of the President).

4 ADB. 1997. *Guidelines for the Economic Analysis of Projects.* Manila; ADB. 1998. *Guidelines for the Economic Analysis of Water Supply Projects.* Manila.

5 No. 103/2009/QD-UBND dated 24 December 2009. The decision states that the tariffs approved are considering the proposal by the general director of the Saigon Water Corporation in dispatch 5189/TCT-HTPTKD dated 15 December 2009 and the recommendation of the proposal by the director of the Department of Finance in dispatch 12771/STC-BVG dated 24 December 2009.

finance charges are excluded. The value of benefits arising from water sales was calculated by multiplying the volume of water sold each year by the proposed tariffs used for each year in constant prices. Taxes and duties on imported equipment and fittings (assumed at 6%) and value-added tax (at 10%) are included as part of the capital costs.

(v) No additional staff costs are expected, as SAWACO is able to maintain and operate the new assets with existing staff.

(vi) There are no significant distortions in the wage rates for skilled labor. Underemployment of unskilled labor, for which casual rates are $2 per day, make the opportunity cost of unskilled labor less than the promulgated minimum wage. A shadow wage rate of 0.67 is adopted when valuing labor inputs in water supply costs in the without-project situation.

(vii) Annual operation and maintenance costs for the subprojects are assumed at 2% of project capital costs. Electricity and chemical usage are based on current SAWACO costs, with electricity estimated to have a long-run marginal cost of $0.08 per kilowatt-hour.

(viii) Average household size is assumed to be five people, with household water consumption assumed at 16.5 cubic meters (m^3) per household per month (110 liters per capita per day) in the without-project case from nonpiped sources, increasing to 25.5 m^3 per month (170 liters per capita per day) in the with-project case from piped sources.

(ix) All project components have been subjected to technical analysis and, where appropriate, to economic analysis to ensure that the project minimizes costs.

C. Water Demand and Revenues Projections

6. Future incremental water supply and demand are based on increased water availability (Table 1). Increased consumption results from increased water volumes available with system improvements. Expanding tertiary networks allows for additional connections and, to alleviate poverty, households sharing a connection will be provided with their own connection. By 2020 the project is expected to increase water availability to 64.1 million m^3 per annum. While there will be increases in supply in subsequent years and decreases in water losses, these will be attributable to additional investments and are therefore not claimed by this project. Revenue projections are based in the water tariff road map in 2013.

Table 1: Increase in Water Availability as a Result of the Project

		Year		
Item	**Unit of measure**	**2013**	**2015**	**2020**
Water production	m^3/day	16,610	66,440	159,456
Expansion of tertiary networks	m^3/day	1,690	6,759	16,220
Total project per day	m^3/day	18,300	73,199	175,676
Total per annum	‘000 m^3/year	6,679	26,717	64,122
NRW (%)		38	32	28

m^3 = cubic meter, NRW = nonrevenue water.
Source: ADB Project Team

D. Capital Costs and Operating Costs

7. Cost streams used to determine the FIRR—i.e., capital investment and operation and maintenance—reflect the costs of delivering benefits. Incremental operating costs are set out in Table 2.

Table 2: Estimate of Variable Operating Costs
(D per cubic meter)

Variable Operating Costs	Amount
Chemicals	189.80
Electricity production	347.95
Electricity distribution	255.09
Fees	145.30

Source: ADB Project Team

E. Weighted Average Cost of Capital

8. For consistency, the WACC is the same as in the Ho Chi Minh City Water Supply Project (footnote 2). Computation of the WACC assumes that financing will consist of equity contributions from SAWACO and/or the HCMC People’s Committee, in addition to an ADB foreign currency loan from ordinary capital resources (OCR).

9. The cost of SAWACO and/or HCMC People’s Committee equity capital is based on an estimate of the cost of equity of 17%. This was adopted as an appropriate estimate of the equity cost for SAWACO. Other assumptions are a tax rate of 25% for SAWACO, international inflation of 1% for determining the real cost of the OCR loan to SAWACO relent in US dollars, and 5% for the cofinancing relent in dong, resulting in an after-tax estimate of the WACC of 2.5%.

F. Economic Benefits

10. Economic benefits arise from increased and improved water supply to both existing and new domestic and commercial customers, while a reduction in water losses from 40% to 32% in 2015 and 25% in 2020 in project zones makes more water available in these and other areas of the city and/or allows reduced pumping, treatment, and operation and maintenance costs as less water production is required for the same amount of sales. Health benefits will arise from households using clean water instead of polluted groundwater.

11. Households without a connection will benefit as lower-cost piped water reduces the costs and time required to collect water and maintain nonpiped sources, as well as by avoiding the costs of boiling, filtering, and storing water and from reduced risk of being exposed to waterborne pathogens from nonpiped sources. Water consumption is expected to increase as a result of the convenience and lower cost of piped sources and the likely improvement in sanitation practices as more water becomes available.

12. For households with a connection, benefits associated with improved distribution services include the provision of 24-hour service in areas currently experiencing interrupted service; improvements in system pressure, security of supply, and drinking water quality; and reduced risk of exposure to waterborne pathogens. Project zones suffer from water stress and need to store water against interrupted supply. The indirect benefits of 24-hour service for domestic beneficiaries include the elimination of financial costs incurred to cope with the interrupted water supply service.

13. Nondomestic customers will benefit financially from improved supply and avoided need to pump and store water. In time, the increased availability of piped water should reduce groundwater use as that source becomes more polluted and saline and nondomestic users transfer to piped supplies.

G. Valuation of Benefits

14. The valuation of these benefits was based on the nonpiped water supply characteristics that include the following:

(i) **Cost and maintenance of existing facilities.** Where households obtain water from tube wells with electric pumps, the capital cost of well construction and maintenance and electricity costs were included as without-project costs. The socioeconomic survey provided a breakdown of water sources by type for the project area, with wells being the main nonpiped source (88%) and capital costs estimated at $400 per household.

(ii) **Cost of storage containers.** The cost of buckets and storage facilities in houses were included in without-project water supply costs, with $50 per household estimated for buckets and other temporary and permanent storage facilities.

(iii) **Time savings to collect and store water.** While the reduction in time spent collecting water is modest (around 30 minutes per day), there is also time associated with filling and emptying containers that is less easy to quantify. The short time required to collect water results from the wide use of tube wells with electric pumps, which allows water to be pumped directly into houses and storage tanks. However, there is still a time cost to handling and storing water compared with the piped situation.

(iv) **Treating and boiling drinking water.** As 30% of households use ceramic or sand filters, and 55% of households boil drinking water (assumed to be 4 liters per capita per day), these costs are included in without-project water supply costs.

(v) **Bottled water.** Bottled water is widely used, supplying 0.5% of consumption. This was valued conservatively at $44/m^3 as survey results indicated that small bottles are often purchased, suggesting higher costs.

15. The financial costs of water supply are converted into economic prices by applying a shadow wage rate of 0.67 and a social conversion factor of 1.10 to derive a weighted cost of $1.95/m^3, or $32.20 per month for 16.5 m^3.

16. In the with-project situation, it is assumed that households consume on average 170 liters per capita per day where consumption is not constrained by supply, or 25.5 m^3 per month. Assuming a tariff of $0.21/m^3, this costs $5.36 per month. The present with- and without-project scenarios provide a basis for deriving a household demand curve and estimating the economic benefits of the incremental consumption. Using the semi-log function, the economic benefit to households was estimated to be $1.02/m^3.

17. This benefit is used to value all household consumption without a piped connection, which applies to 38% of all domestic consumers. In the case of households with a piped connection, survey findings on the hours of supply and whether the service was adequate were cross tabulated and a proportion of the economic benefit was allocated to this consumption. In the case of households not satisfied with the level of service and pressure, 30% of the value of the nonpiped sources was assigned; in the case of households not satisfied with the service, pressure, quality, and/or quantity, 60% of the value was assigned, as they will benefit from both

improved quality and increased consumption. In both cases, households also use tube wells as backup, which represents the bulk of the nonpiped source on which the benefit in the nonpiped situation is based. This represented a further 13.3% of consumption valued at the water treatment plant value.

18. The balance of water sales are valued at the existing average tariff to account for domestic households satisfied with the service as well as nondomestic consumers that will benefit from the project. Nondomestic customers account for only 31.6% of consumption, with half of them being institutional, and they consume water at a rate similar to that of domestic customers. The average tariff is $0.26/m^3. To calculate economic benefit, an average domestic tariff of $0.21/m^3 was assumed.

19. As noted above, less water production will be required to meet the same water sales as water losses in project areas drop from 37% to 28% by 2020. The reduced water production will save electricity costs for water production, treatment, and distribution, as well as chemical costs and water resource fees.

H. Summary of Results of Financial Analysis and Calculation of the Financial Internal Rate of Return

20. The FIRR is calculated at 8.7% for the project with benefits derived from revenues from water sales and savings in chemical and electricity costs as a result of reduced water losses and energy savings. Comparing the FIRR with the estimated WACC of 2.5% indicates that the proposed project is financially viable.

21. **Sensitivity analysis.** Separate analyses were carried out to examine the sensitivity of the FIRR and financial net present value to adverse changes in key variables. The variables considered for the sensitivity analyses were (i) a 10% increase in capital costs, (ii) a 10% increase in operation and maintenance costs, (iii) a 10% decrease in benefits, (iv) a combination of (i)–(iii), and (v) a 2-year implementation delay with a 20% increase in costs. Table 6 demonstrates that, at the current tariff, the results are robust when considering standard sensitivities. The project is most sensitive to construction delays with higher costs, pushing the FIRR down to 5.9%. Design and supervision consultancy and management have been put in place to ensure that the project keeps to its planned schedule, while a 10% contingency has been assumed to allow for unforeseen costs.

Table 3: Sensitivity Analysis for Energy Efficiency for Ho Chi Minh City Water Supply Project

Sensitivity Analyses		**FNPV** (D million)	**FIRR** (%)	**SI** (%)	**SV** (%)
Base Case		**1,864,721**	**8.7**		
Capital costs	+10%	1,711,142	7.8	10.3	69.3
Operating costs	+10%	1,685,755	8.1	6.3	114.0
Benefits	–10%	1,345,704	7.1	17.8	(39.9)
All the above		1,013,159	5.8		
Two-year delay, CAPEX +20%		1,299,102	5.9		
WACC			2.50		

( ) = negative, CAPEX = capital expenditure, FIRR = financial internal rate of return, FNPV = financial net present value, SI = sensitivity index, SV = sensitivity value, WACC = weighted average cost of capital.
Source: ADB Project Team.

I. Summary Economic Analysis and Calculation of the Economic Internal Rate of Return

22. The economic internal rate of return (EIRR) for the project is 24.5% (Table 4). This exceeds the social opportunity cost of capital of 12%. The economic net present value at 12% is D1,578 billion. The average incremental economic cost is D6,431/m^3, which is relatively low as it excludes the cost of developing additional raw water sources that would be required in the future. Existing source development and water treatment capacity are sufficient to meet the incremental project requirements.

23. Sensitivity analysis was undertaken to test the sensitivity of the EIRR to adverse changes in key variables. The variables tested were increases of 10% in capital and operation and maintenance costs, a 10% reduction in project benefits, and a 2-year delay in project implementation and benefits. In the case of the 2-year delay, costs were spread over the additional 2 years and increased by 20% to reflect the additional costs incurred.

24. The results in Table 4 show that the project EIRR exceeds the social opportunity cost of capital. The project is sensitive to a reduction in benefits, with the EIRR falling to 22.2% and a combination of increase in capital expenditures and operating cost and reduction in benefits with the EIRR dropping to 20.2%. However, delays that result in real capital cost increases of 20% and delay benefits as improvements are commissioned later lower the EIRR to 17.1%. Accordingly, efforts must be made in project design to avoid delays and cost increases. Project-specific sensitivities demonstrate that, where the level of benefits ascribed to existing connected households is reduced by 50%, the EIRR falls to 13.8%, suggesting that the project is not that sensitive to a reduction in benefits to existing households.

Table 4: Sensitivity Analysis for the Project

Sensitivity Analyses		**ENPV** (D million)	**EIRR** (%)	**SI** (%)	**SV** (D million)
Base Case		1,578,051	**24.5**		
Capital	+10%	1,464,436	22.9	6.7	75.9
Operating	+10%	1,511,067	24.0	2.0	251.2
Benefits	–10%	1,239,647	22.2	9.5	(53.6)
All the above		1,059,048	20.2		
Two-year delay, CAPEX +20%		802,974	17.1		
Social opportunity cost of capital			12.0		

( ) = negative, CAPEX = capital expenditure, EIRR = economic internal rate of return, ENPV = economic net present value, SI = sensitivity index, SV = sensitivity value.
Source: ADB Project Team